Public Works and
Government Services Canada

Requisition No. _____

DRAWINGS & SPECIFICATIONS
For

Port Hardy Airport Equipment Maintenance Building

PWGSC Project No.: R.077016.001

APPROVED BY:

BJAERM — JUNE 14/2017
Regional Manager — Date

2017-06-15
Construction Safety Coordinator — Date

TENDER:

15JUN17
Project Manager — Date

Real Property Services Branch, Professional and Technical Services, Pacific Region
Room 219 - 800 Burrard Street, Vancouver, B.C. V6Z 0B9

CONSULTANTS – SEAL & SIGNATURE

Discipline	Seal / Signature / Date
	

END OF SECTION

CONSULTANTS – SEAL AND SIGNATURE

Discipline	Seal / Signature / Date
Electrical	
Mechanical	
Structural	
Civil	

END OF SECTION 00 01 07

INTRODUCTORY INFORMATION

DIVISION 01 - GENERAL REQUIREMENTS

DIVISION 02 - SITE WORK

DIVISION 03 - CONCRETE

DIVISION 05 - METALS

DIVISION 06 - WOOD AND PLASTICS

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

DIVISION 23 - HVAC

DIVISION 25 - INTEGRATED AUTOMATION

DIVISION 26 - ELECTRICAL

DIVISION 27 - COMMUNICATIONS

DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

DIVISION 31 - EARTHWORK

DIVISION 32 - EXTERIOR IMPROVEMENTS

DIVISION 33 - UTILITIES

APPENDIX A

DRAWINGS - Bound Separately

ARCHITECTURAL

A-000 Cover Sheet
A-001 General Notes and Construction Assemblies
A-101 Site Plan & Project Data
A-111 Floor Plans
A-112 Roof and Ceiling Plans
A-121 Enlarged Plans
A-201 Building Elevations
A-301 Building Sections
A-501 Exterior Details Sheet 1
A-502 Exterior Details Sheet 2
A-901 Interior Elevations Sheet 1
A-902 Interior Elevations Sheet 2
A-905 Interior Details and Stairs
A-910 Millwork Details
A-950 Door and Room Finish Schedules
A-960 Furniture and Equipment Layout

STRUCTURAL

S-001 General Notes and Typical Details
S-101 Foundation and Level 1 Floor Plan and Crane Rail
S-201 Foundation Sections
S-202 Foundation Pier Details and Equipment Pads
S-203 Stair Plan, Elevations, Sections and Details

MECHANICAL

M-001 Symbol Legend, Schedule and Drawing List
M-100 Plumbing Foundation and Level 1 Plans
M-101 Plumbing Level 2 Plan and Details
M-200 Mechanical Level 1 and Level 2 Plans
M-201 Mechanical Room and HVAC Schematics
M-202 Mechanical In-floor Heating and Details
M-300 Fire Protection Level 1 and Level 2 Plans

ELECTRICAL

CIVIL

END OF SECTION 00 01 10

1. DESCRIPTION OF WORK

.1 Work of this Contract comprises construction of Port Hardy Airport Maintenance Building located at 3675 Byng Road, Port Hardy, B.C.
.2 Physical Limits: Work of the Contract is not necessarily restricted to work within property lines of site, but includes all Work as required by Contract Documents, both within and outside property lines.

2. COMPLETION TIME

.1 Complete work within 60 weeks (14 months) of contract award

3. CONTRACTOR'S USE OF PREMISES

.1 Airport will remain operational throughout duration of Work.
  .1 Comply with Airport Operations requirements in working within all areas including restricted areas of the Airport.
  .2 Exercise extreme caution while on site to prevent injury and incident.
  .3 Smoking is not permitted on site.
.2 Refer to site plan drawing for construction limits. Confine activities/storage to within these limits.
.3 Assume full responsibility for protection and safekeeping of products under this Contract.
.4 Obtain and pay for use of additional storage or work areas needed for operations.
.5 Notwithstanding the Contractor's permitted use of the premises, the Contractor shall comply with all Airport security and operational requirements, regulations and directives when working in designated Restricted Areas of the Airport. Do not unreasonably encumber the Work Site with materials and equipment. At no time shall public, Airport or Airline Operational or Emergency Response access/egress routes be blocked or obstructed by materials or equipment, unless previously authorized by the Airport Representative

4. DOCUMENTS REQUIRED ON SITE

.1 Maintain at job site, one copy each of following:
  .1 Contract drawings.
  .2 Specifications.
  .3 Addenda.
  .4 Reviewed shop drawings.
  .5 Change orders.
  .6 Other modifications to Contract.
  .7 Field test reports.
  .8 Copy of approved work schedule.
  .9 Record Drawings.
  .10 Manufacturers' installation and application instructions.
  .11 Health and Safety Plan and Other Safety Related Documents.
  .12 Other documents as specified.

5. SPECIFICATIONS

.1 Each specification section forms a part of the Contract Documents and is to be read interpreted and coordinated with all other parts.

.2 The specifications are arranged in a manner to illustrate the process of the Work and is not intended to establish limits of responsibility of the sub-contractors or suppliers. It is the General Contractor's obligation to establish the areas or scope of responsibility for each sub-contractor or supplier.

6. CODES AND STANDARDS

.1 Perform Work in accordance with the British Columbia Building Code 2012 and National Building Code (NBC) 2015 and any other code of provincial or local application provided that in any case of conflict or discrepancy, the more stringent requirements will apply.
.2 Meet requirements of Contract Documents, specified standards, codes and referenced documents.
.3 Unless otherwise noted, all references to codes, standards and standard specifications referred to in these Specifications or used on drawings shall mean and intend to be the currently adopted edition, amendment and revision of such reference standards in effect at the time of Bid closing.

7. CO-ORDINATION

.1 Maintain discipline and general orderliness of progress throughout execution of Work.
.2 Direct mechanical and electrical trades to installation of equipment and services without delays or unnecessary cutting and patching of work of other trades.

8. LOCATION OF EQUIPMENT AND FIXTURES

.1 Equipment, fixtures and outlets indicated or specified to be considered to be 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 Consultant of impending installation and obtain his approval for actual location.
.4 Submit field drawings to indicate relative position of various services and equipment when required by Consultant.

9. CONCEALMENT

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

10. CUTTING, FITTING AND PATCHING

.1 Execute cutting including excavation, fitting and patching required to make Work fit properly.
.2 Make cuts with clean, true, smooth edges. Make patches inconspicuous in final assembly.
.3 Fit Work airtight to pipe, sleeves, ducts and conduits.

11. EXISTING SERVICES

.1 Where Work involves breaking into or connecting to existing services,
  .1 do not limit or restrict services connected to or from buildings occupied by Owner,
  .2 carry out Work at times directed by Departmental Representative and
  .3 carry out Work with minimum disturbance to pedestrian and vehicular traffic.
.2 Before commencing Work, establish location and extent of service lines in area of Work and notify Departmental Representative of findings.
.3 Where unknown services are encountered, immediately advise Departmental Representative and confirm findings in writing.
.4 Record locations of maintained, re-routed and abandoned service lines.

12. OWNER FURNISHED ITEMS

.1 Owner's responsibilities:
- .1 Arrange for delivery of shop drawings, product data, samples, manufacturer's instructions and certificates to Contractor.
- .2 Deliver supplier's bill of materials to Contractor.
- .3 Arrange and pay for delivery to site in accordance with construction schedule.
- .4 Inspect deliveries jointly with Contractor.
- .5 Submit claims for transportation damage.
- .6 Arrange for replacement of damaged, defective or missing items.
- .7 Arrange for manufacturer's field services; arrange for and deliver manufacturer's warranties and bonds to Contractor.

.2 Contractor's responsibilities:
- .1 Designate submittals and delivery date for each product in construction schedule.
- .2 Review shop drawings, product data, samples and other materials. Submit to Consultant notification of any observed discrepancies or problems anticipated due to non-conformance with Contract Documents.
- .3 Receive and unload products at site.
- .4 Inspect deliveries jointly with Owner, record shortages and damaged or defective items.
- .5 Handle products at site, including uncrating and storage.
- .6 Protect products from damage and from exposure to elements.
- .7 Assemble, install, connect, adjust and finish products.
- .8 Provide installation inspections required by public authorities.
- .9 Repair or replace items damaged by Contractor or Subcontractor on site.

END OF SECTION 01 11 00

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1	Quality Control:	Section 01 45 00
.2	Execution:	Section 01 73 00
.3	Closeout Submittals:	Section 01 78 00

1.2 ADMINISTRATIVE

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

1.3 SHOP DRAWINGS AND PRODUCT DATA

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

.8 Submissions include:
- .1 Date and revision dates.
- .2 Project title and number.
- .3 Name and address of:
  - .1 Subcontractor.
  - .2 Supplier.
  - .3 Manufacturer.
- .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
- .5 Details of appropriate portions of Work as applicable:
  - .1 Fabrication.
  - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
  - .3 Setting or erection details.
  - .4 Capacities.
  - .5 Performance characteristics.
  - .6 Standards.
  - .7 Operating weight.
  - .8 Wiring diagrams.
  - .9 Single line and schematic diagrams.
  - .10 Relationship to adjacent work.

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

.10 Submit electronic copy of shop drawings for each requirement requested in specification Sections and as Departmental Representative may reasonably request.

.11 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.

.12 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.

.13 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.

.14 Submit electronic copies of manufacturers instructions for requirements requested in specification Sections and as requested by Departmental Representative.
- .1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.

.15 Submit electronic copies of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Departmental Representative.

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

.17 Submit 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 same, and such review shall not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting requirements of construction and Contract Documents.

.2 Without restricting generality of foregoing, Contractor is responsible for dimensions to be confirmed and correlated at job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of Work of sub-trades.

1.4 SAMPLES

.1 Submit for review samples in duplicate as requested in respective specification Sections. Label samples with origin and intended use.

.2 Deliver samples prepaid to Departmental Representative's business address.

.3 Notify Departmental Representative in writing, at time of submission of deviations in samples from requirements of Contract Documents.

.4 Where colour, pattern or texture is criterion, submit full range of samples.

.5 Adjustments made on samples by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.

.6 Make changes in samples which Departmental Representative may require, consistent with Contract Documents.

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

1.5 MOCK-UPS

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

1.6 PHOTOGRAPHIC DOCUMENTATION

.1 Submit electronic copy of colour digital photography in .jpg format, standard resolution monthly with progress statement and as directed by Departmental Representative.

.2 Project identification: name and number of project and date of exposure indicated.

.3 Viewpoints and their location as determined by Departmental Representative.

.4 Frequency of photographic documentation: monthly as directed by Departmental Representative.

1.7 CERTIFICATES AND TRANSCRIPTS

.1 Immediately after award of Contract, submit WorkSafe BC status.

.2 Submiy electronic copies of test results and inspection reports as noted in each section of the specifications.

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

END OF SECTION 01 33 00

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Temporary Barriers and Enclosures: Section 01 56 00

1.2 DEFINITIONS

.1 Restricted zone: Every zone located inside the airport where access is prohibited by a sign or by any other means is a restricted zone.
.2 Movement Area: The part of an aerodrome to be used for the take-off, landing and taxiing of aircraft, consisting of the manoeuvring area and the apron.

1.3 GENERAL PROTECTION

.1 Do not disrupt airport business except as permitted by the Departmental Representative and Port Hardy Airport Authority Representative. I
.2 Provide temporary protection for safe handling of public, personnel, pedestrians and aircraft and vehicular traffic in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

1.4 MOVEMENT OF EQUIPMENT AND PERSONNEL

.1 In areas of Work that are located airside:
  .1 Obtain by the Departmental Representative and Port Hardy Airport Authority Representative and/or Airport Manager approval on scheduling of Work .
  .2 Control movements of equipment and personnel as directed by the Departmental Representative and Port Hardy Airport Authority Representative and/or Airport Manager.
  .3 Provide qualified field personnel at locations designated by the Port Hardy Airport Authority Representative and/or Airport Manager to relay signals from airport traffic control tower to equipment and personnel wishing to cross the airport runway and any other areas with aircraft traffic .
  .4 Obey signals from airport traffic control tower instantly.

1.5 OPERATIONAL RESTRAINTS

.1 Comply with safety and security operational requirements and any other applicable requirements during Work and alongside runway, taxiway and apron in operation, including, but not limited to:
  .1 The integrity of all electronic and visual navigation aids associated to aviation activities taking place at the same time must be maintained for aircraft movements, prevailing on Work; Every shut-down period for electrical work must be done by the Contractor and approved by the Departmental Representative .
  .2 Underground power cables, for transmission and control and all other equipment and underground services located near construction area have to be protected and identified;
  .3 The movement capability of emergency relief services must be maintained at all times. Service roads must be checked by Departmental Representative on a biweekly basis to ensure that access is maintained at all times. Alternate roads, to be approved, must be planned if new work is anticipated to affect the access.

1.6 UNSERVICEABLE AREAS

.1 Mark off areas made unserviceable for aircraft by Work of this Contract by providing plainly visible danger markings by day and red lights by night.
.2 Fire extinguishers must be present for any Hot Work.
.3 Park equipment not in use and stockpile materials such that they do not infringe on the Port Hardy Airport and Airport Manager operations. All material storage areas shall be approved by

the Departmental Representative.

.4 Ensure that the work areas remain clean in accordance with Section 01 74 11 - Cleaning.

1.7 TRENCHING

.1 Obtain the Departmental Representative and Port Hardy Airport Authority Representative's written permission to undertake trenching on pavements open to aircraft traffic which cannot be completed, backfilled and sealed within one working day.

1.8 AIRPORT FACILITIES

.1 Contractor shall complete utility locates prior to starting work. The Contractor shall stake or indicate location of underground facilities such as cables, pipes and ducts.

.2 Notify the Departmental Representative and Port Hardy Airport Authority Representative and Airport Manager of work areas sufficiently in advance of operations so that underground facilities can be located.

1.9 PERMITS & SECURITY CLEARANCES

.1 The Contractor shall obtain all necessary permits from the Port Hardy Airport Authority prior to beginning the work. A copy of all permits that are obtained shall be provided to the Departmental Representative and Airport Manager. .

.2 Obtain necessary security clearance passes prior to commencing work as instructed by the Port Hardy Airport Authority Representative and/or Airport Manager. Ensure that a security escort with a permanent pass is available, as required by the Port Hardy Airport Authority to accompany Contractors required to go airside.

END OF SECTION 01 35 13.13

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Submittal Procedures: Section 01 33 00
.2 Common Product Requirements: Section 01 61 00

1.2 REFERENCES

.1 Government of Canada.
  .1 Canada Labour Code - Part II
  .2 Canada Occupational Health and Safety Regulations .
.2 National Building Code of Canada (NBC 2010):
  .1 Part 8, Safety Measures at Construction and Demolition Sites.
.3 Canadian Standards Association (CSA as amended):
  .1 CSA Z797-09 (2014) Code of Practice for Access Scaffold
  .2 CSA S269.1-16 Falsework and Formwork.
  .3 CSA S350-M1980 (R2003) Code of Practice for Safety in Demolition of Structures
.4 American National Standards Institute (ANSI):
  .1 ANSI A10.3-2013, Safety Requirements for Powder-Actuated Fastening Systems.
.5 Province of British Columbia:
  .1 Workers Compensation Act Part 3 - 0ccupational Health and Safety.
  .2 Occupational Health and Safety Regulation
  .3 Current B.C. Electrical Code

1.3 WORKSAFE BC COVERAGE

.1 Comply fully with the Workers' Compensation Act, regulations and orders made pursuant thereto, and any amendments up to the completion of the work.
.2 Maintain WorkSafe BC 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 PSPC may terminate the Contract without liability to PSPC 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 Submit to Departmental Representative submittals listed for review. In accordance with Section 01 33 00.
.2 Work effected by submittal shall not proceed until review is complete.
.3 Submit the following:
  .1 Site Specific Health and Safety Plan.
  .2 Copies of reports or directions issued by Federal and Provincial health and safety inspectors.
  .3 Copies of incident and accident reports.
  .4 Complete set of Material Safety Data Sheets (MSDS), and all other documentation required by Workplace Hazardous Material Information System (WHMIS) requirements .
  .5 Emergency Procedures.
.4 The Departmental Representative will review the Contractor's site-specific project Health and emergency procedures, and provide comments to the Contractor within 2 days after receipt of

the plan. Revise the plan as appropriate and resubmit to Departmental Representative.

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

.6 Submission of the Site Specific Health and Safety Plan, and any revised version, to the Departmental Representative is for information and reference purposes only. It shall not:
- .1 Be construed to imply approval by the Departmental Representative.
- .2 Be interpreted as a warranty of being complete, accurate and legislatively compliant.
- .3 Relieve the Contractor of his legal obligations for the provision of health and safety on the project.

1.6 RESPONSIBILITY

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

.2 Be responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work .

.3 Comply with and enforce compliance by employees with safety requirements of Contract documents, applicable Federal, Provincial, Territorial and local statutes, regulations, and ordinances, and with site-specific Site Specific Health and Safety Plan.

1.7 HEALTH AND SAFETY COORDINATOR

.1 The Health and Safety Coordinator 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.

1.8 GENERAL CONDITIONS

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

.2 Ensure that non-authorized persons are not allowed to circulate in designated construction areas of the work site.
- .1 Provide appropriate means by use of barricades, fences, warning signs, traffic control personnel, and temporary lighting as required.
- .2 Secure site at night time as deemed necessary to protect site against entry.

1.9 REGULATORY REQUIREMENTS

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

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

1.10 WORK PERMITS

.1 Obtain specialty trade permits related to project before start of work.

1.11 FILING OF NOTICE

.1 The Contractor is to complete and submit a Notice of Project as required by provincial authorities.
.2 Provide copies of all notices to the Departmental Representative.

1.12 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 site-specific project Site Specific 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.
.3 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 .
.4 List hazardous materials to be brought on site as required by work .
.5 Indicate Engineering and administrative control measures to be implemented at the site for managing identified risks and hazards.
.6 Identify personal protective equipment (PPE) to be used by workers .
.7 Identify personnel and alternates responsible for site safety and health.
.8 Identify personnel training requirements and training plan, including site orientation for new workers .
.9 Develop the plan in collaboration with all subcontractors. Ensure that work/activities of subcontractors are included in the hazard assessment and are reflected in the plan.
.10 Revise and update Site Specific Health and Safety Plan as required, and re-submit to the Departmental Representative .
.11 Departmental Representative's review: the review of Site Specific Health and Safety Plan by Public Works and Government Services Canada (PWGSC) shall not relieve the Contractor of responsibility for errors or omissions in final Site Specific Health and Safety Plan or of responsibility for meeting all requirements of construction and Contract documents.

1.13 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 Departmental Representative 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 the fire department or other emergency responders .
  .5 Notify adjacent workplaces or residences which may be affected if the risk extends beyond the workplace .
  .6 Notify Departmental Representative and site 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 Revise and update emergency procedures as required, and re-submit to the Departmental Representative.

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 labeling and provision of material Safety Data Sheets (MSDS) acceptable to the Departmental Representative and in accordance with the Canada Labour Code.
.2 Where use of hazardous and toxic products cannot be avoided:
  .1 Advise Departmental Representative beforehand of the product(s) intended for use. Submit applicable MSDS and WHMIS documents as per Section 01 33 00.

1.15 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 .
  .1 Before undertaking any work, coordinate required energizing and de-energizing of new and existing circuits with Departmental Representative.
  .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.

1.16 ELECTRICAL LOCKOUT

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

1.17 OVERLOADING

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

1.18 CONFINED SPACES

.1 Carry out work in confined spaces in compliance with Occupational Health and Safety Regulation, Part 9.

1.19 POWDER-ACTUATED DEVICES

.1 Use powder-actuated devices in accordance with ANSI A 10.3 only after receipt of written

permission from the Departmental Representative.

1.20 FIRE SAFETY AND HOT WORK

.1 Obtain Departmental Representative's authorization before any welding, cutting or any other hot work operations can be carried out on site.
.2 Hot work includes cutting/melting with use of torch or other open flame devices and grinding with equipment which produces sparks.

1.21 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.

1.22 FIRE PROTECTION AND ALARM SYSTEM

.1 Fire protection and alarm systems shall not be:
  .1 Obstructed .
  .2 Shut off.
  .3 Left inactive at the end of a working day or shift.
.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, the building owner and the tenants, resulting from false alarms.

1.23 UNFORESEEN HAZARDS

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

1.24 POSTED DOCUMENTS

.1 Post legible versions of the following documents on site:
  .1 Site Specific Health and Safety Plan.
  .2 Sequence of work .
  .3 Emergency procedures.
  .4 Site drawing showing project layout, locations of the first-aid station, evacuation route and marshalling station and the emergency transportation provisions.
  .5 Notice of Project.
  .6 Floor plans or site plans.
  .7 Notice as to where a copy of the Workers' Compensation Act and Regulations are available on the work site for review by employees and workers.
  .8 Workplace Hazardous Materials Information System (WHMIS) documents.
  .9 Material Safety Data Sheets (MSDS).
  .10 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 .
.3 Postings should be protected from the weather, and visible from the street or the exterior of the principal construction site shelter provided for workers and equipment, or as approved by the Departmental Representative.

1.25 MEETINGS

.1 Attend health and safety pre-construction meeting and all subsequent meetings called by the Departmental Representative.

1.26 CORRECTION OF NON-COMPLIANCE

.1 Immediately address health and safety non-compliance issues identified by the Departmental Representative.

.2 Provide Departmental Representative with written report of action taken to correct non-compliance with health and safety issues identified.

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

END OF SECTION 01 35 29.06

PART 1 - GENERAL

1.1 GENERAL

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

1.2 REPORTING FIRES

.1 The Departmental Representative will co-ordinate arrangements for the Contractor to be briefed at the pre-construction meeting concerning Building's fire safety protocol.
.2 Know location of nearest fire alarm box and telephone, including emergency phone number.
.3 Report immediately all fire incidents to Fire Department as follows:
  .1 activate nearest fire alarm box; or
  .2 telephone.
.4 Person activating fire alarm box will remain at box to direct Fire Department to scene of fire.
.5 When reporting fire by telephone, give location of fire, name or number of building and be prepared to verify the location

1.3 FIRE WATCH

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

1.4 INTERIOR AND EXTERIOR FIRE PROTECTION AND ALARM SYSTEMS

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

1.5 FIRE EXTINGUISHERS

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

1.6 BLOCKAGE OF ROADWAYS

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

1.7 SMOKING PRECAUTIONS

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

1.8 RUBBISH AND WASTE MATERIALS

.1 Rubbish and waste materials are to be kept to a minimum.

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

1.9 FLAMMABLE AND COMBUSTIBLE LIQUIDS

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

1.10 HAZARDOUS SUBSTANCES

.1 Work entailing use of toxic or hazardous materials, chemicals and/or explosives, or otherwise creating hazard to life, safety or health, will be in accordance with National Fire Code of Canada.
.2 Obtain from Departmental Representative a "Hot Work" permit for work involving welding, burning or use of blow torches and salamanders, in buildings or facilities.
.3 When Work is carried out in dangerous or hazardous areas involving use of heat, provide fire watchers equipped with sufficient fire extinguishers. Determination of dangerous or hazardous areas along with level of protection necessary for Fire Watch is at discretion of the Departmental Representative . Contractors are responsible for providing fire watch service for work on a scale established and in conjunction with Departmental Representative at pre-construction meeting.
.4 Where flammable liquids, such as lacquers or urethanes are to be used, proper ventilation will be assured and all sources of ignition are to be eliminated. Departmental Representative is to be informed prior to and at cessation of such work.

1.11 WELDING, BURNING AND CUTTING

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

1.12 QUESTIONS AND/OR CLARIFICATIONS

.1 Direct any questions or clarification on Fire Safety in addition to above requirements to Departmental Representative.

1.13 FIRE INSPECTION

.1 Site inspections will be coordinated through Departmental Representative.
.2 Immediately remedy all unsafe fire situations.

END OF SECTION 01 35 36

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 31 23 33.01 Excavating, Trenching and Backfilling.

.2 Section 31 32 19.01 Geotextiles

1.2 REFERENCES

.1 Definitions:

.1 Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavourably alter ecological balances of importance to human life; affect other species of importance to humans; or degrade environment aesthetically, culturally and/or historically.

.2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction.

.2 Reference Standards:

.1 U.S. Environmental Protection Agency (EPA)/Office of Water

.1 EPA 832/R-92-005, Storm Water Management for Construction Activities, Chapter 3.

.2 EPA General Construction Permit (GCP) 2012.

.2 Stormwater Management Manual for Western Washington, Volume II, 2014, Chapter 4

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for any stormwater rehabilitation unit and associated flocculants, including product characteristics, performance criteria, environmental data including toxicity, physical size, and limitations.

.2 Before commencing construction activities or delivery of materials to site, submit Construction Activity Pollution Prevention Plan for review and approval by Departmental Representative.

.3 Construction Activity Pollution Prevention Plan must include comprehensive overview of known or potential environmental issues to be addressed during construction.

.4 Address topics at level of detail commensurate with environmental issue and required construction tasks.

.5 Include in Construction Activity Pollution Prevention Plan:

.1 Names of persons responsible for ensuring adherence to Construction Activity Pollution Prevention Plan.

.2 Names and qualifications of persons responsible for manifesting hazardous waste to be removed from site.

.3 Names and qualifications of persons responsible for training site personnel.

.4 Descriptions of environmental protection personnel training program.

.5 Erosion and Sediment Control Plan for construction activities associated with the project. The plan must incorporate practices such as phasing, seeding, grading, mulching, filter socks, stabilized site entrances, preservation of existing vegetation, and other best management practices (BMPs) to control erosion and sedimentation in runoff from the entire project site during construction. The plan must list the BMPs employed and describe how they accomplish the following objectives:

.1 Prevent loss of soil during construction by stormwater runoff and/or wind erosion, including but not limited to stockpiling of topsoil for reuse.

.2 Prevent sedimentation of any affected stormwater conveyance systems or receiving streams.

.3 Prevent polluting the air with dust and particulate matter.

.6 The BMPs to be selected from the Washington State Department of Ecology's Stormwater Management Manual for Western Washington, Volume II, Construction Stormwater Pollution Prevention (2005 edition), or a locally approved equivalent, whichever is more stringent, and must comply with all federal, state (provincial/territorial), and local erosion and sedimentation control regulations.

.7 The Erosion and Sediment Control Plan must describe how the project team will do the following:

.1 Preserve vegetation and mark clearing limits.

.2 Establish and delineate construction access.

.3 Control flow rates.

.4 Install sediment controls.

.5 Stabilize soils.

.6 Protect slopes.

.7 Protect drain inlets.

.8 Stabilize channels and outlets.

.9 Control pollutants.

.10 Control dewatering.

.11 Maintain the BMPs.

.12 Manage the erosion and sedimentation control plan.

.8 Drawings indicating locations of proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on site.

.9 Traffic Control Plans including measures to reduce erosion of temporary roadbeds by construction traffic, especially during wet weather.

.1 Plans to include details and measures to minimize amount of material transported onto paved public roads by vehicles or runoff.

.10 Work area plan showing proposed activity in each portion of area and identifying areas of limited use or non-use.

.1 Plan to include measures for marking limits of use areas and methods for protection of features to be preserved within authorized work areas.

.11 Spill Control Plan to include procedures, instructions, and reports to be used in event of unforeseen spill of regulated substance.

.12 Non-Hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris.

.13 Air pollution control plan detailing provisions to assure that dust, debris, materials, and trash, are contained on project site.

.14 Contaminant Prevention Plan identifying potentially hazardous substances to be used on job site; intended actions to prevent introduction of such materials into air, water, or ground; and detailing provisions for compliance with Federal, Provincial, and Municipal laws and regulations for storage and handling of these materials.

.15 Waste Water Management Plan identifying methods and procedures for management and discharge of waste waters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfection water, hydrostatic test water, and water used in flushing of lines.

1.4 FIRES

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

1.5 DRAINAGE

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

.2 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements.

.3 Contractor shall install, monitor and maintain catch basin sediment traps in the catch basins indicated on the plan. Installation, maintenance and removal of the catch basin sediment trap is to be in accordance with the manufacturers specifications. Install sediment trap until unit is removed as part of excavation and service is abandoned. Records of inspection and maintenance to be completed by the Contractor.

.4 Sediment control structures to be installed in accordance with details on the Contract Drawing prior to commencement of construction activity.

.5 Pumped water discharged to municipal storm drain must meet max 50 NTU turbidity. Contractor may utilize methods/technologies as part of a stormwater rehabilitation unit (SWRU) that may include systems listed below:

.1 settling pond
.2 settling tankage
.3 filtration units
.4 flocculants (product must be in conformance with Ministry of Environment, federal fisheries and the requirements of municipal bylaws)
.5 centrifugal-action separator
.6 filter bags
.7 dewatering bags
.8 vactor trucks (material removed from site must be disposed of in accordance with applicable regulations)
.9 bark mulch (hog fuel)

.6 Provide a water supply complete with approved reduced pressure backflow assembly (RPBA) to facilitate washing truck wheels to prevent the migration of silt onto adjacent streets. All wash activities are to be contained within the site.

.7 Erect and maintain silt fence at the site borders where surface runoff is likely to occur.

.8 Erect and maintain silt fence and/or staked haybales in any ditches until vegetation is established.

.9 Contractor shall provide personnel as required to sample and test site runoff. Samples to be collected and submitted to an approved testing facility. Cost of collection and testing to be at Contractors expense.

.10 Contractor to cover erodible stockpiled material or exposed cut slopes with anchored polyethylene sheeting to prevent displacement by wind or rainwater runoff.

.11 Contractor is responsible to take measures onsite to minimize tracking of sediment onto existing roads and road cleaning as required or as recommended by the Departmental Representative.

.12 A supply of erosion and sediment control materials shall be kept on construction site at all times to provide for minor unexpected erosion or sediment control needs, routine control replacements, and/or sediments emergencies.

.13 Install sediment control structures at times and locations noted or as directed by Departmental Representative.

.14 Contractor shall ensure that all excavation and construction procedures are undertaken in such a manner as to prevent sediment-laden runoff from site entering the municipal storm drainage system.

.15 During periods of heavy rain, all works associated with large machine traffic (e.g. hauling) should be stopped to minimize tracking of debris offsite.

.16 During the construction period the erosion prevention and sediment control facilities shown on the Contract Drawings are the minimum requirements for anticipated site conditions. These structures shall be upgraded as needed for unexpected storm events or site conditions, and to ensure that sediment and sediment-laden water do not leave the site. Contractor to notify Departmental Representative of revisions to the approved plan.

.17 All control measures are to be restored at the end of the day everyday, in the event of a rainfall while the site is not supervised.

.18 Design Criteria:

.1 Water quality test parameters:

.2 Turbidity - 50 NTU (max)

.3 Oil and grease - 15.0 mg/l (max)

.4 Total phosphorus - 1.0 mg/l (max)

.5 75 mg/l - suspended solids

.19 Reporting and documentation

.1 Contractor to provide monthly reports on sediment and erosion control measures including any modifications to structures, maintenance provided, observations, and performance information. The report is to include photographs of the facilities.

1.6 SITE CLEARING AND PLANT PROTECTION

.1 Protect trees and plants on site and adjacent properties by erecting snow fence around the drip zone.

.2 Protect trees and shrubs adjacent to construction work, storage areas and trucking lanes, and encase with protective wood framework.

.3 Protect roots of designated trees to dripline during excavation and site grading to prevent disturbance or damage.

.1 Avoid unnecessary traffic, dumping and storage of materials over root zones.

.4 Minimize stripping of topsoil and vegetation.

1.7 WORK ADJACENT TO WATERWAYS

.1 Construction equipment to be operated on land only.

.2 Watercourses to be kept free of excavated fill, waste material and debris.

.3 Do not skid logs or construction materials across watercourses.

.4 Avoid indicated spawning beds when constructing temporary crossings of waterways.

1.8 POLLUTION CONTROL

.1 Maintain temporary erosion and pollution control features installed under this Contract.

.2 Control emissions from equipment in accordance with local authorities' emission requirements.

.3 Prevent sandblasting and other extraneous materials from contaminating air and waterways beyond application area.

.1 Provide temporary enclosures where indicated.

.4 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.

1.9 NOTIFICATION

.1 Departmental Representative will notify Contractor in writing of observed noncompliance with Federal, Provincial or Municipal environmental laws or regulations, permits, and other elements of Contractor's Construction Activity Pollution Prevention Plan.

.2 Contractor: after receipt of such notice, inform Departmental Representative of proposed corrective action and take such action.

.3 Departmental Representative may issue stop order of work until satisfactory corrective action has been taken.

.4 No time extensions granted or equitable adjustments allowed to Contractor for such suspensions.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Ensure public waterways, storm and sanitary sewers remain free of waste and volatile materials disposal.

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

.4 Waste Management: separate waste materials for in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

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

END OF SECTION 01 35 43

PART 1 - GENERAL

1.1 GENERAL

.1 Section 01 55 00 addresses general requirements for temporary vehicle movement, site access and parking not incorporated into the final or permanent work, as well as traffic control during construction. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.

.2 During progress of the Work, make adequate provision to accommodate normal traffic along onsite roads immediately adjacent to or crossing the Works so as to minimize inconvenience to site operations.

.3 Give minimum 48 h notice or as otherwise required by Departmental Representative to local police, fire departments, emergency services, and site operations staff prior to beginning construction on roadways and comply in all respects with their requirements.

.4 Inform Departmental Representative and tenants where access is affected at least 24 hours in advance of proposed road and/or sidewalk closures.

1.2 SUBMITTALS

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

.2 Contractor to submit traffic control plan to Departmental Representative for review and approval prior to construction.

1.3 EXISTING SITE CONDITIONS AND ENVIRONMENTAL PROTECTION

.1 The contractor shall be held responsible for any damage caused to existing streets or services by construction equipment and/or trucks hauling materials to the site. This shall include daily cleaning or sweeping all existing roads or dirt and debris caused by construction activity.

.2 A truck wash may be required at the discretion of the Departmental Representative.

.3 All work areas, roadways, and site accesses to be restored to as-found or better condition once work is complete.

.4 Mats will be used when operating tracked equipment on all paved areas, with the exception of areas stipulated for re-pavement.

1.4 TEMPORARY HOARDING

.1 Provide temporary hoarding as shown on the drawings.

.2 Hoarding to be 2.4m high interlocking steel fence, secured at all corners and ends.

.3 Hoarding line to be outside existing paved areas to maintain access for Airport equipment. During parking lot prep. work and paving, the hoarding line may be temporarily relocated east.

.4 Secure hoarding as needed to withstand seasonal weather events. Monitor and make good any deficienices, as needed.

1.5 TEMPORARY ACCESS ROADS

.1 Provide and maintain temporary access roads at locations approved by the Departmental Representative.

1.6 TEMPORARY PARKING AREAS

.1 Provide and maintain temporary parking areas as shown in the construction documents.

1.7 CONTRACTOR LAYDOWN AREA

.1 The Contractor may use the area specified in the construction documents for a laydown area including equipment and material storage, site offices, first aid facilities, washrooms, and other required site facilities.

.2 The existing ground surface is to be protected and restored to as-found or better condition once construction is complete.

.3 Fencing, signage, and security are to be provided by the Contractor. Any vandalism is to be removed or repaired within 24-hours.

.4 The Contractor is responsible for any theft or incidental damage in the laydown area.

1.8 TRAFFIC CONTROL AND SIGNAGE

.1 Comply with requirements of the “Traffic Control Manual for Work on Roadways”, published by the British Columbia Ministry of Transportation, for regulation of vehicle and pedestrian traffic or use of roadways upon or over which it is necessary to carry out work or haul materials or equipment.

.2 Regulate traffic in general accordance with Port Hardy Airport requirements for uninterrupted access to all parts of this site except where specified otherwise and in compliance with specific requirements stipulated herein.

.3 Provide and maintain access to corridors specified on Contract Drawings.

.4 Provide and maintain reasonable road and pedestrian access to all temporary facilities, cargo requirements, and emergency access.

.5 Keep travelled way well graded, free of pot holes and of sufficient width that required number of lanes of traffic may pass.

.6 When working on travelled way:

.1 Place equipment in such position as to present a minimum of interference and hazard to the travelling public.

.2 Keep equipment units as close together as working conditions will permit and preferably on same side of travelled way.

.3 Provide lighting as required based on seasonal variations and hours of work.

.4 Do not leave equipment on travelled way overnight.

.7 Traffic Control Informational and Warning Devices

.1 Provide and maintain signs and other devices required to indicate construction activities or other temporary and unusual conditions resulting from project work which may require road user response.

.2 Supply and erect signs, delineators, barricades and other miscellaneous warning devices in accordance with Departmental Representative requirements.

.3 Place signs and other devices in additional locations as appropriate or as directed by the Departmental Representative.

.4 Continually maintain traffic control devices in use by:

.1 Checking signs daily for legibility, damage, suitability and location. Clean, repair or replace to ensure clarity and reflectance.

.2 Removing or covering signs which do not apply to conditions existing from day to day.

.8 Control of Traffic Using Flaggers

.1 Provide flag persons, trained and properly equipped for the following situations:

.1 When it is necessary to institute one-way traffic system through construction area or other blockage where the typical traffic control plant is not in use.

.2 When workers or equipment are employed on travelled way.

.3 Where temporary protection is required while other traffic control devices are being erected or taken down.

.4 For emergency protection when other traffic control devices are not readily available.

.5 In situations where complete protection for workers, working equipment and public traffic is not provided by other traffic control devices.

.9 Provide and maintain suitable detours or temporary hard surfaced access routes for pedestrian traffic, complete with suitable warning and advisory signs.

.10 Maintain existing conditions for traffic throughout period of contract except that, when required for construction under contract and when measures have been taken as specified herein and approved by Departmental Representative to protect and control public traffic, existing conditions for traffic may be restricted.

END OF SECTION 01 55 00

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Submittal Procedures: Section 01 33 00
.2 Common Product Requirements: Section 01 61 00

1.2 INSPECTION

.1 Allow Departmental Representative access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.
.2 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by Departmental Representative instructions, or law of Place of Work.
.3 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.
.4 Departmental Representative 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 INDEPENDENT INSPECTION AGENCIES

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

1.4 ACCESS TO WORK

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

1.5 PROCEDURES

.1 Notify appropriate agency and Departmental Representative in advance of requirement for tests, in order that attendance arrangements can be made.
.2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in 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.

1.6 REJECTED WORK

.1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by Departmental Representative as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.
.2 Make good other Contractor's work damaged by such removals or replacements promptly.

.3 If in opinion of Departmental Representative it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, 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.

1.7 REPORTS

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

1.8 TESTS AND MIX DESIGNS

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

1.9 MOCK-UPS

.1 Prepare mock-ups for Work specifically requested in specifications. Include for Work of Sections required to provide mock-ups.
.2 Construct in locations acceptable to Departmental Representative as specified in specific Section.
.3 Prepare mock-ups for Departmental Representative review with reasonable promptness and in orderly sequence, to not cause delays in Work.
.4 Failure to prepare mock-ups 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.
.5 If requested, Departmental Representative will assist in preparing schedule fixing dates for preparation.
.6 Remove mock-up at conclusion of Work or when acceptable to Departmental Representative.
.7 Mock-ups may remain as part of Work.
.8 Specification section identifies whether mock-up may remain as part of Work or if it is to be removed and when.

1.10 MILL TESTS

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

1.11 EQUIPMENT AND SYSTEMS

.1 Submit adjustment and balancing reports for mechanical, electrical and building equipment systems.

END OF SECTION 01 45 00

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1	Submittal Procedures:	Section 01 33 00
.2	Construction Facilities:	Section 01 52 00
.3	Temporary Barriers and Enclosures:	Section 01 56 00
.4	Closeout Procedures:	Section 01 77 00

1.2 REFERENCES

.1 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.

1.3 SUBMITTALS

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

1.4 INSTALLATION AND REMOVAL

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

1.5 DEWATERING

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

1.6 WATER SUPPLY

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

1.7 TEMPORARY HEATING AND VENTILATION

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

.4 Maintain temperatures of minimum 10°C in areas where construction is in progress
.5 Ventilating:
- .1 Prevent accumulations of dust, fumes, mists, vapours or gases in areas occupied uring construction.
- .2 Provide local exhaust ventilation to prevent harmful accumulation of hazardous substances into atmosphere of occupied areas.
- .3 Dispose of exhaust materials in manner that will not result in harmful exposure to

persons.
.4 Ventilate storage spaces containing hazardous or volatile materials.
.5 Ventilate temporary sanitary facilities.
.6 Continue operation of ventilation and exhaust system for time after cessation of work process to assure removal of harmful contaminants.

.6 Permanent heating system of building, will not be used when available. Be responsible for damage to heating system if use is permitted.
.7 On completion of Work for which permanent heating system is used, restore to “new” condition.
.8 Pay costs for maintaining temporary heat, when using permanent heating system.
.9 Maintain strict supervision of operation of temporary heating and ventilating equipment to:
.1 Conform with applicable codes and standards.
.2 Enforce safe practices.
.3 Prevent abuse of services.
.4 Prevent damage to finishes.
.5 Vent direct-fired combustion units to outside.
.10 Be responsible for damage to Work due to failure in providing adequate heat and protection during construction.

1.8 TEMPORARY POWER AND LIGHT

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

1.9 TEMPORARY COMMUNICATION FACILITIES

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

1.10 FIRE PROTECTION

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

1.11 TEMPORARY EROSION AND SEDIMENTATION CONTROL

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

END OF SECTION 01 51 00

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1	Submittal Procedures:	Section 01 33 00
.2	Construction Utilities:	Section 01 51 00
.3	Temporary Barriers and Enclosures:	Section 01 56 00
.4	Closeout Procedures:	Section 01 77 00

1.2 REFERENCES

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

.2 Canadian Standards Association (CSA International)
- .1 CSA A23.1-09/A23.2-09 (R2014), Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
- .2 CSA O121-08 (R2013), Douglas Fir Plywood.
- .3 CSA Z797-09 (2014), Code of Practice for Access Scaffold.
- .4 CAN/CSA S269.2-16 - Access Scaffolding for Construction Purposes
- .5 CAN/CSA-Z321-96(R2006), Signs and Symbols for the Occupational Environment, withdrawn but still available from CSA, CCOHS and Techstreet.

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

.4 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.

1.3 SUBMITTALS

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

1.4 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.

1.5 SCAFFOLDING

.1 Scaffolding in accordance with CSA Z797 and CAN/CSA S269.2.
.2 Provide and maintain scaffolding, ramps, ladders, swing staging, platforms and temporary stairs.

1.6 HOISTING

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

1.7 SITE STORAGE/LOADING

.1 Confine work and operations of employees to areas defined by Contract Documents. Do not unreasonably encumber premises with products.
.2 Do not load or permit to load any part of Work with a weight or force that will endanger the Work.

1.8 CONSTRUCTION PARKING

.1 Parking will be permitted on site provided it does not disrupt performance of Work.
.2 Provide and maintain adequate access to project site.
.3 Clean runways and taxi areas where used by Contractor's equipment.
.4 Clean construction roads and parking areas where used by Contractor's equipment.

1.9 OFFICES

.1 Provide office heated to 22 degrees C, lighted 750 lx and ventilated, of sufficient size to accommodate site meetings and furnished with drawing laydown table.
.2 Provide marked and fully stocked first-aid case in a readily available location.
.3 Subcontractors to provide their own offices as necessary. Direct location of these offices.
.4 Departmental Representative's Site office.
    .1 Provide temporary office for Departmental Representative.
    .2 Inside dimensions minimum 3.6 m long x 3 m wide x 2.4 m high, with floor 0.3 m above grade, complete with 4 50% opening windows and one lockable door.
    .3 Insulate building and provide heating system to maintain 22 degrees C inside temperature at -20 degrees C outside temperature.
    .4 Finish inside walls and ceiling with plywood, hardboard or wallboard and paint in selected colours. Finish floor with 19 mm thick plywood.
    .5 Install electrical lighting system to provide min 750 lx using surface mounted, shielded commercial fixtures with 10% upward light component.
    .6 Provide private washroom facilities adjacent to office complete with flush or chemical type toilet, lavatory and mirror and maintain supply of paper towels and toilet tissue.
    .7 Equip office with 1 x 2 m table, 4 chairs, 6 m of shelving 300 mm wide, one 3 drawer filing cabinet, one plan rack and one coat rack and shelf.
    .8 Maintain in clean condition.

1.10 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.
.3 When permanent water and drain connections are completed, provide temporary water closets and urinals complete with temporary enclosures, inside building. Permanent facilities may be used on approval of Departmental Representative.

1.11 CONSTRUCTION SIGNAGE

.1 Provide and erect project sign, within three weeks of signing Contract, in a location designated by Departmental Representative.
.2 Construction sign 1.2 m_ x 2.4 m, of wood frame and plywood construction painted with exhibit lettering produced by a professional sign painter.
.3 Indicate on sign design style established by Departmental Representative.
.4 No other signs or advertisements, other than warning signs, are permitted on site.

1.12 PROTECTION AND MAINTENANCE OF TRAFFIC

.1 Provide access and temporary relocated roads as necessary to maintain traffic.
.2 Maintain and protect traffic on affected roads during construction period except as otherwise specifically directed by Departmental Representative.
.3 Provide measures for protection and diversion of traffic, including provision of watch-persons and flag-persons, erection of barricades, placing of lights around and in front of equipment and work, and erection and maintenance of adequate warning, danger, and direction signs
.4 Protect travelling public from damage to person and property.
.5 Contractor's traffic on roads selected for hauling material to and from site to interfere as little as possible with public traffic.
.6 Verify adequacy of existing roads and allowable load limit on these roads. Contractor: responsible for repair of damage to roads caused by construction operations.
.7 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.

1.13 SPILL PROTECTION

.1 Provide on site spill kit.
.2 Kit shall include:
- 45 Gallons plastic drum
- 100 Sorbent pads of 15" X 19" X 12 oz
- 5 Sorbent socks 3" X 48"
- 2 Sorbent booms 5" x 10'
- 1 Epoxy sticks
- 3 Disposal bags 40" x 60" x 6 mil.
- 2 pairs of nitrile gloves

.3 Spill kits must be maintained on site at all time. Personnel must be familiar with spill recovery equipment and its use.

1.14 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.

END OF SECTION 01 52 00

PART 1 - GENERAL

1.1 GENERAL

.1 Section 01 55 00 addresses general requirements for temporary vehicle movement, site access and parking not incorporated into the final or permanent work, as well as traffic control during construction. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.

.2 During progress of the Work, make adequate provision to accommodate normal traffic along onsite roads immediately adjacent to or crossing the Works so as to minimize inconvenience to site operations.

.3 Give minimum 48 h notice or as otherwise required by Departmental Representative to local police, fire departments, emergency services, and site operations staff prior to beginning construction on roadways and comply in all respects with their requirements.

.4 Inform Departmental Representative and tenants where access is affected at least 24 hours in advance of proposed road and/or sidewalk closures.

1.2 SUBMITTALS

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

.2 Contractor to submit traffic control plan to Departmental Representative for review and approval prior to construction.

1.3 EXISTING SITE CONDITIONS AND ENVIRONMENTAL PROTECTION

.1 The contractor shall be held responsible for any damage caused to existing streets or services by construction equipment and/or trucks hauling materials to the site. This shall include daily cleaning or sweeping all existing roads or dirt and debris caused by construction activity.

.2 A truck wash may be required at the discretion of the Departmental Representative.

.3 All work areas, roadways, and site accesses to be restored to as-found or better condition once work is complete.

.4 Mats will be used when operating tracked equipment on all paved areas, with the exception of areas stipulated for re-pavement.

1.4 TEMPORARY HOARDING

.1 Provide temporary hoarding as shown on the drawings.

.2 Hoarding to be 2.4m high interlocking steel fence, secured at all corners and ends.

.3 Hoarding line to be outside existing paved areas to maintain access for Airport equipment. During parking lot prep. work and paving, the hoarding line may be temporarily relocated east.

.4 Secure hoarding as needed to withstand seasonal weather events. Monitor and make good any deficienices, as needed.

1.5 TEMPORARY ACCESS ROADS

.1 Provide and maintain temporary access roads at locations approved by the Departmental Representative.

1.6 TEMPORARY PARKING AREAS

.1 Provide and maintain temporary parking areas as shown in the construction documents.

1.7 CONTRACTOR LAYDOWN AREA

.1 The Contractor may use the area specified in the construction documents for a laydown area including equipment and material storage, site offices, first aid facilities, washrooms, and other required site facilities.

.2 The existing ground surface is to be protected and restored to as-found or better condition once construction is complete.

.3 Fencing, signage, and security are to be provided by the Contractor. Any vandalism is to be removed or repaired within 24-hours.

.4 The Contractor is responsible for any theft or incidental damage in the laydown area.

1.8 TRAFFIC CONTROL AND SIGNAGE

.1 Comply with requirements of the “Traffic Control Manual for Work on Roadways”, published by the British Columbia Ministry of Transportation, for regulation of vehicle and pedestrian traffic or use of roadways upon or over which it is necessary to carry out work or haul materials or equipment.

.2 Regulate traffic in general accordance with Port Hardy Airport requirements for uninterrupted access to all parts of this site except where specified otherwise and in compliance with specific requirements stipulated herein.

.3 Provide and maintain access to corridors specified on Contract Drawings.

.4 Provide and maintain reasonable road and pedestrian access to all temporary facilities, cargo requirements, and emergency access.

.5 Keep travelled way well graded, free of pot holes and of sufficient width that required number of lanes of traffic may pass.

.6 When working on travelled way:

.1 Place equipment in such position as to present a minimum of interference and hazard to the travelling public.

.2 Keep equipment units as close together as working conditions will permit and preferably on same side of travelled way.

.3 Provide lighting as required based on seasonal variations and hours of work.

.4 Do not leave equipment on travelled way overnight.

.7 Traffic Control Informational and Warning Devices

.1 Provide and maintain signs and other devices required to indicate construction activities or other temporary and unusual conditions resulting from project work which may require road user response.

.2 Supply and erect signs, delineators, barricades and other miscellaneous warning devices in accordance with Departmental Representative requirements.

.3 Place signs and other devices in additional locations as appropriate or as directed by the Departmental Representative.

.4 Continually maintain traffic control devices in use by:

.1 Checking signs daily for legibility, damage, suitability and location. Clean, repair or replace to ensure clarity and reflectance.

.2 Removing or covering signs which do not apply to conditions existing from day to day.

.8 Control of Traffic Using Flaggers

.1 Provide flag persons, trained and properly equipped for the following situations:

.1 When it is necessary to institute one-way traffic system through construction area or other blockage where the typical traffic control plant is not in use.

.2 When workers or equipment are employed on travelled way.

.3 Where temporary protection is required while other traffic control devices are being erected or taken down.

.4 For emergency protection when other traffic control devices are not readily available.

.5 In situations where complete protection for workers, working equipment and public traffic is not provided by other traffic control devices.

.9 Provide and maintain suitable detours or temporary hard surfaced access routes for pedestrian traffic, complete with suitable warning and advisory signs.

.10 Maintain existing conditions for traffic throughout period of contract except that, when required for construction under contract and when measures have been taken as specified herein and approved by Departmental Representative to protect and control public traffic, existing conditions for traffic may be restricted.

END OF SECTION 01 55 00

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1	Submittal Procedures:	Section 01 33 00
.2	Construction Utilities:	Section 01 51 00
.3	Construction Facilities:	Section 01 52 00
.4	Construction/Demolition Waste Management and Disposal:	Section 01 74 21
.5	Closeout Procedures:	Section 01 77 00

1.2 REFERENCES

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

1.3 INSTALLATION AND REMOVAL

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

1.4 HOARDING

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

1.5 GUARD RAILS AND BARRICADES

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

1.6 WEATHER ENCLOSURES

.1 Provide weather tight closures to unfinished door and window openings, tops of shafts and other openings in floors and roofs.
.2 Close off floor areas where walls are not finished; seal off other openings; enclose building interior work for temporary heat.
.3 Design enclosures to withstand wind pressure and snow loading.

1.7 DUST TIGHT SCREENS

.1 Provide dust tight screens or insulated partitions to localize dust generating activities, and for protection of workers, finished areas of Work and public.
.2 Maintain and relocate protection until such work is complete.

1.8 ACCESS TO SITE

.1 Provide and maintain access roads, sidewalk crossings, ramps and construction runways as

may be required for access to Work.

1.9 PUBLIC TRAFFIC FLOW

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

1.10 FIRE ROUTES

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

1.11 PROTECTION FOR OFF-SITE AND PUBLIC PROPERTY

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

1.12 PROTECTION OF BUILDING FINISHES

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

1.13 WASTE MANAGEMENT AND DISPOSAL

.5 Separate waste materials for reuse and recycling] in accordance with Section 01 74 21 - Construction/Demolition Waste Management And Disposal.

END OF SECTION 01 56 00

PART 1 - GENERAL

1.1 REFERENCES

.1 Within text of specifications, reference may be made to reference standards.
  .1 Conform to these standards, in whole or in part as specifically requested in specifications.
  .2 Unless otherwise noted, all references to codes, standards and standard specifications referred to in these Specifications or used on drawings shall mean and intend to be the currently adopted edition, amendment and revision of such reference standards in effect at the time of Bid closing.
.2 If there is question as to whether any product or system is in conformance with applicable standards, Departmental Representative reserves right to have such products or systems tested to prove or disprove conformance.
.3 The cost for such testing will be born by Departmental Representative in event of conformance with Contract Documents or by Contractor in event of non-conformance.

1.2 QUALITY

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

1.3 AVAILABILITY

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

1.4 STORAGE, HANDLING AND PROTECTION

.1 Handle and store products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.
.2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.
.3 Store products subject to damage from weather in weatherproof enclosures.
.4 Store cementitious products clear of earth or concrete floors, and away from walls.
.5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.

.6 Store sheet materials, lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.
.7 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.
.8 Remove and replace damaged products at own expense and to satisfaction of Departmental Representative.
.9 Touch-up damaged factory finished surfaces to Departmental Representative's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

1.5 TRANSPORTATION

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

1.6 MANUFACTURER'S INSTRUCTIONS

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

1.7 QUALITY OF WORK

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

1.8 CO-ORDINATION

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

1.9 CONCEALMENT

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

1.10 REMEDIAL WORK

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

1.11 LOCATION OF FIXTURES

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

1.12 PROTECTION OF WORK IN PROGRESS

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

1.13 EXISTING UTILITIES

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

END OF SECTION 01 61 00

PART 1 - GENERAL

1.1 REFERENCES

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

1.2 QUALIFICATIONS OF SURVEYOR

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

1.3 SURVEY REFERENCE POINTS

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

1.4 SURVEY REQUIREMENTS

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

1.5 EXISTING SERVICES

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

1.6 LOCATION OF EQUIPMENT AND FIXTURES

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

1.7 RECORDS

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

1.8 SUBMITTALS

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

1.9 SUBSURFACE CONDITIONS

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

END OF SECTION 01 71 00

PART 1 - GENERAL

1.1 SUBMITTALS

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

1.2 MATERIALS

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

1.3 PREPARATION

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

1.4 EXECUTION

.1 Execute cutting, fitting, and patching to complete Work.
.2 Fit several parts together, to integrate with other Work.
.3 Uncover Work to install ill-timed Work.
.4 Remove and replace defective and non-conforming Work.
.5 Provide openings in non-structural elements of Work for penetrations of mechanical and electrical Work.
.6 Execute Work by methods to avoid damage to other Work, and which will provide proper surfaces to receive patching and finishing.
.7 Employ original installer to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.
.8 Cut rigid materials using masonry saw or core drill. Pneumatic or impact tools not allowed on masonry work without prior approval.
.9 Restore work with new products in accordance with requirements of Contract Documents.
.10 Refinish surfaces to match adjacent finishes: Refinish continuous surfaces to nearest intersection. Refinish assemblies by refinishing entire unit.
.11 Fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

.12 At penetration of fire rated wall, ceiling, or floor construction, completely seal voids with firestopping material in accordance with Section 07 84 00, full thickness of the construction element.

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

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse, recycling, in accordance with Section 01 74 21.

END OF SECTION 01 73 00

PART 1 - GENERAL

1.1 PROJECT CLEANLINESS

.1 Maintain Work in tidy condition, free from accumulation of waste products and debris, other than that caused by Owner or other Contractors.
.2 Remove waste materials from site at daily regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials on site, unless approved by Departmental Representative.
.3 Clear snow and ice from access to the site, including on the bridge, bank/pile snow in designated areas only or remove from site.
.4 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
.5 Provide on-site containers for collection of waste materials and debris.
.6 Provide and use marked separate bins for recycling. Refer to Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
.7 Dispose of waste materials and debris off site.
.8 Store volatile waste in covered metal containers, and remove from premises at end of each working day.
.9 Provide adequate ventilation during use of volatile or noxious substances.
.10 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
.11 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

1.2 FINAL CLEANING

.1 When Work is Substantially Performed remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.
.2 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.
.3 Prior to final review remove surplus products, tools, construction machinery and equipment.
.4 Remove waste 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.
.5 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
.6 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.
.7 Remove dirt and other disfiguration from exterior surfaces.
.8 Sweep and wash clean paved areas.
.9 Clean equipment and fixtures to sanitary condition; clean or replace filters of mechanical equipment.
.10 Remove snow and ice from access to bridge and off the bridge.

1.3 WASTE MANAGEMENT AND DISPOSAL

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

END OF SECTION 01 74 11

PART 1 - GENERAL

1.1 DEFINITIONS

.1 Clean Waste: Untreated and unpainted; not contaminated with oils, solvents, sealants or similar materials.
.2 Construction and Demolition Waste: Solid wastes typically including but not limited to, building materials, packaging, trash, debris, and rubble resulting from construction, re-modelling, repair and demolition operations.
.3 Hazardous: Exhibiting the characteristics of hazardous substances including, but not limited to, ignitability, corrosiveness, toxicity or reactivity.
.4 Non-hazardous: Exhibiting none of the characteristics of hazardous substances, including, but not limited to, ignitability, corrosiveness, toxicity, or reactivity.
.5 Non-toxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.
.6 Recyclable: The ability of a product or material to be recovered at the end of its life cycle and re-manufactured into a new product for reuse by others.
.7 Recycle: To remove a waste material from the Project site to another site for re-manufacture into a new product for reuse by others.
.8 Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
.9 Return: To give back reusable items or unused products to vendors for credit.
.10 Reuse: To reuse a construction waste material in some manner on the Project site.
.11 Salvage: To remove a waste material from the Project site to another site for resale or reuse by others.
.12 Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.
.13 Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.
.14 Toxic: Poisonous to humans either immediately or after a long period of exposure.
.15 Trash: Any product or material unable to be reused, returned, recycled, or salvaged.
.16 Volatile Organic Compounds (VOC): Chemical compounds common in and emitted by many building products over time through outgassing:
    .1 Solvents in paints and other coatings,
    .2 Wood preservatives; strippers and household cleaners,
    .3 Adhesives in particle board, fibreboard, and some plywood; and foam insulation,
    .4 When released, VOC's can contribute to the formation of smog and can cause respiratory tract problems, headaches, eye irritations, nausea, damage to the liver, kidneys, and central nervous system, and possibly cancer.
.17 Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

1.2 WASTE MANAGEMENT GOALS

.1 Owner has established that this Project shall generate the least amount of waste possible and that processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors shall be employed. The owners goal is to divert 75% of waste materials from the landfill.
.2 Owner recognizes that waste in any project is inevitable, but indicates that as much of the waste materials as economically feasible shall be reused, salvaged, or recycled.
.3 Waste disposal in landfills shall be minimized.

1.3 MATERIAL SOURCE SEPARATION PLAN

.1 Before project start-up, prepare Materials Source Separation Program. Provide separate containers for re-usable and/or recyclable materials of following:

.1 Construction waste: including but not limited to following types.
.2 Uncontaminated packaging (wood, metal banding, cardboard, paper, plastic wrappings, polystyrene).
.3 Wood pallets (recycle or return to shipper).
.4 Batt insulation.
.5 Metals (pipe, conduit, ducting, wiring, miscellaneous cuttings)
.6 Wood (uncontaminated).
.7 Gypsum board (uncontaminated).
.8 Paint, solvent, oil.
.9 Other materials as indicated in technical sections.
.10 Administration/worker waste (uncontaminated): including but not limited to following types
.11 Paper, cardboard.
.12 Plastic containers and lids marked types 1 through 6.
.13 Glass and aluminum drink containers (recycle or return to vendor).

.2 Implement MSSP for waste generated on project in compliance with approved methods and as approved by Departmental Representative.
.3 Locate containers in locations, to facilitate deposit of materials without hindering daily operations and as directed by Departmental Representative.
.4 Locate separated materials in areas which minimize material damage.

1.4 STORAGE, HANDLING AND PROTECTION

.1 Store, materials to be reused, recycled and salvaged in locations as directed by Departmental Representative.
.2 Unless specified otherwise, materials for removal becomes Contractor's property.
.3 All materials for recycling must be source separated into separate bins to be accepted by the local processing authority.
.4 Separate non-salvageable materials from salvaged items. Transport and deliver non-salvageable items to licensed disposal facility.
.5 Protect surface drainage, storm sewers, sanitary sewers, and utility services from damage and blockage.

1.5 PREPARATION

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

1.6 USE OF SITE AND FACILITIES

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

1.7 WASTE MANAGEMENT IMPLEMENTATION

.1 Manager: Contractor to designate an on-site party responsible for instructing workers and overseeing the results of the Waste Management Plan for the Project.
.2 Instruction: Contractor shall provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the Project.
.3 Separation facilities: Contractor shall lay out and label a specific area to facilitate separation of materials for potential recycling, salvage, reuse, and return. Recycling and waste bin areas are to be kept neat and clean and clearly marked in order to avoid contamination of materials.
.4 Hazardous wastes: Hazardous wastes shall be separated, stored, and disposed of according to local regulations.

1.8 DISPOSAL OF WASTE

.1 Burying of rubbish and waste materials is prohibited.
.2 Disposal of waste into waterways, storm, or sanitary sewers is prohibited.

1.9 CLEANING

.1 Remove tools and waste materials on completion of work, and leave work area in clean and orderly condition.
.2 Clean-up work area as work progresses.
.3 Source separate materials to be reused/recycled into specified sort areas.

END OF SECTION 01 74 21

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Closeout Submittals: Section 01 33 00

1.2 ADMINISTRATIVE REQUIREMENTS

.1 Acceptance of Work Procedures:
- .1 Contractor's Inspection: Contractor: conduct inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.
  - .1 Notify Departmental Representative in writing of satisfactory completion of Contractor's inspection and submit verification that corrections have been made.
  - .2 Request Departmental Representative inspection.
  - .3 Departmental Representative Inspection: Departmental Representative and Contractor to inspect Work and identify defects and deficiencies.
- .2 Contractor to correct Work as directed.
- .4 Completion Tasks: submit written certificates that tasks have been performed as follows:
  - .1 Work: completed and inspected for compliance with Contract Documents.
  - .2 Defects: corrected and deficiencies completed.
  - .3 Equipment and systems: tested, adjusted and balanced and fully operational.
  - .4 Certificates required by authorities having jurisdiction: submitted.
  - .5 Operation of systems: demonstrated to Owner's personnel.

1.3 FINAL CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.
- .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

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

END OF SECTION 01 77 00

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1	Quality Control:	Section 01 45 00
.2	Execution:	Section 01 73 00
.3	Closeout Procedures:	Section 01 78 00

1.2 SUBMISSION

.1 Prepare instructions and data using personnel experienced in maintenance and operation of described products.
.2 Copy will be returned after final inspection, with Departmental Representative's comments .
.3 Revise content of documents as required prior to final submittal.
.4 Two weeks prior to Substantial Completion of the Work, submit to the Departmental Representative, four final copies of operating and maintenance manuals in English.
.5 An electronic copy Interactive Operating and Maintenance Manual System is required as specified under clause 1.3. Provide a USB drive or DVD the Electronic Interactive Operating and Maintenance Manual System to the Departmental Representative.
.6 Hard copies of the Operating and Maintenance Manual System is required as specified under clause 1.3. Provide 4 sets of the Hard Copy Operating and Maintenance Manual to Departmental Representative.
.7 Ensure spare parts, maintenance materials and special tools provided are new, undamaged or defective, and of same quality and manufacture as products provided in Work .
.8 If requested, furnish evidence as to type, source and quality of products provided.
.9 Defective products will be rejected, regardless of previous inspections. Replace products at own expense.
.10 Pay costs of transportation.

1.3 OPERATING AND MAINTENANCE MANUAL SYSTEM

.1 In addition to the printed copies, submit provide an Operating and Maintenance Manual System as specified herein.
.2 System Description and Requirements
  .1 All as constructed drawings and operation and maintenance (O&M) manuals listed under the Scope of Work shall be converted, where necessary, into Portable Data File (PDF) format for viewing using the Adobe Acrobat Reader.
.3 O&M data and as constructed drawings shall be classified by their corresponding disciplines, including:
  .1 Architectural
  .2 Mechanical
  .3 Electrical
  .4 Under each discipline, data shall be grouped into the following four major categories:
    .1 Basic Documents
      .1 Basic Documents' shall, according to the type of services or disciplines, include the full contents of each hard copy of the O&M manuals with the addition of Miscellaneous Maintenance Reports and Records, or as defined by the user. In general the following shall be included unless specifically excluded by the Departmental Representative:
        .1 Introduction
        .2 Consultant/Contractor/Suppliers List
        .3 System Description
        .4 Maintenance and Lubrication Schedules
        .5 Testing and Commissioning (T&C) Reports
        .6 Misc. Reports
        .7 Specifications

.8 Equipment and/or point schedules as identified in the hard copy documents
.9 Others as stipulated by the Departmental Representative

.2 All Basic Documents *.pdf* files shall be enhanced with appropriate bookmarks to facilitate searching of information within the document or linking to other relevant documents for references.

.4 'As-Constructed' Drawings
.1 'As-Constructed' drawings shall be red-mark hardcopy sets and 'As-Constructed' drawings shall be scanned a resolution minimum of 300 dpi and saved in *.pdf* format. Sprinkler layout 'As-Constructed' shop drawings shall be provided in both *.dwg* and *.pdf* formats .

.5 System Data
.1 Building systems shall be identified by their services, disciplines, function, nature and specific scope. System data shall be classified into the following categories:
.1 System Description
.2 Schematic (where applicable)
.3 Equipment List
.2 Provide hot key buttons, where applicable, for direct access to drawings/data referenced on the schematics. The same shall be applied to listed equipment for direct links to the corresponding equipment data.

.6 Equipment Data
.1 Equipment data shall be classified into the following categories:
.1 Equipment submittals
.2 T&C Report
.3 Maintenance Data
.4 Maintenance Records
.5 Photo
.2 Provide a summary screen to list all equipment classified under a specific system. On the summary screen, provide direct links to the corresponding equipment data under each category with addition links to the relevant 'As Constructed' drawings.

.7 The system shall be executed by Professional Engineers with a minimum of 10 years post qualification experience in the field of Building Services Engineering.

.8 The Contractor shall provide a minimum of 3 past job references as proven record of similar undertakings.

1.4 FORMAT HARD COPY MANUALS

.1 Organize data in the form of an instructional manual.
.2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 219 x 279 mm with spine and face pockets.
.3 When multiple binders are used, correlate data into related consistent groupings. Identify contents of each binder on spine.
.4 Cover: Identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents .
.5 Arrange content by Section numbers and sequence of Table of Contents.
.6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
.7 Text: Manufacturer's printed data, or typewritten data.
.8 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to. size of text pages.
.9 Provide 1:1 scaled CAD files in *.dwg* format on CD.

1.5 CONTENTS - EACH VOLUME

.1 Table of Contents: provide title of project;
.1 date of submission;
.2 names, addresses, and telephone and fax numbers of Contractor, Subcontractors,

Suppliers with name of responsible parties;
.3 schedule of products and systems, indexed to content of volume.
.4 copy of hardware schedule and paint schedules, complete with the actual manufacturer, supplier and identification names and numbers.
.5 all extended guarantees, warranties, maintenance bonds, certificates, letters of guarantees, registration cards, as called for in the various sections of the specification.
.6 complete set of all final reviewed shop drawings.
.7 certificates of inspection by authorities having jurisdiction.
.8 test reports and certificates as applicable.
.9 complete set of as constructed drawings.

.2 For each product or system:
.1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.

.3 Product Data: mark each sheet to clearly identify specific products and component parts, and data applicable to installation; delete inapplicable information.

.4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.

.5 Typewritten Text: as required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00 - Quality Control.

.6 Training: Refer to Section 01 91 41 - Demonstration and Training.

1.6 'AS CONSTRUCTED' DRAWINGS AND SAMPLES

.1 In addition to requirements in General Conditions, maintain at the site one record copy of:
.1 Contract Drawings.
.2 Specifications.
.3 Addenda.
.4 Change Orders and other modifications to the Contract.
.5 Reviewed shop drawings, product data, and samples.
.6 Field test records.
.7 Inspection certificates.
.8 Manufacturer's certificates.

.2 Store record documents and samples in field office apart from documents used for construction. Provide files, racks, and secure storage.

.3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual. Label each document "PROJECT RECORD" in neat, large, printed letters.

.4 Maintain record documents in clean, dry and legible condition. Do not use record documents for construction purposes.

.5 Keep record documents and samples available for inspection by Departmental Representative .

.6 Provide red-mark hardcopies and scan in *.pdf* of all 'As-Constructed' drawings. Provide *.dwg* and *.pdf* format of sprinkler layout shop drawings.

1.7 RECORDING ACTUAL SITE CONDITIONS

.1 Record information on set of black line opaque drawings, provided by Departmental Representative.

.2 Provide felt tip marking pens, maintaining separate colours for each major system, for recording information .

.3 Record information concurrently with construction progress. Do not conceal Work until required information is recorded.

.4 Contract Drawings and shop drawings: legibly mark each item to record actual construction, including:
.1 Measured depths of elements of foundation in relation to finish first floor datum.
.2 Measured horizontal and vertical locations of underground utilities and appurtenances,

referenced to permanent surface improvements .

.3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction .
.4 Field changes of dimension and detail.
.5 Changes made by change orders.
.6 Details not on original Contract Drawings.
.7 References to related shop drawings and modifications .

.5 Specifications: legibly mark each item to record actual construction, including:
.1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
.2 Changes made by Addenda and change orders.

.6 Other Documents: maintain manufacturer's certifications, inspection certifications, field test records, required by individual specifications sections.

1.8 EQUIPMENT AND SYSTEMS

.1 Each Item of Equipment and Each System: include description of unit or system, and component parts. Give function, normal operation characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.
.2 Panel board circuit directories: provide electrical service characteristics, controls, and communications .
.3 Include installed colour coded wiring diagrams.
.4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
.5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly , repair, and reassembly instructions; and alignment, adjusting , balancing, and checking instructions.
.6 Provide servicing and lubrication schedule, and list of lubricants required.
.7 Include manufacturer's printed operation and maintenance instructions.
.8 Include sequence of operation by controls manufacturer.
.9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
.10 Provide installed control diagrams by controls manufacturer .
.11 Provide Contractor's coordination drawings, with installed colour coded piping diagrams .
.12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams .
.13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
.14 Include test and balancing reports as specified in Section 01 45 00 - Quality Control and Division 22 to 25.
.15 Additional requirements: As specified in individual specification sections.

1.9 MATERIALS AND FINISHES

.1 Building Products, Applied Materials, and Finishes: include product data, with catalogue number, size, composition, and colour and texture designations. Provide information for re-ordering custom manufactured products.
.2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance .
.3 Moisture-protection and Weather-exposed Products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
.4 Additional Requirements: as specified in individual specifications sections.

1.10 SPARE PARTS

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

1.11 MAINTENANCE MATERIALS

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

1.12 SPECIAL TOOLS

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

1.13 STORAGE, HANDLING AND PROTECTION

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

1.14 WARRANTIES AND BONDS

.1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.
.2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
.3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers within ten days after completion of the applicable item of work .
.4 Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Substantial Performance is determined .
.5 Verify that documents are in proper form, contain full information, and are notarized.
.6 Co-execute submittals when required.
.7 Retain warranties and bonds until time specified for submittal.

END OF SECTION 01 78 00

PART 1 - GENERAL

1.1 SUMMARY

.1 Section Includes:

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

.2 Related Sections

.1 Section 01 91 15 Enclosure Commissioning Requirements.
.2 Section 01 91 31 Commissioning Plan
.3 Section 01 91 33 Commissioning Forms
.4 Section 01 91 41 Commissioning Training
.5 Section 21 05 05 Common work results for fire suppression
.6 Section 22 11 18 Domestic water piping
.7 Section 22 13 17 Drainage waste and vent piping
.8 Section 22 42 01 Plumbing specialties and accessories
.9 Section 22 42 02 Plumbing fixtures
.10 Section 23 03 00 Common Work Results - Mechanical
.11 Section 23 05 48 Vibration and seismic controls for HVAC piping and equipment
.12 Section 23 05 93 Testing, adjusting and balancing for HVAC
.13 Section 23 21 15 Hydronic systems
.14 Section 23 25 00 HVAC water treatment systems
.15 Section 23 33 16 Dampers – Fire
.16 Section 23 52 00 Heating boilers
.17 Section 25 01 11 EMCS: Start-up and check-out
.18 Section 25 08 20 EMCS: Warranty and Maintenance
.19 Section 25 30 02 EMCS: Field Control Devices
.20 Section 26 05 00 Common Work Results
.21 Section 26 05 03 Operation & Maintenance Manuals
.22 Section 26 05 05 Seismic Restraints
.23 Section 26 05 28 Grounding-Secondary
.24 Section 26 08 00 Commissioning and Demonstration
.25 Section 26 09 23-01 Metering and Switchboard Instruments
.26 Section 26 09 24 Lighting Control Devices Low Voltage
.27 Section 26 09 25 Line Voltage Lighting Control Devices
.28 Section 26 29 10 Motor Starters to 600V
.29 Section 26 32 14 Diesel Generators (outdoor)
.30 Section 26 36 23 Automatic Transfer Switches
.31 Section 26 52 00 Unit Equipment for Emergency Lighting
.32 Section 27 10 00 Structured Cabling for Communications
.33 Section 28 13 00 Access Control
.34 Section 28 13 27 Security Door Supervision
.35 Section 28 23 00 Video Surveillance
.36 Section 28 31 00-01 Multiplex Fire Alarm Systems

.3 Acronyms:

.1 Cx - Commissioning.
.2 EMCS - Energy Monitoring and Control Systems.
.3 O M - Operation and Maintenance.
.4 PI - Product Information.

.5 PV - Performance Verification.
.6 TAB - Testing, Adjusting and Balancing.

1.2 ELECTRICAL COMMISSIONING SCOPE

.1 Provide electrical system verification and supporting documentation as summarized below:

.1 Refer to:
.1 Section 01 91 33 Commissioning Forms
.2 Section 26 08 00 Commissioning and Demonstrations, and
.3 The specific requirements of the electrical specification sections listed below.
.4 Section 26 05 03 Operation & Maintenance Manuals
.1 Maintenance manuals
.5 Section 26 05 05 Seismic Restraints
.1 Seismic consultant's letters of assurance
.6 Section 26 05 28 Grounding-Secondary
.1 Insulation resistance megger test reports
.7 Section 26 08 00 Commissioning and Demonstration
.1 Electrical Commissioning Report
.8 Section 26 09 23-01 Metering and Switchboard Instruments
.1 Simulated operation test report
.9 Section 26 09 24 Lighting Control Devices Low Voltage
.1 Lighting level test reports
.2 ASHRAE 90.1 switching control test reports
.10 Section 26 09 25 Line Voltage Lighting Control Devices
.1 Lighting level test reports
.2 ASHRAE 90.1 switching control test reports
.11 Section 26 27 26 Wiring Devices & Plates
.1 Receptacle and switch test report
.12 Section 26 29 10 Motor Starters to 600V
.1 Test reports for motors, starters, heaters, disconnects, interlocks, breakers, GFIs, buttons, contactors
.13 Section 26 32 14 Diesel Generators (outdoor)
.1 Generator test reports
.14 Section 26 36 23 Automatic Transfer Switches
.1 Automatic Transfer Switch test report
.15 Section 26 52 00 Unit Equipment for Emergency Lighting
.1 Emergency and exit lighting test report.
.16 Section 27 10 00 Structured Cabling for Communications
.1 Testing shall be completed by the owner.
.17 Section 28 13 00 Access Control
.1 Access control test report
.18 Section 28 13 27 Security Door Supervision
.1 Security door supervision test report and certificate
.19 Section 28 23 00 Video Surveillance
.1 Video surveillance verification inspections and test report
.20 Section 28 31 00-01 Multiplex Fire Alarm Systems
.1 Fire Alarm verification
.2 Written confirmation of connection of the Fire Alarm system to the Fire Alarm monitoring company.

.2 Demonstration and Training
.1 Refer to:

.1 Section 26 08 00 Commissioning and Demonstrations

1.3 MECHANICAL COMMISSIONING SCOPE

.1 Provide mechanical system verification and supporting documentation as summarized below:

- .1 Refer to:
  - .1 Section 01 91 33 Commissioning Forms
  - .2 The specific requirements of the mechanical specification sections listed below.
- .2 Section 21 05 05 Common Work Results for Fire Suppression
  - .1 Fire Protection Engineer's letters of assurance
  - .2 Contractor's Materials and test Certificates
- .3 Section 22 11 18 Domestic Water Piping
  - .1 Piping pressure test reports
  - .2 Water quality lab test report
- .4 Section 23 1126 Facility Liquid Petroleum Gas Systems
  - .1 Piping pressure test reports
- .5 Section 22 13 17 Drainage waste and vent piping
  - .1 Piping pressure test reports
- .6 Section 22 42 01 Plumbing specialties and accessories
  - .1 Backflow preventer test reports
  - .2 Trap primer test report
- .7 Section 22 42 02 Plumbing Fixtures
  - .1 Emergency fixture temperature setting confirmation
- .8 Section 23 03 00 Common Work Results for Mechanical
  - .1 Maintenance manuals
  - .2 Fire stopping completion confirmation letter
- .9 Section 23 05 48 Vibration and Seismic Controls for HVAC Piping and Equipment
  - .1 Seismic consultant's letters of assurance
  - .2 Vibration isolation supplier's inspection report
- .10 Section 23 05 93 Testing Adjusting and Balancing for HVAC
  - .1 Air and Water Balancing Report
  - .2 Sealing of penetrations through non-rated and sound partitions completion confirmation letter
  - .3 Verification of water tightness of roof and wall penetrations letter.
  - .4 Confirmation of operation through power failure and emergency generator start-up letter.
- .11 Section 23 21 15 Hydronic Systems
  - .1 Piping pressure test reports
- .12 Section 23 25 00 HVAC Water Treatment Systems
  - .1 Chemical cleaning and treatment report
- .13 Section 23 3114 Metal Ducts - Low Pressure to 500 Pa
  - .1 Duct pressure test report
  - .2 Duct cleanliness letter
- .14 Section 23 33 16 Dampers - Fire
  - .1 Fire damper test report
- .15 Section 23 52 00 Heating Boilers
  - .1 Boiler startup and test report
- .16 Section 25 01 11 EMCS: Start-up and Check-out
  - .1 Seven day test
  - .2 Controls Commissioning Report

.17 Section 25 08 20 EMCS: Warranty and Maintenance
.1 Deferred seasonal system testing and verification report
.18 Section 25 30 02 EMCS: Field Control Devices
.1 CO_2 and NO_2 detection system Commissioning report
.2 Controls field devices test report
.19 Demonstration and Training
.1 Refer to:
.1 Section 23 05 93 Testing Adjusting and Balancing for HVAC
.2 Section 25 01 11 EMCS: Start-up and Check-out

1.4 BUILDING ENVELOPE COMMISSIONING SCOPE

.1 Exterior enclosure commissioning procedures, including substructure, superstructure, exterior enclosure, and roofing construction that protects climate-controlled interior spaces from unconditioned spaces and the exterior environment, as follows:

.1 Below-grade construction including foundations, basements, and slab-on-grade that functions as part of the exterior enclosure system but excluding structural systems and components.
.2 Superstructure floor and roof construction that functions as part of the exterior enclosure system.
.3 Exterior enclosure construction, above grade, including exterior opaque walls, windows, and doors including sheathing, framing, and insulation, and interior finish materials attached to the exterior wall.
.4 Roofing, including roofing system, roofing insulation, hatches, and other roof openings.

1.5 GENERAL

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

.1 Verify installed equipment, systems, assemblies and integrated systems operate in accordance with contract documents and design criteria and intent.
.2 Ensure appropriate documentation is compiled into the Systems Manual.
.3 Effectively train O M staff.

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

.1 Systems to be operated at full capacity under various modes to determine if they function correctly and consistently at peak efficiency. Systems to be tested interactively with each other as intended in accordance with Contract Documents and design criteria.
.2 During these checks, adjustments to be made to enhance performance to meet environmental or user requirements.

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

1.6 COMMISSIONING OVERVIEW

.1 Section 01 91 31 - Commissioning (Cx) Plan.

.2 For Cx responsibilities refer to Section 01 91 31 - Commissioning (Cx) Plan.

.3 Cx to be a line item of the following sub-contractor's cost breakdowns.

.1 Electrical
.2 Mechanical
.3 Roofing
.4 Glazing

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

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

.6 Departmental Representative will issue Interim Acceptance Certificate when:

.1 Completed Cx documentation has been received, reviewed for suitability and approved by Departmental Representative.
.2 Equipment, components and systems have been commissioned.
.3 O M training has been completed.

1.7 NON-CONFORMANCE TO PERFORMANCE VERIFICATION REQUIREMENTS

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

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

1.8 PRE-CX REVIEW

.1 The following Pre-Cx activities are to be carried out by the Commissioning Team members:

.1 Commissioning Authority
.2 Design Consultants
.3 General Contractor
.4 Sub Contractors
.5 Commissioning Agents

.2 Before Construction:

.1 Review contract documents, confirm by writing to Departmental Representative.
.1 Adequacy of provisions for Cx.
.2 Aspects of design and installation pertinent to success of Cx.

.3 During Construction:

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

.4 Before start of Cx:

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

.2 Ensure installation of related components, equipment, sub-systems and systems is complete.
.3 Fully understand Cx requirements and procedures.
.4 Have Cx documentation shelf-ready.
.5 Understand completely design criteria and intent and special features.
.6 Submit complete start-up documentation to Departmental Representative.
.7 Have Cx schedules up-to-date.
.8 Ensure systems have been cleaned thoroughly.
.9 Complete TAB procedures on systems, submit TAB reports to Departmental Representative for review and approval.
.10 Ensure "As-Built" system schematics are available.

.5 Inform Departmental Representative in writing of discrepancies and deficiencies on finished works.

1.9 CONFLICTS

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

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

1.10 ACTION AND INFORMATIONAL SUBMITTALS

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

.1 Submit no later than 4 weeks after award of Contract:
.1 Name of Contractor's Cx agent.
.2 Draft Cx documentation.
.3 Preliminary Cx schedule.
.2 Request in writing to the Commissioning Authority for changes to submittals and obtain written approval at least 8 weeks prior to start of Cx.
.3 Submit proposed Cx procedures to the Commissioning Authority where not detailed in the sections listed in paragraph 1.1 and obtain written approval at least 8 weeks prior to start of Cx.
.4 Provide additional documentation relating to Cx process required by the Commissioning Authority.

1.11 COMMISSIONING DOCUMENTATION

.1 Refer to Section 01 91 33 - Commissioning (Cx) Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms for requirements and instructions for use.

.2 Commissioning Authority to review and approve Cx documentation.

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

1.12 COMMISSIONING SCHEDULE

.1 Provide detailed Cx schedule as part of construction schedule in accordance with Section 01 32 16 - Construction Progress Schedule.

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

.1 Approval of Cx reports.

.2 Verification of reported results.
.3 Repairs, retesting, re-commissioning, re-verification.
.4 Training.

1.13 COMMISSIONING MEETINGS

.1 Preconstruction Commissioning Conference: Commissioning Authority will schedule a preconstruction commissioning conference with the Commissioning Team before installation of assemblies, systems and components to be commissioned, but no later than 30 days after execution of the Agreement with the Contractor. Allow for the conference to be held at Project site or another convenient location. The Commissioning Authority will conduct the meeting to review commissioning responsibilities and personnel assignments.

.1 Agenda: Discuss items of significance that could affect progress, including the following:
.1 Commissioning plan
.2 Tentative construction schedule.
.3 Phasing.
.4 Critical work sequencing and long-lead items.
.5 Designation of key personnel and their duties.
.6 Procedures for testing and inspecting.
.7 Submittal procedures.
.8 Preparation of Record Documents.
.9 Owner's occupancy requirements.
.10 Security.
.2 Minutes: Commissioning Authority will record and distribute meeting minutes.

.2 Convene Cx meetings following project meetings in accordance with 01 32 16 - Construction Progress Schedule, and as specified herein.

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

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

.5 At 60% construction completion stage, and in accordance with the 01 32 16 - Construction Progress Schedule, the Commissioning Authority shall call a separate Cx scope meeting to review progress, discuss schedule of equipment start-up activities and prepare for Cx. Issues at meeting to include:

.1 Review duties and responsibilities of Contractor and subcontractors, addressing delays and potential problems.
.2 Determine the degree of involvement of trades and manufacturer's representatives in the commissioning process.

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

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

.8 Ensure subcontractors and relevant manufacturer representatives are present at 60% and subsequent Cx meetings and as required.

1.14 STARTING AND TESTING

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

1.15 WITNESSING OF STARTING AND TESTING

.1 Provide 7 days' notice prior to commencement of commissioning of each of the following systems.

.1 Building Envelope
.2 Electrical
.3 Mechanical

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

.3 Contractor's Cx Agent to be present at tests performed and documented by sub-trades, suppliers and equipment manufacturers, unless noted in the Commissioning Plan.

.4 The Commissioning Authority shall witness selected testing.

1.16 MANUFACTURER'S INVOLVEMENT

.1 Factory testing: manufacturer to:

.1 Coordinate time and location of testing.
.2 Provide testing documentation for approval by the Design Consultants and the Commissioning Authority.
.3 Arrange for Design Consultants to witness tests, where appropriate.
.4 Obtain written approval of test results and documentation from the Design Consultants before delivery to site.

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

.1 Compare completed installation with manufacturer's published data, record discrepancies, and review with manufacturer.
.2 Modify procedures detrimental to equipment performance and review same with manufacturer before start-up.

.3 Integrity of warranties:

.1 Use manufacturer's trained start-up personnel where specified elsewhere in other divisions or required to maintain integrity of warranty.
.2 Verify with manufacturer that testing as specified will not void warranties.

.4 Qualifications of manufacturer's representative:

.1 Experienced in design, installation and operation of equipment and systems.
.2 Ability to interpret test results accurately.
.3 To report results in clear, concise, logical manner.

1.17 PROCEDURES

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

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

.1 Included in delivery and installation:
.1 Verification of conformity to specification, approved shop drawings and completion of PI report forms.
.2 Visual inspection of quality of installation.
.2 Start-up: follow accepted start-up procedures.
.3 Operational testing: document equipment performance.
.4 System PV: include repetition of tests after correcting deficiencies.
.5 Post-substantial performance verification: to include fine-tuning.

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

.4 Document require tests on approved PV forms.

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

.1 Minor equipment/systems: implement corrective measures approved by Commissioning Authority and Design Consultants.
.2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures approved by Commissioning Authority and Design Consultants.
.3 If evaluation report concludes that major damage has occurred, Design Consultants shall reject equipment.
.1 Rejected equipment to be remove from site and replace with new.
.2 Subject new equipment/systems to specified start-up procedures.

1.18 START-UP DOCUMENTATION

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

.2 Start-up documentation to include:

.1 Factory and on-site test certificates for specified equipment.
.2 Pre-start-up inspection reports.
.3 Signed installation/start-up check lists.
.4 Start-up reports,
.5 Step-by-step description of complete start-up procedures, to permit Commissioning Agent to repeat start-up at any time.

1.19 OPERATION AND MAINTENANCE OF EQUIPMENT AND SYSTEMS

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

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

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

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

1.20 TEST RESULTS

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

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

1.21 INSTRUMENTS / EQUIPMENT

.1 Submit to Commissioning Authority for review and approval:

.1 Complete list of instruments proposed to be used.
.2 Listed data including, serial number, current calibration certificate, calibration date, calibration expiry date and calibration accuracy.

.2 Provide the following equipment as required:

.1 Ladders.
.2 Equipment as required to complete work.

1.22 COMMISSIONING PERFORMANCE VERIFICATION

.1 Carry out Cx:

.1 Under actual operating conditions, over entire operating range, in all modes.
.2 Simulated conditions will be accepted if operating loads are not available or weather conditions do not permit. Obtain approval of simulated testing conditions from the Commissioning Authority before testing under simulated loads.
.3 On independent systems and interacting systems.

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

.3 Follow equipment manufacturer's operating instructions.

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

1.23 AUTHORITIES HAVING JURISDICTION

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

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

.3 Provide copies to Commissioning Authority.

1.24 EXTRAPOLATION OF RESULTS

.1 Where Cx of weather, occupancy, or seasonal-sensitive equipment or systems cannot be conducted under near-rated or near-design conditions, extrapolate part-load results to design conditions when approved by Commissioning Authority in accordance with equipment manufacturer's instructions, using manufacturer's data, with manufacturer's assistance and using approved formulae.

1.25 EXTENT OF VERIFICATION

.1 Provide manpower and instrumentation to verify up to 30% of reported results, unless specified otherwise in other sections.

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

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

.4 Review and repeat commissioning of systems if inconsistencies found in more than 20% of reported results.

.5 Perform additional commissioning until results are acceptable to Commissioning Authority.

1.26 REPEAT VERIFICATIONS

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

.1 Verification of reported results fail to receive Commissioning Authority's approval.
.2 Repetition of second verification again fails to receive approval.
.3 Commissioning Authority deems Contractor's request for second verification was premature.

1.27 SUNDRY CHECKS AND ADJUSTMENTS

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

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

1.28 DEFICIENCIES, FAULTS, DEFECTS

.1 Correct deficiencies found during start-up and Cx to satisfaction of Commissioning Authority and Design Consultants.

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

1.29 COMPLETION OF COMMISSIONING

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

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

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

1.30 ACTIVITIES UPON COMPLETION OF COMMISSIONING

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

1.31 TRAINING

.1 In accordance with Section 01 91 41 - Commissioning (Cx) - Training.

1.32 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS

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

1.33 OCCUPANCY

.1 Cooperate fully with Facility Manager during stages of acceptance and occupancy of facility.

1.34 INSTALLED INSTRUMENTATION

.1 Use instruments installed under Contract for TAB and PV if:

.1 Accuracy complies with these specifications.
.2 Calibration certificates have been submitted to the Commissioning Authority.

.2 Calibrated EMCS sensors may be used to obtain performance data provided that sensor calibration has been completed and accepted.

1.35 PERFORMANCE VERIFICATION TOLERANCES

.1 Application tolerances:

.1 Specified range of acceptable deviations of measured values from specified values or specified design criteria. Except for special areas, to be within +/- 10% of specified values.

.2 Instrument accuracy tolerances:

.1 To be of higher order of magnitude than equipment or system being tested.

.3 Measurement tolerances during verification:

.1 Unless otherwise specified actual values to be within +/- 2 % of recorded values.

1.36 OWNER'S PERFORMANCE TESTING

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

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

.1 This Section includes exterior enclosure commissioning procedures, including substructure, superstructure, exterior enclosure, and roofing construction that protects climate-controlled interior spaces from unconditioned spaces and the exterior environment, as follows:

.1 Below-grade construction including foundations, basements, and slab-on-grade that functions as part of the exterior enclosure system but excluding structural systems and components.

.2 Superstructure floor and roof construction that functions as part of the exterior enclosure system.

.3 Exterior enclosure construction, above grade, including exterior opaque walls, windows, and doors including sheathing, framing, and insulation, and interior finish materials attached to the exterior wall.

.4 Roofing, including roofing system, roofing insulation, and skylights, hatches, and other roof openings.

1.2 GENERAL

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

.1 Verify installed assemblies, products and integrated systems operate in accordance with contract documents and design criteria and intent.

.2 Ensure appropriate documentation is compiled into the Building Management Manual.

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

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

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

.5 Building Enclosure Commissioning Agent will issue Interim Acceptance Certificate when:

.1 Completed Cx documentation has been received, reviewed for suitability and approved by Building Enclosure Commissioning Agent.

.2 Equipment, components and systems have been commissioned.

.3 O M training has been completed.

1.3 CONTRACTOR'S RESPONSIBILITIES

.1 Attend design- and construction-phase coordination meetings.

.2 Provide schedule of field quality control tests and inspections required by the Contract Documents to Commissioning Authority.

.3 Update schedule monthly throughout the construction period.

.4 Submit field quality control testing and inspection reports on exterior enclosure construction to the Commissioning Authority.

.5 Submit operation and maintenance data for systems, subsystems, and components to the Commissioning Authority.

.6 Participate in testing-procedures meetings.

.7 Participate in testing of installed systems, subsystems, and construction.

.8 Provide test data, inspection reports, and certificates to Commissioning Authority.

.9 Participate in maintenance orientation and inspection.

.10 Participate in operation and maintenance training sessions.

.11 Participate in final review at acceptance meeting.

.12 Provide input for final commissioning documentation.

1.4 COMMISSIONING AUTHORITY'S RESPONSIBILITIES

.1 Provide Project-specific construction checklists and commissioning process test procedures.

.2 Witness systems, assemblies, equipment, and component startup.

.3 Compile test data, inspection reports, and certificates and include them in the systems manual and commissioning process report.

1.5 COMMISSIONING DOCUMENTATION

.1 Provide the following information to Commissioning Authority for inclusion in the Commissioning Plan:

1. Submittals, information for systems manuals, and other required documents and reports.
2. Identification of installed exterior enclosure components, assemblies, systems, and equipment, including design changes that occurred during the construction phase.
3. Certificate of completion, certifying that exterior enclosure assemblies, systems, equipment, and associated controls are complete and ready for testing.
4. Test and inspection reports and certificates.
5. Corrective action documents.

.2 Submittals requiring Architect’s action will be returned by the Architect.

1.6 QUALITY ASSURANCE

.1 Quality Assurance and Control: Specific commissioning quality-assurance and –control requirements for individual construction activities are specified in the Sections that specify those activities. Specified commissioning tests, inspections, and related actions

do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.

.2 Preconstruction Commissioning Conference: Commissioning Authority will schedule a preconstruction commissioning conference call before construction of the exterior enclosure starts, at a time convenient to Owner, Contractor, and Architect, but no later than **15** days after execution of the Agreement with the Contractor. Allow for the conference to be held at Project site or another convenient location. The Commissioning Authority will conduct the meeting to review commissioning responsibilities and personnel assignments.

.1 Attendees: Authorized representatives of Owner, Commissioning Authority, Architect and consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to commissioning.

.2 Agenda: Discuss items of significance that could affect progress, including the following:

a. Commissioning plan
b. Tentative construction schedule.
c. Phasing.
d. Critical work sequencing and long-lead items.
e. Designation of key personnel and their duties.
f. Procedures for testing and inspecting.
g. Submittal procedures.
h. Preparation of Record Documents.
i. Owner's occupancy requirements.
j. Security.

.3 Minutes: Commissioning Authority will record and distribute meeting minutes.

1.7 NON-CONFORMANCE TO PERFORMANCE VERIFICATION REQUIREMENTS

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

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

PART 2 PRODUCTS

2.1 NOT USED

PART 3 EXECUTION

3.1 VERIFICATION

.1 Certify that building exterior enclosure systems, subsystems, and construction have been completed according to the Contract Documents.

.2 Commissioning Authority will witness and document field quality-control tests and reviews.

.3 Verify that field quality-control testing of building exterior enclosure has been completed and approved, that discrepancies have been corrected, and corrective work approved.

.4 Annotate checklist or data sheet when a deficiency is observed.

.5 Deferred Testing:

.1 If tests cannot be completed because of a deficiency outside the scope of the Building Exterior Enclosure, the deficiency shall be documented and reported to the Owner.

.2 Deficiencies shall be resolved and corrected by Contractor and tests rescheduled.

.6 If the testing plan indicates specific seasonal testing, appropriate initial performance tests shall be completed and documented and additional tests scheduled.

.7 Testing Reports:

.1 Reports shall include measured data, data sheets, and a comprehensive summary describing the building exterior enclosure systems at the time of testing.

.2 Prepare a preliminary test report. Deficiencies will be evaluated by Architect

3.2 CONFLICTS

.1 Report conflicts between requirements of this section and other sections to Building Enclosure Commissioning Agent before completion and obtain clarification.

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

3.3 COMMISSIONING DOCUMENTATION

.1 Refer to Section [01 91 33 - Commissioning (Cx) Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms for requirements and instructions for use].

.2 Building Enclosure Commissioning Agent to review and approve Cx documentation.

.3 Provide completed and approved Cx documentation to Building Enclosure Commissioning Agent.

3.4 COMMISSIONING SCHEDULE

.1 Provide detailed Cx schedule as part of construction schedule in accordance with the project requirements.

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

.1 Approval of Cx reports.

.2 Verification of reported results.

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

.4 Training.

3.5 TESTING

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

3.6 WITNESSING TESTING

.1 Provide 14 days' notice prior to commencement.

.2 Building Enclosure Commissioning Agent to witness testing.

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

3.7 MANUFACTURER'S INVOLVEMENT

.1 Factory testing: manufacturer to:

.1 Provide testing documentation (e.g., product rating test reports) for approval by Building Enclosure Commissioning Agent.

.2 Obtain written approval of test results and documentation from Building Enclosure Commissioning Agent before delivery to site.

.2 Obtain manufacturers installation instructions (e.g., shop drawings) prior to installation of components and assemblies and review with Building Enclosure Commissioning Agent.

.1 Compare completed installation with manufacturer's published data (including shop drawings), record discrepancies, and review with manufacturer.

.3 Integrity of warranties:

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

.4 Qualifications of manufacturer's personnel:

.1 Ability to interpret test results accurately.

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

3.8 WITNESSING COMMISSIONING

.1 Building Enclosure Commissioning Agent to witness activities and verify results.

.2 Cx to be considered complete when contract Cx deliverables have been submitted and accepted Building Enclosure Commissioning Agent.

3.9 OWNER'S PERFORMANCE TESTING

.1 Performance testing of components or assemblies by Building Enclosure Commissioning Agent will not relieve Contractor from compliance with specified testing procedures.

END OF SECTION

PART 1 - GENERAL

1.1 PURPOSE

.1 This Commissioning Plan describes the methodology to be used for commissioning of the Port Hardy Airport Maintenance Building systems. The commissioning process is the systematic method of documenting:
- .1 Verifying that owner's design requirements have been met.
- .2 Verifying the physical installation of the system,
- .3 The results of a defined start-up procedure for equipment,
- .4 Verifying the performance of the entire system, and
- .5 Demonstration to and training of building operations staff on both the equipment and the integrated system.

.2 Provide a fully functional facility.
- .1 Systems, equipment and components meet user's functional requirements before date of acceptance, and operate consistently at peak efficiencies and within specified energy budgets under normal loads.
- .2 Facility user, Operations and Maintenance personnel have been fully trained in aspects of installed systems.
- .3 Complete documentation relating to installed equipment and systems.

.3 This Commissioning Plan is to be used as master planning document for Commissioning:
- .1 Outlines organization, scheduling and allocation of resources pertaining to the implementation of Commissioning.
- .2 Communicates roles, responsibilities, expectations and deliverables of team members involved in Commissioning.
- .3 Communicates the scope and standards, verification procedures and documentation requirements for Commissioning.

1.2 COMMISSIONING PLAN DEVELOPMENT

.1 The Commissioning Plan is a dynamic document, and will be updated during project construction to take into account:
- .1 Approved shop drawings and product data.
- .2 Approved changes to contract.
- .3 Contractor's project schedule.
- .4 Commissioning schedule.
- .5 Contractor's, sub-contractor's, suppliers' requirements.
- .6 Project construction team's and Commissioning team's requirements.

.2 The Commissioning Plan is to be updated and submitted to the Departmental Representative for approval at the following project milestones:
- .1 100% contract documentation
- .2 2 months after project award (to allow for updates due to addenda, changes, contractor's project schedule and shop drawing reviews)
- .3 One month before the verification of each of the following systems:
  - .1 Building envelope
  - .2 Electrical and mechanical systems

1.3 REFERENCES

.1 Related Specification Requirements
- .1 Section 01 91 13 General Commissioning Requirements.
- .2 Section 01 91 33 Commissioning Forms
- .3 Section 01 91 41 Commissioning Training

.2 Related Codes, Standards and Guidelines
- .1 Canadian Standards Association (CSA)
  - .1 CSA Z320-11 Building Commissioning
- .2 Public Works and Government Services Canada (PWGSC)
  - .1 PWGSC - Commissioning Guidelines CP.1 (4th Edition, Nov. 2006)
- .3 American Society of Heating, Refrigeration and Air Conditioning (ASHRAE)
  - .1 Guideline 0-2013 The Commissioning Process

1.4 DEFINITIONS

.1 Acronyms:
- .1 Cx - Commissioning.
- .2 EMCS - Energy Monitoring and Control Systems.
- .3 ICL - Installation Check List
- .4 MMS - Maintenance Management System
- .5 MSDS - Material Safety Data Sheets.
- .6 O M, or O&M - Operation and Maintenance
- .7 PI - Product Information.
- .8 PV - Performance Verification.
- .9 TAB - Testing, Adjusting and Balancing.
- .10 WHMIS - Workplace Hazardous Materials Information System.

.2 Commissioning terms used in this Section:
- .1 Basis of Design
  - .1 A document that records the concepts, assumptions, decisions and system selections used to meet the Owner's Project Requirements, applicable regulatory requirements, standards and guidelines.
- .2 Bumping
  - .1 Short term start-up to prove ability to start and prove correct rotation.
- .3 Commissioning
  - .1 A systematic verification, documentation and training process applied to a facility and all of its systems and assemblies to ensure they are designed, installed, tested, operated and maintained to meet the Owner's Project Requirements.
- .4 Commissioning Agent
  - .1 An individual or company retained by a contractor, supplier or manufacturer to start up, test, verify and document the performance of installed systems and equipment.
- .5 Commissioning Authority
  - .1 An individual or company retained by and responsible to the Owner who leads, plans, schedules and coordinates the commissioning team to implement the commissioning process.
- .6 Commissioning Logs
  - .1 A record of issues encountered during the commissioning process, describing the actions taken to resolve the issue.
- .7 Commissioning Manager
  - .1 See Commissioning Authority

.8 Commissioning Plan
  .1 A document that outlines the organization, schedule, allocation of resources and documentation requirements of the Commissioning Process.
.9 Commissioning Process
  .1 See Commissioning
.10 Commissioning Report
  .1 A document that contains all completed tests, reports, verifications and certifications of the commissioned project. The Commissioning Report includes the completed Commissioning Checklists, a record of the Commissioning Logs, and recommendations for future building operation, optimization and re-commissioning.
.11 Commissioning Specifications (Division 01)
  .1 Describe the commissioning procedures and documentation requirements for the project.
.12 Commissioning Specifications (Other Divisions)
  .1 Describe specific testing and verification requirements for systems and equipment to be carried out by the contractor or the Commissioning Agent within the scope of the contract. Specific testing and verifications are to be reviewed by the contractor, the design consultants and the Commissioning Authority
.13 Deferred Commissioning
  .1 Commissioning activities delayed for reasons beyond Contractor's control due to lack of occupancy, weather conditions, need for heating/cooling loads.
.14 Master Commissioning Checklist
  .1 A checklist of commissioning activities and documentation to be submitted by all parties involved in commissioning. The Master Commissioning Checklist is used and distributed for tracking Commissioning Progress.
.15 Owner's Project Requirements
  .1 A document that details the functional requirements of a project and the expectations of how it will be used and operated. These include project goals, measurable performance criteria, success criteria and supporting information.
.16 Systems Manual
  .1 A document containing information of use to the Owner during the occupancy and operations phase that describes:
    .1 Operation of systems and equipment
    .2 Modes of operation
    .3 Sequences of operation
    .4 Interaction between systems

1.5 COMMISSIONING TEAM

.1 The commissioning team is comprised of the following members:
  .1 Owner: Name of Organization
  .2 Facilities Manager: Name of Organization
  .3 Commissioning Authority: Name of Organization
  .4 General Contractor: Name of Organization
  .5 Design Consultants: Name of Organization
  .6 Installation Contractor: Electrical Name of Organization
  .7 Installation Contractor: Mechanical Name of Organization
  .8 Commissioning Agent: Electrical Name of Organization
  .9 Commissioning Agent: Mechanical Name of Organization
  .10 Commissioning Agent: equipment various manufacturers

.2 All members of the Commissioning Team participate in Commissionnig Meetings.

1.6 COMMISSIONING ROLES AND RESPONSIBILITIES

.1 The Commissioning Authority shall maintain overall responsibility for project commissioning.

.1 Commissioning Authority is responsible for:
- .1 Organizing Cx.
- .2 Writing the Commissioning Plan
- .3 Ensuring implementation the Cx Plan.
- .4 Writing the Division 01 Commissioning Specifications.
- .5 Provide Project-specific construction checklists and commissioning process test procedures.
- .6 Monitoring Cx activities.
- .7 Writing and distributing Cx progress reports.
- .8 Chair Cx meetings.
- .9 Writing and distributing Cx meeting minutes.
- .10 Updating the Master Cx Checklist.
- .11 Reviewing test records, make recommendations for their approval, and compile the test records for inclusion into the final commissioning report.
- .12 Witnessing, certifying accuracy of selected reports.
- .13 Development of the Training Plan.
- .14 Developing Systems Manual.
- .15 Compiling and writing the Commissioning Report.

.2 PWGSC Design Quality Review Team: during construction, will conduct periodic site reviews to observe general progress.

.3 PWGSC Quality Assurance Commissioning Manager: ensures Cx activities are carried out to ensure delivery of a fully operational project including:
- .1 Review of Cx documentation from operational perspective.
- .2 Review for performance, reliability, durability of operation, accessibility, maintainability, operational efficiency under conditions of operation.
- .3 Protection of health, safety and comfort of occupants and O M personnel.
- .4 Monitoring of Cx activities, training, development of Cx documentation.
- .5 Work closely with members of Cx Team.

.4 General Contractor:
- .1 Implements the commissioning process, and coordinates the work of the installation contractors and equipment vendors.
- .2 Leads the coordination and scheduling of the installation work and the commissioning work.

.5 Contractor's Cx agent:
- .1 Each discipline may have a separate, specialized Commissioning agent.
- .2 Prepares and submits test reports.
- .3 Completes the PI and PV forms and reports.
- .4 Participates in the scheduling of commissioning and construction activities
- .5 Cooperates with equipment vendors in preparing systems for startup and participates in startup activities.
- .6 Executes inspections and verifications of the following systems in accordance with check list requirements:
  - .1 Electrical systems
  - .2 Building enclosure, windows and doors
  - .3 Mechanical systems
- .7 Witnesses all testing.
- .8 Report issues that require resolution and participate in the resolution of those issues.

.9 Witness demonstrations.
.10 Coordinates the training activities of contractors, sub-contractors, suppliers and manufacturer's representatives.
.11 Gathers O&M manuals and data on all equipment, and assemble in binders as specified.

.6 Third party and specific testing companies:
.1 Manufacturer's representative, to start-up and test the equipment in accordance with their own instructions and those of the commissioning specifications.
.2 Building enclosure tests to assess wall resistance to water ingress and window resistance to wind-driven rain.
.3 Mechanical TAB: conducts the Testing, Adjusting and Balancing program.

.7 Installation Contractors
.1 The contractor is responsible for the installation, start-up and placing into service the various systems.
.2 Completion of ICLs.
.3 Coordination: ensure cooperation and participation of sub-contractors, and participation of major equipment manufacturers in appropriate testing and training activities.
.4 Scheduling: confirm schedules for systems orientation and review, O&M manual submission, training sessions, systems testing, equipment start-up, specialty testing, and completion of deficiency work.
.5 Notify the Commissioning Agent for up-coming tests.
.6 Implement the test procedures, and record results including provision of supporting test documentation and manufacturer's start-up and test procedures.
.7 Equipment Documentation: Include requirements for submittal data, start-up and testing, O&M data, and training in each purchase order or sub-contract written.
.8 Provide training on equipment, using either direct skilled technicians, or provide the services of manufacturer service personnel and sub-contractors as required and/or specified.
.9 Submits O&M manual information and data on all equipment and systems for the Commissioning Agent to compile into the O&M Manual.

.8 Equipment Suppliers and Miscellaneous Contractors
.1 Provide submittals and appropriate O&M manuals.
.2 Attend initial commissioning coordination meetings scheduled by the Commissioning Agent.
.3 Participate in training sessions as scheduled by the Installation Contractor.
.4 Demonstrate performance of equipment as applicable. This includes in-season and out-of season testing depending on time of year of Substantial Completion.
.5 Provide written and signed start-up reports and submit to the Installation Contractor.

.9 Building Enclosure Component Suppliers and Installers
.1 Provide submittals (e.g., shop drawings, warranty information).
.2 Provide schedule of field quality control tests and inspections required by the Contract Documents to Commissioning Authority.
.3 Update schedule monthly throughout the construction period.
.4 Attend construction-phase coordination meetings.
.5 Participate in testing-procedures meetings and assist with resolution of concerns as required.
.6 Participate in testing of installed systems, subsystems, and construction.
.7 Submit field quality control testing and inspection reports on exterior enclosure construction to the Commissioning Authority.

.8 Submit operation and maintenance data for systems, subsystems, and components to the Commissioning Authority.
.9 Participate in operation and maintenance training sessions.
.10 Participate in final review at acceptance meeting.

.10 Design Consultants
.1 The commissioning work does not replace the design consultants' role and responsibilities with regards to construction review.
.2 Conduct periodic construction reviews to determine that the work is in general conformance with the contract documents.
.3 Review shop drawings for general conformance to the contract documents.
.4 Attend initial meeting with TAB or similar testing contractor(s) to review testing methodology and acceptance criteria.
.5 Assist in resolving technical problems during installation, start-up and operating the equipment / systems.
.6 Review as-built records as required to the contract documents.
.7 Review Operating and Maintenance manuals.
.8 Participate in the Systems training sessions, by providing information on the design intent and other design implications not shown in the contract documents.
.9 Conduct final construction reviews, identify deficiencies and monitor project completion status.
.10 Arrange for, or conduct, testing to assess wall resistance to water ingress and window resistance to wind-driven rain, at an appropriate performance level.

.11 Facility Manager: represents lead role in Operation Phase and onwards and is responsible for:
.1 Receiving the facility.
.2 Day-To-Day operation and maintenance of the facility.
.3 Ensuring the attendance of buildings operations staff at training sessions.
.4 Providing manpower during the performance verification testing stage when such testing is conducted after Substantial Completion.

1.7 COMMUNICATIONS

.1 All Commissioning communications shall follow the chain of communication listed below.
.1 Departmental Representative
.2 Commissioning Authority
.3 General Contractor
.4 Subcontractor
.5 Commissioning Agent

.2 This chain of communication shall run parallel to and does not replace the chain of communication established by the construction team.

1.8 SITE MEETINGS

.1 The Commissioning Authority will attend selected planning and job-site meetings in order to remain informed on construction progress and to update parties involved in commissioning.

.2 The Construction Manager and the General Contractor will provide the Commissioning Authority with information regarding substitutions, change orders, and any Engineer / Architect supplemental instructions that may affect the commissioning of the various systems and assemblies or the commissioning schedule.

1.9 COMMISSIONING MEETINGS

.1 Commissioning meetings will be scheduled during construction by the Commissioning Authority to include all of the commissioning team members. Those meetings shall address commissioning related responsibilities as well as the preparation for all specified testing, documentation, operation & maintenance manuals, training, and post-construction requirements.

1.10 COMMISSIONING SCHEDULE

.1 The General Contractor is responsible for integrating, optimizing, and maintaining/updating the commissioning schedule and scheduling commissioning activities in the overall construction schedule.

.2 The General Contractor shall prepare a detailed Cx Schedule and submit to the Commissioning Authority for review and approval. The Commissioning Schedule shall include:
- .1 Milestones, testing, documentation, training and Cx activities of components, equipment, subsystems, systems and integrated systems, including:
  - .1 Cx procedures and reporting meeting: 3 months after award of contract.
  - .2 Building envelope testing
  - .3 Electrical systems
    - .1 Startup
    - .2 Testing
  - .4 Mechanical systems
    - .1 Startup
    - .2 Testing
  - .5 TAB
  - .6 Training for each system.
  - .7 Deferred Cx.

1.11 COMMISSIONING METHODOLOGY

.1 The general commissioning methodology is summarized as follows:
- .1 The Commissioning Authority conducts a review of the construction documents near completion of these documents and prior to issuing these documents for construction.
- .2 The design consultant conducts their final construction reviews and records any noted deficiencies.
- .3 The Contractor's Commissioning Agent prepares the commissioning check lists.
- .4 The Commissioning Agent reviews the check list procedures with the installation contractor prior to start-up.
- .5 The Contractor co-ordinates and schedules the start-up and commissioning testing.
- .6 The installation contractor, his Commissioning Agent and / or Equipment Vendors conduct their equipment and system start-up, and utilizes the commissioning check lists to test and document the commissioning results.
- .7 The Commissioning Authority reviews all of the test reports, and randomly witnesses the contractor's test-in-progress. The test results are signed-off by applicable parties.
- .8 The Commissioning Authority compiles the commissioning test results into a Final Commissioning Report.
- .9 Certain test procedures may include seasonal test requirements, which will be conducted after Substantial Performance.

1.12 COMMISSIONING PROCESS

.1 Design Phase
- .1 The Owner's Project Requirement (OPR) is established and the Basis of Design (BOD) provided by the Consulting Team.
- .2 Commissioning requirements are developed and incorporated into the Construction document.
- .3 Commissioning Plan is developed.
- .4 Review of the design development documents of systems and assemblies.
- .5 Review of the construction documents of systems and assemblies.

.2 Construction Phase
- .1 Contractor submittals are reviewed.
- .2 Commissioning meetings are held with the commissioning team to review the commissioning plan and schedule.
- .3 Building envelope in situ testing and mock-up dates are established and incorporated into the construction schedule.
- .4 Review of the installation in progress and compliance testing.
- .5 Review contractor test procedures and witness.
- .6 Develop and review functional testing and verification procedures and implementation of the procedures.

.3 Verification and Testing Phase
- .1 Commissioning check lists are provided by the Commissioning Agent.
- .2 Each commissioning procedure tests the equipment and systems, and building enclosure, and consists of the following major elements:
  - .1 Installation Verification – Equipment and Systems
  - .2 Installation Verification – Building Enclosure Components
  - .3 Pre-start readiness and Initial Test
  - .4 Functional Verification
  - .5 Controls Verification
  - .6 Appendices
- .3 Document Sign-Off
  - .1 Each completed check list is signed off by the following parties:
    - .1 Contractor's Commissioning Agent, for testing,
    - .2 Commissioning Authority, for review and witnessing,
- .4 Pre-Start and Initial Test
  - .1 Checklists consisting of: confirmation of completion of installation, authorities inspections, pre-start safety checks (where applicable) and operational readiness.
  - .2 Use of pre-printed manufacturer installation and start-up checklists are required; however, the commissioning procedure checklists may contain supplemental items.
- .5 Performance Verification
  - .1 Functional performance testing of the systems and assemblies to verify compliance with the design intent.
  - .2 Prescribed performance measurements including but not limited to electrical load data, thermal load data, air and water balancing, and noise and vibration data.`
  - .3 Step-by-step testing methodologies to prove the functional operation of control systems, for normal and abnormal operating conditions, and alarm conditions.
  - .4 Review contractor's and independent third party test reports.

.4 Post-Construction Phase

.1 Review the requirements of the operation and maintenance manuals.
.2 Review the as-built drawings.
.3 Review the procedures for orientation and training of the operation and maintenance staff.
.4 Schedule the training of the maintenance staff.
.5 Review warranties of systems and assemblies.
.6 Schedule off- season functional performance testing and report on the findings.
.7 Review performance of the systems and assemblies with the operating staff prior to end of the warranty period.
.8 Prepare the final commissioning report.
.9 Provide assistance to PWGSC in full implementation of MMS identification system of components, equipment, sub-systems, systems In later stages of Cx, before hand-over and acceptance, the Departmental Representative, Contractor, and Cx Authority to co-operate to complete inventory data sheets and.

1.13 DELIVERABLES

.1 Provided by Owner:
  .1 Owner's Project Requirements

.2 Provided by Design Consultants:
  .1 Basis of Design

.3 Provided by Commissioning Authority:
  .1 Cx Specifications.
  .2 Description of Cx activities and documentation.
  .3 Description of Cx of integrated systems and documentation.
  .4 Training Plans.
  .5 Cx Reports.
  .6 List of commissioning activities to be completed during warranty period.

.4 Refer to Section 01 91 33 - Commissioning (Cx) Forms for the following forms:
  .1 Installation Check Lists (ICL)
  .2 Product Information (PI) forms
  .3 Performance Verification (PV) forms

.5 Provided by Commissioning Agent:
  .1 Completed product information (PI) report forms.
  .2 Completed performance verification (PV) report forms.
  .3 Results of Performance Verification Tests and Inspections.
  .4 Maintenance Management System (MMS) tag list.

.6 Provided by Contractor and Suppliers:
  .1 Shop Drawings
  .2 Completed installation checklists (ICL).
  .3 Identification of design changes that occurred during the construction phase.
  .4 Certificate of Completion certifying that assemblies, systems, equipment, and associated controls are complete and ready for testing.
  .5 Warranties.
  .6 Project record documentation.
  .7 Inventory of spare parts, special tools and maintenance materials.
  .8 WHMIS information.
  .9 MSDS data sheets.

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

1.14 REPORTING

.1 Installation Checklists
  .1 Installation checklists are completed by installing contractors, their Commissioning Agents and by Manufacturer's Representatives. Upon completion of each checklist, the applicable parties sign-off the document as required. Completed checklists are collected by the Commissioning Authority, and collated into the Commissioning Report.

.2 PV Reports
  .1 The Commissioning Agent submit witnessed and certified PV reports to the Commissioning Authority who will verify selected results and collate into the Commissioning Report.

.3 Master Commissioning Checklist
  .1 The Commissioning Authority maintains the Master Commissioning Checklist of the status of all commissioning documentation to be submitted for the project.

.4 Commissioning Logs
  .1 Commissioning Logs are created as required during Start-Up and Performance testing. Commissioning Logs are initiated by the Commissioning Authority.
  .2 Log information to include:
    .1 Date of log
    .2 Description of issue encountered
    .3 Recommendations for remedial work or change required
    .4 Communication with design consultants and the Departmental Representative regarding any changes the design.
    .5 Once the issue has been resolved, the implications on system operation shall be documented.

.5 Monthly Status Report
  .1 The monthly status report is written by the Commissioning Authority. It provides a general summary of work completed to-date, and upcoming work in the next reporting period. The report includes the following as a minimum:
    .1 A matrix summary, by system, of the estimated percent of the commissioning program completed.
    .2 A brief summary of major deficiencies encountered, and resolution status
    .3 Resources required from the Owner/Operator for commissioning activities in the next reporting period.

.6 Final Commissioning Report
  .1 The Final Commissioning Report is written by the Commissioning Authority. It includes:
    .1 Purpose
    .2 Conclusions
    .3 General Remarks
    .4 Summary of Commissioning Activities
    .5 Summary of Commissioning Outstanding Items
    .6 Record Sheets/Documents
    .7 References

.7 Alternate Season Report
  .1 The alternate season report may be required and if so is the final deliverable, and is an updated revision of the Final Commissioning Report.

1.15 PERFORMANCE VERIFICATION (PV):

.1 Performance verification shall be documented on PV forms and checklists approved by the Commissioning Authority.

.2 The Cx Agent will witness, verify and document performance verification.

.3 The installing contractors shall assist the Commissioning Agent to conduct performance verification.

.4 Commissioning Agent will complete PV reports and provide to the Commissioning Authority.

.5 Use procedures to suit project requirements.

.6 Repeat when necessary until results are acceptable to Commissioning Authority.

.7 Commissioning Authority will witness and review selected reported results using approved PI and PV forms.

.8 Commissioning Authority reserves right to verify up to 30% of reported results at random.

.9 Failure of randomly selected item shall result in rejection of PV report or report of system startup and testing.

1.16 TRAINING

.1 Refer to Section 01 91 41 - Commissioning (Cx) - Training.

.2 Training for each system is coordinated by the Commissioning Authority, with assistance from the installing contractors, equipment and system manufacturers, commissioning agents, and the design consultants.

.3 The design consultants will provide information on the basis of design, design intent, general operating strategies, automatic control systems, etc.

.4 The General Contractor and Installation Contractors shall and organize and schedule the training sessions to achieve the requirements of the Training Plan, scheduled in cooperation with the Owner's Facility Manager.
  .1 Schedule all training activities, and coordinate with the installation contractors, and with Client staff for dates and resources required.
  .2 Organize training sessions by trade in accordance with the Owner's requirements.
  .3 Confirm training topics (breadth and depth) with the Commissioning Authority in accordance with above.
  .4 Each training session will be schedule to allow for up to two (2) separate training sessions for each topic, to allow for adequate operator shift coverage.
  .5 Training materials for specific equipment and systems shall be provided by the system or equipment manufacturer, and training provided by a qualified manufacturer's representative.

.5 Equipment Training
  .1 The installation contractor is responsible for providing training on the equipment, and with general aspects of the system. This includes providing the services of

manufacturer's representatives to provide detailed operating and maintenance instruction.

.6 Systems Training
- .1 Training sessions topics will include:
  - .1 Types of installed systems
  - .2 Design intent and design criteria
  - .3 Design constraints
  - .4 Different operating modes – occupied, unoccupied, emergency conditions, etc
  - .5 Seasonal operating modes
  - .6 Energy efficiency
  - .7 System operation
  - .8 Automatic controls
  - .9 Service, maintenance, diagnostics, and repairs (by vendors)
  - .10 Troubleshooting

1.17 EXTENT OF CX

.1 Electrical systems:
- .1 Low voltage below 750 V:
  - .1 Low voltage switch gear and transformation equipment.
  - .2 Metering and switchboard requirements
  - .3 Low voltage distribution systems.
  - .4 Ground fault Detection and interruption
  - .5 Wiring devices, receptacles and switches
  - .6 Motor starters
- .2 Emergency power generation systems:
  - .1 Emergency generator.
  - .2 Automatic transfer switchgear and controllers.
- .3 Lighting systems:
  - .1 Lighting equipment.
  - .2 Lighting controls.
  - .3 Emergency lighting systems, including battery packs.
- .4 Communication Systems
  - .1 To be commissioned by the owner
- .5 Fire alarm systems, equipment:
  - .1 Annunciators.
  - .2 Control panels.
- .6 Security Systems:
  - .1 Access control systems
  - .2 Video Surveillance
- .7 Other systems and equipment:
  - .1 Lightning protection systems.
- .8 Digital SCADA Metering

.2 Mechanical systems:
- .1 Plumbing systems
  - .1 Domestic hot water recirculation pumps
  - .2 Domestic hot water heaters
  - .3 Expansion tanks
  - .4 Backflow preventers
  - .5 Water meters
  - .6 Trap seal primers

.7 Roof drainage systems
.8 Washroom and shower plumbing fixtures and sinkware
.9 Emergency plumbing fixtures

.2 HVAC and exhaust systems
.1 Boilers
.2 Hydronic pumps
.3 HVAC piping systems and water treatment
.4 Heating convectors
.5 Unit heaters
.6 Force flow heaters
.7 In-floor heating systems
.8 Propane piping systems
.9 Ductwork and fire dampers
.10 Cabinet fans
.11 Ceiling exhaust fans
.12 In-line fans
.13 Range hood fans
.14 Heat recovery ventilators
.15 Controls
.16 Variable speed drives
.17 Noise and vibration control systems for mechanical systems.

.3 Fire protection systems
.1 Wet sprinkler alarm valves
.2 Wet sprinkler systems
.3 Fire extinguishers

.4 Seismic restraint and control measures.

.3 Building Envelope Systems:
.1 Underslab (slab on grade) System
.1 Drainage
.2 Membrane

.2 Foundation System
.1 Drainage
.2 Membrane

.3 Metal Cladding System
.1 Drainage
.2 Membrane
.3 Exterior wall-mock-up
.4 Air/vapour retarder
.5 Insulation
.6 Air space
.7 Veneer

.4 Window Systems
.1 Window mock-up

.5 Roofing Systems

1.18 ELECTRICAL SYSTEMS COMMISSIONING

.1 General
.1 The Commissioning Authority will provide equipment data forms and the commissioning team will complete them.
.2 Manufacturer/supplier to submit test forms. Test forms to incorporate all testing and commissioning requirements.

.3 All equipment to be started up as per the manufacturers' recommendations and specification requirements.
.4 System operation matrix to be submitted and reviewed by the Consultant and Commissioning Authority prior to site verification. All operations in the matrix to be tested and verified.
.5 Manufacturer to submit startup and test reports to the Consultant and Commissioning Authority for review prior to system operation and performance verification.
.6 System operation and performance verification includes the complete system and their interfaces with other systems.
.7 All documentation such as all testing and commissioning test reports, shop drawings, manuals, as-built, etc., to be submitted for review by the Commissioning Authority.

.2 Power Distribution System
.1 LV power distribution system includes equipment such as switchboards, distribution panels, transformers, generators, automatic transfer switches, distribution cables and panelboards. The Commissioning Authority shall review test reports and to witness certain testing of the equipment and systems by the manufacturers and/or independent testing agent, and to verify the breakers are set according to the Coordination Study for a safe and reliable system operation.
.2 All protective devices to be properly set, tested and calibrated. The report is to be submitted to the Consultant and Commissioning Authority for review prior to energizing the equipment.
.3 Low voltage distribution systems under 750 V require independent testing agency to perform pre- energization and post-energization tests.
.4 Generators and transfer switches: test by simulating loss of power. Verify availability of power at equipment requiring same.

.3 Lighting Control System
.1 The Commissioning Authority shall review the test reports demonstrating that the system has been started up and tested in accordance with manufacturer's and contract requirements, controlled in accordance with ASHRAE 90.1, and to witness the system operation and performance verification.
.2 Emergency lighting system tests to include verification of lighting levels and coverage, initially by disrupting normal power.

.4 Fire Alarm System
.1 Fire Alarm System includes fire detection, voice communication system and interface with the other systems. The Commissioning Authority shall review the test reports that the system has been started up and tested in accordance with CSA/ULC S537 requirements. The Commissioning Authority shall witness the fire alarm system operation and performance verification.
.2 Fire alarm system testing to include a complete verification in accordance with ULC requirements. After Consultant has reviewed report, devices and zones shall be demonstrated during system training.

.5 Communication Systems
.1 The owner will test and commission data and communication systems.

.6 Security, Video Surveillance and Access Control Systems
.1 Access control, CCTV and intrusion systems shall have each device verified for address, functionality and intercommunication with other systems. The manufacturer shall assist the electrical contractor and Departmental Representative with the entire system verification and provide documentation detailing each device tests with pass/fail for each device.

1.19 MECHANICAL SYSTEMS COMMISSIONING

.1 General
- .1 Commissioning of the Mechanical Systems shall commence once the systems have reached the required level of completeness, tested by the contractor and manufacturer, reviewed by the independent 3rd party inspection and testing firm responsible for field quality testing with test reports submitted for review by the Consultants and Commissioning Authority.
- .2 Test data forms for the equipment will be provided by the Commissioning Authority and completed by the commissioning team;
- .3 All equipment to be started up as per the manufacturers recommendations;
- .4 All verification of the systems to be done as part of the building automation system control points testing;
- .5 All shop drawings, manuals, as-builts, are to be submitted for review by the Commissioning Authority.

.2 Ventilation Systems
- .1 The ventilation system includes exhaust fans and a heat recovery ventilator. Our intent is to witness the contractor's testing of the equipment and systems and compare the test results with the Owner's Project Requirements and Basis of Design; therefore all components must be operational and tested prior to commissioning.
- .2 Pre-operational duct leakage testing and cleaning to be completed for the air handling systems and reports provided to the Consultant for review;
- .3 Test reports to be submitted by the contractor for review by the Commissioning Authority.

.3 Heating Systems
- .1 The heating system includes boiler, circulating pumps, heating terminals including convectors, unit heaters, force flow units and in-floor radiant heating. Our intent is to witness the contractor's testing of the equipment and systems and compare the test results with the Owner's Project Requirements and Basis of Design; therefore all components must be operational and tested prior to commissioning.
- .2 Pre-operational pipe tests, cleaning, water treatment and testing and to be completed for the hydronic systems and reports provided to the Consultant for review;
- .3 Test reports to be submitted by the contractor for review by the Commissioning Authority.

.4 Plumbing System
- .1 The plumbing system includes hot water generators, pumps, storage tanks, plumbing fixtures and all associated accessories. The Commissioning Authority shall witness the contractor's testing of the equipment and systems and the associated plumbing controls as outlined in the control sequences and compare the test results with the Owner's Project Requirements and Basis of Design.
- .2 Pre-operational cleaning to be completed for the plumbing systems and reports provided to the Consultant for review;
- .3 Water test and pipe test reports, laboratory water analysis, to be submitted for review by the Commissioning Authority.

.5 Building Automation Controls System
- .1 The controls system includes the controllers, control panels, field devices, sensors, will be commissioned at the same time. The Commissioning Authority shall witness the contractor's testing of the equipment and systems and the associated controls as outlined in the control sequences and compare the test results with the Owner's Project Requirements and Basis of Design.
- .2 Verify all points, sensors and sequence of operation;

.3 Perform seven day performance test;
.4 Points verification list to be submitted for review by the Commissioning Authority.

.6 Fire Protection Sprinkler System
.1 The fire protection system includes a wet sprinkler system with three zones, and fire extinguishers. The system shall be designed and verified by the sprinkler contractor's Fire Protection Engineer. The Commissioning Authority shall witness the contractor's demonstration of the equipment and systems.

1.20 BUILDING ENVELOPE COMMISSIONING

.1 General
.1 Commissioning of the assemblies shall commence once the envelope has reached the required level of completeness, has been tested by the contractor and manufacturer, reviewed by the independent 3rd party inspection and testing firm responsible for field quality testing (test reports submitted for review by the Consultants and building envelope commissioning authority) and reviewed by the Consultant.
.2 Data forms for systems will be provided by the Commissioning Authority and completed by the commissioning team.
.3 All shop drawings, test reports, field quality control reports, manuals, as-built, etc. to be submitted by the contractor for review by the Commissioning Authority.
.4 Minutes of the Pre-installation meeting to be provided for review of the Commissioning Authority.
.5 Reports related to the mock-up review and acceptance by the Consultant of record and any 3rd party inspection and testing firm to be provided for review of the Commissioning Authority.
.6 Progressive verification of the system to be undertaken by 3rd party inspection and testing firm or Consultant of record.

.2 Verification
.1 Certify that building exterior enclosure systems, subsystems, and construction have been completed according to the Contract Documents.
.2 Commissioning Authority will witness and document field quality-control tests and reviews.
.3 Verify that field quality-control testing of building exterior enclosure has been completed and approved, that discrepancies have been corrected, and corrective work approved.
.4 Annotate checklist or data sheet when a deficiency is observed.
.5 Deferred Testing:
.1 If tests cannot be completed because of a deficiency outside the scope of the Building Exterior Enclosure, the deficiency shall be documented and reported to the Commissioning Authority.
.2 Deficiencies shall be resolved and corrected by Contractor and tests rescheduled.
.6 If the testing plan indicates specific seasonal testing, appropriate initial performance tests shall be completed and documented and additional tests scheduled.
.7 Testing Reports:
.1 Reports shall include measured data, data sheets, and a comprehensive summary describing the building exterior enclosure systems at the time of testing.
.2 Prepare a preliminary test report. Deficiencies will be evaluated by Design Consultants.

.3 Underslab (slab on grade) System
  .1 The underslab or slab on a grade system includes use of drainage and membrane components to reduce transmission of ground moisture to interior spaces. The underslab system may include an active drainage system where the water table or moisture content of the soil is elevated for extended periods and may include a design solution where soil expansion is of concern to the Structural Consultant.

.4 Foundation System
  .1 The foundation system includes use of drainage and membrane components to reduce transmission of ground moisture to interior spaces. It has been determined to be a combination damp-proofing/waterproofing system by the Consultant and includes an active drainage system.

.5 Metal Cladding System
  .1 The metal cladding system includes use of drainage and membrane components to manage moisture transmission at the exterior wall. The Commissioning Authority shall review the Consultant mock-up report for the exterior wall assembly compiled by the Contractor (which is anticipated to include examples of relevant transitions). One validation review of the complete exterior wall assembly for integrity will be completed by the Commissioning Authority for conformance with the design intent.
  .2 Commissioning Authority will undertake one validation review during the compilation of the remaining wall assembly.

.6 Window Systems
  .1 The Window system includes use of a specifically designed component assembly to manage light, air and moisture transmission at the exterior wall. The Commissioning Authority shall witness the Specified ASTM E1105 test, and one designated mock-up compilation (which is anticipated to include examples of relevant transitions). One validation review of select areas of the installation will be completed by the Commissioning Authority as a means of assurance against the design intent.
  .2 Commissioning Authority will undertake one validation review during the compilation of the remaining window system installation.

.7 Roofing Systems
  .1 The specified roofing involves assembly of a designed system of components to manage air and moisture transmission at the roof. The Commissioning Authority shall review the roofing assembly Contractor and Consultant review reports, all in conformance with the design intent. The Commissioning Authority intends to complete at least one validation of the installation in progress.
  .2 Commissioning Authority will undertake one validation review during the compilation of the remaining roofing system installation.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 NOT USED

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

.1 Section Includes:
- .1 Commissioning forms to be completed for equipment, system and integrated system.

.2 Related Requirements
- .1 Section 01 91 13 General Commissioning Requirements.
- .2 Section 01 91 31 Commissioning Plan
- .3 Section 01 91 41 Commissioning Training

1.2 INSTALLATION/START-UP CHECK LISTS

.1 Include the following data:
- .1 Product manufacturer's installation instructions and recommended checks.
- .2 Special procedures as specified in relevant technical sections.
- .3 Items considered good installation and engineering industry practices deemed appropriate for proper and efficient operation.

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

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

.4 Installer to sign check lists upon completion, certifying stated checks and inspections have been performed. Return completed check lists to the Commissioning Authority. Check lists will be required during Commissioning and will be included in the Commissioning Report at the completion of the project.

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

1.3 PRODUCT INFORMATION (PI) REPORT FORMS

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

.2 Prior to Performance Verification (PV) of systems complete items on PI forms related to systems and obtain the Commissioning Authority's approval.

1.4 PERFORMANCE VERIFICATION (PV) FORMS

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

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

.3 Prior to PV of integrated system, complete PV forms of related systems and obtain the Commissioning Authority's approval.

1.5 SAMPLES OF COMMISSIONING FORMS

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

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

.3 Samples of Commissioning forms and a complete index of produced to date will be attached to this section.

1.6 CHANGES AND DEVELOPMENT OF NEW REPORT FORMS

.1 When additional forms are required, but are not available from the Commissioning Authority, develop appropriate verification forms and submit to the Commissioning Authority for approval prior to use.
- .1 Additional commissioning forms to be in the same format as provided by the Commissioning Authority

1.7 COMMISSIONING FORMS

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

.2 Strategy for Use:
- .1 Commissioning Authority provides Contractor project-specific Commissioning forms with Specification data included.
- .2 Contractor will provide required shop drawings information and verify correct installation and operation of items indicated on the Commissioning forms.
- .3 Confirm operation as per design criteria and intent.
- .4 Identify variances between design and operation and reasons for variances.
- .5 Verify operation in specified normal and emergency modes and under specified load conditions.
- .6 Record performance results. Add written comments explaining unusual conditions or incomplete work.
- .7 Verify reported results as requested by the Commissioning Authority.
- .8 Form to bear signatures of recording technician and reviewed and signed off by Commissioning Agent.
- .9 Submit immediately after tests are performed.
- .10 Reported results in true measured SI unit values.
- .11 Provide Commissioning Authority originals of completed forms.
- .12 Maintain copy on site during start-up, testing and commissioning period.
- .13 Forms to be both hard copy and electronic format with typed written results in the Operation and Maintenance Manual.

1.8 COMMISSIONING VERIFICATION REPORTS

.1 Refer to specific mechanical, electrical and building envelope specification sections for specific system and equipment testing reports.

.2 Refer to section 01 91 13 General Commissioning Requirements for a summary of testing and verification reports to be completed and submitted for commissioning.

1.9 LANGUAGE

.1 To suit the language profile of the awarded contract.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

.1 Section Includes:
- .1 This Section specifies roles and responsibilities of Commissioning Training.

.2 Related Requirements
- .1 Section 01 91 13 General Commissioning Requirements.
- .2 Section 01 91 31 Commissioning Plan
- .3 Section 01 91 33 Commissioning Forms

1.2 TRAINEES

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

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

1.3 INSTRUCTORS

.1 Design Consultants will provide:
- .1 Descriptions of systems.
- .2 Instruction on design philosophy, design criteria, and design intent.

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

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

1.4 TRAINING OBJECTIVES

.1 Training to be detailed and duration to ensure:
- .1 Safe, reliable, cost-effective, energy-efficient operation of systems in normal and emergency modes under all conditions.
- .2 Effective on-going inspection, measurements of system performance.
- .3 Proper preventive maintenance, diagnosis and trouble-shooting.
- .4 Ability to update documentation.
- .5 Ability to operate equipment and systems under emergency conditions until appropriate qualified assistance arrives.

1.5 TRAINING MATERIALS

.1 Instructors to be responsible for content and quality.

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

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

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

.5 Supplemental training materials:
- .1 Multimedia presentations.
- .2 Manufacturer's training videos.

1.6 SCHEDULING

.1 Include in Commissioning Schedule time for training.

.2 Deliver training during regular working hours, training sessions to be 3 hours in length, with two training sessions per day.

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

1.7 RESPONSIBILITIES

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

.2 Commissioning Authority will evaluate training and materials.

.3 Upon completion of training, provide dated sign-in sheet from all attendees and presenters.

1.8 TRAINING CONTENT

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

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

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

1.9 VIDEO-BASED TRAINING

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

.2 Production methods to be professional quality.

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 Not used

1.2 REFERENCES

.1 CSA International

.1 CSA S350-M1980, Code of Practice for Safety in Demolition of Structures.

.2 U.S. Environmental Protection Agency (EPA)/Office of Water

.1 EPA 832/R-92-005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

.2 Canadian Environmental Protection Act (CEPA), 1993, C.33.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Hazardous Materials:

.1 Provide description of Hazardous Materials and Notification of Filing with proper authorities prior to beginning of Work as required.

1.4 SITE CONDITIONS

.1 This specification refers only to civil-related demolition works outside the building envelope.

.2 Take precautions to protect environment and undertake works in conformance with Contract Documents for siltation control and pollution prevention.

.3 If material resembling asbestos or other designated substance listed as hazardous is encountered, stop work, take preventative measures, and notify Departmental Representative immediately.

.1 Proceed only after receipt of written instructions have been received from Departmental Representative.

.4 Notify Departmental Representative before disrupting building access or services.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Store and manage hazardous materials in accordance with Section 01 35 43 - Environmental Procedures.

.2 Storage and Protection.

.1 Protect in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

.2 Protect existing items designated to remain and items designated for salvage. In event of damage to such items, immediately replace or make repairs to approval of Departmental Representative and at no cost.

.3 Remove and store materials to be salvaged, in manner to prevent damage.

.4 Store and protect in accordance with requirements for maximum preservation of material.

.5 Handle salvaged materials as new materials.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not used.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Inspect site with Departmental Representative and verify extent and location of items designated for removal, disposal, alternative disposal, recycling, salvage and items to remain.

.2 Locate and protect utilities. Preserve active utilities traversing site in operating condition.

.3 Notify and obtain approval of utility companies before starting demolition.

3.2 PREPARATION

.1 Locate and protect utilities. Preserve active utilities traversing site in operating condition.

.2 Temporary Erosion and Sedimentation Control:

.1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to: requirements of authorities having jurisdiction.

.2 Inspect, repair, and maintain erosion and sedimentation control measures during demolition.

.3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal after completion of demolition work.

.3 Protection of In-Place Conditions:

.1 Prevent movement, settlement, or damage to adjacent structures, utilities, and landscaping features and parts of building to remain in place. Provide bracing and shoring required.

.2 Keep noise, dust, and inconvenience to occupants to minimum.

.3 Protect building systems, services and equipment.

.4 Provide temporary dust screens, covers, railings, supports and other protection as required.

.5 Do Work in accordance with Section 01 35 29.06 - Health and Safety Requirements.

3.3 REMOVAL OF HAZARDOUS WASTES

.1 Remove contaminated or dangerous materials defined by authorities having jurisdiction, relating to environmental protection, from site and dispose of in safe manner to minimize danger at site or during disposal.

.2 Provide a work plan for cutting, handling, and disposal of asbestos cement pipe.

.1 Complete all asbestos cement cutting, removal and disposal in accordance with WorkSafeBC regulations and safe work practices.

3.4 DEMOLITION/REMOVAL:

.1 Remove items as indicated.

.2 Disconnect, cap, plug or divert, as required, existing utilities within the property where they interfere with the execution of the work, in conformity with the requirements of the authorities having jurisdiction. Mark the location of these and previously capped or plugged services on the site and indicate location (horizontal and vertical) on the record drawings. Support, shore up and maintain pipes and conduits encountered.

.1 Coordinate any service disruptions with Departmental Representative for hours of work, duration of shutdown, and emergency procedures in case of prolonged outage.

.2 Immediately notify Departmental Representative and utility company concerned in case of damage to any utility or service, designated to remain in place.

.3 Immediately notify the Departmental Representative should uncharted utility or service be encountered, and await instruction in writing regarding remedial action.

.3 Excavate at least 200mm below pipe invert, when removing pipes under existing or future pavement area.

.4 Removal of Pavements, Concrete Slabs, Curbs and Gutters:

.1 Square up adjacent surfaces to remain in place by saw cutting or other method approved by Departmental Representative.

.2 Protect adjacent joints and load transfer devices.

.3 Protect underlying and adjacent granular materials.

.4 Use cold milling, planning or grinding equipment with automatic grade controls capable of operating from stringline, and capable of removing part of pavement surface to depths or grades indicated.

.5 Trim edges of partially demolished building elements to tolerances as defined by Departmental Representative to suit future use.

.6 Expose, cut, remove, and dispose of any asbestos cement pipe in accordance with all applicable WorkSafeBC guidelines and regulations.

3.5 STOCKPILING

.1 Proper stockpiling will help maintain the value of salvaged materials.

.2 Label stockpiles, indicating material type and quantity.

.3 Designate appropriate security resources/measures to prevent vandalism, damage and theft.

.4 Locate stockpiled materials convenient for use in new construction to eliminate double handling wherever possible.

.5 Stockpile in locations as directed by Departmental Representative.

.1 Stockpile height not to exceed 2 m and should be protected from erosion.

.6 Stockpile materials designated for alternate disposal in location which facilitates removal from site and examination by potential end markets, and which does not impede disassembly, processing, or hauling procedures.

3.6 RESTORATION AND CLEANING

.1 Restore areas and existing works outside areas of demolition to match condition of adjacent, undisturbed areas or to conditions that existed prior to beginning of Work.

.2 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.3 .1 Leave Work areas clean at end of each day.

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

.5 Refer to demolition drawings and specifications for items to be salvaged for reuse.

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

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

END OF SECTION 02 41 99

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 03 20 00 – Concrete Reinforcing

.2 Section 03 30 00 – Cast-in-Place Concrete

1.2 REFERENCE STANDARDS

.1 All referenced standards shall be the current edition or the edition referenced by the applicable Building Code in force at the time of building permit application, as noted on Structural Drawings.

.2 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.

.2 CSA-O86, Engineering Design in Wood.

.3 CSA O121, Douglas Fir Plywood.

.4 CSA O141, Softwood Lumber.

.5 CAN/CSA-O325.0, Construction Sheathing.

.6 CSA S269.1, Falsework and Formwork.

.3 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S701, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

.4 American Concrete Institute (ACI):

.1 ACI 347, Guide to Formwork for Concrete.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 29.06 – Health and Safety Requirements.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Store and manage hazardous materials in accordance with Section 01 35 29.06 – Health and Safety Requirements and Section 01 35 43 – Environmental Procedures.

.2 Waste Management and Disposal:

.1 Separate waste materials for recycling and reuse in accordance with Section 01 47 21 - Construction/Demolition Waste Management and Disposal.

.2 Place materials defined as hazardous or toxic in designated containers.

.3 Divert wood materials from landfill to a recycling, reuse, or composting facility as approved by Departmental Representative.

.4 Divert plastic materials from landfill to a reuse, recycling, or composting facility as approved by Departmental Representative.

.5 Divert unused form release material from landfill to an official hazardous material collections site as approved by the Departmental Representative.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Formwork materials:

.1 For concrete without special architectural features, use wood and wood product formwork materials to CSA-O121, CSA-O141, and CSA-O86.

.2 For concrete with special architectural features, use formwork materials to CSA-A23.1/A23.2.

.3 Rigid insulation board: to CAN/ULC-S701.

.2 Tubular column forms: round, spirally wound laminated fibre forms, internally treated with release material.

.1 Spiral pattern to show in hardened concrete.

.3 Form ties:

.1 For concrete not designated 'Architectural', use removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25 mm diameter in concrete surface.

.2 For Architectural concrete, use snap ties complete with plastic cones and light grey concrete plugs.

.3 Snap ties to snap cleanly at least 25mm from concrete surface without damage to the concrete.

.4 Cone ties to be internal disconnecting type which snaps cleanly at least 38mm from concrete surface without damage to the concrete.

.4 Form liner:

.1 Plywood: medium density overlay Douglas Fir to CSA O121, square edge, 19mm thickness.

.5 Form release agent: biodegradable, low VOC, non-toxic.

.6 Form stripping agent: colourless mineral oil, non-toxic, biodegradable, low VOC, free of kerosene, with viscosity between 70 and 110s Saybolt Universal at 40 degrees C, flashpoint minimum 150 degrees C, open cup.

.7 Grooves, reglets and chamfers: White pine selected for straightness and accurately dressed to size.

.8 Sealant: to Section 07 90 00 - Joint Sealants.

PART 3 - EXECUTION

3.1 FABRICATION AND ERECTION

.1 Verify lines, levels and centres before proceeding with formwork/falsework and ensure dimensions agree with drawings.

.2 Obtain Departmental Representative's approval for use of earth forms not indicated on drawings.

.3 Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.

.4 Refer to architectural drawings for concrete members requiring architectural exposed finishes.

.5 Do not place shores and mud sills on frozen ground.

.6 Provide site drainage to prevent washout of soil supporting mud sills and shores.

.7 Fabricate and erect formwork in accordance with CSA-S269.1 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA-A23.1/A23.2.

.8 Align form joints and make watertight.

.1 Keep form joints to minimum.

.9 Use 25 mm chamfer strips on external corners and/or 25 mm fillets at interior corners, joints, unless specified otherwise.

.10 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.

.11 Construct forms for architectural concrete, and place ties as directed.

.1 Joint pattern not necessarily based on using standard size panels or maximum permissible spacing of ties.

.12 Build in anchors, sleeves, and other inserts required to accommodate Work specified in other sections.

.1 Ensure that anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.

.13 If concrete surfaces require cleaning after form removal, use only pressurized water stream so as not to alter concrete's smooth finish.

.14 Clean formwork in accordance with CSA-A23.1/A23.2, before placing concrete.

3.2 REMOVAL AND RESHORING

.1 Leave formwork in place for following minimum periods of time after placing concrete.

.1 1 day for footings.

.2 3 days for foundation walls, foundation piers, and grade beams.

.2 Re-use formwork and falsework subject to requirements of CSA-A23.1/A23.2.

END OF SECTION 03 10 00

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 03 10 00 – Concrete Forming and Accessories

.2 Section 03 30 00 – Cast-in-Place Concrete

1.2 REFERENCE STANDARDS

.1 All referenced standards shall be the current edition or the edition referenced by the applicable Building Code in force at the time of building permit application, as noted on Structural Drawings.

.2 American Concrete Institute (ACI)

.1 SP-66, ACI Detailing Manual 2004.

.3 ASTM International

.1 ASTM A143/A143M, Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.

.2 ASTM A767/A767M Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.

.3 ASTM A1064/A1064M, Standard Specification for Carbon Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.

.4 CSA International

.1 CSA-A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.

.2 CSA-A23.3, Design of Concrete Structures.

.3 CSA-G30.18, Carbon Steel Bars for Concrete Reinforcement.

.4 CSA-G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.5 CSA W186, Welding of Reinforcing Bars in Reinforced Concrete Construction.

.5 Reinforcing Steel Institute of Canada (RSIC)

.1 RSIC, Reinforcing Steel Manual of Standard Practice.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Prepare reinforcement drawings in accordance with SP-66 and RSIC Manual of Standard Practice.

.3 Shop Drawings:

.1 Submittal of reinforcement drawings is not required.

.1 Indicate placing of reinforcement and:

.1 Bar bending details.

.2 Lists.

.3 Quantities of reinforcement.

.4 Sizes, spacings, locations of reinforcement and mechanical splices if approved by Departmental Representative, with identifying code marks to permit correct placement without reference to structural drawings.

.5 Indicate sizes, spacings and locations of chairs, spacers and hangers.

.2 Detail lap lengths and bar development lengths to CAN/CSA-A23.3, unless otherwise indicated.

.1 Provide Class B, unless otherwise indicated.

.4 When Chromate solution is used as replacement for galvanizing non-prestressed reinforcement, provide product description for review by Departmental Representative prior to its use.

1.4 QUALITY ASSURANCE

.1 Submit in accordance with Section 01 45 00 - Quality Control and as described in PART 2 - SOURCE QUALITY CONTROL.

.1 Mill Test Report: Upon request, provide Departmental Representative with certified copy of mill test report of reinforcing steel, minimum 4 weeks prior to beginning reinforcing work.

.2 Upon request, submit in writing to Departmental Representative proposed source of reinforcement material to be supplied.

1.5 DELIVERY, STORAGE AND HANDLING

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

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

.3 Storage and Handling Requirements:

.1 Store materials off ground, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Replace defective or damaged materials with new.

.4 Develop Waste Reduction Workplan and Construction Waste Management Plan related to Work of this Section and in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Substitute different size bars only if permitted in writing by Departmental Representative.

.2 Reinforcing steel: billet steel, grade 400, deformed bars to CSA-G30.18, unless indicated otherwise.

.3 Reinforcing steel: weldable low alloy steel deformed bars to CSA-G30.18.

.4 Hot-rolled threadbar:

.1 To CSA G30.18 or ASTM A615.

.2 Yield strength 517 MPa.

.3 Ultimate strength 690 MPa.

.4 Compatible accessories including bearing plates, nuts, washers, and couplers.

.5 Cold-drawn annealed steel wire ties: to ASTM A1064/A1064M.

.6 Deformed steel wire for concrete reinforcement: to ASTM A1064/A1064M.

.7 Welded steel wire fabric: to ASTM A1064/A1064M.

.1 Provide in flat sheets only.

.8 Welded deformed steel wire fabric: to ASTM A1064/A1064M.

.1 Provide in flat sheets only.

.9 Galvanizing of non-prestressed reinforcement: to ASTM A767/A767M, minimum zinc coating 610 g/m^2.

.1 Protect galvanized reinforcing steel with chromate treatment to prevent reaction with Portland cement paste.

.2 If chromate treatment is carried out immediately after galvanizing, soak steel in aqueous solution containing minimum 0.2% by weight sodium dichromate or 0.2% chromic acid.

.1 Temperature of solution equal to or greater than 32 degrees and galvanized steels immersed for minimum 20 seconds.

.3 If galvanized steels are at ambient temperature, add sulphuric acid as bonding agent at concentration of 0.5% to 1%.

.1 In this case, no restriction applies to temperature of solution.

.4 Chromate solution sold for this purpose may replace solution described above, provided it is of equivalent effectiveness.

.1 Provide product description as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.

.10 Chairs, bolsters, bar supports, spacers: to CSA-A23.1/A23.2.

.11 Mechanical splices: subject to approval of Departmental Representative.

.12 Plain round bars: to CSA-G40.20/G40.21.

2.2 FABRICATION

.1 Fabricate reinforcing steel in accordance with Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada, SP-66, and CSA-A23.1/A23.2.

.2 Obtain Departmental Representative's written approval for locations of reinforcement splices other than those shown on placing drawings.

.3 Upon approval of Departmental Representative, weld reinforcement in accordance with CSA W186.

.4 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.

2.3 SOURCE QUALITY CONTROL

.1 Upon request, provide Departmental Representative with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis, minimum 4 weeks prior to beginning reinforcing work.

.2 Upon request, inform Departmental Representative of proposed source of material to be supplied.

PART 3 - EXECUTION

3.1 PREPARATION

.1 Galvanizing to include chromate treatment.

.1 Duration of treatment to be 1 hour per 25 mm of bar diameter.

.2 Conduct bending tests to verify galvanized bar fragility in accordance with ASTM A143/A143M.

3.2 FIELD BENDING

.1 Do not field bend or field weld reinforcement except where indicated or authorized by Departmental Representative.

.2 When field bending is authorized, bend without heat, applying slow and steady pressure.

.3 Replace bars, which develop cracks or splits.

3.3 PLACING REINFORCEMENT

.1 Place reinforcing steel as indicated on placing drawings in accordance with CSA-A23.1/A23.2.

.2 Remove all loose scale, dirt, oil or other coatings which would reduce bond.

.3 Turn ends of tie wire towards the interior of concrete.

.4 Use bar supports for beams and slabs.

.5 Use precast concrete chairs where supports rest on the ground. Where welded wire fabric is used in slabs-on- grade, place precast concrete chairs at 600 mm on centre each way. Do not attempt to position welded wire fabric by lifting it after concrete is poured.

.6 Pre-assemble reinforcement for footings and lower full cages into place not to disturb soil at founding elevation.

.7 Use side form spacers for walls and columns.

.8 Do not splice reinforcing at locations other than shown on placing drawings without Consultant's written approval.

.9 Do not cut reinforcement without Consultant's written approval.

.10 Use plain round bars as slip dowels in concrete.

.1 Paint portion of dowel intended to move within hardened concrete with one coat of asphalt paint.

.2 When paint is dry, apply thick even film of mineral lubricating grease.

.11 Prior to placing concrete, obtain Departmental Representative's approval of reinforcing material and placement.

.12 Ensure cover to reinforcement is maintained during concrete pour.

.13 Protect paint coated portions of bars with covering during transportation and handling.

3.4 FIELD TOUCH-UP

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

3.5 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

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

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

END OF SECTION 03 20 00

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 03 10 00 – Concrete Forming and Accessories

.2 Section 03 20 00 – Concrete Reinforcing

1.2 REFERENCE STANDARDS

.1 All referenced standards shall be the current edition or the edition referenced by the applicable Building Code in force at the time of building permit application, as noted on Structural Drawings.

.2 ASTM International

.1 ASTM C260/C260M, Standard Specification for Air-Entraining Admixtures for Concrete.

.2 ASTM C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

.3 ASTM C494/C494M, Standard Specification for Chemical Admixtures for Concrete.

.4 ASTM C1017/C1017M, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.

.5 ASTM D412, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.

.6 ASTM D624, Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomer.

.7 ASTM D6817/D6817M, Standard Specification for Rigid Cellular Polystyrene Geofoam.

.8 ASTM D1751, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

.9 ASTM D1752, Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.

.10 ASTM E1745, Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.

.11 ASTM E1643, Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.

.3 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-37.2, Emulsified Asphalt, Mineral Colloid-Type, Unfilled, for Dampproofing and Waterproofing and for Roof Coatings.

.2 CAN/CGSB-51.34, Vapour Barrier, Polyethylene Sheet for Use in Building Construction.

.4 CSA International

.1 CSA A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

.2 CSA A283, Qualification Code for Concrete Testing Laboratories.

.3 CSA A3000, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

.5 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S701, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.3 ABBREVIATIONS AND ACRONYMS

.1 Portland Cement: hydraulic cement, blended hydraulic cement (XXb - b denotes blended) and Portland-limestone cement.

.1 Type GU, GUb and GUL - General use cement.

.2 Type MS and MSb - Moderate sulphate-resistant cement.

.3 Type MH, MHb and MHL - Moderate heat of hydration cement.

.4 Type HE, HEb and HEL - High early-strength cement.

.5 Type LH, LHb and LHL - Low heat of hydration cement.

.6 Type HS and HSb - High sulphate-resistant cement.

.2 Fly ash:

.1 Type F - with CaO content less than 15%.

.2 Type CI - with CaO content ranging from 15 to 20%.

.3 Type CH - with CaO greater than 20%.

.3 GGBFS - Ground, granulated blast-furnace slag.

1.4 ADMINISTRATIVE REQUIREMENTS

.1 Pre-installation Meetings: in accordance with Section 01 32 16.07 - Construction Progress Schedules - Bar (GANTT) Chart, convene pre-installation meeting two weeks prior to beginning concrete works.

.1 Ensure site supervisor, concrete producer, speciality contractor -finishing, forming, Departmental Representative, and any other key personnel attend.

.1 Verify project requirements.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Provide concrete mix designs for review by Departmental Representative.

.3 Provide testing reports for review by Departmental Representative and do not proceed without written approval when deviations from mix design or parameters are found.

.4 Concrete pours: provide accurate records of poured concrete items indicating date and location of pour, quality, air temperature and test samples taken as described in PART 3 - FIELD QUALITY CONTROL.

.5 Concrete hauling time: provide for review by Departmental Representative deviations exceeding maximum allowable time of 120 minutes for concrete to be delivered to site of Work and discharged after batching.

.6 Submit WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.6 QUALITY ASSURANCE

.1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.

.2 Provide Departmental Representative, minimum 4 weeks prior to starting concrete work, with valid and recognized certificate from plant delivering concrete.

.1 Provide test data and certification by qualified independent inspection and testing laboratory that materials and mix designs used in concrete mixture will meet specified requirements.

.3 Minimum 4 weeks prior to starting concrete work, provide proposed quality control procedures for review by Departmental Representative on following items:

.1 Falsework erection.

.2 Hot weather concrete.

.3 Cold weather concrete.

.4 Curing.

.5 Finishes.

.6 Formwork removal.

.7 Joints.

.4 Quality Control Plan: provide written report to Departmental Representative verifying compliance that concrete in place meets performance requirements of concrete as established in PART 2 - PRODUCTS.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Delivery and Acceptance Requirements:

.1 Concrete hauling time: deliver to site of Work and discharged within 120 minutes maximum after batching.

.1 Do not modify maximum time limit without receipt of prior written agreement from Departmental Representative and concrete producer as described in CSA A23.1/A23.2.

.2 Deviations to be submitted for review by Departmental Representative.

.2 Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.

.2 Packaging Waste Management: remove for reuse of pallets, padding, packaging materials, crates, in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 DESIGN CRITERIA

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

2.2 PERFORMANCE CRITERIA

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

2.3 MATERIALS

.1 Portland Cement: to CSA A3001, Type GU.

.2 Blended hydraulic cement: Type GUb to CSA A3001.

.3 Water: to CSA A23.1.

.4 Aggregates: to CSA A23.1/A23.2.

.5 Admixtures:

.1 Air entraining admixture: to ASTM C260.

.2 Chemical admixture: to ASTM C1017 and ASTM C494. Departmental Representative to approve accelerating or set retarding admixtures during cold and hot weather placing.

.6 Shrinkage compensating grout: premixed compound consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agents to CSA A23.1/A23.2.

.1 Compressive strength: 50 MPa at 28 days.

.7 Non-premixed dry pack grout: composition of non-metallic aggregate Portland cement with sufficient water for mixture to retain its shape when made into ball by hand and capable of developing compressive strength of 50 MPa at 28 days.

.8 Curing compound: to CSA A23.1/A23.2 and ASTM C309, Type 1-chlorinated rubber.

.9 Type 1 waterstops: ribbed extruded PVC of sizes indicated with shop welded corner and intersecting pieces with legs not less than 600 mm long:

.1 Tensile strength: to ASTM D412, method A, Die "C", minimum 48 MPa.
.2 Elongation: to ASTM D412, method A, Die "C", minimum 275%.
.3 Tear resistance: to ASTM D624, method A, Die "B", minimum 30 kN/m.

.10 Type 2 Waterstops:

.1 Bentonite waterstop.

.11 Premoulded joint fillers:

.1 Bituminous impregnated fibre board: to ASTM D1751.
.2 Sponge rubber: to ASTM D1752, Type I, flexible grade.

.12 Weep hole tubes: plastic.

.13 Dampproofing: to Section 07 11 13 - Bituminous Dampproofing.

.14 Expanded polystyrene (EPS) geofoam below slab on grade with radiant heating:

.1 To ASTM D6817.
.2 Minimum density: 38.4 kg/m^3.
.3 Minimum compressive resistance at 1% strain: 103 kPa.
.4 Minimum compressive modulus: 10.3 MPa.
.5 Minimum flexural strength: 414 kPa

.15 Polyethylene film:

.1 Office area: to ASTM E1745, 0.38 mm thickness multi-plastic polyolefin sheet under-slab vapour barrier, 0.0086 permeance or less.
.2 Shop area: to ASTM E1745 Class A, 0.25 mm thickness multi-plastic polyolefin sheet under-slab vapour barrier, 0.03 permeance or less.

2.4 MIXES

.1 Alternative 1 - Performance Method for specifying concrete: to meet Departmental Representative performance criteria to CSA A23.1/A23.2.

.1 Ensure concrete supplier meets performance criteria as established below and provide verification of compliance as in Quality Control Plan.
.2 Provide concrete mix to meet following plastic state requirements:
.1 Uniformity: uniform density, air content, and slump
.2 Workability: free of segregation, surface blemishes, loss of mortar, and colour variations.
.3 Finishability: to CSA A23.1/A23.2.
.3 Provide concrete mix to meet following hard state requirements:
.1 Mix Type 1:
.1 Durability and class of exposure: N.
.2 Compressive strength at 28 days age: 25 MPa minimum.
.3 Intended application: Footings and grade beams.
.4 Aggregate size: 20mm maximum.
.2 Mix Type 2:
.1 Durability and class of exposure: F-2.
.2 Compressive strength at 28 days age: 30 MPa minimum.
.3 Intended application: Exterior foundation walls and piers.
.4 Aggregate size: 20mm maximum.
.3 Mix Type 3:

.1 Durability and class of exposure: N.
.2 Compressive strength at 28 days age: 30 MPa minimum.
.3 Intended application: Interior foundation walls and piers.
.4 Aggregate size: 20mm maximum.

.4 Mix Type 4:
.1 Durability and class of exposure: N.
.2 Compressive strength at 28 days age: 25 MPa minimum.
.3 Intended application: Interior slab on grade, trenches.
.4 Aggregate size: 20mm maximum.

.5 Mix Type 5:
.1 Durability and class of exposure: C-4.
.2 Compressive strength at 28 days age: 30 MPa minimum.
.3 Intended application: Heated vehicle accessible areas slab on grade, trenches.
.4 Aggregate size: 20mm maximum.

.6 Mix Type 6:
.1 Durability and class of exposure: C-2.
.2 Compressive strength at 28 days age: 32 MPa minimum.
.3 Intended application: Unheated vehicle accessible areas slab on grade, trenches, sidewalks.
.4 Aggregate size: 20mm maximum.

.7 Mix Type 7:
.1 Durability and class of exposure: N.
.2 Compressive strength at 28 days age: 20 MPa minimum.
.3 Intended application: Concrete topping on steel deck.
.4 Aggregate size: 20mm maximum.

.8 Mix Type 8:
.1 Durability and class of exposure: N.
.2 Compressive strength at 28 days age: 20 MPa minimum.
.3 Intended application: Non-structural toppings, housekeeping pads.
.4 Aggregate size: 20mm maximum.

.9 Mix Type 9:
.1 Durability and class of exposure: N.
.2 Compressive strength at 28 days age: 10 MPa minimum.
.3 Intended application: Lean concrete, mudslabs.
.4 Aggregate size: 20mm maximum.

.4 Provide quality management plan to ensure verification of concrete quality to specified performance.

.5 Concrete supplier's certification: both batch plant and materials meet CSA A23.1 requirements.

PART 3 - EXECUTION

3.1 PREPARATION

.1 Obtain Departmental Representative's written approval before placing concrete.

.1 Provide 5 business days minimum notice prior to placing of concrete.

.2 Place concrete reinforcing in accordance with Section 03 20 00 - Concrete Reinforcing.

.3 During concreting operations:

.1 Development of cold joints not allowed.

.2 Ensure concrete delivery and handling facilitates placing with minimum of re-handling, and without damage to existing structure or Work.

.4 Pumping of concrete is permitted only after approval of equipment and mix.

.5 Ensure reinforcement and inserts are not disturbed during concrete placement.

.6 Prior to placing of concrete obtain Departmental Representative's approval of proposed method for protection of concrete during placing and curing in adverse weather.

.7 Protect previous Work from staining.

.8 Clean and remove stains prior to application for concrete finishes.

.9 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.

.10 Do not place load upon new concrete until authorized by Departmental Representative.

3.2 INSTALLATION/APPLICATION

.1 Do cast-in-place concrete work to CSA A23.1/A23.2.

.2 Sleeves and inserts:

.1 Do not permit penetrations, sleeves, ducts, pipes or other openings to pass foundation piers and grade beams, except where indicated or approved by Departmental Representative.

.2 Where approved by Departmental Representative, set sleeves, ties, pipe hangers and other inserts and openings as indicated or specified elsewhere.

.3 Sleeves and openings greater than 100 x 100 mm not indicated, must be reviewed by Departmental Representative.

.4 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain written approval of modifications from Departmental Representative before placing of concrete.

.5 Confirm locations and sizes of sleeves and openings shown on drawings.

.3 Anchor bolts:

.1 Set anchor bolts to templates in co-ordination with appropriate trade prior to placing concrete.

.4 Drainage holes and weep holes:

.1 Form weep holes and drainage holes in accordance with Section 03 10 00 - Concrete Forming and Accessories. If wood forms are used, remove them after concrete has set.

.2 Install weep hole tubes and drains as indicated.

.5 Grout under base plates using procedures in accordance with manufacturer's recommendations which result in 100 % contact over grouted area.

.6 Finishing and curing:

.1 Finish concrete to CSA A23.1/A23.2.

.2 Use procedures as reviewed by Departmental Representative or those noted in CSA A23.1/A23.2 to remove excess bleed water. Ensure surface is not damaged.

.3 Use curing compounds compatible with applied finish on concrete surfaces.

.4 Finish concrete floor to CSA A23.1/A23.2.Class A.

.5 Concrete floor to have finish hardness equal to or greater than Mohs hardness in accordance with CSA A23.1/A23.2.

.6 Provide hand screeded, scratch finish where floor tile is to be applied.

.7 Provide hand screeded, steel trowel finish, unless otherwise indicated.

.8 Rub exposed sharp edges of concrete with carborundum to produce 3 mm minimum radius edges unless otherwise indicated.

.7 Waterstops:

.1 Install waterstops to provide continuous water seal.

.2 Do not distort or pierce waterstop in way as to hamper performance.

.3 Do not displace reinforcement when installing waterstops.

.4 Use equipment to manufacturer's requirements to field splice waterstops.

.5 Tie waterstops rigidly in place.

.6 Use only straight heat sealed butt joints in field.

.7 Use factory welded corners and intersections unless otherwise approved by Departmental Representative.

.8 Joint fillers:

.1 Furnish filler for each joint in single piece for depth and width required for joint, unless otherwise authorized by Departmental Representative.

.2 When more than one piece is required for joint, fasten abutting ends and hold securely to shape by stapling or other positive fastening.

.3 Locate and form construction joints as indicated.

.4 Install joint filler.

.5 Use 12 mm thick joint filler to separate slabs on grade from vertical surfaces and extend joint filler from bottom of slab to within 12mm of finished slab surface unless otherwise indicated.

.9 Under-slab vapour barrier:

.1 Install vapour barrier membrane under concrete slabs-on-grade inside building.

.2 Lap vapour barrier minimum 150 mm at joints and seal.

.3 Seal punctures in vapour barrier before placing concrete.

.4 Use patching material at least 150 mm larger than puncture and seal.

3.3 SURFACE TOLERANCE

.1 Concrete tolerance to CSA A23.1 Straightedge Method to tolerance of 8mm in 3000mm.

3.4 FIELD QUALITY CONTROL

.1 Site tests: conduct tests as follows [in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.

.1 Concrete pours.

.2 Slump.

.3 Air content.

.4 Compressive strength at 7 and 28 days.

.5 Air and concrete temperature.

.2 Inspection and testing of concrete and concrete materials will be carried out by testing laboratory approved by Departmental Representative for review to CSA A23.1/A23.2.

.1 Ensure testing laboratory is certified to CSA A283.

.3 Ensure test results are distributed for review by the Departmental Representative.

.4 Contractor will retain testing laboratory and pay for costs of tests.

.5 Contractor will take additional test cylinders during cold weather concreting. Cure cylinders on job site under same conditions as concrete which they represent.

.6 Non-Destructive Methods for Testing Concrete: to CSA A23.1/A23.2.

.7 The inspection or testing noted above will not augment or replace Contractor quality control nor relieve Contractor of his contractual responsibility.

3.5 CLEANING

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

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

.1 Divert unused concrete materials from landfill to local facility or quarry after receipt of written approval from Departmental Representative.

.2 Provide appropriate area on job site where concrete trucks and be safely washed.

.3 Divert unused admixtures and additive materials (pigments, fibres) from landfill to official hazardous material collections site as approved by Departmental Representative.

.4 Do not dispose of unused admixtures and additive materials into sewer systems, into lakes, streams, onto ground or in other location where it will pose health or environmental hazard.

.5 Prevent admixtures and additive materials from entering drinking water supplies or streams.

.6 Using appropriate safety precautions, collect liquid or solidify liquid with inert, non-combustible material and remove for disposal.

.7 Dispose of waste in accordance with applicable local, Provincial/Territorial and National regulations.

END OF SECTION 03 30 00

PART 1 - GENERAL

1.1 RELATED WORK

.1	Concrete Formwork:	Section 03 10 00
.2	Cast-in-Place Concrete:	Section 03 30 00
.3	Painting:	Section 09 90 00

1.2 REFERENCES

.1 CAN/CSA-A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete.
.2 CAN/CGSB-25.20, Surface Sealer for Floors.
.3 The Master Painters Institute (MPI), Architectural Painting Specification Manual.
.4 American Concrete Institute ACI 303R, Guide to Cast-In-Place Architectural Concrete Practice.
.5 American Concrete Institute ACI 303.1, Standard Specification for Cast-In-Place Architectural Concrete.

1.3 SUBMITTALS

.1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
.2 Product Data
  .1 Provide manufacturer's printed product literature and data sheets for concrete finishes and include product characteristics, performance criteria, physical size, finish and limitations.
  .2 Include application instructions for concrete floor treatment.
  .3 Submit WHMIS MSDS - Material Safety Data Sheets for each product. Indicate VOC levels.

1.4 QUALITY ASSURANCE

.1 Standards: Conform to CAN/CSA-A23.1, for concrete finishes.
.2 Qualifications: Work shall be carried out by personnel having proven experience in this type of work in accordance with the drawings and specifications.

1.5 ENVIRONMENTAL REQUIREMENTS

.1 Temporary lighting:
  .1 Minimum 1200 W light source, placed 2.5 m above floor surface, for each 40 sq m of floor being treated.
.2 Electrical power:
  .1 Provide sufficient electrical power to operate equipment normally used during construction.
.3 Work area:
  .1 Make work area water tight protected against rain and detrimental weather conditions.
.4 Temperature:
  .1 Maintain ambient temperature of not less than 10 degrees C from 7 days before installation to at least 48 hours after completion of work and maintain relative humidity not higher than 40% during same period.
.5 Moisture:
  .1 Ensure concrete substrate is within moisture limits prescribed by flooring manufacturer.
.6 Safety:
  .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials.

.7 Ventilation:
.1 Departmental Representative will arrange for ventilation system to be operated during installation of concrete floor treatment materials. Ventilate area of work as directed by Departmental Representative by use of approved portable supply and exhaust fans.
.2 Ventilate enclosed spaces in accordance with Section 01 51 00 - Temporary Utilities.
.3 Provide continuous ventilation during and after coating application

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Deliver materials to site in containers sealed and labeled by manufacturers in accordance with Section 01 61 00 - Common Product Requirements.
.2 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding storage, handling and disposal of hazardous materials.
.3 Waste Management and Disposal:
.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Project Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Concrete materials shall conform to requirements of Section 03 30 00 - Cast-In-Place Concrete and CAN/CSA - A23.1.
.2 Bonding Agent: Formulated for bonding new concrete to cured concrete.
.3 Concrete Curing & Sealing Compound:
.1 Water clear, high gloss, non-yellowing, acrylic emulsion cure and seal.
.2 Cure and seal shall meet the moisture retention requirements of ASTM C309 Type 1, Clear.
.3 Acid resistant, adhesion-promoting qualities and UV light degradation properties of ASTM C1315 Type 1, Class A.
.4 Yield: 7.4 m^2/L.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verify that slab surfaces are ready to receive work recommended by manufacturer's written instructions.

3.2 PLAIN FLOOR FINISH (TROWELLED)

.1 Roll or tamp concrete to force coarse aggregate into concrete mix and then screed.
.2 Float surface with wood or metal floats or with power finishing machine and bring surface to true grade.
.3 Steel trowel to smooth and even surface.
.4 Follow with second steel trowelling to produce smooth burnished surface to within tolerance described in CAN/CSA-A23.1, Clause 22.1.3 - F-Number Method/Table 19 for Class B Finish Classification to all floors receiving carpet, resilient flooring. All other floors shall be finished to a Class A Finish Classification. Check conformance to tolerance limits within 72 hours of curing.
.5 Sprinkling of dry cement or dry cement and sand mixture over concrete surfaces is not acceptable.
.6 Apply curing compound in accordance with manufacturer's instructions to all areas not scheduled to receive further floor finish.
.7 Protect surfaces which will be exposed to direct sunlight during the curing period in accordance with manufacturer's instructions.

3.3 APPLICATION CURING/SEALING COMPOUNDS

.1 Apply only when air temperature is above 5ºC and tests show less than 5% moisture present on surfaces to be treated.
.2 Apply sealing and curing compound to concrete floors in accordance with manufacturer's directions using low pressure sprayer at a minimum application rate of 10 m^2 per litre for smooth steel trowelled surfaces and at 5 to 7.5 m^2 per litre for float or broom finished surfaces.

3.4 DEFECTIVE CONCRETE

.1 Repair honeycombing, rock pockets, chips, spalls, rain damaged areas and other voids in exposed concrete surfaces, using patching materials as specified to provide a smooth surface. Remove fins and other protrusions in concrete surfaces.
.2 Consult with Consultant on the repair of defective concrete surfaces prior to execution of the work.
.3 Patch form tie holes in all exposed concrete surfaces and surfaces designated to receive waterproofing.

3.5 PROTECTION

.1 Take every precaution to protect finished surfaces from stains and abrasions. Surfaces and edges likely to be damaged during the construction period shall be especially protected.
.2 Protect Work of other sections from damage resulting from Work of this Section.
.3 Provide suitable enclosures for collecting grit and dust from sandblasting operation.
.4 Erect barricades to prevent traffic on newly finished surfaces.

3.6 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Project Waste Management and Disposal.

3.7 ADJUSTING & CLEANING

.1 At completion and during progress of the Work maintain premises in a neat and orderly manner. Rubbish and debris resulting from work of this Section shall be collected regularly, and removed from the project site and disposed of.
.2 Repair, remove and clean all drips or smears resulting from the work of this section on exposed, finished surfaces or surfaces to be subsequently finished.

END OF SECTION 03 35 00

PART 1 - GENERAL

1.1 RELATED WORK

.1	Metal Doors and Frames:	Section 08 10 00
.2	Aluminum Glazed Sectional Doors:	Section 08 36 13
.3	Non-Structural Metal Framing:	Section 09 22 16
.4	Painting:	Section 09 90 00

1.2 REFERENCE STANDARDS

.1 ASTM A53/A53M, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
.2 ASTM A307, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.
.3 CAN/CGSB-1.40, Anti-Corrosive Structural Steel Alkyd Primer.
.4 CAN/CGSB-1.108, Bituminous Solvent Type Paint.
.5 CAN/CGSB-1.181, Ready-Mixed, Organic Zinc-Rich Coating.
.6 CAN/CSA-G40.20-G40.21, General Requirements for Rolled or Welded Structural Quality Steel.
.7 CAN/CSA-G164 Hot Dip Galvanizing of Irregularly Shaped Articles.
.8 CAN/CSA-S16.1, Limit States Design of Steel Structures.
.9 CSA W59, Welded Steel Construction (Metal Arc Welding).
.10 CSA W48-01, Filler Metals and Allied Materials for Metal Arc Welding
.11 The Society of Protective Coatings (SSPC)
.12 CCD-047a-98, Paints, Surface Coatings.
.13 CCD-048-98, Surface Coatings - Recycled Water-borne.
.14 British Columbia Building Code (BCBC).
.15 Master Painters Institute Green Performance Standard GPS-1-08

1.3 SUBMITTALS

.1 Shop Drawings
  .1 Prepare shop drawings by, or under the direct supervision of, a Registered Professional licenced in the Province of British Columbia.
  .2 Submit shop drawings in accordance with Section 01 33 00.
  .3 Indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details and accessories.
  .4 Submit railing shop drawings under seal of qualified Registered Professional licensed in British Columbia, certifying compliance with lateral loading design requirements.
.2 Letters of Assurance
  .1 The Supporting Registered Professional responsible for sealing engineered shop drawings shall submit to the Registered Professional of Record, AIBC/APEGBC Schedule S-B Assurance of Professional Design and Commitment for Field Review with the shop drawings.
  .2 The Supporting Registered Professional shall provide field review of the installation and submit to the Registered Professional of Record, AIBC/APEGBC Schedule S-C Assurance of Professional Field Review and Compliance upon completion of the Work.
.3 Record Drawings (As-builts)
  .1 Submit record drawings (as-builts) in accordance with Section 01 33 00.
  .2 Submit shop paint primer manufacturer's product data verifying compliance with MPI Green Performance Standard GPS-1-08, for VOC content.

1.4 DELIVERY, STORAGE AND HANDLING

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

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

.3 Storage and Handling Requirements:

.1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.5 PROJECT CONDITIONS

.1 Field Measurements: Check actual locations of walls and other construction to which metal fabrications must fit, by accurate field measurements before fabrication; show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of work.

.2 Where field measurements cannot be made without delaying the work, guarantee dimensions and proceed with fabrication of products without field measurements. Coordinate construction to ensure that actual opening dimensions correspond to guaranteed dimensions. Allow for trimming and fitting.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Metal Surfaces, General: Form metal fabrications exposed to view upon completion of the work, provide materials selected for their surface flatness, smoothness, and freedom from surface blemishes. Do not use materials whose exposed surfaces exhibit pitting, seam marks, roller marks, rolled trade names, roughness, and, for steel sheet, variations in flatness exceeding those permitted by referenced standards for stretcher-leveled sheet.

.2 Miscellaneous steel: to ASTM A36/A36M or to CAN/CSA-G40.20 and CAN/CSA-G40.21, 300W yield strength.

.3 Structural steel: to ASTM A36/A36M or to CAN/CSA-G40.20 and CAN/CSA-G40.21, 350W yield strength.

.4 Steel sections and plates: to CAN/CSA-G40.21 Grade 300W.

.5 Steel pipe: to ASTM A53 standard weight black and galvanized finish.

.6 Steel angles: galvanized, sizes indicated for openings.

.7 Welding materials: to CSA W59.

.8 Shop primer: to suit exposure location and material and of a type as specified for such work within Painting specification Section 09 90 00. Where non-complying primers are used this section of work shall completely remove same from all surfaces and prepare and prime surfaces in accordance with the requirements of Section 09 90 00 for painted steel work at no additional cost to the Owner.

.9 Galvanizing: hot dipped galvanizing with minimum zinc coating of 600 g/m^2 to CSA G164.

.10 Galvanize touch-up primer: zinc rich, organic, ready mixed type to CAN/CGSB-1.181.

.11 Isolation Coating: alkali resistant bituminous paint to CAN/CGSB-1.108.

2.2 GROUT

.1 Non-Shrink Grout: Premixed, factory packaged, non-ferrous aggregate, non-staining, shrinkage resistant, non-corrosive, non-gaseous, ASTM C1107.

.1 Minimum Strength at 28 Days: 5000 PSI.

2.3 ANCHORS

.1 Flush or Shield Type Expansion Anchor Sleeve:

.1 Size: As indicated on Drawings.
.2 Finish: Zinc plated.

2.4 FASTENERS

.1 General: Provide zinc-coated fasteners for exterior use or where built into exterior walls. Select fasteners for type, grade and class required.
.2 Bolts and Nuts: Regular hexagon head type, ASTM A307, Grade A.
.3 Lag Bolts: Square head type, FS FF-B-561.
.4 Machine Screws: Cadmium plated steel, FS FF-S-92.
.5 Plain Washers: Round, carbon steel, FS FF-W-92.
.6 Toggle Bolts: Tumble-wing type, FS FF-B-588, type, class and style as required.
.7 Lock Washers: Helical spring type carbon steel, FS FF-W-84.

2.5 FABRICATION

.1 Build items square, true, straight and accurate to required size, with joints fitted closely and secured properly.
.2 Fabricate items from steel and use galvanized steel for exterior items, unless indicated otherwise.
.3 Use self-tapping shake-proof countersunk flat headed screws on items requiring assembly by screws or as indicated. Use security screws in all exposed locations.
.4 Where possible, fit and shop assemble items, ready for erection.
.5 Ensure exposed welds are continuous and non-porous for length of each joint. File or grind exposed welds smooth and flush.

2.6 STEEL PIPE GUARDRAILS AND HANDRAILS

.1 General: Fabricate pipe handrails to comply with reviewed shop drawings and requirements indicated for dimensions, details, finish, and member sizes, including wall thickness of pipe, post spacings, and anchorage.
.2 Interconnect guardrails and handrail members by butt-welding or welding with internal connectors, at fabricator's option, unless otherwise indicated.
.3 At tee and cross intersections, cope ends of intersecting members to fit contour of pipe to which end is joined, weld all around and grind smooth.
.4 Form changes in directions of railing members as follows:
  .1 By use of welded prefabricated steel elbow fittings.
  .2 By bending, of radius indicated.
  .3 By mitering at elbow bends.
.5 Form simple and compound curves by bending pipe in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross-section of pipe throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of pipe.
.6 Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated.
.7 Close exposed ends of pipe by welding 4.8 mm thick steel plate in place or by use of prefabricated fittings, except where clearance of end of pipe and adjoining wall surface is 6.4 mm or less.
.8 Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnections of pipe and attachment of guardrails and handrails to other work. Furnish inserts and other anchorage devices for connecting guardrails and handrails to concrete or masonry work.
  .1 Backing: Provide steel sheet or plate backing of thickness and size indicated or required to support structural loads of handrails where needed to transfer wall bracket loads through wall finishes to structural supports. Size to suit wall finish thicknesses. Size to produce adequate bearing to prevent bracket rotation and overstressing of substrate.

2.7 OVERHEAD DOOR FRAME

.1 Fabricate and install overhead door frame as detailed on the drawings and reviewed shop drawings.
.2 Fabricate and install for openings at locations indicated.
.3 Fabricate and install to withstand all superimposed loading.
.4 Fabricate and install of sizes indicated and for attachment to adjacent structure.

2.8 PIPE BOLLARDS

.1 Fixed Pipe Bollard: Standard weight Schedule 40 steel pipe, ASTM A53, sizes as indicated
.2 For bollards with concrete fill: 3000 PSI, air-entrained concrete.
.3 Concrete Foundation: 3000 PSI, air-entrained concrete.

2.9 CLEANING OF STEEL SURFACES

.1 Thoroughly clean all steel surfaces after fabrication and prior to galvanizing, priming and/or painting or pre-painting in strict accordance with The Society of Protective Coatings (SSPC) and Section 09 90 00 requirements.
.2 Remove all oil, grease and other foreign matter from surfaces and solvent wash in accordance with SSPC 1 and SSPC 2 requirements.
.3 Clean steel work to be painted in accordance with the requirements of Section 09 90 00 and minimum SSPC 6 (abrasive blast) cleaning specifications.

2.10 GALVANIZING

.1 Items designated on the drawings as galvanized including all connecting materials, exterior steel and interior steel in high humidity locations shall be hot-dipped galvanized as specified herein.
.2 Hot dip galvanize all such items after fabrication as specified herein.
.3 Locate galvanizing drain/vent holes such that all holes will be to underside of installed item in final position.
.4 After steel is erected or welded, any damage to galvanizing shall be made good by applying two coats of specified zinc rich paint in accordance with manufacturer's specifications.

2.11 PRIMING

.1 Shop prime all steel surfaces, except stainless steel, aluminum, and those surfaces to be galvanized or which are encased in concrete, after fabrication and cleaning.
.2 Use primer unadulterated and apply on clean dry surfaces, within manufacturer’s temperature application requirements.
.3 Apply a minimum of (1) one coat of primer thoroughly and evenly, worked well into joints and open spaces to a minimum dry film thickness of 0.08 mm.
.4 Provide a field touch up coat of primer to all surfaces that have been scraped or chipped after erection and after connections are completed.
.5 Thoroughly coat the heads of all bolts previously set in concrete with two (2) coats of specified zinc rich paint after nuts and washers are in place.
.6 Bolts, nuts and other threaded fasteners and their accessories such as washers, shall have heavy galvanized finish.
.7 Coat surfaces next to concrete and masonry with two coats of isolation coating.

PART 3 - EXECUTION

3.1 EXAMINATION

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

manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative.
.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION, GENERAL

.1 Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction; include threaded fasteners for concrete inserts, toggle bolts, through-bolts, lag bolts and other connectors as required.
.2 Cutting, Fitting and Placement: Perform cutting, drilling, and fitting required for installation of miscellaneous metal fabrications. Set metal fabrication accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
.3 Provide temporary bracing or anchors in formwork for items that are to be built into concrete or similar construction.
.4 Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints, but cannot be shop-welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units which have been hot-dip galvanized after fabrication, and are intended for bolted or screwed field connections.
.5 Field welding:
  .1 Make field connections with high tensile bolts or weld to CAN/CSA-S16.1. appearance and quality of welds made, methods used in correcting welding work, and the following:
  .2 Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  .3 Obtain fusion without undercut or overlap.
  .4 Remove welding flux immediately.
  .5 At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing and contour of welded surfaces matches those adjacent.
.6 Grout: Follow manufacturer's recommendations for substrate preparation and application.
.7 Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, or dissimilar metals with a heavy coat of bituminous paint.
.8 Touch up rivets, field welds, bolts and burnt or scratched surfaces after completion of erection using primer.
.9 Touch up galvanized surfaces with zinc rich primer where burned by field welding.
.10 Miscellaneous metal items which will be exposed to view in the completed building shall have smooth, high quality finish.

3.3 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Waste Management and Disposal.

3.4 ITEMS

.1 Provide and install all non-structural metal fabrication items.

END OF SECTION 05 50 00

PART 1 - GENERAL

1.1 RELATED WORK

.1	Glazing:	Section 08 80 00
.2	Toilet and Bath Accessories:	Section 10 28 00
.3	Plumbing:	Division 22
.4	HVAC:	Division 25
.5	Electrical:	Division 26

1.2 REFERENCE STANDARD

- .1 Architectural Woodwork Manufacturers Association of Canada (AWMAC) and Architectural Woodwork Institute (AWI)
  - .1 Architectural Woodwork Standards.
- .2 American National Standards Institute (ANSI)
  - .1 ANSI A208.2, Medium Density Fiberboard (MDF) for Interior Applications.
- .3 American Society for Testing and Materials (ASTM)
  - .1 ASTM E1333, Standard Test Method for Determining Formaldehyde Concentrations in Air and Emission Rates From Wood Products Using a Large Chamber.
- .4 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-71.20, Adhesive, Contact, Brushable.
- .5 Canadian Standards Association (CSA)
  - .1 CSA B111, Wire Nails, Spikes and Staples.
  - .2 CSA O112.4, Standards for Wood Adhesives.
  - .3 CSA O121, Douglas Fir Plywood.
  - .4 CSA O141, Softwood Lumber.
  - .5 CSA O151, Canadian Softwood Plywood.
  - .6 CSA O153, Poplar Plywood.
- .6 National Lumber Grades Authority (NLGA)
  - .1 Standard Grading Rules for Canadian Lumber.
- .7 National Electrical Manufacturers Association (NEMA)
  - .1 ANSI/NEMA LD-3-05, High-Pressure Decorative Laminates (HPDL).

1.3 QUALITY ASSURANCE

- .1 Do cabinet and casework in accordance with Architectural Woodwork Standards (AWS) of the Architectural Woodwork Institute (AWI), Woodwork Institute (WI) and Architectural Woodwork Manufacturers Association of Canada (AWMAC).

1.4 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for architectural woodwork and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit two copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .3 Samples
  - .1 Submit samples of cabinet hardware upon request of Consultant.
  - .2 Submit duplicate samples of laminated plastic for colour selection.
  - .3 Approved samples will become standard for cabinets and casework installed on site and may form part of Work.

.4 Shop Drawings
.1 Submit shop drawings, indicate locations of all service outlets in casework; typical and special installation conditions; all connections, attachments, anchorage and locations of exposed fastenings.

1.5 MOCK-UPS

.1 Shop prepare one base cabinet unit, wall cabinet, counter top, shelving unit, complete with hardware and shop applied finishes, and install on project in designated location.
.2 Allow 24 hours for inspection of mock-up by Departmental Representative before proceeding with this work.
.3 When accepted, mock-up will demonstrate minimum standard for this work. Mock-up may remain as part of finished work.

1.6 GUARANTEE

.1 Provide 2 Year AWMAC Guarantee Certificate or equivalent Maintenance Bond, to the full value of the Architectural Woodwork sub-contract, certifying that the Architectural Woodwork has been manufactured and/or installed in accordance with the standards incorporated in the Architectural Woodwork Quality Standards Illustrated.
.2 The guarantee shall cover replacing, reworking and/or 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 year period following the date of Substantial Performance

1.7 INSPECTION

.1 Provide and pay for AWMAC BC Inspection for both maintenance bond and guarantee.
.2 Shop drawings shall be submitted for review before any work is commenced.

1.8 COOPERATION

.1 Cooperate with other trades and do all cutting, trimming etc in order to accommodate the work of others.
.2 Coordinate and sequence installation with Mechanical and Electrical for plumbing and electrical work.

1.9 WASTE MANAGEMENT AND DISPOSAL

.1 Remove from site and dispose of packaging materials at appropriate recycling facilities.
.2 Collect and separate for disposal packaging material in appropriate on-site bins for recycling.
.3 Dispose of unused finish and adhesive materials at hazardous material collections site.
.4 Do not dispose of unused finish and adhesive materials into sewer system, into streams, lakes, onto ground or in other locations where it will pose health or environmental hazard.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Plywood core: to CSA O153 S2S, Grade Popular Plywood, 19 mm thick.
.2 High Pressure Decorative Laminate (HPDL): to CAN3-A172 or National Electric Manufacturers Association (NEMA)LD 3; of grades, types and thicknesses listed below.
.1 (HGS) Horizontal General Purpose Standard Grade and Chemical Resistant: 1.22 mm in thickness. Flame retardant where required to CAN/ULC S-102 shall have a Flame Spread Classification UL/ULC Class I or A .
.2 (HGP) Horizontal General Purpose Postformable Grade: 1.07 mm in thickness.
.3 (VGS) Vertical General Purpose Standard Grade: be 0.71 mm in thickness.

.4 (CLS) Cabinet Liner Standard Grade: 0.51 mm in thickness.
.5 (BK) Backing Sheet 0.51 mm in thickness. Backing sheets shall be provided for all laminated casework components where plastic laminate finish is applied to only one surface of the component substrate

.3 Adhesive for Bonding Plastic Laminate: Waterbase contact cement. Toxicity/IEQ: Comply with applicable regulations regarding toxic and hazardous materials, GS-36 for Commercial Adhesive, South Coast Air Quality Management District Rule 1168.

.4 Homogeneous quartz surfaces material.:
.1 Description: comprised of reacted monomers and resins, natural quartz particles, and colourants; meeting following.
.1 Flexural Strength: >5,300 psi to ASTM D 790
.2 Flexural Modulus: 5.3-5.7E6 psi to ASTM D 790
.3 Flexural Elongation:>0.1% to ASTM D 790
.4 Compression Strength (Dry): ~27,000 psi to ASTM C 170
.5 Compression Strength (Wet): ~24,000 psi to ASTM C 170
.6 Hardness: 7 to Mohs' Hardness Scale
.7 Thermal Expansion: 1.45 x 10-5 in./in./°C to ASTM D 696
.8 Gloss (60° Gardner): 45-50 to ANSI Z 124
.9 Colourfastness: Pass ANSI Z 124.6.5.1
.10 Wear and Cleanability: Pass ANSI Z 124.6.5.3
.11 Stain Resistance: Pass ANSI Z 124.6

.2 Joint adhesives: types recommended by quartz material manufacturer.
.3 Sealant: CGSB 19-GP-22M silicone in accordance with Section 07 90 00.
.4 Plywood: type and grade recommended by quartz material manufacturer to support components.

2.2 CASEWORK

.1 Casework: (HPDL)
.1 AWS quality grade: Custom.
.2 Construction: Flush Overlay in accordance with AWS Section 10, and as detailed.
.3 Core: veneer core plywood, S2S, Grade Popular Plywood, 19 mm thick.
.4 Exposed parts:
.1 Countertops: (HGS) Horizontal General purpose Standard Grade.
.2 Vertical surfaces: Vertical General Purpose Standard (VGS) Grade.
.5 Semi-exposed parts:
.1 Face veneer: Cabinet Liner Standard (CLS) Grade.
.6 Concealed surfaces:
.1 Backing Sheet (BK) Grade.

2.3 CASEWORK DOORS AND DRAWERS

.1 AWS quality grade: Custom.
.2 Construction (HPDL): to match casework with box style drawers with flush overlay applied fronts in accordance with AWS Section 10.
.1 Applied fronts: Vertical General Purpose Standard (VGS) Grade on minimum 19 mm MDF in accordance with AWS Section 4.
.2 Sides, backs, fronts: Cabinet Liner Standard (CLS) Grade HPDL on minimum 12 mm thick veneer core plywood
.3 Bottoms: Cabinet Liner Standard (CLS) Grade HPDL on minimum 6 mm thick veneer core plywood.

2.4 EDGE BANDING

.1 Band all exposed and semi-exposed plywood edges (drawer fronts, casework doors, gables,

shelves and exposed panels), using 3 mm rigid PVC accent edge. Colour as selected from the manufacturer's complete range, allow for a minimum of three colours.

2.5 EDGE BANDING COUNTERTOPS

.1 Provide thermoplastic edge banding to plastic laminate countertop edges as detailed.
  .1 Edge banding: wood tape rigid PVC accent edge, 5 mm thick, custom colour, allow for a minimum of three colours.
  .2 Install with hot melt glue on edge banding machine as per manufacturers instructions, finish with round edges.

2.6 CASEWORK HARDWARE

.1 Cabinet door hinges:, 170 degree swing opening, all metal, full and half overlay 4 way adjustment, spring loaded for closure, two per door. Grass 3000 Series, Blum Clip Style. Coordinate keying requirements with building masterkey system.
.2 Cabinet door, drawer pulls: D pulls, nominal 191 mm,. Richelieu BP8160160195 stainless steel.
.3 Cabinet door/drawer locks: drawer locks Olympus 600 DW series. Door locks Olympus 500 DR series.
.4 Magnetic catches: Knape & Vogt 918ALUM.
.5 Drawer slides: Drawer slides: side-mounted, full-extension, self-closing, epoxy-coated steel drawer slides, load rated 68 kg: Knape & Vogt #8400 or Accuride 3832.
.6 Adjustable shelf hardware: wood shelves.
  .1 Standards: Knape & Vogt 255ZC surface mounted standards.
  .2 Shelf rests: Knape & Vogt 256ZC.
.7 Cable entry plugs (grommets): supply one of each of Richelieu 600 90 and 16576 90, per 900 mm of countertop length (other than for counters with sinks) and install where directed on site.
.8 Provide clear silicone self-adhesive bumpers, two per door and drawer. Provide colour-coordinated plastic screw caps on countersunk screws.

2.7 SEALANTS

.1 Silicone, one part, containing anti-fungicide properties. Colours: to match plastic laminate or clear.
  .1 Approved product: Sanitary 1700 sealant by GE Silicones.
.2 CAN/CGSB 19.17, acrylic emulsion base.
  .1 Approved product: Tremflex 834 sealant by Tremco Ltd.

2.8 FABRICATION

.1 Fabricate to AWMAC Custom Grade requirements and arrangements indicated.
.2 Shop install cabinet hardware for doors, shelves and drawers. Key cabinets to Owners requirements.
.3 Surface mount shelf standards, unless noted otherwise. Notch shelves to fit around surface mounted shelf standards, for seismic restraint of shelving.
.4 Make all cabinet shelving adjustable, unless noted otherwise.
.5 Provide cut-outs for plumbing fixtures, inserts, appliances, outlet boxes and other fixtures.
.6 Shop assemble work for delivery to site in size easily handled and to ensure passage through building openings.
.7 Shop finish casework ready for installation. Limit on site finishing to touch-up and to site fabricated/fitted items where shop finishing impractical.
.8 Install cabinet glazing. Provide glass for shelves and sliding doors.

2.9 QUARTZ SURFACING FABRICATION

.1 Shop fabricate plywood support framework and quartz surfacing components.

.2 Provide components of longest practical lengths, complete with integral support and fixing flanges.
.3 Form joints between components using manufacturer's joint adhesives, without conspicuous seams.
.4 Provide cut-outs required to accept basins.
.5 Route radii and contours to template. Smooth and polish sharp edges.
.6 Fabricate components with invisible joints and seams.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install casework in accordance with Architectural Woodwork Standards.
.2 Apply small bead of silicone sealant at junction of laminated plastic counter and backsplash and between backsplash and adjacent wall finish.
.3 Apply a small bead of acrylic sealant around the perimeter of the casework and adjacent wall finish.

END OF SECTION 06 40 00

PART 1 - GENERAL

1.1 RELATED WORK

.1 Gypsum Board: Section 09 29 00

1.2 REFERENCES

.1 ASTM D 5319 - Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels.
.2 ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

1.3 SUBMITTALS

.1 Product Data: Submit sufficient manufacturer's data to indicate compliance with these specifications, including:
  .1 Preparation instructions and recommendations.
  .2 Storage and handling requirements and recommendations.
  .3 Installation methods.
.2 Selection Samples: Submit manufacturer's standard color pattern selection samples representing manufacturer's full range of available colors and patterns.
.3 Samples for Verification: Submit appropriate section of panel for each finish selected indicating the colour, texture, and pattern required.
  .1 Submit complete with specified applied finish.
  .2 Exposed Molding and Trim: Provide samples of each type, finish, and colour.
.4 Manufacturers Material Safety Data Sheets (MSDS) for adhesives, sealants and other pertinent materials prior to their delivery to the site
.5 Provide maintenance data for panels for incorporation into maintenance manual.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver materials factory packaged on strong pallets.
.2 Store panels and trim lying flat, under cover and protected from the elements. Allow panels to acclimate to room temperature 21°C for 48 hours prior to installation.

1.5 PROJECT CONDITIONS

.1 Environmental Limitations: Building are to be fully enclosed prior to installation with sufficient heat 21° C and ventilation consistent with good working conditions for finish work
.2 During installation and for not less than 48 hours before, maintain an ambient temperature and relative humidity within limits required by type of adhesive used and recommendation of adhesive manufacturer.
.3 Provide ventilation to disperse fumes during application of adhesive as recommended by the adhesive manufacturer.

1.6 WARRANTY

.1 Furnish one year guarantee against defects in material and workmanship.

PART 2 - PRODUCTS

2.1 MATERIAL

.1 Panels: Fiberglass reinforced thermosetting polyester resin panel sheets complying with ASTM D 5319.
  .1 Coating: Multi-layer print, primer and finish coats or applied over-layer.

.2 Dimensions: 2.29 mm thick x 4' x 8'.
.3 Back Surface: Smooth.
.4 Front Finish: Pebbled
.5 Fire Rating: Class A
.6 Colour: White

.2 Trim:
.1 PVC Trim: Thin-wall semi-rigid extruded PVC.
.2 Provide inside Corner, Outside Corner, Edge,
.3 Colour: White

2.2 ACCESSORIES

.1 Fasteners: Non-staining nylon drive rivets. Match panel colour.
.2 Adhesive: Water- resistant, non-flammable adhesive or flexible, water-resistant, solvent based adhesive, formulated for fast, easy application.
.3 Sealant: as recommended by manufacturer,

PART 3 - EXECUTION

3.1 PREPARATION

.1 Examine backup surfaces to determine that corners are plumb and straight, surfaces are smooth, uniform, clean and free from foreign matter, nails countersunk, joints and cracks filled flush and smooth with the adjoining surface.
.2 Repair defects prior to installation. Level wall surfaces to panel manufacturer's requirements. Remove protrusions and fill indentations

3.2 INSTALLATION

.1 Install panels in accordance with panel manufacturer's directions.
.2 Install inside and outside corner trim using 1 continuous length for each location.
.3 Remove adhesive smears, residue and hand marks.

END OF SECTION 06 82 00

PART 1 - GENERAL

1.1 RELATED WORK

.1	Cast-in-Place Concrete:	Section 03 30 00.
.2	Sheet Metal Flashing and Trim:	Section 07 62 00

1.2 REFERENCE STANDARDS

.1 CGSB 37-GP-11M: Application of Cutback Asphalt Plastic Cement.
.2 CGSB 37-GP-15M: Application of Asphalt Primer for Asphalt Roofing, Dampproofing and Water Proofing .
.3 CGSB 37-GP-36M: Application of Filled Cutback Asphalts for Dampproofing and Waterproofing
.4 CAN/CGSB-37.2: Emulsified Asphalt, Mineral-Colloid Type, Unfilled, for Dampproofing and Waterproofing and For Roof Coating
.5 CAN/CGSB-37.3: Application of Emulsified Asphalts for Dampproofing or Waterproofing
.6 CAN/CGSB-37.5: Cutback Asphalt Plastic Cement.
.7 CAN/CGSB-37.9M: Primer, Asphalt, Unfilled for Asphalt Roofing, Dampproofing and Waterproofing
.8 CAN/CGSB-37.16: Filled, Cutback Asphalt for Dampproofing and Waterproofing

1.3 SUBMITTALS

.1 Submit product data sheets for bituminous dampproofing products in accordance with Section 01 33 00. Including:
  .1 Product characteristics.
  .2 Performance criteria.
  .3 Application methods.
  .4 Limitations.
  .5 Manufacturer's Instructions: Provide to indicate special handling criteria, installation sequence, cleaning procedures.
.2 Test Reports: Evaluation service reports or other independent testing agency reports showing compliance with specified requirements.
.3 Provide two copies of MSDS for all products and indicate VOC content.

1.4 QUALITY ASSURANCE

.1 Installer Qualifications: Company specializing in performing work of this type and approved by the membrane manufacturer.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, handle, store and protect materials of this section in accordance with Section 01 60 00 - Materials and Equipment.
.2 Provide and maintain dry, off-ground weatherproof storage.
.3 Store materials on supports to prevent deformation.
.4 Remove only in quantities required for same day use.
.5 Store materials in accordance with manufacturer's written instructions.

1.6 ENVIRONMENTAL REQUIREMENTS

.1 Temperature, relative humidity, moisture content.
  .1 Apply dampproofing materials only when surfaces and ambient temperatures are within manufacturers' prescribed limits.
  .2 Do not proceed with Work when wind chill effect would tend to set bitumen before proper curing takes place.

.3 Maintain air temperature and substrate temperature at dampproofing installation area above 5°C for 24 hours before, during and 24 hours after installation.
.4 Do not apply dampproofing in wet weather.

.2 Safety: Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of asphalt, sealing compounds, primers and caulking materials.

PART 2 - PRODUCTS

2.1 DAMPROOFING MATERIALS

.1 For application and curing at temperatures above 5 degrees C: waterproof emulsion, mineral colloid emulsifier type to CAN/CGSB 37.2.
.1 Package label or bill of lading for bulk hot liquid asphalt must indicate type, flash point, equiviscous temperature range and final blowing temperature.

.2 For applications and curing at temperatures above 0 degrees C but below 5 degrees C: solvent type waterproofing and dampproofing compound of selected asphalts and fibers to CAN/CGSB 37.16.
.1 Package label or bill of lading for bulk hot liquid asphalt must indicate type, flash point, equiviscous temperature range and final blowing temperature.

.3 Primer: as recommended by manufacturer.
.4 Sealing compound: plastic cutback asphalt cement to CAN/CGSB-37.5. C.

2.2 INSULATION

.1 Vertical foundation walls. Rigid Type 4 extruded closed cell polystyrene to CAN/ULC-S701 with maximum water absorption of 0.7% in accordance with ASTM D2842 and a minimum 5 year aged thermal resistance value of RSI 0.87 (R 5) per 25 mm (1") of thickness, 210 kPa (30 psi), butt and shiplap edges as required.

2.3 COMPATIBILITY

.1 Ensure that all materials used are compatible where dampproofing is in contact with insulation.
.2 Provide proof of compatibility upon request of Consultant.

PART 3 - EXECUTION

3.1 PREPARATION

.1 Before applying dampproofing, seal with sealing compound:
.1 exterior joints between foundation walls and footings,
.2 joints between concrete ground seal and foundation and
.3 around penetrations through damproofing.

3.2 APPLICATION DAMPROOFING

.1 Do dampproofing in accordance with CAN/CGSB 37.3 and CGSB 37-GP-36M except where specified otherwise.
.2 Do sealing work in accordance with CGSB 37-GP-11M except where specified otherwise.
.3 Do priming of surface in accordance with CGSB 37-GP-15M except where specified otherwise.
.4 Apply primer.
.5 Apply continuous, uniform coating to faces of exterior foundation walls from 50 mm below finished grade level down to and including tops of foundation wall footings.
.6 Apply 2 additional coats to vertical corners and construction joints for a minimum width of 230 mm on each side, and all around and for 230 mm along pipes passing through walls.

3.3 APPLICATION INSULATION

.1 Install insulation to maintain continuity of thermal protection of building elements and spaces.
.2 Fit insulation tight around electrical boxes, pipes, ducts, frames and other objects in or passing through insulation.
.3 Do not use broken, crushed or chipped boards.
.4 Protect plastic insulations from sunlight exposure.

3.4 PROTECTION

.1 Do not leave installed membrane exposed to sunlight for more than 30 days after installation; cover with insulation.
.2 Prior to backfilling, inspect membrane for damage and repair.
.3 Take care when backfilling to avoid damage to insulation; replace insulation damaged during backfilling.
.4 Protect installed products until completion of project.
.5 Touch-up, repair or replace damaged products before Substantial Completion

END OF SECTION 07 11 13

PART 1 - GENERAL

1.1 REFERENCE

.1 CAN/ULC-705.1: Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density, Material Specification.
.2 CAN/ULC-S705.2: Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density, Installer's Responsibilities - Specification.
.3 CAN/ULC-S101: Fire Endurance Tests of Building Construction and Materials.
.4 CAN/ULC-S102: Surface Burning Characteristics of Building Materials and Assemblies
.5 ASTM E84: Standard Test Method for Surface Burning Characteristics of Building Materials.

1.2 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 21 - Waste Management and Disposal.
.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
.3 Collect and separate for disposal paper, steel strapping, plastic, polystyrene, corrugated cardboard packaging material in appropriate on site bins for recycling in accordance with Waste Management Plan.
.4 Divert waste materials from landfill to approved recycling facility.

1.3 QUALITY ASSURANCE

.1 Insulation: use experienced applicators trained and approved by insulation manufacturer, who are members of Canadian Urethane Foam Contractors Association Inc. (CUFCA).
.2 Tests shall be conducted daily on both core density and cohesion/adhesion to the substrate, following procedures established by CUFCA/NECA.

1.4 TEST REPORTS

.1 Submit product information and test reports in accordance with Section 01 33 00.
.2 Insulation: submit product data on insulation proposed for use on this project.

1.5 PROTECTION

.1 Ventilate areas to receive insulation and by introducing fresh air and exhausting air continuously during and 24 hours after application to maintain non-toxic, unpolluted, safe working conditions.
.2 Provide temporary enclosures to prevent spray and noxious vapours from contaminating air beyond application area.
.3 Protect workers as recommended by insulation manufacturers.
.4 Protect adjacent surfaces and equipment from damage by overspray, fall-out and dusting of insulation materials.
.5 Dispose of waste insulation material daily in safe manner and decontaminate empty drums, both in accordance with health and environment regulations.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Sprayed polyurethane foam material, when tested, shall meet the requirements of CAN/ULC S705.1 Standard for Thermal Insulation-Spray Applied Rigid Polyurethane Foam, Medium Density, Material- Specification, with the following physical properties:
    .1 Density minimum: 1.9 lb/ft.3
    .2 Compressive strength, parallel to rise (10% compression): 32 psi.
    .3 Tensile strength: 49 psi.

.4 Open cell content: <1%
.5 Water absorption % by volume: 2.5%
.6 Water vapour permeance, without the skins, core only: 125 ng/Pa.s.m²
.7 Flame spread classification: 375
.8 Smoke determined: 288

.2 Prime substrate when required by spray polyurethane manufacturer. The type of primer and the installation of the primer shall follow the requirements of the manufacturer for the surface conditions.

PART 3 - EXECUTION

3.1 PROTECTION

.1 Mask and cover adjacent areas to protect from over spray.
.2 Ensure any required foam stop or back up material are in place to prevent over spray and achieve complete seal.

3.2 PREPARATION

.1 The substrate being sprayed should have no traces of oil, grease, wax, rust, oxidization, dirt, or water. Apply primer in order to promote adhesion of the foam as required.
.2 Surface temperature shall be minimum 21°C. Water (in the form of rain, fog, condensation, etc.) reacts with the isocyanate and will affect the foam and the product's properties, particularly its adhesive qualities, protect the work area against rain, snow, dew, etc. The foam shall not be sprayed when relative humidity is higher than 80%, as this will also affect the properties of the foam.
.3 Cold weather applications: prior to applying sprayed insulation in cold weather, notify the Departmental Representative. Insulation shall not be applied until proper precautions have been taken to prevent inadequate adhesion to the substrate and complete curing of the spray foam.

3.3 APPLICATION

.1 Apply insulation to clean surfaces in accordance with CAN/ULC-705.2 and manufacturer's directions to seal junctions of building components against thermal and air leakage.
.2 Apply only when surfaces and environmental conditions are within limits prescribed by the material manufacturer and the CAN/ULC S705.2-05 Installation standard.
.3 Apply in consecutive passes as recommended by manufacturer to thickness as indicated on drawings.
.4 Finished surface of foam insulation to be free of voids and imbedded foreign objects.
.5 Remove masking materials and over spray from adjacent areas immediately after foam surface has hardened. Ensure cleaning methods do not damage work performed by other sections.
.6 Trim, as required, any excess thickness that would interfere with the cladding/covering system by other trades.

END OF SECTION 07 21 19

PART 1 - GENERAL

1.1 RELATED WORK

.1	Insulated Metal Wall Panels:	Section 07 42 13
.2	Joint Protection:	Section 07 90 00
.3	Metal Building Systems:	Section 13 34 19

1.2 REFERENCES

.1 American Society for Testing and Materials International, (ASTM).
- .1 ASTM A792; Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
- .2 ASTM B117; Standard Practice for Operating Salt Spray (Fog) Apparatus
- .3 ASTM C518: Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
- .4 ASTM D523; Standard Test Method for Specular Gloss
- .5 ASTM D522; Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings
- .6 ASTM D714; Standard Test Method for Evaluating Degree of Blistering of Paints
- .7 ASTM D968; Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive
- .8 ASTM D1308; Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes
- .9 ASTM D2244; Standard practice for Calculation of Colour Tolerances and Colour Differences from Instrumentally Measured Colour Coordinates
- .10 ASTM D2247; Standard Practice for Testing Water Resistance of Coatings in 100 percent Relative Humidity
- .11 ASTM D2794; Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
- .12 ASTM D3359; Standard Test Methods for Measuring Adhesion by Tape Test
- .13 ASTM D3363; Standard Test Method for Film Hardness by Pencil Test
- .14 ASTM D4145; Standard Test Method for Coating Flexibility of Prepainted Sheet
- .15 ASTM D4214; Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films
- .16 ASTM E72; Standard Test Methods of Conducting Strength Tests of Panels for Building Construction
- .17 ASTM E84; Standard Test Method for Surface Burning Characteristics of Building Materials
- .18 ASTM E283; Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
- .19 ASTM E331; Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
- .20 ASTM E1646; Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference
- .21 ASTM E1680; Standard Test Method for Rate of Air Leakage Through Exterior Metal Roof Panel Systems
- .22 ASTM G153; Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials
- .23 ASTM G154; Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials

.2 United Laboratories (UL)
- .1 UL 580; Tests for Uplift Resistance of Roof Assemblies

.3 Factory Mutual (FM) Approvals
- .1 FM 4471; Approval Standard for Class 1 Panel Roofs

1.3 SUBMITTALS

.1 Submit under provisions of Section 01 33 00.
.2 Manufacturer's data sheets on each product to be used, including:
  .1 Preparation instructions and recommendations.
  .2 Storage and handling requirements and recommendations.
  .3 Installation methods.
.3 Shop Drawings: Furnish drawings showing panel layout, finishes, corners, custom geometries, and locations of openings. Provide detailed drawings of joints, engineered anchorage system and clips, sealants, edge conditions, closures, and other details as may be required for a weather-tight installation. Distinguish between factory and field-assembled work. Shop drawings shall include the following:
  .1 Profile
  .2 Gauge of both exterior and interior sheet
  .3 Location, layout and dimensions of panels on roof structure
  .4 Location and type of fasteners
  .5 Shape and method of attachment of all trim
  .6 Locations and type of sealants
  .7 Other details as may be required for a weather tight and airtight installation
.4 Submit shop drawings under seal of qualified Registered Professional licensed to practice in British Columbia.
.5 Selection Samples: For each finish product specified, two complete sets of colour chips representing manufacturer's full range of available colours and patterns.
.6 Verification Samples: For each finish product specified, two full width panel sections, minimum 200 mm long, representing actual product, colour, and construction.

1.4 LETTERS OF ASSURANCE

.1 The Supporting Registered Professional responsible for sealing shop drawings shall submit to the Registered Professional of Record, AIBC/APEGBC Schedule S-B Assurance of Professional Design and Commitment for Field Review with the shop drawings.
.2 The Supporting Registered Professional shall provide field review of the installation and submit to the Registered Professional of Record, AIBC/APEGBC Schedule S-C Assurance of Professional Field Review and Compliance upon completion of the Work.

1.5 PERFORMANCE CRITERIA

.1 Design roofing system to:
  .1 withstand local windload,
  .2 accommodate local temperature extremes,
  .3 accommodate building movement and
  .4 produce watertight installations.
.2 Panel Analysis: Provide panel calculations to indicate compliance with max deflection of L/240 for the indicated design loads. Include effects of thermal differential between the exterior and interior panel facings.

1.6 QUALITY ASSURANCE

.1 Installer Qualifications: The installer shall be qualified by the panel manufacturer and have a minimum of 5 years experience on projects of similar size and scope.
.2 Installer shall be authorized by the panel manufacturer and the work shall be supervised by a person having a minimum of five (5) years experience installing insulated metal roof panels on similar type and size projects.
.3 Installation shall be in accordance with manufacturer's installation guidelines and recommendations

.4 Wind and Uplift Rating
  .1 Design Uplift Load
  .2 Units shall be rated and carry the following listings:
    .1 Factory Mutual 1-105 uplift rating for 1500 mm spans with minimum 1.89 mm (14 ga.) purlins
    .2 Factory Mutual 4771 - Class 1 Approval
    .3 UL 580, Class 90 uplift ratings for 1500 mm spans with a minimum 1.89 mm (14 ga.) purlins
    .4 UL 580, Class 90 uplift rating for panels attached to .91 mm (20 ga.) decking with fastening, 3 foot on centre.
.5 Fire Classifications
  .1 Factory Mutual Class 1A Approval when installed at a maximum roof slope of 5:12.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Store products in manufacturer's unopened packaging until ready for installation.
.2 Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.
.3 Handle and store panels in conformance with good construction practice to prevent permanent distortion and mechanical damage.

1.8 WARRANTY

.1 Limited Warranty: Standard form in which manufacturer agrees to repair or replace items that fail in materials or workmanship within specified warranty period. The items covered by the warranty include structural performance and finish performance.
  .1 Warranty Period: Five (5) years from date of Substantial Completion,.
.2 Finish Warranty: Standard form in which manufacturer agrees to repair or replace metal panels that evidence deterioration of fluoropolymer finish, including flaking or peeling from approved primed metal substrate, chalk in excess, and /or colour fading.
  .1 Warranty Period: Twenty (20) years from date of Substantial Completion, or 20 years and 3 months from the date of shipment from manufacturer's plant, whichever occurs first.

PART 2 - PRODUCTS

2.1 STANDING SEAM ROOF PANELS

.1 Panel Description:
  .1 Panel thickness: 152 mm thick.
  .2 Panel width: 1066.8 mm wide
  .3 Panel length: maximum to eliminate joints.
  .4 The side joint shall consist of a 50 mm vertical sidelap, mechanically seamed, with fasteners and thermally broken attachment clip completely concealed within the side joint.
  .5 Exterior Face of Panel:
    .1 Material: AZ50/Galvalume/Zincalume per ASTM A 792
    .2 Profile: Shallow "minor rib"
    .3 Texture: Shadowline embossed
    .4 Gauge: 0.61 mm (24 ga.)
    .5 Yield: 33 ksi minimum
    .6 Exterior Finish: polyvinyldene coating system containing 70% Kynar or Hylar resins, ceramic and other inorganic pigments. paint finish up to 1.0 mil.
    .7 Colour: TBD.
  .6 Interior Face of Panel:
    .1 Material: AZ50/Galvalume/Zincalume per ASTM A792

.2 Profile: Shadowline embossed
.3 Gauge: 0.45 (26 ga.)
.4 Yield: 33 ksi minimum
.5 Interior Finish: Valspar Dynapon modified polyester finish with a total minimum dry film thickness of 1.0 mil including primer.
.6 Colour: as selected by Consultant from manufacturers complete range.

.7 Insulating Core: Minimum 88 percent closed cell structure urethane modified isocyanurate core with the following minimum physical properties:
.1 Density Nominal: 38.44 kg/m3
.2 Shear Strength: 0.103 Mpa (to rise)
.3 Tensile Strength: 0.12 Mpa
.4 Compressive Strength: 0.09 - 0.15 Mpa
.5 Surface burning characteristics when tested in accordance with ASTM E84:
.1 Flame Spread: less than 25
.2 Smoke Developed: less than 450

.2 Physical Characteristics:
.1 Structural Test: Design shall be verified by representative structural test for wind loads in accordance with ASTM E72. The deflection criteria shall be L/240.
.2 Thermal Properties: The panel shall provide a nominal RSI-value of 1.32 per 25 mm (R-7.5 per inch) thickness when tested in accordance with ASTM C518 at a mean temperature of 23 deg. C.
.3 Fatigue Test: There shall be no evidence of metal/insulation interface delamination when the panel is tested by simulated wind loads of 0.95 kPa (positive and negative loads), when applied for two million alternate cycles.
.4 Bond Strength: No metal primer interface corrosion and/or delamination shall occur after 1000 hours at 60 deg. C and 100 percent relative humidity. No delamination shall occur after 2-1/2 hours in a 2 psi 212 deg. F autoclave.
.5 Water Penetration: There shall be no uncontrolled water leakage at pressures of up to 0.95 kPa when tested in accordance with ASTM E331 and ASTM E1646. Tested assembly must include endlap and sidelap conditions.
.6 Air Infiltration: Air infiltration through the roof shall not exceed 0.003 cfm/sf at 6.24 psf air pressure differential when tested in accordance with ASTM E283 and ASTM E1680. Tested assembly must include endlap and sidelap conditions.

2.2 ACCESSORIES

.1 Gutters and Down Spouts: provide sufficient sheet metal material for the fabrication of metal gutters and down spouts by the Insulated Metal Roof manufacturer. Metal thickness and number of down spouts shall be determined based on local environmental conditions. Provide shop drawings and details as required.
.2 Fasteners:
.1 Self drilling fasteners shall be cadmium plated steel, designed to resist maximum negative pulloff loads and hold the face sheet mechanically to the structural support.
.2 Panel attachment clip shall be two pieces and fully concealed within the panel sidejoint. Base clip shall be a minimum 1.89 mm (14 ga) galvanized, and top clip shall be a minimum 0.91 mm (20 ga.) stainless steel with an integral thermal break.
.3 Vibration resistant type (anti-backout threads) fasteners. Self-drilling flathead screws with sealing washers and square drives, designed to resist back out by increasing thread friction as screw loosens.
.3 Perimeter Trim and Penetration Treatments: All required trim and metal flashing with same coating, colour, and gauge as the exterior face of the insulated metal roof panel.
.4 Butyl Tape: Per panel manufacturer's recommendations for panel to panel and panel to trim seal.
.5 Butyl Sealants: Non-skinning type per panels manufacturer's recommendations.
.6 Liquid applied Gutter Liner: synthetic rubber liquid applied gutter liner. Approved product: RC2000 by Inland Coatings.

2.3 SNOW GUARDS

.1 Shop Drawings: Show locations of the snow retention system on the roof plan and specify bracket/clamp spacing as required by an Engineer.
.2 Include detailed product cut sheets, installation instructions and specifications.
.3 Design Requirements:
  .1 Proprietary snow retention system for standing seam metal roof systems.
  .2 Non-penetrating attachment directly to the roof panel seam.
  .3 Provide brackets, clamps, set screws, fasteners and all other component parts that make up the snow retention system
  .4 Bracket/clamp spacing to be recommended by manufacturer.
  .5 Spacing shall be based on several factors including geographical region, snow load and building characteristics.
  .6 Install a minimum of 2 fasteners per bracket.
  .7 Departmental Representative shall review the project and any contemplated snow retention layout to ascertain and confirm the projected loads applicable to this project.
.4 Components:
  .1 Bracket: Stainless Steel
  .2 25 mm clamp: 6061-T6 Aluminum
  .3 25 mm x 25 mm Square Tubing: 6061-T6 Aluminum or Stainless Steel
  .4 Insert: Zinc Zamak #3
  .5 End Cap: Zinc Zamak #3
  .6 Set screws: 300 Series Stainless Steel
  .7 Barricade Plate: Aluminum or Stainless Steel
  .8 Fastener: compatible with the specified roof application.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Examine alignment of the structure and supports prior to installing the insulated metal roof panels.
  .1 Structure Tolerance: In the plane of the roof 0 mm inward, plus 12.6 mm outward
  .2 All deviations from structural tolerances shall be corrected party prior to installation of the panels.
.2 Examine individual panels upon removing from the bundle; both edges should be visually examined and any slight overfill of insulation should be carefully removed.

3.2 PANEL INSTALLATION

.1 Remove protective film before installation, or immediately thereafter to prevent sunlight damage.
.2 Cut panels, where indicated on shop drawings, using a power circular saw with fine tooth carbide tip blades or a band saw prior to installation. Ventilate area where polyurethane dust is generated. Personnel should wear respiratory and eye protection devices.
.3 Apply butyl sealant vapor seal around interior perimeter of roof assembly per panel manufacturer's instructions.
.4 Apply butyl tape on panel sidelaps and clip assemblies per panel manufacturer's instructions.
.5 Secure units to the steel supports with manufacturer's recommended fastener.
.6 Place panel fasteners through predrilled top clip and base clip, concealed within the side joint of the panel.
  .1 Heads of concealed fasteners shall be insulated from the exterior environment to prevent condensation and "ice balling" from occurring on the fastener shaft.
.7 Apply endlap sealing tape and butyl to panel surface to be lapped per manufacturer's instructions.
.8 Endlap panel stitch fasteners to be vibration resistant type.
.9 As each panel is installed, crimp hidden clip assembly prior to placement of next panel.

.10 Repair or replace metal panels and trim that have been damaged.

3.3 TRIM INSTALLATION

.1 Place trim to determine the location of the closure strips, sealant and ridge closure trims.
.2 Apply butyl tape above and below the foam closure strip and seat the closure strip firmly in the tape to ensure a continuous seal. If any voids exist add butyl caulking and reseat the closure.
.3 Place a continuous layer of butyl tape on top of the metal ridge closure trims for the length of the building.
.4 Fasten the exterior ridge trim to the metal ridge closure trims, per manufacturer's recommendations, on centre with 6 mm by 22 mm low profile vibration resistant stitch fasteners.

3.4 SNOW GUARD INSTALLATION

.1 Inspect the roof system in its entirety to verify proper attachment, completion and the ability of the building structure to withstand additional loading applied by the snow retention system.
.2 Install the snow retention system in accordance with an approved layout, installation instructions and reviewed submittals.
.3 Products shall be installed by a qualified Roofing Contractor who will have the knowledge and ability to properly install the product.

END OF SECTION 07 41 00

PART 1 - GENERAL

1.1 RELATED WORK

.1	Insulated Metal Roof Panels:	Section 07 41 00
.2	Metal Doors and Frames:	Section 08 10 00
.3	Joint Protection:	Section 07 90 00
.4	Aluminum Glazed Sectional Doors:	Section 08 36 13
.5	Aluminum Glazed Curtain Wall:	Section 08 44 13
.6	Glazing:	Section 08 80 00
.7	Metal Building Systems:	Section 13 34 19

1.2 REFERENCES

.1 American Society for Testing and Materials International, (ASTM).
- .1 ASTM E 72 - Standard Test Methods of Conducting Strength Tests of Panels for Building Construction.
- .2 ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- .3 ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials
- .4 ASTM E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C
- .5 ASTM C273 / C273M - Standard Test Method for Shear Properties of Sandwich Core Materials
- .6 ASTM E 283 - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
- .7 ASTM C303 - Standard Test Method for Dimensions and Density of Preformed Block and Board-Type Thermal Insulation
- .8 ASTM E330 / E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference
- .9 ASTM E 331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.
- .10 ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
- .11 ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
- .12 ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation
- .13 ASTM A 653 / A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .14 ASTM A755 / A755M - Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products
- .15 ASTM A792 / A792M - Standard Specification for Steel Sheet, 55 % Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
- .16 ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems
- .17 ASTM A 924 / A 924M Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
- .18 ASTM D 1621 - Standard Test Method for Compressive Properties Of Rigid Cellular Plastics
- .19 ASTM D 1622 - Standard Test Method for Apparent Density of Rigid Cellular Plastics.
- .20 ASTM D 1623 - Standard Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics.
- .21 ASTM D1929 - Standard Test Method for Determining Ignition Temperature of Plastics

.22 ASTM D 2126 - Standard Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging.
.23 ASTM D2244 - Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
.24 ASTM D 2856 - Standard Test Method for Open-Cell Content of Rigid Cellular Plastics by the Air Pycnometer.
.25 ASTM D4214 - Standard Test Method for. Evaluating Degree of Chalking of Exterior Paint.
.26 ASTM D6226 - Standard Test Method for Open Cell Content of Rigid Cellular Plastics
.27 American Metal Manufacturers Association

.2 American Architectural Manufacturers Association (AAMA)
.1 AAMA 501 - Methods of Test for Exterior Walls.
.2 AAMA 501.1, Standard Test Method for Water Penetration of Windows, Curtain Walls and Doors Using Dynamic Pressure

.3 Underwriters' Laboratories of Canada (ULC).
.1 CAN/ULC-S134 Fire Test of Exterior Wall Assemblies
.2 CAN/ULC-S101 - Standard Methods of Fire Endurance Tests of Building Construction and Materials.
.3 CAN/ULC-S102 - Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
.4 CAN/ULC-S114 - Standard Method of Test for Determination of Non-combustibility in Building Materials
.5 CAN/ULC-S115 - Standard Method of Fire Tests of Firestop Systems
.6 CAN/ULC-S126 - Standard Method of Test for Fire Spread Under Roof-Deck Assemblies.
.7 CAN/ULC-S134 - Standard Method of Fire Test of Exterior Wall Assemblies.

.4 Canadian Standards Association (CSA International).
.1 CSA Standard 16.1 - Limit States Design of Steel Structures.

.5 Factory Mutual (FM) Approvals
.1 FM Standard 4880 - Approval Standard for Class 1 (A) Insulated Wall or Wall & Roof/Ceiling Panels (B) Plastic Interior Finish Materials (C) Plastic Exterior Building Panels (D) Wall/Ceiling Coating Systems (E) Interior or Exterior Finish Systems.
.2 FM Standard 4881 - Approval Standard for Class 1 Exterior Wall Systems

.6 Uniform Building Code
.1 UBC 26-3 - Room Fire Test Standard for Interior of Foam Plastic Systems.
.2 UBC 26-4 - Method of Test for the Evaluation of Flammability Characteristics of Exterior, Non-load-bearing Wall Panel Assemblies Using Foam Plastic Insulation.

.7 United Laboratories (UL)
.1 UL Standard 1040 - Standard for Fire Test of Insulated Wall Construction.
.2 UL Standard 1715 - Standard for Fire Test of Interior Finish Material.
.3 ULC/ORD C376 - Fire Growth of Foamed Plastic Insulated Building Panels in a Full-Sale Room Configuration.
.4 UL 263 - Fire Tests of Building Construction and Materials.
.5 UL 1479 - Fire Tests of Through-Penetration Firestops

.8 National Fire Protection Association (NFPA)
.1 NFPA 259, Standard Test Method for Potential Heat of Building Materials
.2 NFPA 268, Standard Test Method for Determining Ignitability of Exterior Wall Assemblies Using a Radiant Heat Energy Source
.3 NFPA 285, Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components

1.3 SUBMITTALS

.1 Submit under provisions of Section 01 33 00 - Submittal Procedures.
.2 Manufacturer's data sheets on each product to be used, including:
.1 Preparation instructions and recommendations.

.2 Storage and handling requirements and recommendations.
.3 Installation methods.

.3 Shop Drawings: Furnish drawings showing panel layout, finishes, corners, custom geometries, and locations of openings. Provide detailed drawings of joints, engineered anchorage system and clips, sealants, edge conditions, closures, and other details as may be required for a weather-tight installation. Distinguish between factory and field-assembled work. Shop drawings shall include:
.1 Profile
.2 Gauge of both exterior and interior sheet
.3 Location, layout and dimensions of panels
.4 Location and type of fasteners
.5 Shape and method of attachment of all trim
.6 Locations and type of sealants
.7 Installation sequence
.8 Coordination Drawings: Provide elevation drawings and building sections which show panels in relationship to required locations for structural support. Include panel details and details showing attachment to structural support.
.9 Other details as may be required for a weathertight and airtight installation.

.4 Submit shop drawings under seal of qualified Registered Professional licensed to practice in British Columbia.

.5 Selection Samples: For each finish product specified, two complete sets of colour chips representing manufacturer's full range of available colours and patterns.

.6 Verification Samples: For each finish product specified, two full width panel sections, minimum 200 mm long, representing actual product, colour, and construction.

1.4 LETTERS OF ASSURANCE

.1 The Supporting Registered Professional responsible for sealing shop drawings shall submit to the Registered Professional of Record, AIBC/APEGBC Schedule S-B Assurance of Professional Design and Commitment for Field Review with the shop drawings.

.2 The Supporting Registered Professional shall provide field review of the installation and submit to the Registered Professional of Record, AIBC/APEGBC Schedule S-C Assurance of Professional Field Review and Compliance upon completion of the Work.

1.5 PERFORMANCE CRITERIA

.1 Design siding system to:
.1 withstand local windload,
.2 accommodate local temperature extremes,
.3 accommodate building movement and
.4 produce watertight installations.

.2 Panel Analysis: Provide panel calculations to verify panels will withstand the design wind loads indicated without detrimental effects or deflection exceeding L/180. Include effects of thermal differential between the exterior and interior panel facings and resistance to fastener pullout.

1.6 QUALITY ASSURANCE

.1 Installer Qualifications: The installer shall be qualified by the panel manufacturer and have a minimum of 5 years experience on projects of similar size and scope.

.2 Installer Qualifications: Authorized by the manufacturer and the work shall be supervised by a person having a minimum of five (5) years experience installing insulated wall panels on similar type and size projects.

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

.4 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

.5 Pre-Installation Meetings: conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Store products in manufacturer's unopened packaging until ready for installation.
.2 Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.
.3 Handle and store panels in conformance with good construction practice to prevent permanent distortion and mechanical damage.

1.8 PROJECT CONDITIONS

.1 Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.9 WARRANTY

.1 Standard form in which manufacturer agrees to repair or replace items that fail in materials or workmanship within specified warranty period. The items covered by the warranty include structural performance including bond integrity, deflection and buckling.
  .1 Warranty Period: Five (5) years from date of Substantial Completion.
.2 Finish Warranty: Standard form in which manufacturer agrees to repair or replace metal panels that evidence deterioration of fluoropolymer finish, including flaking or peeling from approved primed metal substrate, chalk in excess of 8 when tested in accordance with ASTM D4214, Method A, and /or colour fading in excess of 5 AE Hunter units on panels when tested in accordance with ASTM D2244.
  .1 Warranty Period: Twenty (20) years from date of Substantial Completion, or 20 years and 3 months from the date of shipment from manufacturer's plant, whichever occurs first.

PART 2 - PRODUCTS

2.1 EXTERIOR WALL PANELS (Non-Fire Rated) - BASIS OF DESIGN

.1 Performance Criteria:
  .1 Structural Test: Structural performance shall be verifiable by witnessed structural testing for simulated wind loads in accordance with ASTM E72 and E330. Deflection criteria shall be L/180.
  .2 Fatigue Test: There shall be no evidence of metal/insulation interface delamination when the panel is tested by simulated wind loads (positive and negative loads), when applied for two million alternate cycles of L/180 deflection.
  .3 Freeze / Heat Cycling Test: Panels shall exhibit no delamination, surface blisters, permanent bowing or deformation when subjected to cyclic temperature extremes of minus -6 deg. C to plus 82 deg. C temperatures for twenty one, eight-hour cycles.
  .4 Water Penetration: There shall be no uncontrolled water penetration through the panel joints at a pressure differential of 0.95kPa, when tested in accordance with ASTM E331.
  .5 Dynamic Water Penetration: There shall be no uncontrolled water penetration through the panel assembly at a pressure difference of 0.57 kPa, when tested in accordance with AAMA 501.1.
  .6 Air Infiltration: Air infiltration through the panel shall not exceed 0.001 cfm/sf at 20 psf air pressure differential when tested in accordance with ASTM E283.
  .7 Humidity Test: Panels shall exhibit no delamination or metal interface corrosion when subjected to plus 60 deg. C temperature and 100 percent relative humidity for a total of 1200 hours (50 days).

.8 Autoclave Test: Panels shall exhibit no delamination or shrinkage/melting of the foam core from the metal skins after being subjected in an autoclave to a pressure of 13.8 kPa at a temperature of plus plus 103 deg. C for a period of 2 1/2 hours.

.9 Panel Fire Tests:

.1 Fire Endurance Test - 10 minutes: Panels remained in place without joint stitch fastening per CAN/ULC-S101.

.2 Fire Endurance Test - 15 minutes: Panels remained in place with joint stitch fastening per CAN/ULC-S101.

.10 Flame Spread and Smoke Developed Tests on exposed Insulating Core:

.1 Flame Spread: Less than 25.

.2 Smoke Developed: Less than 250.

.3 Tests performed in accordance with CAN/ULC-S102 and ASTM E84.

.11 Fire Test Response Characteristics: Steel-faced panels with polyisocyanurate (ISO) core.

.1 FM 4880: Class I rated per FM Global, panels are approved for use without a thermal barrier and do not create a requirement for automatic sprinkler protection.

.2 NFPA 259 Potential Heat Content; established for foam core.

.3 NFPA 268 Ignitability of Exterior Wall Assemblies Using a Radiant Heat Source; successfully passed acceptance criteria.

.4 NFPA 285 Intermediate Scale Multi-story Fire Evaluation; successfully passed acceptance criteria.

.5 UL 263 Fire Resistive Rating; classified as a component of a fire-rated wall assembly for 1-hour and 2-hour rating Design No. U053 (rated assemblies include appropriate layers of fire-rated Type X Gypsum board).

.6 ASTM D1929 Minimum Flash and Self Ignition; established for foam core.

.7 S101, S102, S127, S134 UL Canada fire test standards; successfully passed.

.12 Windborne Debris rating for Wall Panel:

.1 Meet requirements for high velocity hurricane zone with large missile impact when tested in accordance with FM Standard 4881.

.13 Insulating Core: Polyisocyanurate (ISO) core, ASTM C591 Type IV, CFC and HCFC free, compliant with Montreal Protocol and Clean Air Act, with the following minimum physical properties:

.1 Core is 90 percent closed cell when tested in accordance with ASTM D6226

.2 Panel shall provide a nominal RSI value of 1.32 per 25 mm thickness (R-7.5 per inch) when tested in accordance with ASTM C518 at a mean temperature of 23 deg. C.

.3 Foam has a density of 35 to 44 kg/m^3 when tested in accordance with ASTM D1622

.4 Compressive Stress:

.1 Parallel to Rise: 0.29 MPa

.2 Perpendicular to Rise: 0.16 MPa

.3 Tested in accordance to ASTM D1621

.5 Shear Stress: 0.12 MPa when tested in accordance with ASTM C273

.6 Tensile Stress: 0.17 MPa when tested in accordance with ASTM D1623

.7 Oven Aging at 93 degrees C:

.1 1 day: plus 1 percent volume change

.2 7 days: plus 3 percent volume change

.3 Tested according to ASTM D2126

.8 Low Temperature Aging at minus 20 degrees F:

.1 1 day: 0 percent volume change

.2 7 days: 0 percent volume change

.3 Tested according to ASTM D2126

.2 Panel Assembly:

.1 Panel thickness: 101 mm thick.

.2 Panel width: 1066.8 mm.

.3 Panel Lengths: Minimum 2438 mm.
.4 Panel Attachment: Shall consist of fasteners and stainless steel attachment clip completely concealed within the panel side joint.
.5 Vertical Panel Joint Reveals: 3 mm.
.6 Exterior Face of Panel:
.1 Material:
.1 Steel coil material shall be in accordance with ASTM A755: AZ50 Galvalume / Zincalume (55 percent aluminum, 45 percent zinc) in accordance with ASTM A792 or Grade 33, G90 galvanized steel in accordance with ASTM A653 and A924.
.2 Gauge: 0.45 mm (26 ga.)
.3 Profile: Shadowline embossed.
.2 Exterior Paint Finish Colour:
.1 As selected.
.2 Finish System:
.1 Polyvinyldene coating system containing 70% Kynar or Hylar resins, ceramic and other inorganic pigments. paint finish up to 1.0 mil..
.7 Interior Face of Panel:
.1 Material:
.1 Steel coil material shall be in accordance with ASTM A755: AZ50 Galvalume / Zincalume (55 percent aluminum, 45 percent zinc) in accordance with ASTM A792 or Grade 33, G90 galvanized steel in accordance with ASTM A653 and A924.
.2 Profile: Shadowline embossed.
.1 Profile description: Linear striations nominal 1.6 mm deep by 19 mm wide at 76 mm on centre.
.3 Gauge: 0.45 MM (26 ga.)
.4 Interior Finish: PVDF finish, dry film thickness of 1.0 mil including primer.
.5 Colour: as selected.

2.2 ACCESSORIES

.1 Fasteners:
.1 Hidden fasteners with clips applied from the exterior and concealed in the panel side joint connecting both metal faces to supporting steel structure.
.2 Self drilling fasteners shall be cadmium plated steel with neoprene washer, as recommended by manufacturer.
.3 Material: Hex-head type with steel and neoprene washer and 2.65 mm stainless steel clip supplied by the manufacturer.
.4 Size: As recommended by manufacturer.
.2 Perimeter Trim:
.1 Fabricated perimeter trim and metal flashing: Shall be same gauge, material and coating colour as exterior face of insulated metal wall panel.
.2 Extruded perimeter trim: Shall be extruded aluminum 6063-T5 alloy with spray applied PVF coating in same colour as exterior face of insulated metal wall panel.
.3 Sealants: Butyl, non-skinning/curing type as recommended by manufacturer.
.4 Min. 100 mm wide air/vapour seal sheet membrane transition strip on galvanized sheet metal backers.

PART 3 - EXECUTION

3.1 INSPECTION

.1 Provide field measurements to manufacturer as required to achieve proper fit of the preformed

wall panel envelope. Measurements shall be provided in a timely manner so that there is no impact to construction or manufacturing schedule.

.2 Supporting Steel: All structural supports required for installation of panels shall be by others. Support members shall be installed within the following tolerances:
  .1 Plus or minus 3 mm in 1524 mm in any direction along plane of framing.
  .2 Plus or minus 6 mm cumulative in 6096 mm in any direction along plane of framing.
  .3 Plus or minus 12.7 mm from framing plane on any elevation.
  .4 Plumb or level within 3 mm at all changes of transverse for pre-formed corner panel applications.
  .5 Verify that bearing support has been provided behind vertical joints of horizontal panel systems and horizontal joints of vertical panel systems. Width of support shall be as recommended by manufacturer.

.3 Examine individual panels upon removing from the bundle; notify manufacturer of panel defects. Do not install defective panels.

3.2 PANEL INSTALLATION

.1 Installation shall be in accordance with manufacturer's installation guidelines and recommendations.

.2 Install panels plumb, level, and true-to-line to dimensions and layout indicated on approved shop drawings.

.3 Cut panels prior to installing, where indicated on shop drawings, using a power circular saw with fine tooth carbide tip blade per manufacturer's instructions. Personnel should wear respiratory and eye protection devices.

.4 Butyl Weather Barrier Sealant:
  .1 Apply non-skinning butyl sealant as shown on shop drawings and manufacturer's installation instructions as necessary to establish the vapour barrier for the panels.
  .2 Use non-skinning butyl tube sealant only for tight metal-to-metal contact.
  .3 Do not use non-skinning butyl tube sealant to bridge gaps.

.5 Place panel fasteners through pre-punched holes in attachment clips, concealed within the joint of the panel. Secure units to the structural supports. Space clips as recommended by manufacturer or otherwise indicated on the approved shop drawings.

3.3 TRIM INSTALLATION

.1 Place trim and trim fasteners only as indicated per details on the approved shop drawings.

.2 Field drill weep holes where appropriate in horizontal trim; minimum 6 mm diameter at 609 mm on centre.

.3 Place a continuous strip of butyl tube sealant between the inside back face of closure trims and interior panel faces for proper vapour seal.

3.4 SEALANT INSTALLATION FOR EXPOSED JOINTS

.1 Clean and prime surfaces to receive exterior exposed sealants in accordance with sealant manufacturer's recommendations.

.2 Follow sealant manufacturer's recommendations for joint width-to-depth ratio, application temperature range, size and type of backer rod, and compatibility of materials for adhesion.

.3 Direct contact between butyl and silicone sealants shall not be permitted.

3.5 TRIM INSTALLATION

.1 Place trim and trim fasteners only as indicated per details on the approved shop drawings.

.2 Field drill weep holes where appropriate in horizontal trim where indicated on shop drawings.

.3 Place a continuous strip of butyl tape or butyl sealant on closure trims for the length of the panel to be covered as indicated on shop drawings.

3.6 FIELD QUALITY CONTROL

.1 Inspection and testing of application will be carried out by testing laboratory designated by Departmental Representative.
.2 Field Water Test: After completing portion of metal wall panel assembly including accessories and trim, test a 2-bay area selected by the Architect for water penetration in accordance with AAMA 501.2.

3.7 CLEANING AND PROTECTION

.1 Remove protective film immediately after installation.
.2 Touch-up, repair or replace metal panels and trim that have been damaged.
.3 After metal wall panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

END OF SECTION 07 42 13

PART 1 - GENERAL

1.1 RELATED WORK

.1	Joint Protection:	Section 07 90 00
.2	Glazed Aluminum Curtain Wall:	Section 08 44 13
.3	Gypsum Board:	Section 09 29 00
.4	Plumbing:	Division 22
.5	HVAC:	Division 23
.6	Electrical:	Division 26.

1.2 REFERENCES

.1 ULC List of Equipment and Materials
.2 National Fire Protection Association (NFPA)
.3 CAN/ULC-S115, Standard Method of Fire Tests of Firestop Systems.
.4 CAN/ULC S101 Standard Method of Fire Endurance Tests of Building Construction and Materials.
.5 CAN/ULC-S102, Standards Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
.6 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  .1 Material Safety Data Sheets (MSDS).

1.3 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.

1.4 SUBMITTALS

.1 Submit in accordance with Section 01 33 00.
.2 Manufacturer’s listed systems designs.
.3 Manufacturer’s product data sheets.
.4 Manufacturer’s Materials Safety Data Sheets (MSDS)
.5 Manufacturer’s printed instructions for installation on each proposed product.
.6 Manufacturer’s prefabricated devices providing descriptions sufficient for identification at the project site.
.7 Manufacturer’s third party testing agency firestop systems report (if requested).
.8 Clearly indicate which firestop sealant products are single component firestops and which are multiple component (ones that require high temperature insulation filler materials to comply with the CAN/ULC S115 Standard).
.9 Samples of each type of firestopping and smoke seal material.
.10 Submit trade qualifications certificate or related experience of each installer performing work on the site.
.11 Submit individual firestop seal details in lieu of certification system listings only where the listing's and/or material's limitations are expected to be exceeded, complete with a rationale for approving any listing deviation.
.12 Provide maintenance manuals as part of the Owner training session, including literature, installation instructions and MSDS

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver all materials and store in their original, unopened containers, with certification labels and seals intact.
.2 Protect from damage and environmental conditions as noted under the manufacturer's recommendations.

1.6 SYSTEM DESCRIPTION

.1 Firestopping:
  .1 Materials and/or systems intended to act as a firestop and smoke seal within fire resistive wall and floor assemblies such as fire-resistance rated concrete, masonry or gypsum wallboard, for any through-penetrating items, poke-through termination devices, electrical outlet boxes or any unpenetrated openings or joints, including openings and spaces at perimeter edge conditions.
  .2 Testing of service penetrations shall be in accordance with ULC-S115. Testing of architectural joints shall be in accordance with ANSI/UL 2079 Tests for Fire Resistance of Building Joint Systems.
  .3 All joints must be certified to dynamic conditions, exhibition motion compensation not less than 15%. Plastic pipe penetration firestops must have been tested and certified in 50Pa positive furnace pressure conditions during the fire exposure.
  .4 Through penetrations in fire walls and occupancy separations must be FT rated per ULC-S115, with the fire protection rating of the firestop being equivalent to the fire-resistance rating of the fire wall and/or the occupancy separation. Firestop installations must be bounded by certification listings, as per BCBC.
.2 Smoke Seals:
  .1 Seals forming draft-tight barriers to retard the passage of smoke, flame and hose-stream.
  .2 All service penetration firestops shall be FH or FTH rated, as per ULC-S115. F rated and FT rated firestops are not permitted without an equivalent FH rating unless specifically indicated otherwise in the contract documents.
  .3 Fire resistance durations of firestops shall conform to the minimum requirements of BCBC.
  .4 All cable penetration firestops shall be installed in such a manner that the firestop systems are spread uniformly between all cables to ensure a continuous firestop as well as 'smoke seal' inside of all cable bundles and/or groups of cables, regardless of whether the cables are running inside or outside of cable trays and/or wire ways.
.3 Firestopping and smoke seals within mechanical (i.e., inside ducts, dampers and electrical assemblies (i.e., inside bus ducts)) shall be provided as part of the work of Division 15 and 16 respectively. Firestopping and smoke seals around the outside of such mechanical and electrical assemblies, where they penetrate rated fire separations, shall be part of the work of this Section.
.4 Installed service penetration and joint firestop configurations shall be bounded by certification listings of certification organizations bearing the accreditation of the Standards Council of Canada for testing and certifying firestops as per ULC-S115. Deviations from any third party firestop listings, whether for service penetrations or joint treatments, must be approved by the Consultant prior to installation.

1.7 TAGS

.1 Mark both sides of all service penetrations and every 3000 mm of joint with printed Du Pont Tyvec tags complete with stainless wires, held in metallic eyes at the short end of each tag. Tags shall be sized minimum 3.0 in^2 or 19cm^2 and indicate name and telephone number of Subcontractor and the following statement on the front of the tag:

CAUTION! FIRESTOP: DO NOT RE-ENTER, PUNCTURE OR DESTROY WITHOUT AN AUTHORISATION NUMBER. UNSEALED BREACHES OF FIRESTOPS CONSTITUTE BUILDING AND FIRE CODE VIOLATIONS AND ARE SUBJECT TO LEGAL CONSEQUENCES. FIRESTOPS ARE NOT EVALUATED FOR LOAD-BEARING PROPERTIES. AVOID FOOT TRAFFIC OR OTHER LOADING ON FIRESTOPS!

PROJECT_____FLOOR_____

INSTALLED BY_____HOLE#_____

SYSTEM #_____

CONTACT: (Enter Name, Address, Telephone #, Fax #, E-mail and URL of Firestop Subcontractor)

The back of the tag shall show a table permitting room to indicate as line items the following information per breach and repair: Date of breach and date of repair and authorisation number covering each seal alteration.

PART 2 - PRODUCTS

2.1 ACCEPTABLE PRODUCTS AND OR MANUFACTURERS

.1 Only firestop systems tested to the CAN/ULC S115 standard complete with listed systems designs showing their appropriate individual applications are acceptable.

2.2 MATERIALS

.1 All firestop systems and listed systems designs selected for use shall be listed and tested by a Standards Council of Canada (SCC) recognized and accredited third party testing agency in accordance with CAN/ULC S115, Standard Method of Fire Tests of Firestop Systems.
.2 All smoke seal materials shall have been tested in accordance with CAN/ULC S102 Standard Method of Testing for Surface Burning Characteristics of Building Materials and Assemblies and have a flame spread classification of 25 or less.
.3 Fire resistance ratings of installed firestop systems shall not be less than the fire resistance rating of the surrounding fire separation or firewall.
.4 All listed systems designs selected for use shall have a smoke seal incorporated within the CAN/ULC S115 rated firestop systems.
.5 All firestop materials that will come directly in contact with plastic pipe or plastic coated wire shall have undergone firestop material compatibility testing by the firestop systems manufacturer and/or the pipe or wire manufacturer.
.6 All firestop materials and smoke seals shall have elastomeric characteristics to allow for building settling and seismic movement.
.7 All firestop materials and smoke seals shall be free of asbestos.
.8 Site firestop systems must be installed in accordance with the listed system design limitations, unless a technical evaluation is approved by one of the acceptable third party testing agencies.
.9 All listed systems designs used must provide a Flame (F), Temperature (T) and Hose (H) stream rating in accordance with those outlined in the most recent British Columbia Building Code, include any additional requirements of the Work in this Section.

PART 3 - EXECUTION

3.1 PREPARATION

.1 Examine sizes and conditions of voids to be filled to establish correct thickness and installation

of firestop materials. If silicones are to be used ensure that substrates and penetrating item surfaces are dry, clean and frost free.

.2 Prepare surfaces in contact with firestop systems and smoke seals to manufacturer's instructions.

.3 Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.

3.2 INSTALLATION

.1 CAN/ULC S115 tested and listed systems designs govern all installations of firestop systems and firestop materials.

.2 In all firestop systems that require mineral wool or ceramic fiber backer or filler materials, these materials must be dry and free of other contaminants before, during and after installation of sealant firestop materials. Alkaline water contamination of the backer or filler materials may cause corrosion of metallic penetrating items.

.3 Apply firestop systems and smoke seals in strict accordance with manufacturer's instructions and listed systems designs to provide required temperature and flame rated seals, to prevent the passage of fire and smoke, and where specifically designated, the passage of fluids.

.4 Provide temporary forming and packing as required.

.5 Tool or trowel all exposed surfaces to smooth, neat and tidy finish.

.6 Notify Consultant when completed installations are ready for inspection and prior to concealing or enclosing firestop systems and smoke seals.

3.3 SERVICE PENETRATION FIRESTOP SYSTEMS

.1 Firestop and smoke seal gaps and holes in all fire separation and firewall construction through which conduit, wire, cables, ductwork, piping and all other protrusions pass as a result of work using an appropriate listed system design identifying substrate type, penetrating material type, penetrating item size, minimum and maximum annular space and overall "FTH" ratings.

.2 In combustible construction (membrane GWB type) where the framing members are wood a Fire and Temperature rise "FT" rating is required equal to that of the rating of the fire separation. Include openings which have been formed and sleeved.

.3 In combustible construction (membrane GWB type) where paper faced insulation or combustible vapor and air barriers are incorporated within the separation a Fire and Temperature rise "FT" rating is required equal to that of the rating of the fire separation.

.4 In combustible construction (membrane GWB type), firestop and smoke seal all through penetrations of the faces as above and firestop and smoke seal all penetrations that enter or exit (transverse) the edges of one fire separation into another fire separation. (i.e. where the header or sill plate is penetrated in the interior of a wall separation into the hollow ceiling or floor cavity of the adjacent separation).

.5 In combustible construction (membrane GWB type), fire taping of service penetrations and HVAC duct work is not acceptable unless a tested CAN/ULC S115 firestop systems is submitted.

.6 Apply firestop systems at unpenetrated openings and sleeves installed for future use through fire separations and firewalls.

.7 Install 6 mm to 10 mm bead of firestop caulking at interface of retaining angles around fire dampers, where angles meet fire-rated assembly, and between retaining angles and fire damper, both sides of penetration. At floor locations, sealant bead at top of assembly is adequate.

.8 Where necessary, remove fiberglass insulation and replace with mineral wool insulation from insulated pipes and ducts where such services penetrate a fire separation or firewall unless the listed systems design permits such insulation to remain within the firestop system.

3.4 HORIZONTAL JOINT

.1 For joint configurations through floor slabs, ceiling fire separation unless otherwise stipulated; the detail to be used shall state the substrate material that it has been tested for i.e.; (concrete to concrete) or (concrete to metal).

.2 Single Component Firestop Systems; Install as per the listed systems design with the following additional provisions;

.1 All listed systems designs selected for use shall have a smoke seal incorporated within the firestop system.

.2 For joints 25 mm and under in width; Install as per listed systems design.

.3 For joints 30 mm-75 mm; Install 6 lb./pcf mineral wool board stock at a depth of 100 mm. Cut mineral wool board stock 10% over the width dimension and compress into the opening.

.4 For joints 75 mm and over; Use mineral wool as above and insert impaling clips on 400 mm centers. Impaling clips, minimum heavy gauge galvanized steel 25 mm wide x 0.65 mm thick, Z formed, dimensions to suit location and width of void to be filled. Butt succeeding sections of mineral wool backer material tightly up against preceding. Leave no voids.

.3 Multiple Component Firestop Systems; Install as per the listed systems design with the following additional provisions;

.1 All firestop systems selected for use shall have a smoke seal incorporated within the listed system design.

.2 For all joints 25 mm-75 mm; Install 6 lb./pcf mineral wool board stock at a depth of 100 mm. Cut mineral wool board stock 10% over the width dimension and compress into the opening.

.3 For joints 25 mm and over; Use mineral wool as above and insert impaling clips on 400 mm centers. Impaling clips, minimum heavy gauge galvanized steel 25 mm wide x 0.65 mm thick, Z formed, dimensions to suit location and width of void to be filled. Butt succeeding sections of mineral wool backer material tightly up against preceding. Leave no voids.

3.5 VERTICAL JOINT AND WALL FIRESTOP SYSTEMS

.1 Firestop and smoke seals at top of gypsum wall board fire separations and firewalls which extend nominally to within 20 mm of underside of deck above. Provide adequate depth of material to fill gap flush with face of wall, except as otherwise specified.

.2 Insert at both sides of vertical joints where concrete firewalls or fire separations intersect with fire separations of combustible construction (GWB).

.3 Insert at both sides of control and sway joints in concrete firewalls or fire separations.

.4 Where wall/slab junction is exposed in finished work, apply a concrete gray in color fire-rated sealant to gap, tooling to a concave joint.

3.6 SCHEDULE OF LOCATIONS

.1 Service Penetrations:

.1 All mechanical penetrations and poke through termination devices in fire separations and firewalls.

.2 Penetrations in sills and headers of gypsum wall board fire separations. (interior of wall)

.3 All electrical penetrations and poke through termination devices in fire separations and firewalls.

.4 All telecommunication and cable penetrations and poke through termination devices in fire separations and firewalls.

.5 All HVAC penetrations and poke through termination devices in fire separations and firewalls.

.6 All sprinkler heads protruding from fire separations.

.2 Joint Firestopping:
- .1 Concrete vertical or horizontal joints with dissimilar firewalls or fire separations.
- .2 Gypsum wall board vertical or horizontal joints with dissimilar firewalls or fire separations.
- .3 All mechanical damper joints in fire separations and firewalls. Completely around all wall and floor dampers, both sides of the wall on wall dampers, top side only in floor dampers.

3.7 ABNORMAL CONDITIONS NOT COVERED BY SUBMITTED LISTED SYSTEMS DESIGNS

.1 Where any of the following conditions are encountered after Work has commenced notify the Consultant and/or the site Contractor prior to proceeding.
- .1 Penetrating item materials not covered by listed systems design(s)
- .2 Penetrating item sizes exceeding the parameters of listed systems design(s)
- .3 Annular spaces exceeding the parameters of listed systems design(s)
- .4 Vertical or horizontal joints exceeding the parameters of listed systems design(s)

3.8 INFORMATION TO BE RETAINED ON SITE AT ALL TIMES

.1 Firestop system trade qualification certificate or installer resume of experience.
.2 Firestop system manufacturer's listed systems designs, product data sheets and Materials Safety Data Sheets.
.3 Firestop system manufacturer's printed instructions for installation on each product and prefabricated device.

3.9 CLEAN UP

.1 Remove excess materials and debris and clean adjacent surfaces immediately after application to satisfaction of Departmental Representative. Remove and or correct staining and discoloring of adjacent surfaces as directed.
.2 Remove temporary dams after initial set of firestop systems where such materials are left exposed in finished areas and flame spread rating of such materials exceed a value of 25.

3.10 TESTING

.1 Destructive Testing
- .1 Cut tests will be performed at random locations throughout the Work to check for firestop systems component sealant depths and fill weights of filler/backer materials.

.2 Non Destructive Testing
- .1 At the Departmental Representative's discretion perform a series of 5 fog tests to random locations as designated by Departmental Representative. Should any penetration, joint or void, under the jurisdiction of this Section, emit visible fog, make repairs and replace deficiencies and re-perform fog test at no addition cost.
- .2 Fog units (machines) shall have a formulation output range of 6.8 L/h. Formulation particle size 0.5 - 25 microns. Fogging agent shall be non-toxic, non-staining and shall provide a heavy fog at 30 PPM with a permissible airborne level concentration of 50 PPM.
- .3 Fog at a rate of 4 s / 2.8 m3. Maintain the fog density until inspection is complete.

END OF SECTION 07 84 00

PART 1 - GENERAL

1.1 RELATED WORK

.1 Fire Stopping: Section 07 84 00

1.2 REFERENCES

.1 CAN/ULC- S101 Standard Methods of Fire Endurance Tests of Building Construction and Materials.
.2 CAN/ULC-S102 Methods of Test for Surface Burning Characteristics of Building Materials and Assemblies.
.3 ASTM E84 Surface Burning Characteristics.
.4 ASTM E119 Standard Methods of Fire Tests of Building Construction and Materials.
.5 ASTM E605 Standard Test Methods for Thickness and Density of Sprayed Fire-Resistive Material Applied to Structural Members.
.6 ASTM E761Compressive Strength of Sprayed Fire-Resistive Material Applied to Structural Members.
.7 UL/ANSI 263 Fire Tests of Building Construction Materials.
.8 ULC List of Equipment and Materials and UL Fire Resistance Directory.
.9 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  .1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
.2 Product Data:
  .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
  .2 Submit two copies of WHMIS MSDS - Material Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.
  .3 Samples: submit duplicate 300 x 300 mm size sample of exposed fireproofing for approval of texture and colour.
  .4 Quality assurance submittals: submit following in accordance with Section 01 45 00 - Quality Control.
    .1 Test Reports:
      .1 Submit product data including certified copies of test reports verifying fireproofing applied to substrate as constructed on project will meet or exceed requirements of Specification.
      .2 Submit test results in accordance with CAN-ULC-S101 for fire endurance and CAN-ULC-S102 for surface burning characteristics.
      .3 For assemblies not tested and rated, submit proposals based on related designs using accepted fireproofing design criteria.
    .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
    .3 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures.

1.4 QUALITY ASSURANCE

.1 Appply by applicator acceptable to Owner's Representative and approved by manufacturer for application of its products.
.2 Applicators: minimum 5 years proven experience.
.3 Steel Surfaces: Structural steel and steel decking shall be unprimed.

.4 Painted Steel Surfaces: Steel surfaces requiring fireproofing that are painted and/or primed, shall meet UL requirements for application and adhesion characteristics. Provide certifications from fireproofing manufacturer of compatibility of fireproofing and painted systems.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Packing, shipping, handling and unloading:
  .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
  .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
  .3 Deliver packaged materials in original unopened containers, marked to indicate brand name, manufacturer, ULC markings.
.2 Storage and Protection:
  .1 Store materials indoors in dry location.
  .2 Store and protect materials from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.
  .3 Damaged or opened containers will be rejected.
  .4 Packaging to indicate shelf-life and materials to be applied prior to expiration of shelf-life.
  .5 Provide temporary enclosures to prevent spray from contaminating air beyond application area.
  .6 Protect adjacent surfaces and equipment from damage by overspray, fall-out, and dusting of fireproofing materials.
.3 Waste Management and Disposal:
  .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.6 AMBIENT CONDITIONS

.1 At temperatures less than 5 degrees C, ensure that 5 degrees C air and substrate temperature is maintained during and for 24 hours after application. Ensure that natural ventilation to properly dry the fireproofing during and subsequent to its application is provided. In enclosed areas lacking openings for natural ventilation, ensure that interior air is circulated and exhausted to the outside.
.2 Maintain relative humidity within limits recommended fireproofing manufacturer.
.3 Ensure that natural ventilation to properly dry fireproofing during and subsequent to its application is provided.
.4 In enclosed areas lacking openings for natural ventilation, provide minimum of 4 air exchanges per hour by forced air circulation.

1.7 SEQUENCING

.1 Sequence and coordinate application of sprayed fireproofing with other related work specified in other Sections.
.2 Provide temporary enclosure for interior applications to prevent deterioration of applied materials exposed to unfavorable environmental conditions.
.3 Avoid exposure of fireproofing to unnecessary damage or abrasion.
.4 Do not apply fireproofing to metal decking until installation of all air handling systems.

1.8 WARRANTY

.1 Warranty: Submit a written warranty, for 2 years, from date of substantial completion, executed by the contractor and cosigned by the installer, agreeing to repair or replace sprayed fireproofing materials that fall within the specified warranty period.

.1 Failures include, but are not limited to cracking, flaking, eroding in excess of specified requirements, peeling and delaminating of sprayed fireproofing from substrates due to defective materials or installation.

.2 Not include are failures due to damage by others, such as occupants and owner maintenance personnel, exposure to environmental conditions other than those investigated and approved during fire-response testing, excessive flexing of floor systems, and work on said roof systems, and other causes not reasonable foreseeable under conditions of normal use.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Fireproofing for building elements: spray applied, ULC labelled and listed; asbestos-free, ceramic fibre-free cementitious based composition; meeting following in-place cured performance requirements.

.1 Combustibility: noncombustible
.2 Cohesion Adhesion, ASTM E736: minimum 9.7 kPa.
.3 Air Erosion, ASTM E859: maximum 0.235 g/m2 @ 24hr
.4 Surface Burning, ASTM E84 Flame Spread: 0, Smoke: 0

.2 Fireproofing: minimum dry density and cohesion/adhesion properties as follows:

.1 Fireproofing for structural components concealed above ceiling, or within wall, chase, or furred space: average applied dry density of 240 kg per cubic meter and cohesion/adhesion strength of 9.57 kPa.
.2 Fireproofing for exposed structural components, except where otherwise specified or indicated: minimum applied dry density of 350 kg per cubic meter and cohesion/adhesion strength of 20.83 kPa.
.3 Ensure spray-applied fireproofing: does not crack, spall or delaminate under downward deflection conditions over 3 m clear span.
.4 Minimum compressive strength: 48 kPa.
.5 Spray-Applied fireproofing material: not contribute to corrosion of test panels.
.6 Dust removal: not exceed 0.25 gram per square meter.

2.2 MISCELLANEOUS MATERIALS

.1 Primers: It is not recommended that any structural steel primers are used on any steel surfaces, unless tested and listed by UL in designs proposed to be used. Compatible primers may be used, providing the fireproofing manufacturer can verify such compatibility in accordance with UL requirements.

.2 Adhesives: Provide adhesives as necessary, to comply with manufacturer requirements for adhesion of fireproofing.

.3 Reinforcements: Provide fiberglass mesh or wire lath for areas where adhesion is not compatible.

PART 3 - EXECUTION

3.1 PREPARATION

.1 Pre-Installation Examination: The applicator and the contractor shall examine surfaces to be fire protected, and determined if the surfaces are satisfactory. Substrate conditions must comply with the following:

.1 Substrates must be free of grease, oil, rolling compounds, incompatible primers, loose mill scale, dirt or any other foreign matter which would prevent proper bonding of fireproofing.

.2 Structural steel shall be unprimed. Steel roof and floor decking shall be galvanized only.
.3 Any objects such as hangers, piping attachments, and other suspended retainer devices shall be properly secured.
.4 Ducts, piping, and other equipment shall not be placed or suspended until the fire protection materials are in place.

.2 Clean any substrate not ready to receive fireproofing. Consult with manufacturer if conditions exist not easily remedied.
.3 Apply adhesives as necessary.
.4 Cover all work subject to oversprays during application. Provide temporary enclosure when necessary to temporarily confine fireproofing and protect the environment.
.5 Assure maintenance of ambient temperatures, and/or heat and ventilation when required.

3.2 INSTALLATION, GENERAL

.1 Comply with manufacturers written application instructions and procedures for mixing, conveying and applying products, in accordance with the types of recommended equipment, admixtures and specific procedures regarding special conditions.
.2 Coat substrates with adhesives if necessary.
.3 Extend fireproofing materials in full thickness per approved design, to be protected. Unless otherwise recommended, install fireproofing complete in each area, prior to another.
.4 Provide a uniform surface matching UL requirements for designs approved. Apply products at the minimum densities required, or greater.
.5 Cure fireproofing to prevent premature drying; protect from freezing.

3.3 APPLICATION

.1 Apply fireproofing to extent and thicknesses required to produce fire ratings indicated.
.2 Apply fireproofing to produce specified fire rating.
.3 Apply fireproofing over substrate and build up to obtain required thickness to cover substrate with monolithic blanket of uniform density.

3.4 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:
.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
.3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

.2 Inspection and Site Tests:
.1 Inspection and testing of fireproofing will be carried out by Testing Laboratory engaged by Contractor.
.2 Contractor will pay costs for testing.

3.5 CLEANING AND REPAIR

.1 Proceed in accordance with Section 01 74 11 - Cleaning.
.2 After completion of each day's work, the applicator shall broom clean the area fireproofed. Areas not to receive fireproofing but are finished surfaces shall be masked.
.3 All patching of damaged fireproofing shall be completed by applicator.

END OF SECTION 07 81 00

PART 1 - GENERAL

1.1 RELATED WORK

.1	Architectural Woodwork:	Section 06 40 00
.2	Firestopping:	Section 07 84 00
.3	Metal Doors and Frames:	Section 08 11 00
.4	Glazed Aluminum Curtain Wall:	Section 08 44 13
.5	Aluminum Windows:	Section 08 51 13
.6	Glazing:	Section 08 80 00
.7	Gypsum Board:	Section 09 29 00
.8	Plumbing:	Division 22

1.2 REFERENCE STANDARDS

.1 CGSB 19-GP-5M, Sealing Compound, One Component, Acrylic Base, Solvent Curing.
.2 CAN/CGSB19.13, Sealing Compound, One component, Elastomeric, Chemical Curing
.3 CGSB 19-GP-14M, Sealing Compound, One-Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing.
.4 CAN/CGSB 19.17, One Component Acrylic Emulsion Base Sealing Compound.
.5 CAN/CGSB-19.24, Multicomponent, Chemical-Curing Sealing Compound.
.6 ASTM C834, ASTM C834, Standard Specification for Latex Sealants
.7 ASTM C920, Standard Specification for Elastomeric Joint Sealants
.8 ASTM C919, Standard Practice for Use of Sealants in Acoustical Applications
.9 ASTM C1193, Standard Guide for Use of Joint Sealants
.10 ASTM C1248, Standard Test Method for Staining of Porous Substrate by Joint Sealants
.11 ASTM C1330, Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants
.12 ASTM D2240, Standard Test Method for Rubber Property—Durometer Hardness
.13 Health Canada/Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS).
.14 Canadian Environmental Protection Act, 1999 (CEPA

1.3 SUBMITTALS

.1 Submit in accordance with Section 01 33 00.
.2 Product Data Sheet: Submit manufacturer's catalog data and application instructions for each material proposed for use.
.3 Submit duplicate samples of each type of material and colour.
.4 Asbestos-Free and Lead-Free Paint Certification: Submit manufacturer's written certification that all materials are free of asbestos and lead paint.
.5 Manufacturer's Certifications: Submit manufacturer's representative certification that the proposed products are recommended and compatible with each other and substrates for the intended applications.
.6 Material Safety Data Sheets (MSDS): Submit MSDS for joint sealant products.

1.4 QUALITY ASSURANCE/MOCK-UP

.1 Construct mock-up in accordance with Section [01 45 00 - Quality Control].
.2 Construct mock-up to show location, size, shape and depth of joint [s] complete with back-up material, primer, caulking and sealant.
.3 Mock-up will be used to judge workmanship, substrate preparation, operation of equipment and material application.
.4 Locate where directed.
.5 Allow 24 hours for inspection of mock-up by Consultant before proceeding with sealant work.

.6 When accepted, mock-up will demonstrate minimum standard of quality required for this Work. Approved mock-up may remain as part of finished Work.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Deliver and store packaged materials in manufacturer's original unopened containers with seals unbroken and labels intact until time of use.
.2 Store materials off ground and under cover to prevent damage or contamination to materials by water, freezing, foreign matter or other causes.
.3 Promptly remove from site any materials which show evidence of damage and immediately make all replacements necessary.

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management And Disposal.
.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
.4 Place materials defined as hazardous or toxic in designated containers.
.5 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional and Municipal regulations.
.6 Unused material must not be disposed of into sewer system, into streams, lakes, onto ground or in other location where it will pose health or environmental hazard.
.7 Divert unused joint sealing material from landfill to official hazardous material collections site approved by Consultant.
.8 Empty plastic joint sealer containers are not recyclable. Do not dispose of empty containers with plastic materials destined for recycling.
.9 Fold up metal banding, flatten, and place in designated area for recycling.

1.7 PROJECT CONDITIONS

.1 Environmental Limitations:
  .1 Do not proceed with installation of joint sealants under following conditions:
    .1 When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 4.4 degrees C.
    .2 When joint substrates are wet.
.2 Joint-Width Conditions:
  .1 Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.
.3 Joint-Substrate Conditions:
  .1 Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.8 ENVIRONMENTAL REQUIREMENTS

.1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and provision of Material Safety Data Sheets (MSDS) acceptable to Labour Canada.
.2 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.

PART 2 - PRODUCTS

2.1 SEALANT MATERIALS

.1 Do not use caulking that emits strong odours, contains toxic chemicals or is not certified as mould resistant in air handling units.
.2 When low toxicity caulks are not possible, confine usage to areas which offgas to exterior, are contained behind air barriers, or are applied several months before occupancy to maximize offgas time.
.3 Where sealants are qualified with primers use only these primers.

2.2 SEALANT MATERIAL DESIGNATIONS

.1 Type S-1; acrylic sealant: One part acrylic latex, Shore A Hardness 20, conforming to CAN/CGSB-19.17-M and ASTM C834.
.2 Type S-2; silicone sealant: Mould and mildew resistant, Shore A Hardness 15-25, conforming to ASTM C920, Type S, Grade NS, Class25, use NT, G, and A.
.3 Type S-3; silicone sealant: Exterior Weatherproofing Sealant, One-part, low modulus, neutral cure, Shore A Hardness 15-25, conforming to CAN/CGSB-19.13-M, Classification C-1-40-B-N and C-1-25-B-N, and ASTM C 920, Type S, Grade NS, Class 25, use NT, M, G, A and O.
.4 Type S-4, Silicone Sealant: Butt glazing, one part, moisture curing, shore A hardness 15-25, conforming to CAN/CGSB-19.13-M, Classification C-1-40-B-N and C-1-25-B-N and ASTM C920, Type S, Grade NS, Class 25, use NT, G, A, O; Colour. clear (translucent).
.5 Type S-5; interior acoustical sealant: Non-skinning, non-hardening, single component synthetic rubber sealant, conforming to CAN/CGSB-19.21-M.
.6 Type S-6; air-seal sealant: One part, silicone, shore A hardness 15 – 25, conforming to CGSB 19-GP-13M, classification C-1-40-B-N and C-1-25-B-N and ASTM C920, Type S, Grade NS, Class 25. Use NT, M, G, A and O.
.7 Type S-7; two part multi-component sealant: Chemical curing, non-sag, exterior wall sealant, Shore A Hardness 20-35, conforming to CAN/CGSB-19.24-M, Type 2, Class B, and ASTM C920, Type S, Grade NS, Class 25, use NT, M, and A.
.8 Type S-10; polyurethane sealant: One component, non-sag, for general construction, Shore A Hardness 15+, conforming to CAN/CGSB-19.13-M, Type 2, Classification MCG-2-25-A-N and ASTM C920, Type S, Grade NS, Class 25, Use NT, M, and A.
.9 Type S-11; saw-cut sealant: Multi-component, self-levelling, conforming to ASTM D2240.
.10 Type S-12; control joint sealant: Two-component, solvent free, flexible epoxy urethane, load bearing, conforming to ASTM D2240, Shore A Hardness 65-75.

2.3 SEALANT BACKING

.1 Provide sealant backings of material and type that are non-staining, compatible with joint substrates, sealants, primers, and other joint fillers, and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
.2 Rod Type Sealant Backings:
  .1 ASTM C1330, Type C (closed cell material with a surface skin), Type O (open cell material) or Type B (bi-cellular material with a surface skin).
  .2 Use any of the preceding types, as approved in writing by joint sealant manufacturer for joint application indicated.
  .3 Size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
  .4 Non-adhering to sealant, to maintain two sided adhesion across joint.
.3 Bond Breaker Tape: Self adhesive polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint filler materials or joint surfaces at back of joint where three sided adhesion will result in sealant failure.

2.4 ACCESSORIES

.1 Primer: Material recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from pre-construction joint sealant substrate tests and field tests.
.2 Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
.3 Masking Tape: Non-staining, non-absorbent material compatible with joint sealants and surfaces adjacent to joints.

2.5 SEALANT SELECTION

.1 Where no specified type of sealant is shown or specified choose one of the sealants specified in this Section applicable to that intended application, and consistent with manufacturer's recommendations.
.2 Use acrylic sealant Type S-1 only on the interior and only in situations where little or no movement can occur.
.3 Use mould and mildew resistant silicone sealant Type S-2 for non-moving joints in washrooms and kitchens(e.g. sinks, tubs, urinals, stools, waterclosets, basins, vanities); do not use on floors.
.4 Use silicone general construction sealant Type S-3 or polyurethane sealant Type S-7 and S-10 for all joints, interior and exterior, where no other specific sealant type specified; do not use on horizontal traffic joints or where immersed in water.
.5 Use structural glazing silicone Type S-4 for sealing structural glass, exterior.
.6 Use acoustical sealant Type S-5 for interior applications only where they will be fully concealed and only where no constant or consistent air pressure difference will exist across the joint.
.7 Use air seal sealant Type S-6 for exterior walls only where constant or consistent air pressure difference will exist across the joint.
.8 Use multi-component sealant Type S-7 for exterior vertical joints where large movement is anticipated; not for continuous water immersion.
.9 Use multi-component sealant type S-11 for saw-cuts in slabs on grade and horizontal joint sealant of floors and decks, interior areas only.
.10 Use multi-component sealant type S-7 for edge joint sealant at slab edges at walls, columns, interior shaft walls and grade beams.
.11 In addition, seal the following joints:
    .1 Seal perimeters of hollow metal door frames on both sides.
    .2 Seal perimeters of aluminum door frames on both sides.
    .3 Seal control joints in gypsum board, and junctures between interior partitions with exterior walls.
    .4 Seal window and door frames around the inside perimeter, so that an airtight seal is obtained, as indicated on drawings.
    .5 Seal control, expansion joints in floors and walls and around service and fixture penetrations.

PART 3 - EXECUTION

3.1 PROTECTION

.1 Protect installed Work of other trades from staining or contamination.

3.2 SURFACE PREPARATION

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

other matter which may impair Work.

.3 Do not apply sealants to joint surfaces treated with sealer, curing compound, water repellent, or other coatings unless tests have been performed to ensure compatibility of materials. Remove coatings as required.

.4 Ensure joint surfaces are dry and frost free.

.5 Prepare surfaces in accordance with manufacturer's directions.

3.3 PRIMING

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

.2 Prime sides of joints in accordance with sealant manufacturer's instructions immediately prior to caulking.

3.4 BACKUP MATERIAL

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

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

3.5 MIXING

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

3.6 APPLICATION

.1 Sealant.

.1 Apply sealant in accordance with manufacturer's written instructions.

.2 Mask edges of joint where irregular surface or sensitive joint border exists to provide neat joint.

.3 Apply sealant in continuous beads.

.4 Apply sealant using gun with proper size nozzle.

.5 Use sufficient pressure to fill voids and joints solid.

.6 Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities.

.7 Tool exposed surfaces before skinning begins to give slightly concave shape.

.8 Remove excess compound promptly as work progresses and upon completion.

.2 Curing.

.1 Cure sealants in accordance with sealant manufacturer's instructions.

.2 Do not cover up sealants until proper curing has taken place.

.3 Cleanup.

.1 Clean adjacent surfaces immediately and leave Work neat and clean.

.2 Remove excess and droppings, using recommended cleaners as work progresses.

.3 Remove masking tape after initial set of sealant.

END OF SECTION 07 90 00

PART 1 - GENERAL

1.1 RELATED WORK

.1	Joint Protection:	Section 07 90 00
.2	Finish Hardware:	Section 08 70 00
.3	Glazing:	Section 08 80 00
.4	Painting:	Section 09 90 00
.5	Electrical:	Division 26

1.2 REFERENCE STANDARDS

.1 American Society for Testing and Materials (ASTM)
- .1 ASTM A653/A653M, Specificaton for Steel Sheet Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvanized) by the Hot Dip Process.

.2 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB1.181, Ready Mixed Organic Zinc Rich Coating.
- .2 CGSB 41GP19Ma, Rigid Vinyl Extrusions for Windows and Doors.

.3 Canadian Standards Association (CSA International)
- .1 G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .2 CSA W59, Welded Steel Construction (Metal Arc Welding).

.4 Canadian Steel Door Manufacturers' Association, (CSDMA).
- .1 CSDMA, Specifications for Commercial Steel Doors and Frames.
- .2 CSDMA, Recommended Selection and Usage Guide for Commercial Steel Doors.

.5 National Fire Protection Association (NFPA)
- .1 NFPA 80, Standard for Fire Doors and Fire Windows.
- .2 NFPA 252, Standard Methods of Fire Tests of Door Assemblies.

.6 Underwriters' Laboratories of Canada (ULC)
- .1 CAN4S104M, Fire Tests of Door Assemblies.
- .2 CAN4S105M, Fire Door Frames Meeting the Performance Required by CAN4S104.
- .3 CAN/ULCS701, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
- .4 CAN/ULCS702, Thermal Insulation, Mineral Fibre, for Buildings.
- .5 CAN/ULCS704, Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.

1.3 SYSTEM DESCRIPTION

.1 Design Requirements:
- .1 Design exterior frame assembly to accommodate to expansion and contraction when subjected to minimum and maximum surface temperature of -35 degrees C to 35 degrees C.
- .2 Maximum deflection for exterior steel entrance screens under wind load of 1.2 kPa not to exceed 1/175th of span.
- .3 Steel fire rated doors and frames: labelled and listed by an organization accredited by Standards Council of Canada in conformance with CAN4-S104 NFPA 252 for ratings specified or indicated.

1.4 SUBMITTALS

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

.2 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.
- .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province British Columbia, Canada.
- .2 Indicate each type of door, material, steel core thicknesses, mortises, reinforcements, location of exposed fasteners, openings, arrangement of hardware fire rating and finishes.

.3 Indicate each type frame material, core thickness, reinforcements, glazing stops, location of anchors and exposed fastenings, reinforcing, fire rating, finishes.
.4 Include schedule identifying each unit, with door marks and numbers relating to numbering on drawings and door schedule.
.5 Submit test and engineering data, and installation instructions.

.3 Provide samples in accordance with Section 01 33 00 - Submittal Procedures.
.4 Submit one 300 x 300 mm corner sample of each type of frame.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
.2 Inspect all materials for discrepancies, deficiencies, and damage.
.3 Store materials on planks, away from water and moisture and cover to protect from damage.
.4 Store doors in vertical position and space with blocking to permit air circulation.
.5 Waste Management and Disposal:
.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Commercial grade steel to ASTM A653, CS, Type B, Coating Designation ZF75 (A25) minimum. Minimum steel thicknesses shall be in accordance with Appendix 1 of the CSDMA, Recommended Specifications for Commercial Steel Door and Frame Products. Steel shall be free from scale pitting, coil breaks or other surface blemishes and also be free of buckles, waves or any other defects caused by use of improper levelled sheets.
.2 Reinforcement channel: to CSA G40.20/G40.21, Type 44W, coating designation to ASTM A653M, ZF75.
.3 Thickness for steel components:
.1 Shall be in accordance with the CSDFMA specification 'Table 1 - Minimum Steel Gauges for Component Parts', unless otherwise specified.
.2 Door faces:
.1 Standard duty: 20 ga.
.2 Heavy duty: 18 ga.
.3 Door frames:
.1 Standard duty: 18 ga.
.2 Heavy duty: 16 ga.

2.2 DOOR CORE MATERIALS

.1 Honeycomb construction:
.1 Structural small cell, 24.5 mm maximum kraft paper honeycomb, weight: 36.3 kg per ream minimum, density: 16.5 kg/m^3 minimum sanded to required thickness.
.2 Stiffened: face sheets laminated insulated core.
.1 Polyurethane: to CAN/ULC-S704 rigid, modified poly/isocyanurate, closed cell board. Density 32 kg/m^3.

2.3 ADHESIVES

.1 Honeycomb cores and steel components: heat resistant, spray grade, resin reinforced neoprene/rubber (polychloroprene) based, low viscosity, contact cement.
.1 Adhesive: maximum VOC content 50 g/L to SCAQMD Rule 1168.
.2 Polyurethane cores: heat resistant, epoxy resin based, low viscosity, contact cement.

2.4 PRIMER

.1 Touch-up prime CAN/CGSB-1.181.

2.5 PAINT

.1 Field paint steel doors and frames in accordance with Sections 09 91 23 - Interior Painting, 09 91 13 - Exterior Painting. Protect weatherstrips from paint. Provide final finish free of scratches or other blemishes.
.2 Maximum VOC emission level 50 g/L to GS-11.

2.6 ACCESSORIES

.1 Door silencers: single stud rubber/neoprene type.
.2 Exterior top caps: steel.
.3 Fabricate glazing stops as formed channel, minimum 16 mm height, accurately fitted, butted at corners and fastened to frame sections with counter-sunk oval head sheet metal screws.
.4 Metallic paste filler: to manufacturer's standard.
.5 Fire labels: metal riveted.
.6 Glazing: in accordance with Section 08 80 00.
.7 Make provisions for glazing as indicated and provide necessary glazing stops.

2.7 FRAMES FABRICATION GENERAL

.1 Fabricate frames in accordance with CSDMA specifications.
.2 Fabricate frames to profiles and maximum face sizes as indicated.
.3 Exterior frames: thermally broken.
.4 Blank, reinforce, drill and tap frames for mortised, templated hardware, using templates provided by finish hardware supplier. Reinforce frames for surface mounted hardware.
.5 Protect mortised cutouts with steel guard boxes.
.6 Prepare frame for door silencers, 3 for single door, 2 at head for double door.
.7 Manufacturer's nameplates on frames and screens are not permitted.
.8 Conceal fastenings except where exposed fastenings are indicated.
.9 Provide factory-applied touch up primer at areas where zinc coating has been removed during fabrication.
.10 Insulate exterior frame components with polyurethane insulation.

2.8 FRAME ANCHORAGE

.1 Provide appropriate anchorage to floor and wall construction.
.2 Locate each wall anchor immediately above or below each hinge reinforcement on hinge jamb and directly opposite on strike jamb.
.3 Provide 2 anchors for rebate opening heights up to 1520 mm and 1 additional anchor for each additional 760 mm of height or fraction thereof.

2.9 FRAMES: WELDED TYPE

.1 Welding in accordance with CSA W59.
.2 Accurately mitre or mechanically joint frame product and securely weld on inside of profile.
.3 Cope accurately and securely weld butt joints of mullions, transom bars, centre rails and sills.
.4 Grind welded joints and corners to a flat plane, fill with metallic paste and sand to uniform smooth finish.
.5 Securely attach floor anchors to inside of each jamb profile.
.6 Weld in 2 temporary jamb spreaders per frame to maintain proper alignment during shipment.

2.10 DOOR FABRICATION GENERAL

.1 Doors: swing type, flush, with provision for glass and/or louvre openings as indicated.
.2 Exterior doors: polyurethane construction. Interior doors: honeycomb construction.
.3 Fabricate doors with longitudinal edges welded. Seams: grind welded joints to a flat plane, fill with metallic paste filler and sand to a uniform smooth finish.
.4 Blank, reinforce, drill doors and tap for mortised, templated hardware.
.5 Factory prepare holes 12.7 mm diameter and larger except mounting and through-bolt holes, on site, at time of hardware installation.
.6 Reinforce doors where required, for surface mounted hardware. Provide flush steel top caps to exterior doors. Provide inverted, recessed, spot welded channels to top and bottom of interior doors.
.7 Provide factory-applied touch-up primer at areas where zinc coating has been removed during fabrication.
.8 Provide fire labelled doors for those openings requiring fire protection ratings, as scheduled.
.9 Manufacturer's nameplates on doors are not permitted.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION GENERAL

.1 Install labelled steel fire rated doors and frames to NFPA 80 except where specified otherwise.
.2 Install doors and frames to CSDMA Installation Guide.

3.3 FRAME INSTALLATION

.1 Set frames plumb, square, level and at correct elevation.
.2 Secure anchorages and connections to adjacent construction.
.3 Brace frames rigidly in position while building-in. Install temporary horizontal wood spreader at third points of door opening to maintain frame width. Provide vertical support at centre of head for openings over 1200 mm wide. Remove temporary spreaders after frames are built-in.
.4 Make allowances for deflection of structure to ensure structural loads are not transmitted to frames.
.5 Caulk perimeter of frames between frame and adjacent material.

3.4 DOOR INSTALLATION

.1 Install doors and hardware in accordance with hardware templates and manufacturer's instructions and Section 08 71 00 - Door Hardware.
.2 Provide even margins between doors and jambs and doors and finished floor and thresholds as follows.
  .1 Hinge side: 1.0 mm.
  .2 Latchside and head: 1.5 mm.
  .3 Finished floor, top of carpet and thresholds: 13 mm.
.3 Adjust operable parts for correct function.

3.5 FINISH REPAIRS

.1 Touch up with primer finishes damaged during installation.
.2 Fill exposed frame anchors and surfaces with imperfections with metallic paste filler and sand to

a uniform smooth finish.

3.6 GLAZING

.1 Install glazing for doors and frames in accordance with Section 08 80 50 - Glazing.

END OF SECTION 08 10 00

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes materials and requirements for access doors and panels to all concealed mechanical equipment for operating, inspecting, adjusting, balancing and servicing.

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 SUBMITTALS

.1 Shop Drawings:

.1 Submit shop drawings for each type of access door.

.2 Closeout Submittals

.1 Provide maintenance data for incorporation into Operational and Maintenance manual.

PART 2 - PRODUCTS

2.1 ACCESS DOORS

.1 Supply flush mounted access doors, for installation by Building Trades in non-accessible type ceilings and walls where necessary for access to service and/or to inspect mechanical equipment and accessories and life safety devices and where specifically indicated.

.2 Sizes: Except as indicated otherwise, to be minimum sizes as follows:

.1 600 x 600 mm [24” x 24”] for body entry.

.2 300 x 300 mm [12” x 12”] for hand entry.

.3 200 x 200 mm [8” x 8”] for cleanout access.

.3 Construction: 180 degree door swing, mitred rounded safety corners flush welded, concealed hinges, screwdriver latches, and anchor straps or lugs to suit construction, all steel shall be prime coated.

.4 Drywall construction: 16 gauge for 400 mm x 400 mm [16” x 16”] and smaller, 14 gauge for 450 mm x 450 mm [18” x 18”] and larger, bonderized steel, mounted on face of wall or ceiling with exposed flange.

.5 Ceramic tile or wet wall construction in washrooms and other special areas: 14 gauge stainless steel flush with wall or ceiling with concealed flange.

2.2 EXCLUSIONS

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

PART 3 - EXECUTION

3.1 LOCATION

.1 Locate access doors so that all concealed items are within view, readily accessible for adjustment, operation, maintenance and inspection without using special tools.

.2 Locate in service and storage areas wherever possible.

.3 Do not locate in panelled, feature or special finish walls or ceilings, without prior approval of the Departmental Representative.

END OF SECTION 08 31 19

PART 1 - GENERAL

1.1 RELATED WORK

.1	Metal Fabrications:	Section 05 50 00
.2	Joint Sealants:	Section 07 90 00
.3	Electrical:	Division 26.

1.2 REFERENCES

.1 ANSI/DASMA 102 - 2011 – Specifications for Sectional Doors.
.2 ASTM E84-14 - Standard Test Method for Surface Burning Characteristics of Building Materials.

1.3 SYSTEM DESCRIPTION

.1 Panels: Aluminum frame panels with full-width clear polycarbonate glazing.
.2 Lift Type: Vertical lift and High lift operating style with track and hardware.
.3 Operation: manual chain hoist with motor interlock.
.4 Loads: Design and size components to withstand dead and live loads caused by pressure and suction of wind acting normal to plane of wall as measured in accordance with ANSI/DASMA 102.

1.4 SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
.2 Shop Drawings: Indicate opening dimensions and required tolerances, connection details, anchorage spacing, hardware locations, installation details.
.3 Product Data: Provide component construction, anchorage method, hardware.
.4 Samples: Submit aluminum and polycarbonate glazing panel samples, illustrating colour and finish.

1.5 CLOSEOUT SUBMITTALS

.1 Section 01 78 00: Closeout Submittals.
.2 Operation and Maintenance Data:
  .1 Include electrical control adjustments.
  .2 Include data for motor, shaft and gearing, lubrication frequency, spare part sources.
.3 Warranty Documentation: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

.1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum ten (10) years documented experience.
.2 Installer Qualifications: Company specializing in performing the work of this section with minimum five (5) years documented experience and approved by the manufacturer.

1.7 REGULATORY REQUIREMENTS

.1 Conform to applicable code for motor and motor control requirements.
.2 Products Requiring Electrical Connection: Listed and classified by testing firm acceptable to the Departmental Representative CSA and ULC as suitable for the purpose specified.

1.8 DELIVERY, STORAGE AND HANDLING

.1 Door sections should be carried and handled in the upright position, on edge. Carrying flat may result in damage.
.2 Store in manufacture's unopened packaging until time of installation. Protect from moisture.

1.9 WARRANTY

.1 Warranty: Manufacturer's ten (10) year warranty against materials and workmanship of door sections.
  .1 Include coverage of polycarbonate to manufacturers tolerances, including discolouration, loss of light transmission, and loss of strength due to weathering.
.2 Provide ten (10) year manufacturer warranty for electric operating equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Aluminum: Extruded, 6063-T5, 2 mm thick, 4 mm thick at hinge fastening locations.
.2 Glazing: Continuous full width Polycarbonate, Triple-wall construction, 16 mm, clear.
.3 Glazing gasket: Glazing wedge, compression fit rubber glazing wedge.
.4 Aluminum Finish: Clear Anodized.
.5 Weatherstripping:
  .1 Glazing: Thermoplastic vulcanizate, polyolefin based, recyclable. Santoprene 201-64.
  .2 Between sections: Bulb weatherstripping, factory installed.

2.2 PANEL CONSTRUCTION

.1 Stiles and rails: Extruded aluminum frame stiles and rails, minimum 2 mm thick, and 4 mm thick at hardware fastening locations.
  .1 Provide integral aluminum truss wall concealed within rail extrusion, from exterior to interior at the centre, on both interior and exterior frames. Truss wall to run whole width of door panel.
.2 Panels:
  .1 Glazing Panels: Polycarbonate, one-piece continuous triple-wall glazing, full width of panel, with extruded aluminum frame. Seal exterior glazing joints with gasket; do not use silicone.
  .2 Colours: clear.
.3 Door Nominal Thickness: 45 mm thick.

2.3 HARDWARE COMPONENTS

.1 Track: Rolled galvanized steel, 2.0 mm (12 gauge) thick; 75 mm wide, continuous one piece per side; galvanized steel mounting brackets 1.6 mm (14 gauge) thick.
.2 Hinge and Roller Assemblies: Heavy duty hinges and adjustable roller holders of galvanized steel ; floating hardened steel bearing rollers, located at top and bottom of each panel, each side.
.3 Lift Mechanism: Torsion spring on cross head shaft, with braided galvanized steel lifting cables. Manual operation with maximum exertion of 110 N, force.
.4 Operator: manual chain hoist with motor interlock.
.5 Sill Weatherstripping: Fit to bottom of door panel, full length contact.
.6 Jamb Weatherstripping: Place full height of jamb, in moderate contact with door panels.
.7 Head Weatherstripping: One piece full length, fixed to top section.
.8 Panel Joint Weatherstripping: One piece full length, bulb weather stripping.

2.4 ELECTRICAL CHARACTERISTICS AND COMPONENTS

.1 Electrical Characteristics:
  .1 1HP-575V-3 Phase continuous duty motor.
  .2 60Hz high starting torque, continuous-duty.
.2 Motor: NEMA MG1, Type 1 enclosure.
.3 Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.
.4 Disconnect Switch: Factory mount disconnect switch in control panel
.5 Electric Operator:
  .1 Side mounted on cross head shaft, adjustable safety friction clutch.
  .2 Brake system actuated by independent voltage solenoid controlled by motor starter; enclosed gear driven limit switch; enclosed magnetic cross line reversing starter; mounting brackets and hardware.
.6 Control Station:
  .1 Standard three (3) button (open-close-stop) continuous pressure type, control for each electric operator; 24 volt circuit, surface mounted .
.7 Wireless bottom 'FeatherEdge' safety reversing edge system
.8 Dual photocell reversing safety eyes

2.5 FINISHES

.1 Door Panels:
  .1 Clear anodized.
  .2 Track: Uncoated.
  .3 Hardware: Uncoated.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Section 01 71 00 - Examination and Preparation: Verify existing conditions before starting work.
.2 Verify that wall openings are ready to receive work and opening dimensions and tolerances are within specified limits.
.3 Verify that electric power is available and of the correct characteristics.

3.2 PREPARATION

.1 Prepare opening to permit correct installation of door unit to perimeter air and vapour barrier seal.

3.3 INSTALLATION

.1 Install door unit assembly to manufacturer written instructions.
.2 Anchor assembly to wall construction and building framing without distortion or stress.
.3 Securely brace door tracks suspended from structure. Secure tracks to structural members only.
.4 Fit and align door assembly including hardware.
.5 Coordinate installation of electrical service. Complete power and control wiring from disconnect to unit components. Final connection of electrical service to be performed by qualified personnel.
.6 Coordinate installation of sealants and backing materials at frame perimeter as specified in Section 07 90 00.

3.4 ERECTION TOLERANCES

.1 Maximum Variation from Plumb: 1.5 mm.

.2 Maximum Variation from Level: 1.5 mm.
.3 Longitudinal or Diagonal Warp: Plus or minus 3 mm, from 3 m straight edge.
.4 Maintain dimensional tolerances and alignment with adjacent work.

3.5 ADJUSTING

.1 Ensure the operation and adjustments to door assembly for specified operation.
.2 Adjust door assembly to smooth operation and in full contact with weatherstripping.

3.6 CLEANING

.1 Section 01 74 00: Cleaning installed work.
.2 Clean frames, doors, glass.
.3 Remove temporary labels and visible markings.

3.7 PROTECTION OF FINISHED WORK

.1 Do not permit construction traffic through overhead door openings after adjustment and cleaning.

3.8 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:
.1 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

END OF SECTION 08 36 13

PART 1 - GENERAL

1.1 RELATED WORK

.1	Insulated Metal Wall Panels:	Section 07 42 13
.2	Joint Sealants:	Section 07 90 00
.3	Glazing:	Section 08 80 00

1.2 REFERENCES

.1 National Building Code (NBC).
.2 CAN3-S157, Strength Design in Aluminum.
.3 CAN/CSA-A440, Windows.
.4 IGMA North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use.
.5 AAMA 2604, Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.

1.3 QUALITY ASSURANCE

.1 Work shall be installed, glazed and adjusted by experienced workmen in accordance with manufacturer's written instructions and the reviewed shop drawings.

1.4 PERFORMANCE REQUIREMENTS

.1 Components, assemblies and completed work shall conform to the following performance requirements, and comply with the. Loads shall be designed to act in the most unfavourable combinations.
.2 Thermal movement: Allow for free and noiseless thermal movement within a temperature range of -18°C to +65°C. Warping, buckling, glass breakage, open joints, stress on fasteners, failure of sealants, or any other detrimental effects due to thermal movement will not be acceptable. Fabrication, assembly and erection procedures shall take into account the ambient temperature range at time work is carried out.
.3 Water penetration: Glass assemblies shall be completely watertight. No water shall appear on inside face of glass assemblies. Provide drainage to exterior for water and condensation.
.4 Wind loads: Glass assemblies shall be designed to withstand local positive and negative wind pressures acting normal to all planes of the assemblies in accordance with requirements of the , NBC, and its supplements, Part 4, for a 60 seconds gust velocity with a probability of return of 1 in 10 years, but not less than a design pressure of +/- 30 psf to all windows and +/- 53 psf to all screens.
.5 Seismic movement: Glass assemblies shall be designed for all applicable seismic forces as required by BCBC.
.6 Air infiltration: Maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq.ft. of fixed wall area as determined according to ASTM E 283 and TAS 202 at a minimum static-air-pressure differential of 6.24 psf.
.7 Deflection of window framing:
  .1 Under design wind pressures, the deflection of members supporting glass shall not exceed 1/175 of the span of the member.
  .2 Parallel to plane of glass, the deflection of supporting members shall not exceed 1/8".
  .3 Allowable deflections shall be reduced if they affect the integrity of the watertightness, or are detrimental to any assembly component.
.8 Glass performance: Glass thickness and type as required to conform to these performance requirements, and to requirements of BCBC. Glazing shall meet the requirements of the Insulating Glass Manufacturers Association of Canada and to the recommendations of the glass and sealed glazing manufacturer. Glass thickness shall be determined on the basis of the probability of failure under design wind pressures of 8/1000 using a safety factor of 2.5.

.9 Anchorage: Provide all anchorage assemblies, components, braces reinforcements, connections and fasteners to comply with these performance requirements. Anchorage shall be designed to accommodate thermal, seismic and building movements.

.10 Aluminum design: In addition to the above deflection limitations, all aluminum shall conform to the requirements of CAN3-S157 Strength Design in Aluminum and, where applicable, of CAN 3-S16.1, Steel Structures for Building.

1.5 SUBMITTALS AND SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01 33 00 -Submittal Procedures.

.2 Submit shop and erection drawings, to the Consultant for review prior to fabrication. No work shall be fabricated until the shop drawings and other related documentation, certification and samples have been reviewed by the Consultant.

.3 Shop drawings shall bear the seal of a Registered Professional licenced in B. C.

.4 Submit samples of all components of structural curtain wall system.

1.6 WARRANTY

.1 Work included in this Section shall be fully warranted to meet all design and performance requirements for 5 years from date of Substantial Performance.

.2 Insulating glass units shall be warranted against failure of seal of enclosed air space and deposits on inner faces of glass detrimental to vision for 5 years.

1.7 MAINTENANCE DATA

.1 Provide maintenance data for cleaning and maintenance of aluminum curtain wall for incorporation into maintenance manual described in Section 01 33 00.

PART 2 - PRODUCTS

2.1 METALS

.1 Alloy and temper recommended by glazed aluminum curtain wall manufacturer for strength, corrosion resistance, and application of required finish and not less than 0.070" wall thickness at any location for the main frame and complying with ASTM B 221: 6063-T6 alloy and temper.

.2 Structural components: Steel to CSA G40.21. Concealed items galvanized or protective painted. Exposed items, Primer and 2 coats of enamel paint.

.3 Fasteners: Screws, bolts and fasteners where used between aluminum and steel shall be Series 300 non-magnetic stainless steel, between 2 pieces of aluminum shall be Series 302 stainless steel cadmium plated. Shims shall be stainless steel only.

2.2 CURTAIN WALL COMPONENTS

.1 Mullions: tubular 1-piece aluminum extrusions without snap-on sides or panels, with continuous gasket receivers, minimum 1.8 mm extrusion wall thickness x depths required in accordance with the specified performance criteria.

.2 Pressure plates: shall be either aluminum or fiberglass and fastened to the mullion with stainless steel screws.

.3 Caps: 50 mm x 19 mm system companion aluminum extrusions designed to engage and lock onto pressure plates, without fasteners.

.4 Thermal Barrier: Thermal barrier consists of 25 mm separation between the interior and exterior metal members in a typical condition, while maintaining a continuous watertight seal. Thermal barrier assembly shall be tested to the thermal cycling requirements of ASTM E2692 and show no sign of degradation following the test.

.5 4 sided captured, front.

2.3 DOORS

.1 Swing doors, 45 mm thick, butt hung, square stops, suitable for insulating glass units.
  .1 Stiles, top rails: approx. 125 mm.
  .2 Bottom rail: approx. 165 mm.
.2 Construct doors using porthole aluminum extrusions with minimum 3 mm wall thickness.
.3 Reinforce mechanically-joined corners of doors to produce sturdy door units using welding and spigotting or using 1-piece cast aluminum angle.
.4 Glazing stops: interlocking snap-in type for dry glazing.

2.4 METAL FINISH

.1 Anodized: Colour (Clear): AA-C22-A41 Architectural Class I.

2.5 ACCESSORIES

.1 Glass: in accordance with Section 08 80 00.
.2 Door Adapters: Companion aluminum extruded aluminum door adapters for installation of aluminum automatic sliding doors. Include full length adjustable replaceable weatherstripping full length of jamb, head and astragal profiles to seal frame-to-door junctions.
.3 Insulation: semi-rigid inorganic glass fibre insulation boards to CGSB 51-GP-10M,.
.4 Backpan: zinc coated sheet steel conforming to ASTM A653/A653, minimum Grade 33, with base metal thickness 0.76 mm and a minimum zinc coating designation Z275.

2.6 SEALANTS

.1 Sealants shall be compatible with adjoining materials and finishes.
.2 Sealants shall be curtain wall manufacturer's recommended sealant to meet performance requirements.
.3 Sealant for metal to metal, concrete or other materials shall be multi-component chemically curing sealant, see Section 07 90 00, or curtain wall manufacturer's recommended sealant to meet performance requirements.
.4 Joint filler and backup materials, see Section 07 90 00, or curtain wall manufacturer's recommended products to meet performance requirements.

2.7 FABRICATION

.1 Construct units to manufacturer's standard. Formed with clean, sharply defined profiles. Joints to be accurately machined, fitted, assembled and sealed to provide neat weathertight joinery. Glass stops shall be extruded square edge lock-in, screwless type, with adequate, shielded drainage and pressure equalization. Expansion joints shall provide free movement and be watertight.
.2 Insulate joints of unlike materials with bituminous paint to prevent electrolytic or chemical action.
.3 Welding shall be carried out in accordance with CSA W47. Materials or finishes damaged or distorted by welding process will be rejected.
.4 Fabricate units square, true, accurate to size, free from distortions, waves, twists, buckles or other defects detrimental to appearance and/or performance. Units too large for handling or shipping shall be fitted and assembled by trial at the shop for accuracy, disassembled and marked for shipping and field assembly.
.5 Glazing shall be in accordance with manufacturer's instructions and reviewed shop drawings. All units shall be factory glazed in strict accordance with manufacturer's directions. Insulated glass sealed units shall be shop glazed into aluminum frames. Framing of structural glazing will not be permitted at the job site.

PART 3 EXECUTION

INSTALLATION

.1 Anchor units firmly to surrounding construction, in a perfectly true, plumb and accurate location. All metal shall be screwed in place, using backing, or anchor straps as required, or welded.

.2 Erection tolerances shall not exceed 1.5 mm in 3 m. Maximum offset from true alignment between 2 adjacent members shall be 0.8 mm.

.3 Install exterior and interior aluminum trim as required for the aluminum work installation. Trim shall be broken to shape as required. Where mouldings are jointed, they shall be accurately cut and fitted to result in a tightly closed joint.

.4 Aluminum which will be placed in contact with concrete, masonry, steel or other dissimilar metal, shall be coated with alkali resistant bituminous paint and allowed to dry before installation.

.5 Seal all joints at interior and exterior between aluminum work and surrounding construction as required using materials and methods as specified under Section 07 90 00. All joints shall be completely wind and watertight.

END OF SECTION 08 44 13

PART 1 - GENERAL

1.1 RELATED WORK

.1	Metal Doors and Frames:	Section 08 10 00
.2	Glazing:	Section 08 80 00.
.3	Painting:	Section 09 91 00.
.4	Electrical:	Division 26.

1.2 Quality Assurance

.1 C.G.S.B. (Canadian Government Specifications Board), C.S.A. (Canadian Standards Association), ASTM (American Society for Testing and Materials), or other standards shall be the latest edition of that standard including all revisions.

.2 Conform to materials specified, in brand and quality, unless otherwise approved in writing by the Consultant. No claim as to their unsuitability or unavailability or this Subcontractor's unwillingness to use the same, will be considered, unless such claims are made in writing prior to the closing of Tenders.

.3 Hardware supplier shall be an established contract builders hardware firm who shall have in his employ one or more A.H.C. (Architectural Hardware Consultant) who are members in good standing of the American (Canadian) Society of Architectural Hardware Consultants And who will be responsible for the complete hardware contract.

1.3 Submittals

.1 Samples: If required by the Consultant, a returnable sample of each item of proposed hardware shall be submitted for approval not later than 10 days after request. Samples to be properly tagged, indicating name of supplier, name of manufacturer, item number, intended function and location. Installed item to equal in all respects to approved samples.

.2 Submit the following to Consultant:

- .1 Five (5) copies of a detailed hardware schedule for the Consultants approval within two (2) weeks of being awarded this contract.
- .2 Indicate manufacturer's name and article number in complete detail including active hands of pairs of doors, degree of opening and other information pertinent to the intended function of the door and frame details.
- .3 In addition to hardware, the schedule shall include, for each heading or group of doors, Consultants door reference number as per Door Schedule, the room designations, door size and material and label requirements.
- .4 The schedule shall also incorporate detailed keying for final approval by the Owner.
- .5 Provide "as-installed" hardware list, Including name of supplier, to the Consultant upon Substantial Performance of the Contract.
- .6 List to be complete with key to explain manufacturer's names, abbreviations and codes.
- .7 Templates shall not be issued or material supplied until the hardware list has been approved. Provide additional copies of

the hardware lists to the Consultant on request.

1.4 Compliance

.1 The hardware supplier shall check the listed hardware for compliance with local fire codes and regulations regarding required hardware for fire doors and report to the Consultant, any discrepancies or omission in the listed hardware in this respect. Failure to report any such discrepancies of omission render supplier responsible for cost of rectification.

1.5 Delivery, Storage and Handling

.1 Deliver hardware to the site in accordance with the construction schedule prepared by the Contractor. Inspect all hardware on site for compliance to specifications before installation, stored in the original sealed packages in a locked, secure place until required for installation. The Contractor will be responsible for receiving and storing of hardware at the site. Hardware suppliers shall tag and deliver any sealed packages to the contractor.

.2 Supply hardware complete with required screws, bolts and fastenings necessary for proper installation, wrapped in paper and packed in the same package as hardware. Label legibly each package indicating that portion of work for which it is intended. Deliver door hardware in unopened original boxes.

.3 Mail one copy of hardware delivery sheets to the Consultant at time of each shipment.

1.6 Templates

.1 Hardware supplier shall supply templates to all trades requiring them.

1.7 Guarantee

.1 All Finish Hardware, except door closers shall be guaranteed by the hardware manufacturer, by written certification, for a period of one (1) year from certified date of Substantial Performance against any defects in the design, materials, finish, function and workmanship and that any defects shall be made good by the manufacturer at not additional cost to the Owner. A similar guarantee for a ten (10) year period shall be provided for door closers by the manufacturer.

PART 2 - PRODUCTS

2.1 Materials

.1 Hardware shall be best grade, entirely free from imperfections in manufacture and finish and shall be supplied in accordance with the hardware list specified herein.

.2 The following list of manufactures and products are considered approved for this project.

.3 Installed item to be equal in all respects to approved samples.

.4 Supply all templates as required. Frame manufacturer will allow for maximum swing of doors when templating for closers. On pairs of doors LHR Leaf is to be active unless otherwise noted.

.5 Any doors not listed shall have hardware as listed for similar locations.

.6 Package hardware with all necessary screws and fittings, clearly labeled with door number as per Door Schedule, as to intended location.
Included all necessary installation instructions.

2.2 Approved Manufacturers

.1 Hinges: McKinney, Stanley, Hager.

.2 Locks: Sargent 8200 series
Note: -All lock & latches to meet H/C requirements and to have temporary cylinders.

.3 Closers: Norton 7501BF/8501BF series
Note: -All closers to meet all H/C requirements.

.4 Exit Devices: Sargent 80 series
Note: -All closers to meet all H/C requirements and to have temporary cylinders.

.5 Pushes, Pulls, and Kick plates:
Rockwood, Hager, and Gallery
Note: -All flatware to be 16ga-304-stainless steel, beveled 4 sides, countersunk with SS screws unless otherwise specified.
-All kick plates to be undersized in width to suit all hardware, door and frame clearances.

.6 Stops,Bolts and Holders:
Rockwood, Hager, Glynn Johnson, Rixson and Gallery

.8 Thresholds, Seals, Door Bottoms, Astragals:
Pemko, Crowder and DraftSeal

2.3 Keying

.1 All locks to be keyed to a existing keying system and construction keyed.

.2 Allow sufficient type line spacing to allow the owner to insert keying information after each Lock or Cylinder.

.3 Supply:
- .1 4 -Keys per Lock
- .3 4 -Only construction keys.

.4 Note:
- .1 All cylinders to be factory keyed and shipped installed in locks from factory.
- .2 Construction keys only to the general contractor at site.
- .3 Master keys, operating keys, and extractor keys to be via registered mail by factory direct to the Owner or to the Owner's representative.

2.4 Finishes

.1 As scheduled on the hardware schedule

PART 3 - EXECUTION

3.1 Installation .1 Installation will be done under other sections.

3.2 Hardware Mounting .1 Mount hardware in accordance with the recommended locations as per standard locations for builders hardware locations (metric) as listed in Canadian Metric conversion Guide for Steel Doors and Frames prepared by the Canadian Steel Door and Frame Manufacturers association, B.C.B.C. and Building Access Handbook.

.2 Hardware positioning:

.1 Conform to ASAHC Standards and as follows unless otherwise described under the Hardware Schedule:

-Door Knobs - centres 1024 mm from floor.
-Panic Hardware - centre of crossbar 1024 mm from floor.
-Hinges - upper edge of door to centre of top hinge 244 mm below frame.
-lower edge of door to centre of bottom hinge 244 mm above floor.
-centre hinge spaced equally between other two.

.2 Door seals shall be fitted and adjusted to make continuous contact with door or floor.

.3 Exterior thresholds shall be set in solid mastic. Secure thresholds with countersink chrome plated screws and metal shields every 304 mm.

3.3 Attachment .1 Include all necessary screws, special screws, bolts, special bolts, expansion shields, and other devices required for proper hardware application.

3.4 Coordination .1 Confer with the various sections of work to be sure that they will conform to and fit actual conditions on the job.

PART 4 - SCHEDULE

4.1 Finish Hardware Schedule .1 The following hardware schedule is provided as a comprehensive Guide to define the quality, functions, design, type and finish of required finish hardware.

.2 Examine hardware set schedule, door schedule and all contract documents for the true quantities of hardware required, their exact location, function and operation, and check delivered items to ensure that all requirements are met.

4.2 Finish Hardware Schedule .1 See following.

Door Index

Door #	Set #	Door #	Set #	Door #	Set #	Door #	Set #	Door #	Set #
D01a	AL01	D10a	WA03	D17a	SE03	D18i	EX07	D25a	SE05
D03a	OF01	D11a	EX03	D18a	ST01	D18j	EX07	D26a	WA03
D03b	EX01	D11b	OF02	D18b	ST01	D18k	EX07	D27a	EX06
D04a	SE01	D11c	WA04	D18c	EX05	D18l	EX07	D29a	SE04

D05a	WA01	D12a	EX02	D18d	EX05	D18m	EX07	D30a	SE06
D06a	EX02	D13a	EX04	D18e	EX07	D18n	EX07		
D07a	OF01	D13b	OF03	D18f	EX07	D19	WA03		
D08a	WA02	D14a	SE02	D18g	EX07	D22a	OF04		
D09a	WA03	D15a	SE02	D18h	EX07	D23a	OF04		

ALUMINUM DOORS

Hardware Set AL01

2 Ea.	Hinges	Mckinney	TA386-114mm x 101mm x NRP	630
1 Ea.	Transfer	McKinney	QC12-TA386-114mm x 101mm	630

Note: -Conduits (hinge side) from junction box to transfer by Div 26 & 28.
-Conduits in door from T/F hinge to lock set by door supplier.
-1 Len ElectroLynx cable 12 conductor QC-C-len from lock to hinge supplied & installed by door supplier

1 Len.	Lynx cable	McKinney	12 conductor QC-C-len-P from hinge to junction box.	
1 Ea.	Lock Set	Sargent	SELP10 M1-82271-12VDC-FIPS-03 x LNL x ws	626

Note: -Power/conduits/wiring/junction box/ power supply and hookups to power supply & junction box by Div 26 & 28.
-All hookups to lock/transfer to junction box by hardware supplier.
-Hookups to junction box by Div 26 & 28.
-Include riser and point to point drawings.
-Remote switch/conduits/wiring/junction boxes/ & hookups to DPS and junction box by Div Div 26 & 28
-Card reader, DPS switch & REX switch included with lock.

1 Ea.	Cylinder		Type x Length x Cam to suit	626
1 Ea.	Closer	Norton	UNI-8501BF-DA	689
1 Ea.	Threshold	Pemko	2005AKS-width	

-Seals by door supplier.

EXTERIOR DOORS

Hardware Set EX01

3 Ea.	Hinges	McKinney	TA386-114mm x 101mm x NRP	630
1 Ea.	Transfer	McKinney	QC12-TA386-114mm x 101mm	630

Note: -Conduits (hinge side) from junction box to transfer by Div 26 & 28.
-Conduits in door from T/F hinge to lock set by door supplier.
-1 Len ElectroLynx cable 12 conductor QC-C-len from lock to hinge supplied & installed by door supplier

1 Len.	Lynx cable	McKinney	12 conductor QC-C-len-P from hinge to junction box.	
1 Ea.	Lock Set	Sargent	SELP10 M1-82271-12VDC-FIPS-03 x LNL x ws	626

Note: -Power/conduits/wiring/junction box/ power supply and hookups to power supply & junction box by Div 26 & 28.
-All hookups to lock/transfer to junction box by hardware supplier.
-Hookups to junction box by Div 26 & 28.
-Include riser and point to point drawings.
-Remote switch/conduits/wiring/junction boxes/ & hookups to DPS and junction box by Div Div 26 & 28
-Card reader, DPS switch & REX switch included with lock.

1 Ea.	Cylinder		Type x Length x Cam to suit	626
1 Ea.	Closer	Norton	UNI-7500BF-DA x SN	689
1 Ea.	Kick Plates	Rockwood	K1050F-B4E-254mm x width less 38mm	630
1 Ea.	Threshold	Pemko	2005AT-width (undersize door to suit)	

1	Set	Door Seal	Pemko	S773W-2/height x 1/width	
1	Ea.	Astragal	Pemko	3572SP-height (welded to door by door supplier)	

Hardware Set EX02

2	Ea.	Hinges	McKinney	TA314-114mm x 101mm x NRP	630
1	Ea.	Transfer	McKinney	QC12-TA314-114mm x 101mm	630

Note: -Conduits (hinge side) from junction box to transfer by Div 26 & 28.
-Conduits in door from T/F hinge to lock set by door supplier.
-1 Len ElectroLynx cable 12 conductor QC-C-len from lock to hinge supplied & installed by door supplier

1	Len.	Lynx cable	McKinney	12 conductor QC-C-len-P from hinge to junction box.	
1	Ea.	Lock Set	Sargent	SELP10 M1-82271-12VDC-FIPS-03 x LNL x ws	626

Note: -Power/conduits/wiring/junction box/ power supply and hookups to power supply & junction box by Div 26 & 28.
-All hookups to lock/transfer to junction box by hardware supplier.
-Hookups to junction box by Div 26 & 28.
-Include riser and point to point drawings.
-Remote switch/conduits/wiring/junction boxes/ & hookups to DPS and junction box by Div Div 26 & 28
-Card reader, DPS switch & REX switch included with lock.

1	Ea.	Cylinder		Type x Length x Cam to suit	626
1	Ea.	Closer	Norton	UNI-7500BF-DA-SN	689
1	Ea.	Threshold	Pemko	177AT-width	
1	Set	Door Seal	Pemko	S773W-2/height x 1/width	
1	Ea.	Astragal	Pemko	3572SP-height (welded to door by door supplier)	

Hardware Set EX03

3	Ea.	Hinges	McKinney	TA314-114mm x 101mm x NRP	630
1	Ea.	Transfer	McKinney	QC12-TA314-114mm x 101mm	630

Note: -Conduits (hinge side) from junction box to transfer by Div 26 & 28.
-Conduits in door from T/F hinge to exit device set by door supplier.
-1 Len ElectroLynx cable 12 conductor QC-C-len from exit device to hinge supplied & installed by door supplier

1	Len.	Lynx cable	McKinney	12 conductor QC-C-len-P from hinge to junction box.	
1	Ea.	Exit Device	Sargent	SE LP10-M1-8976-rail size x 12VDC x FIPS x 03 x ETL x weather seals	630

Note: -Power/conduits/wiring/junction box/ power supply and hookups to power supply & junction box by Div 26 & 28.
-All hookups to exit device/transfer to junction box by hardware supplier.
-Hookups to junction box by Div 26 & 28.
-Include riser and point to point drawings.
-Remote switch/conduits/wiring/junction boxes/ & hookups to DPS and junction box by Div Div 26 & 28
-Card reader, DPS switch & REX switch included with exit device.

1	Ea.	Cylinder		Type x Length x Cam to suit	626
1	Ea.	Closer	Norton	UNI-7500BF-DA-SN	689
1	Ea.	Threshold	Pemko	2005AT-width (undersize door to suit)	
1	Set	Door Seal	Pemko	S773W-2/height x 1/width	
1	Ea.	Astragal	Pemko	3572SP-height (welded to door by door supplier)	

Hardware Set EX04

2	Ea.	Hinges	McKinney	TA386-114mm x 101mm x NRP	630
1	Ea.	Transfer	McKinney	QC12-TA386-114mm x 101mm	630

Note: -Conduits (hinge side) from junction box to transfer by Div 26 & 28.

-Conduits in door from T/F hinge to lock set by door supplier.
-1 Len PoE-306P/400P cable from lock set to hinge supplied & installed by door supplier hooked up by hardware supplier

1	Len.	POE cable	McKinney	PoE-C1500P from hinge to junction box Supplied, installed & hooked up to hinge by hardware supplier Hook ups to junction box by Div 26 & 28	
1	Ea.	Lock Set	Sargent	v.S1 S1-82278-PK-L x weather gasket	626

Note: -Power/conduits/wiring/junction box and hookups to junction box by Div 26 & 28.
-All hookups from lockset to transfer, junction box by hardware supplier.
-Include riser and point to point drawings.
-Remote switch/conduits/wiring/junction boxes & hookups to DPS and junction box by Div Div 26 & 28
-Card reader, DPS switch & REX switch included with lockset.

1	Ea.	Cylinder		Type x Length x Cam to suit	626
1	Ea.	Closer	Norton	UNI-7500BF-DA x SN	689
1	Ea.	Stretcher	Rockwood	K1062-B4E-254mm x width less 38mm	630
1	Ea.	Kick Plates	Rockwood	K1062-B4E-400mm x width less 38mm	630
1	Set	Door Seal	Pemko	S773W-2/height x 1/width	
1	Ea.	Door Bottom	Pemko	420APKL-width	
1	Ea.	Astragal	Pemko	3572SP-height (welded to door by door supplier)	

Hardware Set EX05

2	Ea.	Hinges	McKinney	TA386-114mm x 101mm x NRP	630
1	Ea.	Transfer	McKinney	QC12-TA386-114mm x 101mm	630

Note: -Conduits (hinge side) from junction box to transfer by Div 26 & 28.
-Conduits in door from T/F hinge to exit device set by door supplier.
-1 Len ElectroLynx cable 12 conductor QC-C-len from exit device to hinge supplied & installed by door supplier

1	Len.	Lynx cable	McKinney	12 conductor QC-C-len-P from hinge to junction box.	
1	Ea.	Exit Device	Sargent	SE LP10-M1-8976-rail size x 12VDC x FIPS x 03 x ETL x weather seals	630

Note: -Power/conduits/wiring/junction box/ power supply and hookups to power supply & junction box by Div 26 & 28.
-All hookups to exit device/transfer to junction box by hardware supplier.
-Hookups to junction box by Div 26 & 28.
-Include riser and point to point drawings.
-Remote switch/conduits/wiring/junction boxes/ & hookups to DPS and junction box by Div Div 26 & 28
-Card reader, DPS switch & REX switch included with exit device.

1	Ea.	Cylinder		Type x Length x Cam to suit	626
1	Ea.	Closer	Norton	UNI-7500BF-DA x SN	689
1	Ea.	Kick Plates	Rockwood	K1050F-B4E-254mm x width less 38mm	630
1	Set	Door Seal	Pemko	S773W-2/height x 1/width	
1	Ea.	Door Bottom	Pemko	420APKL-width	
1	Ea.	Astragal	Pemko	3572SP-height (welded to door by door supplier)	

Hardware Set EX06

2	Ea.	Hinges	McKinney	TA314-114mm x 101mm x NRP	630
1	Ea.	Transfer	McKinney	QC12-TA314-114mm x 101mm	630

Note: -Conduits (hinge side) from junction box to transfer by Div 26 & 28.
-Conduits in door from T/F hinge to lock set by door supplier.
-1 Len ElectroLynx cable 12 conductor QC-C-len from lock to hinge supplied & installed by door supplier

1	Len.	Lynx cable	McKinney	12 conductor QC-C-len-P from hinge to junction box.	

1	Ea.	Lock Set	Sargent	SELP10 M1-82271-12VDC-FIPS-03 x LNL x ws	626
	Note:	-Power/conduits/wiring/junction box/ power supply and hookups to power supply & junction box by Div 26 & 28.			
		-All hookups to lock/transfer to junction box by hardware supplier.			
		-Hookups to junction box by Div 26 & 28.			
		-Include riser and point to point drawings.			
		-Remote switch/conduits/wiring/junction boxes/ & hookups to DPS and junction box by Div Div 26 & 28			
		-Card reader, DPS switch & REX switch included with lock.			
1	Ea.	Cylinder		Type x Length x Cam to suit	626
1	Ea.	Closer	Norton	UNI-7500BF-DA-SN	689
1	Ea.	Threshold	Pemko	2005AT-width (undersize door to suit)	
1	Set	Door Seal	Pemko	S773W-2/height x 1/width	
1	Ea.	Astragal	Pemko	3572SP-height (welded to door by door supplier)	

Hardware Set EX07

All hardware by door supplier

STAFF/OFFICE/PUBLIC USE ROOM DOORS

Hardware Set OF01

3	Ea.	Hinges	McKinney	TA714-114mm x 101mm x NRP	652
1	Ea.	Lock Set	Sargent	8205 x LNL	626
1	Ea.	Cylinder		Type x Length x Cam to suit	626
1	Ea.	W/F Stop	Rockwood	426/441/443	630
1	Ea.	Kick Plates	Rockwood	K1050F-B4E-254mm x width less 38mm	630

Hardware Set OF02

3	Ea.	Hinges	McKinney	TA714-114mm x 101mm x NRP	652
1	Ea.	Lock Set	Sargent	8237 x LNL	626
1	Ea.	Cylinder		Type x Length x Cam to suit	626
1	Ea.	W/F Stop	Rockwood	426/441/443	630
1	Ea.	Stretcher	Rockwood	K1062-B4E-254mm x width less 38mm	630
1	Ea.	Kick Plates	Rockwood	K1062-B4E-400mm x width less 38mm	630

Hardware Set OF03

2	Ea.	Hinges	McKinney	TA786-114mm x 101mm x NRP	652
1	Ea.	Transfer	McKinney	QC12-TA786-114mm x 101mm	652
	Note:	-Conduits (hinge side) from junction box to transfer by Div 26 & 28.			
		-Conduits in door from T/F hinge to lock set by door supplier.			
		-1 Len ElectroLynx cable 12 conductor QC-C-len from lock to hinge supplied & installed by door supplier			
1	Len.	Lynx cable	McKinney	12 conductor QC-C-len-P from hinge to junction box.	
1	Ea.	Lock Set	Sargent	SELP10 M1-82271-12VDC-FIPS-03 x LNL	626
	Note:	-Power/conduits/wiring/junction box/ power supply and hookups to power supply & junction box by Div 26 & 28.			
		-All hookups to lock/transfer to junction box by hardware supplier.			
		-Hookups to junction box by Div 26 & 28.			
		-Include riser and point to point drawings.			
		-Remote switch/conduits/wiring/junction boxes/ & hookups to DPS and junction box by Div Div 26 & 28			
		-Card reader, DPS switch & REX switch included with lock.			
1	Ea.	Cylinder		Type x Length x Cam to suit	626

1 Ea.	Closer	Norton	7500BF-DA x SN	689
1 Ea.	W/F Stop	Rockwood	426/441/443	630
1 Ea.	Stretcher	Rockwood	K1062-B4E-254mm x width less 38mm	630
1 Ea.	Kick Plates	Rockwood	K1062-B4E-400mm x width less 38mm	630

Hardware Set OF04

2 Ea.	Hinges	McKinney	TA714-114mm x 101mm x NRP	652
1 Ea.	Transfer	McKinney	QC12-TA786-114mm x 101mm	652

Note: -Conduits (hinge side) from junction box to transfer by Div 26 & 28.
-Conduits in door from T/F hinge to lock set by door supplier.
-1 Len ElectroLynx cable 12 conductor QC-C-len from lock to hinge supplied & installed by door supplier

1 Len.	Lynx cable	McKinney	12 conductor QC-C-len-P from hinge to junction box.	
1 Ea.	Lock Set	Sargent	SELP10 M1-82271-12VDC-FIPS-03 x LNL	626

Note: -Power/conduits/wiring/junction box/ power supply and hookups to power supply & junction box by Div 26 & 28.
-All hookups to lock/transfer to junction box by hardware supplier.
-Hookups to junction box by Div 26 & 28.
-Include riser and point to point drawings.
-Remote switch/conduits/wiring/junction boxes/ & hookups to DPS and junction box by Div Div 26 & 28
-Card reader, DPS switch & REX switch included with lock.

1 Ea.	Cylinder		Type x Length x Cam to suit	626
1 Ea.	Closer	Norton	8501BF-DA-SN	689
1 Ea.	W/F Stop	Rockwood	426/441/443	630
1 Ea.	Kick Plates	Rockwood	K1050F-B4E-254mm x width less 38mm	630
1 Ea.	Threshold	Pemko	151A-width	
1 Set	Door Seal	Pemko	350CSR-2/height x 1/width	
1 Ea.	Door Bottom	Pemko	430CRL-width	

SERVICE and STORAGE ROOM DOORS

Hardware Set SE01

3 Ea.	Hinges	McKinney	TA714-114mm x 101mm x NRP	652
1 Ea.	Exit Device	Sargent	16-8904 x ETL	630
2 Ea.	Cylinder		Type x Length x Cam to suit	626
1 Ea.	Closer	Norton	UNI-8501BF-DA-SN	689
1 Ea.	Kick Plates	Rockwood	K1050F-B4E-254mm x width less 38mm	630
1 Ea.	Threshold	Pemko	171A-width	

Hardware Set SE02

3 Ea.	Hinges	McKinney	TA714-114mm x 101mm x NRP	652
1 Ea.	Lock Set	Sargent	8204 x LNL	630
1 Ea.	Cylinder		Type x Length x Cam to suit	626
1 Ea.	Closer	Norton	8501BF-DA-SN	689
1 Ea.	W/F Stop	Rockwood	426/441/443	630
1 Ea.	Kick Plates	Rockwood	K1050F-B4E-254mm x width less 38mm	630
1 Ea.	Threshold	Pemko	271A-width	

Hardware Set SE03

2 Ea.	Hinges	McKinney	TA714-114mm x 101mm x NRP	652
1 Ea.	Transfer	McKinney	QC12-TA714-114mm x 101mm	652

Note: -Conduits from junction box to transfer by Div 26 & 28.

-Conduits in door from T/F hinge to lock set by door supplier.
-1 Len ElectroLynx cable 12 conductor QC-C-len from lock set to hinge supplied & installed by door supplier

1	Len. Lynx cable	McKinney	12 conductor QC-C-len-P from hinge to junction box.	
1	Ea. Lock Set	Sargent	SELP10 M1-82271-12VDC-FIPS-03 x LNL	630

Note: -Power/conduits/wiring/junction box/ power supply and hookups to power supply & junction box by Div 26 & 28.
-All hookups to lock/transfer to junction box by hardware supplier.
-Hookups to junction box by Div 26 & 28.
-Include riser and point to point drawings.
-Remote switch/conduits/wiring/junction boxes/ & hookups to DPS and junction box by Div Div 26 & 28
-Card reader, DPS switch & REX switch included with lock.

1	Ea. Cylinder		Type x Length x Cam to suit	626
1	Ea. Closer	Norton	8501BF-DA-SN	689
1	Ea. W/F Stop	Rockwood	426/441/443	630
1	Ea. Kick Plates	Rockwood	K1050F-B4E-254mm x width less 38mm	630
1	Ea. Threshold	Pemko	271A-width	

Hardware Set SE04

2	Ea. Hinges	McKinney	TA714-114mm x 101mm x NRP	652
1	Ea. Transfer	McKinney	QC12-TA714-114mm x 101mm	652

Note: -Conduits from junction box to transfer by Div 26 & 28.
-Conduits in door from T/F hinge to lock set by door supplier.
-1 Len ElectroLynx cable 12 conductor QC-C-len from lock set to hinge supplied & installed by door supplier

1	Len. Lynx cable	McKinney	12 conductor QC-C-len-P from hinge to junction box.	
1	Ea. Lock Set	Sargent	SELP10 M1-82271-12VDC-FIPS-03 x LNL	630

Note: -Power/conduits/wiring/junction box/ power supply and hookups to power supply & junction box by Div 26 & 28.
-All hookups to lock/transfer to junction box by hardware supplier.
-Hookups to junction box by Div 26 & 28.
-Include riser and point to point drawings.
-Remote switch/conduits/wiring/junction boxes/ & hookups to DPS and junction box by Div Div 26 & 28
-Card reader, DPS switch & REX switch included with lock.

1	Ea. Cylinder		Type x Length x Cam to suit	626
1	Ea. Closer	Norton	UNI-8501BF-DA-SN	689
1	Ea. Kick Plates	Rockwood	K1050F-B4E-254mm x width less 38mm	630
1	Ea. Threshold	Pemko	177AT-width	
1	Set Door Seal	Pemko	S773W-2/height x 1/width	

Hardware Set SE05

2	Ea. Hinges	McKinney	TA714-114mm x 101mm x NRP	652
1	Ea. Transfer	McKinney	QC12-TA714-114mm x 101mm	652

Note: -Conduits from junction box to transfer by Div 26 & 28.
-Conduits in door from T/F hinge to lock set by door supplier.
-1 Len ElectroLynx cable 12 conductor QC-C-len from lock set to hinge supplied & installed by door supplier

1	Len. Lynx cable	McKinney	12 conductor QC-C-len-P from hinge to junction box.	
1	Ea. Lock Set	Sargent	SELP10 M1-82271-12VDC-FIPS-03 x LNL	630

Note: -Power/conduits/wiring/junction box/ power supply and hookups to power supply & junction box by Div 26 & 28.
-All hookups to lock/transfer to junction box by hardware supplier.

-Hookups to junction box by Div 26 & 28.
-Include riser and point to point drawings.
-Remote switch/conduits/wiring/junction boxes/ & hookups to DPS and junction box by Div Div 26 & 28
-Card reader, DPS switch & REX switch included with lock.

1	Ea.	Cylinder		Type x Length x Cam to suit	626
1	Ea.	Closer	Norton	PR-8501BF-DA-SN	689
1	Ea.	W/F Stop	Rockwood	426/441/443	630
1	Ea.	Kick Plates	Rockwood	K1050F-B4E-254mm x width less 38mm	630
1	Ea.	Threshold	Pemko	271A-width	

Hardware Set SE06

3	Ea.	Hinges	McKinney	TA714-114mm x 101mm x NRP	652
1	Ea.	Lock Set	Sargent	8204 x LNL	630
1	Ea.	Cylinder		Type x Length x Cam to suit	626
1	Ea.	Closer	Norton	UNI-8501BF-DA-SN	689
1	Ea.	Threshold	Pemko	271A-width	

CORRIDOR & STAIR DOORS

Hardware Set ST01

2	Ea.	Hinges	McKinney	TA786-114mm x 101mm x NRP	652
1	Ea.	Transfer	McKinney	QC12-TA786-114mm x 101mm	652

Note: -Conduits (hinge side) from junction box to transfer by Div 26 & 28.
-Conduits in door from T/F hinge to exit device set by door supplier.
-1 Len ElectroLynx cable 12 conductor QC-C-len from exit device to hinge supplied & installed by door supplier

1	Len.	Lynx cable	McKinney	12 conductor QC-C-len-P from hinge to junction box.	
1	Ea.	Exit Device	Sargent	SE LP10-M1-8976-rail size x 12VDC x FIPS x 03 x ETL x weather seals	630

Note: -Power/conduits/wiring/junction box/ power supply and hookups to power supply & junction box by Div 26 & 28.
-All hookups to exit device/transfer to junction box by hardware supplier.
-Hookups to junction box by Div 26 & 28.
-Include riser and point to point drawings.
-Remote switch/conduits/wiring/junction boxes/ & hookups to DPS and junction box by Div Div 26 & 28
-Card reader, DPS switch & REX switch included with exit device.

2	Ea.	Cylinder		Type x Length x Cam to suit	626
1	Ea.	Closer	Norton	UNI-J7500BF-DA x SN	689
1	Ea.	Stretcher	Rockwood	K1062-B4E-254mm x width less 38mm	630
1	Ea.	Kick Plates	Rockwood	K1062-B4E-400mm x width less 38mm	630
1	Set	Door Seal	Pemko	S773W-2/height x 1/width	
1	Ea.	Door Bottom	Pemko	420APKL-width	

WASH ROOM DOORS

Hardware Set WA01

3	Ea.	Hinges	McKinney	TA714-114mm x 101mm x NRP	652
1	Ea.	Privacy Set	Sargent	49-8265 x LNL	626
1	Ea.	Closer	Norton	8501BF-DA-SN	689
1	Ea.	W/F Stop	Rockwood	426/441/443	630

1 Ea.	Kick Plates	Rockwood	K1050F-B4E-254mm x width less 38mm	630

Hardware Set WA02

3 Ea.	Hinges	McKinney	TA786-114mm x 101mm x NRP	652
1 Ea.	Dead Lock	Sargent	4877	626
1 Ea.	Cylinder		Type x Length x Cam to suit	626
1 Ea.	Pulls	Rockwood	RM3020-24”	630
1 Ea.	Push Plate	Rockwood	73E-152mm x 456mm	630
1 Ea.	Closer	Norton	8501BF-DA x SN	689
1 Ea.	W/F Stop	Rockwood	426/441/443	630
1 Ea.	Kick Plates	Rockwood	K1050F-B4E-254mm x width less 38mm	630

Hardware Set WA03

3 Ea.	Hinges	McKinney	TA714-114mm x 101mm x NRP	652
1 Ea.	Privacy Set	Sargent	49-8265 x LNL	626
1 Ea.	W/F Stop	Rockwood	426/441/443	630
1 Ea.	Kick Plates	Rockwood	K1050F-B4E-254mm x width less 38mm	630

Hardware Set WA04

3 Ea.	Hinges	McKinney	TA714-114mm x 101mm x NRP	652
1 Ea.	Dead Lock	Sargent	4874	626
2 Ea.	Cylinder		Type x Length x Cam to suit	626
1 Ea.	Pulls	Rockwood	RM3020-24”	630
1 Ea.	Push Plate	Rockwood	73E-152mm x 456mm	630
1 Ea.	Closer	Norton	UNI-8501BF-DA x SN	689
1 Ea.	Kick Plates	Rockwood	K1050F-B4E-254mm x width less 38mm	630

END OF SECTION 08 70 00

PART 1 - GENERAL

1.1 RELATED WORK

.1	Metal Doors and Frames:	Section 08 10 00
.2	Aluminum Glazed Sectional Doors:	Section 08 36 13
.3	Glazed Aluminum Curtain Wall:	Section 08 44 13
.4	Toilet and Bathroom Accessories:	Section 10 28 00

1.2 REFERENCES

.1 Building Codes
  .1 British Columbia Building Code (BCBC)
  .2 National Energy Code for Buildings
  .3 Local or municipal Building By-laws
.2 Manuals of Recommended Practice
  .1 IGMA - Glazing Recommendations for Sealed Insulating Glass Units.
.3 Structural Design Standards
  .1 CAN/CGSB-12.20 - Structural Design of Glass for Buildings
.4 Material Quality Standards - Glass
  .1 CAN/CGSB-12.1 - Glass, Safety, Tempered or Laminated
  .2 CAN/CGSB-12.3 - Glass, Polished Plate or Float, Flat, Clear
  .3 CAN/CGSB-12.8 - Insulating Glass Units
  .4 CAN/CGSB-12.9 - Spandrel Glass
.5 Glazing Contractors Association of B.C. (GCA)
.6 Glass Association of North American (GANA)
  .1 GANA Glazing Manual.
  .2 GANA Laminated Glazing Reference Manual.

1.3 DESIGN REQUIREMENTS

.1 Structural Design:
  .1 Design glass and glazing to meet the requirements of the BCBC.
  .2 Design glass according to CAN/CGSB-1 2.20. Limit glass deflection to L/175, (to a maximum of 20 mm for any single light of insulating glass.)
  .3 All glass design to BCBC Part 4 requirements and CGSB 12.20.
  .4 Thickness and heat treatment of clear glass may be adjusted to suit structural design requirements.
  .5 Allow for deflection of building structure and framing members. Ensure no structural loads are imposed on glass.

1.4 SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
.2 Shop Drawings: Show scale elevations, sections, dimensions, or otherwise schedule quantity and type of glazing to be provided at each location. Indicate clearances to rough opening or to adjacent framing, and maximum tolerances of adjacent construction. Submit drawings stamped and signed by professional engineer registered or licensed in Province of B.C., Canada.
.3 Provide details of perimeter and interface conditions. Show relationship to other work, engagement of glass, drainage of glazing channel, location of setting blocks, and placement of sealants and glazing splines or tapes.
.4 Provide information on sealed unit makeup. Identify coatings and their location, edge construction and sealants, and any other information required to indicate compliance with contract documents.
.5 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

.6 Operation and Maintenance Data: submit operation and maintenance data for [glazing] for incorporation into manual.

1.5 WARRANTY

.1 Provide manufacturers warranty in writing for insulating glass units against failure of seal of enclosed air space and deposits on inner faces of glass detrimental to vision for period of 10 Years from date of Substantial Performance of Work.

PART 2 - PRODUCTS

2.1 GLASS MATERIALS

.1 Glass thicknesses: indicated or to industry standards for size of opening, local wind loading and use, but shall be not less than 5 mm thick.
.2 Float glass: clear glass to CAN/CGSB-12.3, glazing quality.
.3 Safety glasses: to CAN/CGSB-12.1.
  .1 Tempered: free of tong marks in final position.
  .2 Laminated: plastic interlayer sandwiched between 2 layers of glass. Laminated glass to achieve specified STC ratings.
.4 Insulating glass units: double insulating glass units: IGMA certified to CAN/CGSB-12.8, with 13 mm and/or 11 mm thick argon filled air space enclosed by interior / exterior lites (glass) as scheduled. Warm edge, reverse dual seal design spacer consisting of a thermoset foam spacer, mutli-layer vapour barrier and pre-applied sealant/adhesive for glass bonding requiring a secondary seal.
.5 Low-E insulating unit:
  .1 Exterior Lite: clear 6 mm tempered safety glass, Solarban 60 (#2 surface).
  .2 Gas Fill : 12.7 mm, 100% Argon
  .3 Interior Lite: 6 mm clear tempered safety glass.
  .4 Low-E Performance:
    .1 Visible light transmittance: 70%
    .2 Total Solar Energy: 34%
    .3 Visible Light Reflectance: 11%
    .4 Shading Coefficient: 0.45
    .5 Solar Heat Gain: 0.39
    .6 U-Value: winter night: 0.29, summer day: 0.27
.6 Spandrel Glass:
  .1 Tempered safety glass with silicone waterbase elastomer coating with a minimum dry thickness of 5 mils (0.14 mm)
  .2 Coating shall be medium modulus, self extinguishing, and non-corrosive.
  .3 Coating applicator shall be approved and certified by coating manufacturer.
  .4 Colour as selected by the Consultant.
.7 Light Diffusing Insulated Glass:
  .1 Light diffusing insulating glass with capillary slab and glass fiber tissue.
  .2 Outer pane: 6 mm tempered or heat strengthened float glass
  .3 Air-space: 12 mm PMMA acrylic UV stable capillary slab encased in fiber tissue. Capillaries are not to exceed 3 mm diameter to assure proper diffusion.
  .4 Inner pane:6 mm heat strengthened, tempered or laminated float glass with .030 pvb interlayer.
  .5 Sealant: Dual sealed units: Primary sealant: Polyisobutylene, Secondary sealant: Silicone.

2.2 GLAZING AND SEALING COMPOUND MATERIALS

.1 Sealant compounds: in accordance with glass manufacturers recommendation and Section 07 90 00.

.2 Glazing tape: extruded glazing seal, EPDM rubber extrusion positioned at the sightline with a 100% solids, highly adhesive and elastic, cross linked butyl preformed sealant bonded below.
.3 Setting blocks: neoprene, Shore "A" durometer hardness 70-90, 100 mm long x 6 mm high x widths to suit glass and insulating glass units.
.4 Glazing splines/wedges: purpose-made extruded neoprene profiles designed to engage aluminum extrusions and form integral part of respective framing system.
.5 Gaskets: purpose-made extruded hollow compressible EPDM or neoprene profiles designed to engage aluminum extrusions and form integral part of framing system.
.6 Primers, sealers and cleaners: to glass manufacturer's standard.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for glazing installation in accordance with manufacturer's written instructions.
  .1 Verify that openings for glazing are correctly sized and within tolerance.
  .2 Verify that surfaces of glazing channels or recesses are clean, free of obstructions, and ready to receive glazing.
  .3 Visually inspect substrate in presence of Departmental Representative.
  .4 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  .5 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 WORKMANSHIP

.1 Remove protective coatings and clean contact surfaces with solvent and wipe dry.
.2 Apply primer-sealer to contact surfaces.
.3 Place setting blocks as per manufacturer's instructions.
.4 Install glazing, rest on setting blocks, ensure full contact and adhesion at perimeter.
.5 Install removable stops, without displacing tape.
.6 Provide edge clearance of 3 mm minimum. Do not cut or abrade glass surfaces.
.7 Make door, transom and sidelight glass installations rattle free.
.8 Ensure compatibility of glazing sealants where in contact with insulating glass unit sealant.

3.3 PREPARATION

.1 Perform all work using skilled glaziers, in accordance with rules and customs of best trade practices, this specification and manufacturer's printed specifications.
.2 Check all openings to make certain that they are square, plumb, and secure in order that uniform face and edge clearances will be maintained.
.3 Verify glass sizes from site measurement with allowances made for thicknesses, bites or overlaps and edge clearances.
.4 Glass to have straight clean edges, with no splinters or cracks.
.5 Maintain the following bites or overlaps on glass edges without exception:
  .1 6 mm bite under 1270 united millimetres.
  .2 9 mm bite between 1270 to 2540 united millimetres.
  .3 13 mm bite over 2540 united millimetres.
.6 Maintain the following edge clearances for glass, unless otherwise noted:
  .1 3 mm for glass up to 1 sq. metre.
  .2 5 mm for glass of 1 to 2 sq. metre.
  .3 6 mm for glass over 2 sq. metres.
.7 Edge clearance may be reduced in sash glazing when continuous neoprene channel gaskets are used.

.8 Maintain a minimum face clearance of 3 mm except where continuous neoprene channel gaskets are used.
.9 Do not cut or abrade tempered or heat treated glass.
.10 Do not mark or chip pre finished metal surfaces.

3.4 INSTALLATION

.1 Manufacturer's Instructions: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.
.2 Perform work in accordance with GANA Glazing Manual and GANA Laminated Glazing Reference Manual for glazing installation methods.
.3 Install glass and glazing of types to meet BC Building Code requirements and as specified herein and noted on drawings.
.4 Remove protective coatings, clean and prime contact surfaces as recommended by framing manufacturer to suit substrate, glazing and glass types.
.5 Install setting blocks, spacers / shims and gaskets to provide recommended clearances in strict accordance with IGMAC and manufacturer's recommendations as and where recommended by glass and framing manufacturers.
.6 Install all glass with edges aligned, true to planes, secure, rigid and free from rattle and distortion.
.7 Install glass in pressed steel framing, hollow metal doors in full contact with full length pieces of glazing tape against permanent stops. At corners butt tapes together (do not lap in corners). Ensure full adhesion at perimeter.
.8 Install glass using neoprene gaskets of sizes and shapes to suit glass thicknesses all in accordance with manufacturer's recommendations in aluminum curtain wall and entrance door framing and railing systems. Use roll-in wedges using the prime seal method of glazing.
.9 Install safety glass in all glazed doors and sidelites, sliding, glazed guardrails and to other areas in accordance with BC Building Code requirements.
.10 Install light diffusing glass in accordance with the general rules applicable for insulating glass. The glazing plane support system shall be free of any internal obstructions and structurally adequate for the application.
.11 Install glass resting on setting blocks, ensuring full contact with gaskets and adhesion to glazing tape at perimeter.
.12 Install removable stops without displacing tape or sealant.
.13 Apply a heal bead of specified sealant around perimeter of framing as recommended by framing manufacturer, maintaining minimum bite to glass and positive bond to sash with corners and void around glass sealed completely. Do not block condensation channels or weep holes.

3.5 GLAZING SCHEDULE

.1 Exterior
  .1 **(GL1)**: Double glazed aluminum curtain wall, windows and aluminum doors: Low-E insulating glass units with 6 mm clear tempered safety glass exterior lite with Low-E coating on #2 surface, 12.7 mm argon filled cavity, 6 mm clear tempered safety glass.
  .2 **(GL2)**: 6 mm tempered or heat-strengthened glass/silicone-polymer back-painted Spandrel glass
.2 Interior
  .1 **(GL3)**: 25 mm Light Diffusing Insulated Glass
  .2 **(GL4)**: 6 mm tempered - interior glass windows and doors
  .3 **(GL5)**: 12 mm laminated glass - Interior Sidelite glazing (in STC 52 wall)

3.6 FINISHING

.1 Remove immediately sealant and compound droppings from finished surfaces.
.2 Remove labels at completion of Work.

END OF SECTION 08 80 00

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1	Thermal Insulation:	Section 07 21 00
.2	Metal Roofing Panels:	Section 07 41 13
.3	Modified Bituminous Roofing:	Section 07 52 00
.4	Acoustical Ceiling Suspension Assemblies:	Section 09 53 00
.5	Non-Structural Metal Framing:	Section 09 22 16
.6	Painting:	Section 09 90 00

1.2 REFERENCES

.1 AWCC - Association of Wall and Ceiling Contractors of British Columbia.
.2 ASTM C36 - Standard Specification for Gypsum Wallboard.
.3 ASTM C442 - Standard Specification for Gypsum Backing Board, Gypsum Coreboard, and Gypsum Shaftliner Board.
.4 ASTM C475 - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
.5 ASTM C630 - Standard Specification for Water-Resistant Gypsum Backing Board.
.6 ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board.
.7 ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications.
.8 ASTM C954 - Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.84 mm to 2.84 mm in Thickness.
.9 ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
.10 ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base
.11 GA-214-10E - Gypsum Association Recommended Levels of Finish.
.12 CAN/ULC-S102, Standard Method of Test of Surface Burning Characteristics of Building Materials and Assemblies.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
.2 Product Data:
  .1 Submit manufacturer's instructions, printed product literature and data sheets for gypsum board assemblies and include product characteristics, performance criteria, physical size, finish and limitations.
.3 Samples:
  .1 Submit for review and acceptance of each unit.
  .2 Samples will be returned for inclusion into work.
  .3 Submit 300 mm long samples of corner and casing beads.

1.4 DELIVERY, HANDLING AND STORAGE

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
.3 Storage and Handling Requirements:
  .1 Store gypsum board assemblies materials level off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  .2 Store and protect gypsum board from nicks, scratches, and blemishes.

.3 Protect from weather, elements and damage from construction operations.
.4 Handle gypsum boards to prevent damage to edges, ends or surfaces.
.5 Replace defective or damaged materials with new.
.4 Develop Construction Waste Management Plan related to Work of this Section.
.5 Packaging Waste Management: remove for reuse and return pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.5 AMBIENT CONDITIONS

.1 Maintain temperature 10 degrees C minimum, 21 degrees C maximum for 48 hours prior to and during application of gypsum boards and joint treatment, and for 48 hours minimumafter completion of joint treatment.
.2 Apply board and joint treatment to dry, frost free surfaces.
.3 Ventilation: ventilate building spaces as required to remove excess moisture that would prevent drying of joint treatment material immediately after its application.

PART 2 - PRODUCTS

2.1 GYPSUM BOARD

.1 Standard gypsum board:
.1 To ASTM C36, tapered longitudinal edges thickness 16 mm as indicated 1219 mm wide longest length for minimum joints.
.2 Fire rated gypsum board:
.1 To ASTM C36, Type X, 16 mm thick x widths to suit framing centres x maximum practical lengths, wrapped tapered edges, square cut ends, fire rated ULC labelled.
.3 Damage resistant gypsum board:
.1 High impact resistant and indent resistant boards with high density cellulosic fibres and gypsum dispersed evenly throughout panel thickness , reinforced with a fibre mesh backing and face coating for abrasion resistance, Type X, thickness indicated x widths to suit framing centres x maximum practical lengths, tapered edges, square cut ends, fire rated ULC labelled.
.4 Shaft system boards:
.1 Coreboard: to ASTM C442, 1" thick x widths to fit between system studs x maximum practical lengths, moisture resistant paper facing, square cut edges and ends.
.2 Exposed to view finishing board: to ASTM C36, Type X, 5/8" thick x widths to suit framing centres x maximum practical lengths, wrapped tapered edges, square cut ends, fire rated ULC labelled.

2.2 FASTENINGS AND ADHESIVES

.1 Screws: to ASTM C954
.2 Nails: to ASTM C514.
.3 Laminating compound: asbestos-free.

2.3 ACCESSORIES

.1 Casing beads: fill type, galvanized metal and vinyl extrusion types, perforated flanges, full length pieces to ASTM C1047.
.2 Corner beads: 0.5 mm metal thickness commercial grade sheet steel with Z275 designation zinc finish, fill type, expanded wing style, full length pieces ASTM C1047.
.3 Jointing compound and tape: to ASTM C475.
.4 Acoustical/air barrier sealants:
.1 Concealed: sealing and bedding compound to CAN/CGSB 19.21.

.2 Exposed: to CAN/CGSB 19.17 one component, acrylic emulsion base in accordance with Section 07 90 00.

.5 Acoustical insulation: unfaced mineral or glass fibre friction fit batt, full stud thickness x widths required to suit stud centres.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 ERECTION

.1 Do application and finishing of gypsum board to ASTM C840 except where specified otherwise.
.2 Do application of gypsum sheathing to ASTM C1280.
.3 Install work level to tolerance of 1:1200.
.4 Frame with furring channels, perimeter of openings for access panels, light fixtures, diffusers, grilles.
.5 Install furring channels parallel to, and at exact locations of steel stud partition header track.
.6 Furr above suspended ceilings for gypsum board fire and sound stops and to form plenum areas as indicated.
.7 Install wall furring for gypsum board wall finishes to ASTM C840, except where specified otherwise.
.8 Furr duct shafts, beams, columns, pipes and exposed services where indicated.

3.3 APPLICATION

.1 Apply gypsum board after bucks, anchors, blocking, sound attenuation, electrical and mechanical work have been approved.
.2 Apply gypsum board to metal furring or framing using screw fasteners, screw fasteners. Maximum spacing of screws 300 mm on centre.
.3 Apply 12 mm diameter bead of acoustic sealant continuously around periphery of each face of partitioning to seal gypsum board/structure junction where partitions abut fixed building components. Seal full perimeter of cut-outs around electrical boxes, ducts, in partitions where perimeter sealed with acoustic sealant.
.4 Install gypsum board on walls vertically to avoid end-butt joints. At stairwells and similar high walls, install boards horizontally with end joints staggered over studs, except where local codes or fire-rated assemblies require vertical application.
.5 Install gypsum board with face side out.
.6 Do not install damaged or damp boards.
.7 Locate edge or end joints over supports. Stagger vertical joints over different studs on opposite sides of wall.

3.4 INSTALLATION

.1 Erect accessories straight, plumb or level, rigid and at proper plane. Use full length pieces where practical. Make joints tight, accurately aligned and rigidly secured. Mitre and fit corners accurately, free from rough edges. Secure at 150 mm on centre.

.2 Install casing beads where gypsum board butts against surfaces having no trim concealing junction and where indicated. Seal joints with sealant.

.3 Install insulating strips continuously at edges of gypsum board and casing beads abutting metal window and exterior door frames, to provide thermal break.

.4 Install access doors to electrical and mechanical fixtures specified in respective sections.
- .1 Rigidly secure frames to furring or framing systems.

.5 Finish face panel joints and internal angles with joint system consisting of joint compound, joint tape and taping compound installed according to manufacturer's directions and feathered out onto panel faces.

.6 Gypsum Board Finish: finish gypsum board walls and ceilings to following levels in accordance with AWCI Levels of Gypsum Board Finish:
- .1 Levels of finish:
  - .1 Level 1: embed tape for joints and interior angles in joint compound. Surfaces to be free of excess joint compound; tool marks and ridges are acceptable, in areas where the walls or ceiling are concealed
  - .2 Level 2: embed tape for joints and interior angles in joint compound and apply one separate coat of joint compound over joints, angles, fastener heads and accessories; surfaces free of excess joint compound; tool marks and ridges are acceptable, where aesthetic appearance is not a primary concern.
  - .3 Level 4: embed tape for joints and interior angles in joint compound and apply three separate coats of joint compound over joints, angles, fastener heads and accessories; surfaces smooth and free of tool marks and ridges, where paint finish is specified..

.7 Finish corner beads, control joints and trim as required with two coats of joint compound and one coat of taping compound, feathered out onto panel faces.

.8 Fill screw head depressions with joint and taping compounds to bring flush with adjacent surface of gypsum board so as to be invisible after surface finish is completed.

.9 Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surface of board.

.10 Completed installation to be smooth, level or plumb, free from waves and other defects and ready for surface finish.

.11 Mix joint compound slightly thinner than for joint taping.

3.5 CLEANING

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

.2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.6 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by gypsum board assemblies installation.

END OF SECTION 09 21 16

PART 1 - GENERAL

1.1 RELATED WORK

.1 Structural Metal Stud Framing: Section 05 41 00
.2 Acoustical insulation: Section 09 29 00
.3 Gypsum Board Assemblies: Section 09 21 16

1.2 REFERENCE STANDARDS

.1 Association of Wall and Ceiling Contractors (AWCC) of British Columbia.
.2 Canadian Sheet Steel Building Institute (CSSBI) Lightweight Steel Framing Manual.
.3 CSA W59 Series, Welded Steel Construction (Metal Arc Welding).
.4 CSA W47.1, Certification of Companies for Fusion Welding of Steel.
.5 CAN/ULC-S101, Standard Methods of Fire Endurance Tests of Building Construction and Materials.
.6 CAN/CGSB-1.181, Ready-Mixed Organic Zinc-Rich Coating
.7 CAN/CGSB-7.1, Lightweight Steel Wall Framing Components.
.8 ASTM A924/A924, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process Document Number.
.9 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process Document Number.
.10 ASTM C645, Standard Specification for Nonstructural Steel Framing Members Document Number.
.11 BC Building Code, including Clause 4.1.9.1.15 and Table 4.1.9.1.D.

1.3 DESIGN CRITERIA

.1 Interior studs:
  .1 Limit deflection to L/120 for gypsum board finishes.

1.4 SUBMITTALS

.1 Shop Drawings
  .1 Prepare shop drawings by, or under the direct supervision of, a Registered Professional licenced in the Province of British Columbia.
  .2 Submit shop drawings in accordance with Section 01 33 00.
.2 Indicate all details including stud/track material and sizes, stud-to-track fixing and intervals, track-to-structure fixing and intervals, stud spacings, installation details, indicate temporary bracing required for erection purposes, and provide calculations verifying compliance with deflection requirements.
.3 Seismic restrained engineered studwork, bracing, and suspension systems, including where such systems act as support for work requiring seismic restraints.
.4 Letters of Assurance
  .1 The Supporting Registered Professional responsible for sealing engineered shop drawings shall submit to the Registered Professional of Record, AIBC/APEGBC Schedule S-B Assurance of Professional Design and Commitment for Field Review with the shop drawings.
  .2 The Supporting Registered Professional shall provide field review of the installation and submit to the Registered Professional of Record, AIBC/APEGBC Schedule S-C Assurance of Professional Field Review and Compliance upon completion of the Work.
.5 Record Drawings (As-builts)
  .1 Submit record drawings (as-builts) in accordance with Section 01 78 00.

1.5 QUALITY ASSURANCE

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

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Waste Management and Disposal: Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Project 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 for recycling in accordance with Waste Management Plan.
.4 Divert unused metal materials from landfill to metal recycling facility approved by Departmental Representative.
.5 Divert unused gypsum materials from landfill to recycling facility approved by Departmental Representative.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Interior studs:
  .1 Non-load bearing channel stud framing: to ASTM C645, roll formed hot dipped galvanized steel sheet, 25 ga. thickness for stud lengths up to 3500 mm, 20 ga. thickness for stud lengths greater than 3500 mm, unless indicated otherwise on the drawings, for screw attachment of gypsum board. Knock-out service holes at 460 mm centres.
  .2 Material: ASTM C645 sheet steel.
  .3 Finish: electro-galvanized finish or ASTM A653/A653M - Z120 (G40) designation zinc coating.
  .4 Stud sizes: refer to wall schedules.
.2 Top and bottom tracks: widths to accept stud depths x 32 mm flange height, same material/metal thickness/finish as respective studs, unless indicated/scheduled otherwise.
.3 Deflection tracks: widths to accept stud depths x flange height required to accommodate anticipated building structural deflection, same material as respective studs, one gauge thicker than respective metal stud, unless indicated/scheduled otherwise.
.4 Metal channel stiffeners: 19 mm size x 2 mm base metal thickness cold rolled steel channel profile, rust inhibitive finish.
.5 Sill gasket: pre-cut 6 mm thick x plate width x roll length closed cell polyethylene foam material.
.6 Acoustical sealant: to CGSB 19-GP-21M.
.7 Zinc rich paint and touch-up primer for interior surfaces: meeting requirements of Green Seal Standard GS-11, Paints and Coatings, for VOC content to be less than 250 g/l.
.8 Shaftwall enclosure system framing: purpose-made I-Stud, C-H Stud or C-T Studs and J runners, companion proprietary studs and track system.
  .1 Studs: to ASTM C645-83, roll formed using min. 0.53 mm metal thickness hot dipped or electrogalvanized sheet steel, with knurled faces for screw attachment of gypsum board finishes, coreboard retaining tabs, knock out service holes at 460 mm centres.
  .2 Top and bottom tracks, slip top tracks: same material as interior top and bottom tracks and slip top tracks, with uneven J-track leg heights to facilitate installation of coreboard into erected stud system.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

.1 Align partition tracks at floor and ceiling and secure at 600 mm on centre maximum.
.2 Install damp proof course under stud shoe tracks of partitions on slabs on grade.
.3 Erect studs to 1:1000 tolerance and no more than 3 mm out of face alignment measured from stud to adjacent stud.
.4 Position studs in top and bottom tracks. Cross brace as required to produce rigid installations; do not use surface applied straps.
.5 Fix studs to top and bottom tracks using screws or crimping tool. Do not fix studs to deflection tracks.
.6 Cut studs short, by amount required for structural deflection, where deflection tracks installed. Building structural deflection must occur within deflection tracks and must not transfer deflection loads onto studs. Provide secondary top tracks to align studs within deflection tracks. Loose fill voids created between secondary top tracks and deflection tracks with glass fibre batt insulation; do not pack tight to prevent design deflection from occurring.
.7 Co-ordinate installation of studs with installation of service lines/bracing. Ensure that knock-out holes align.
.8 Co-ordinate installation of studs with installation of door and window frames and special supports for work stated on other sections.
.9 Co-ordinate with applicable trades for installation of blocking and backing for wall hung items.
.10 Alter stud metal thickness (gauge) and spacings as required to be within design criteria deflection requirements.

3.2 INSTALLATION - INTERIOR STUDS

.1 Place studs vertically at maximum 400 mm centres, at each side of openings and corners. Place studs no more than 50 mm from abutting walls.
.2 Alter stud metal thickness (gauge) and spacings as required to be within design criteria deflection requirements.
.3 Use minimum 20 ga. studs at walls supporting abuse resistant gypsum board, plywood, MDF, or cement boards, refer to board manufacturers design criteria for minimum gauge requirements.
.4 Extend studs to structure above, unless noted otherwise.
.5 Install 20 ga. jamb studs at interior door/window openings. Use double studs at openings up to 4 times stud spacing and minimum triple studs at openings exceeding 4 times stud spacing. Extend from floor to structure over.
.6 Provide continuous horizontal channel reinforcement at 1200 mm above finished floor. Provide horizontal channel reinforcement above each door opening; extend minimum 2 stud spaces both sides of opening.
.7 Provide track at head of interior door/window openings and at sills of interior sidelight/window openings to accommodate intermediate studs. Secure track to studs at each end in accordance with manufacturer's directions. Install intermediate studs above and below openings in same manner and spacings as wall studs.
.8 Frame openings and around built-in equipment, cabinets and access panels on 4 sides. Extend framing into reveals. Check clearances with equipment suppliers.
.9 Provide furring channels or heavy gauge studs between studs for attachment of fixtures behind lavatory basins, vanities, toilet and bath accessories, door stops and other wall hung/wall braced items, including Owner installed washroom accessories.
.10 Provide furring channels or studs between wall studs for attachment of electrical and other service/device boxes.
.11 Provide 2 continuous beads of acoustical sealant between tracks and adjacent construction, and between studs and adjacent construction to produce sound seal to full perimeter of acoustical insulation filled partitions.

.12 Install shaft enclosure system framing in accordance with manufacturer's directions and requirements to produce required fire rating.

END OF SECTION 09 22 16

PART 1 - GENERAL

1.1 RELATED WORK

.1 Gypsum Board: Section 09 29 00
.2 Resilient Flooring: Section 09 65 00

1.2 REFERENCES

.1 Terrazzo, Tile and Marble Association of Canada (TTMAC) 09300, Tile Specification Guide, Maintenance Guide (latest edition)
.2 ANSI A108.1, Specification for the Installation of Ceramic Tile: Collection of 20 ANSI A108, A118 and A136 Series of Standards on Tile Installation
.3 ANSI A137.1 Specifications for Ceramic Tile
.4 ASTM C207, Standard Specification for Hydrated Lime for Masonry Purposes
.5 ASTM C778, Standard Specification for Standard Sand
.6 CSA A23.1, Aggregate for Masonry Mortar
.7 CAN/CGSB-75.1, Tile, Ceramic

1.3 QUALITY ASSURANCE

.1 Materials and Workmanship shall be in accordance with the specifications and recommendations of Terrazzo, Tile and Marble Association of Canada (TTMAC) and the requirements of the ANSI A108.1 Series of Standards.
.2 Obtain materials from one source with resources to provide products from the same production run for each contiguous area of consistent quality in appearance and physical properties.
.3 Tile that does not meet a Grade 1 Standard, or is marked as a factory second or discount will be rejected, immediately removed from the site and replaced with specified materials.
.4 Execute Work of this Work of this Section using qualified personnel skilled in ceramic tile installation, having a minimum of five (5) years proven experience and have completed tile installations similar in material, design, and extent to that indicated for this Project.

1.4 SUBMITTALS

.1 Product Data:
  .1 Submit manufacturer's product data for each type of product specified. Data shall indicate compliance with specification and installation recommendations of manufacturer of products being used.
  .2 Submit a written statement from manufacturers indicating compatibility with respect to other manufacturer's materials where more than one manufacturer's products form a part of a single tile assembly.
.2 Shop Drawings: Submit shop Drawings for the following:
  .1 Tile patterns and locations
  .2 Indicate locations of inserts and edging details.
.3 Samples for Initial Selection:
  .1 Tile: Manufacturer's colour charts consisting of actual tiles or sections of tiles showing the full range of colours, textures, and patterns available for each type and composition of tile indicated. Include Samples of accessories involving colour selection.
  .2 Grout: Manufacturer's colour charts consisting of actual sections of grout showing the full range of colours available for each type of grout indicated.
  .3 Samples for Verification: Include Sample sets showing the full range of variations expected where products involve normal colour and texture variations.
  .4 Full size units of each type of trim and accessory for each colour required.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use in accordance with ANSI A137.1 for labelling sealed tile packages.
.2 Prevent damage or contamination to materials by water, freezing, foreign matter, and other causes.
.3 Store cementitious materials in a dry area, and blocked off floor and ground surfaces.

1.6 PROJECT CONDITIONS

.1 Apply tile only to surfaces sufficiently dry, clean, firm, level, plumb and free from oil or wax or any other material, which may act as a bond barrier.
.2 Do not commence work until the related work of other trades is completed.
.3 Maintain tile materials and substrate temperature between TTMAC recommended minimum and maximum temperature range, unless indicated otherwise by manufacturer, for 48 hours before and during installation until materials are fully set and cured.
.4 Maintain temperatures after installation for time period recommended by setting and grouting materials manufacturer.
.5 Hoard and heat areas to receive tile finishes for a minimum of 48 hours before Work of this Section starts during winter months or at any other time when there is a risk that surface temperatures may drop below minimum recommended temperatures.
.6 Maintain adequate ventilation where Work of this Section generates toxic gases or where there is a risk of raising relative humidity to levels that could damage building finishes and assemblies.

1.7 MAINTENANCE DATA AND MATERIALS

.1 Submit copies of TTMAC Maintenance Guide for inclusion in the operations manual, additional materials as follows:
  .1 Provide specific warning of any maintenance practice or materials that may damage or disfigure the finished Work.
  .2 Provide manufacturer’s maintenance data sheets for floor sealers and other non-tile accessories.
.2 Provide minimum 2% of each type and colour tile installed, for project for maintenance use,.
.3 Furnish extra materials that match products installed, packaged with protective covering for storage, and identified with labels describing contents and location within building [as follows:]
.4 Provide extra grout and tile materials in sealed containers and cartons.

1.8 WARRANTY

.1 Provide manufacturer's 10 year warranty on waterproof membrane and setting materials against breakdown or deterioration, from date of Substantial Performance of Work.

PART 2 - PRODUCTS

2.1 MATERIALS: GENERAL

.1 Tile products shall be in accordance with CAN/CGSB 75.1 or ANSI A137.1 as appropriate to the named products listed herein.
.2 Factory blend tile that exhibits colour variations within the ranges selected and package so tile units taken from one package show the same range in colours as those taken from other packages.

2.2 FLOOR TILE

.1 Tile: 300 mm x 600 mm (12" x 24") through body porcelain - rectified.
- .1 Slip Resistance DCOF .0.62, R10A (Matte
- .2 Moisture Rating (MR) 1(.0.08% Impervious)
- .3 Breaking Strength (ISO 10545-4) .1300 N
- .4 Frost Resistance (ISO 10545-12) Yes
- .5 Thickness 3/8" or 9.5mm

2.3 WALL TILE

.1 Glass Tile: 2 x 10 glass low lead/Starfrit glass tile.

2.4 MORTAR SETTING MATERIALS

.1 Acceptable materials: Mortar and grout materials shall be of a uniform quality for each mortar and grout component from a single manufacturer and each aggregate from one source or producer.

.2 Portland Cement Mortar to CSAA179 containing the following:
- Cement: grey to CSAA3000
- Sand: to ASTM C778.
- Water: potable.
- Hydrated Lime: to ASTM C207.

.3 Interior Thin Set Mortar: Non-Modified mortar meeting or exceeding the requirements of ANSI A118.1 formulated for thin set applications, proprietary blend of Portland cement, inorganic aggregates and chemicals..

2.5 GROUT

.1 Portland cement grout for walls: factory blended polymer modified mixture to ANSI A118.6.

.2 Latex-Portland cement grout for floors: factory blended stain resistant latex modifiers, portland cement and graded silica sand to ANSI A118.6 dry-set grout and A118.4 grout additive.

2.6 MISCELLANEOUS MATERIALS

.1 Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers and as follows:

.2 Control joint primers, fillers, bond breakers: in accordance with Section 07 90 00.

2.7 MIXING MORTARS AND GROUT

.1 Mix mortars and grouts in accordance with referenced standards, and mortar and grout manufacturers' written instructions.

.2 Add materials, water, and additives in accurate proportions.

.3 Obtain and use type of mixing equipment, mixer speed, mixing containers, mixing time, and other procedures to product mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Examine substrates, areas, and conditions where tile will be installed for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.

.2 Verify that substrates for setting tile are firm; dry; clean; free from oil, waxy films, and curing compounds; and are within flatness tolerances required by TTMAC.
.3 Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of Work, and similar items located in or behind tile have been completed before installing tile.
.4 Verify that joints and cracks in tile substrates are coordinated with tile joint locations; adjust joints in consultation with CM where joints are not coordinated.
.5 Verify that concrete substrates have been allowed to cure for a minimum of 90 days in accordance with TTMAC requirements.
.6 Verify that tile subject to colour variations has been blended in the factory and packaged so tile units taken from one package show the same range of colours as those taken from other package. If not factory blended, blend tiles at site before installing.
.7 Verify that back of tile is free from contamination before installation.
.8 Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

.1 Remove coatings, including curing compounds, and other substances that contain soap, wax, oil, or silicone and are incompatible with tile-setting materials by using a terrazzo or concrete grinder, a drum sander, or a polishing machine equipped with a heavy-duty wire brush.
.2 Use trowelable levelling and patching compounds in accordance with tile setting material manufacturer's written instructions to fill cracks, holes, and depressions.
.3 Remove protrusions, bumps, and ridges by sanding or grinding.

3.3 INSTALLATION

.1 Comply with requirements of TTMAC Tile Specification Guide and parts of ANSI A108 Series of tile installation standards that apply to types of setting and grouting materials, and to methods required for complete ceramic tile installation.
.2 Install backer board and waterproof membrane in accordance with manufacturers instructions.
.3 Extend tile Work into recesses and under or behind equipment and fixtures to form a complete covering without interruptions.
.4 Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces.
.5 Lay tile in grid pattern as indicated on Drawings.
.6 Press setting material into the back of tile having raised or textured backs to provide a minimum of 95% coverage.
.7 Prevent rapid drying of setting material:

3.4 GROUT

.1 Install grout in accordance with manufacturer's written instructions, the requirements of the Terrazzo, Tile and Marble Association of Canada (TTMAC), and as follows:
.2 Install grout for ceramic tile (sand-Portland cement, dry-set, commercial Portland cement, and latex-Portland cement grouts) in accordance with ANSI A108.10.

3.5 CLEANING AND PROTECTION

.1 On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

END OF SECTION 09 30 00

PART 1 - GENERAL

1.1 RELATED WORK

.1 Gypsum Board Assemblies: Section 09 21 16
.2 Non-Structural Metal Stud Framing: Section 09 22 16

1.2 REFERENCES

.1 ASTM International
  .1 ASTM C635/C635M-07, Standard Specifications for the Manufacture, Performance and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings.
  .2 ASTM C636/C636M-08, Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.
  .3 ASTM E1477-98a(2008), Standard Test Method for Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers.
.2 Canadian General Standards Board (CGSB)
  .1 CAN/CGSB-92.1-M89, Sound Absorptive Prefabricated Acoustical Units.
.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  .1 Material Safety Data Sheets (MSDS).
.4 Underwriter's Laboratories of Canada (ULC)
  .1 CAN/ULC-S102-2007, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
.2 Product Data:
  .1 Submit manufacturer's instructions, printed product literature and data sheets for ceiling panels and ceiling suspension system and include product characteristics, performance criteria, physical size, finish and limitations.
  .2 Submit 2 copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements.
.3 Shop Drawings:
  .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of British Columbia, Canada.
  .2 Submit reflected ceiling plans for special grid patterns as indicated.
  .3 Indicate lay-out, insert and hanger spacing and fastening details, splicing method for main and cross runners, and acoustical unit support at ceiling fixture, lateral bracing and accessories.
.4 Samples:
  .1 Submit for review and acceptance of each unit.
  .2 Samples will be returned for inclusion into work.
  .3 Submit duplicate full size samples of acoustical units.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
.3 Storage and Handling Requirements:
  .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  .2 Store materials inside, level, under cover. Protect from weather, damage from construction operations and other causes, in accordance with manufacturer's printed

instructions.
.3 Handle materials to prevent damage to edges or surfaces. Protect metal accessories and trim from being bent or damaged.
.4 Store and protect acoustic ceiling materials from nicks, scratches, and blemishes.
.5 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan Waste Reduction Workplan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 COMPONENTS

.1 Acoustic units for suspended ceiling system: to CAN/CGSB-92.1.
.1 Type: lay-in exposed grid.
.2 Pattern: non-directional fine fissured, Class A.
.3 Flame spread rating of 25 or less in accordance with CAN/ULC-S102.
.4 Smoke developed 50 or less in accordance with CAN/ULC-S102.
.5 Noise Reduction Coefficient (NRC) designation of 0.80.
.6 Light Reflectance (LR) range of 0.87 to ASTM E1477.
.7 Edge type square-cut lay-in.
.8 Colour: white.
.9 Size: 610 mm x 610 mm x 22 mm thick.
.10 Shape flat.

.2 Acoustical Suspension:
.1 Intermediate duty system to ASTM C635.
.2 Basic materials for suspension system: commercial quality cold rolled steel, zinc coated.
.3 Suspension system: non fire rated, two directional exposed tee bar grid.
.4 Exposed tee bar grid components: shop painted satin sheen, white colour. Components die cut. Main tee with double web, rectangular bulb and 25 mm rolled cap on exposed face. Cross tee with rectangular bulb; web extended to form positive interlock with main tee webs; lower flange extended and offset to provide flush intersection.
.5 Hanger wire: galvanized soft annealed steel wire, 3.6 mm diameter for access tile ceilings.
.6 Hanger inserts: purpose made.
.7 Carrying channels: galvanized steel.
.8 Accessories: splices, clips, wire ties, retainers and wall moulding flush, to complement suspension system components, as recommended by system manufacturer.

.3 Performance/Design Criteria:
.1 Maximum deflection: 1/360th of span to ASTM C635 deflection test.

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 prior to acoustical ceiling installation.
.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 Installation: in accordance with ASTM C636 except where specified otherwise.
.2 Suspension System:
  .1 Erect ceiling suspension system after work above ceiling has been inspected by Departmental Representative.
  .2 Secure hangers to overhead structure using attachment methods acceptable to Departmental Representative.
  .3 Install hangers spaced at maximum 1200 mm centres and within 150 mm from ends of main tees.
  .4 Lay out system according to reflected ceiling plan.
  .5 Install wall moulding to provide correct ceiling height.
  .6 Completed suspension system to support super-imposed loads, such as lighting fixtures diffusers grilles and speakers.
  .7 Support at light fixtures diffusers with additional ceiling suspension hangers within 150 mm of each corner and at maximum 600 mm around perimeter of fixture.
  .8 Interlock cross member to main runner to provide rigid assembly.
  .9 Ensure finished ceiling system is square with adjoining walls and level within 1:1000.

.3 Acoustic Panels:
  .1 Install acoustical panels and tiles in ceiling suspension system.
  .2 Co-ordinate ceiling work with work of other sections such as interior lighting, fire protection communication, and intrusion and detection systems.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  .1 Leave Work area clean at end of each day.
.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by acoustical ceiling installation.

END OF SECTION 09 51 99

PART 1 - GENERAL

1.1 RELATED WORK

.1	Concrete Finishing:	Section 03 35 00
.2	Tile Carpeting:	Section 09 68 13

1.2 REFERENCE STANDARDS

.1 ASTM F710, Standard Practice for Preparing Concrete Floors and other Monolithic Floors to Receive Resilient Flooring.
.2 ASTM F1913, Standard Specification for Sheet Vinyl Floor Covering Without Backing.
.3 ASTM F1516, Standard Practice for Sealing Seams of Resilient Flooring Products by the Heat Weld Method.
.4 ASTM F1861, Standard Specification for Resilient Wall Base.
.5 ASTM F 2169 Standard Specification for Resilient Stair Treads, Type TS, Class 1 and 2, Group 1 and 2.
.6 ASTM F 1869, Standard Test Method for Measuring Moisture Vapour Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
.7 National Floor Covering Association of Canada (NFCA), Floor Covering Reference Manual.

1.3 SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures
.2 Provide product data in accordance with Section 01 33 00 - Submittal Procedures.
.3 Provide samples in accordance with Section 01 33 00 - Submittal Procedures.
  .1 Submit duplicate 300 x 300 mm sample pieces of sheet material, 300 mm long base, nosing, treads, edge strips.
.4 Closeout Submittals:
  .1 Provide maintenance data for resilient flooring for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
.2 Waste Management and Disposal:
  .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.5 AMBIENT CONDITIONS

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

1.6 MAINTENANCE

.1 Provide 5% of full width material for each colour, pattern and type sheet flooring installed, for project maintenance use, in accordance with Section 01 33 00.
.2 Provide extra materials of resilient sheet flooring and adhesives in accordance with Section 01 78 00 - Closeout Submittals
.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 MATERIALS

.1 Sheet vinyl: (homogeneous)
- .1 Composition: Minimum 50% vinyl compound binder consisting of a blended composition of pigments stabilized against heat and light deterioration. Design, colour and pattern shall extend through the full thickness of the material.
- .2 Standards: ASTM F 1913 Vinyl Sheet Floor Covering Without Backing.
- .3 Intended use: Commercial
- .4 Thickness: 2 mm.
- .5 Colours: colours as scheduled or selected by Consultant from manufacturer's complete range.

.2 Resilient Base:
- .1 Composition: pre-moulded rubber.
- .2 Standard: ASTM F1861.
- .3 Thickness: 3 mm.
- .4 Height: 101 mm
- .5 Colours: colours as scheduled or selected by Consultant from manufacturer's complete range.
- .6 Style: top-set cove style.

2.2 STAIRS

.1 All stair accessories shall be by same manufacturer.
.2 Integrated Stair tread with riser:
- .1 Standards: ASTM F 2169 Standard Specification for Resilient Stair Treads, Type TS, Class 1 and 2, Group 1 and 2.
- .2 Hardness: ASTM D 2240 – Not less than 85 Shore A.
- .3 Abrasion Resistance: ASTM D 3389 – less than 1 gram weight loss.
- .4 Solid colour integrated stair tread and riser, 50 mm height hinged square nose, tapering 5.3 mm to 2.8 mm, 508 mm overall width including 330 mm tread depth with 178 mm integrated riser, with 50 mm contrasting colour grit tape insert

2.3 ACCESSORIES

.1 Primers and adhesives: of types recommended by resilient flooring manufacturer for specific material on applicable substrate.
.2 Sub-floor filler and leveller: as recommended by flooring manufacturer for use with their product.
.3 Metal edge strips: Aluminum extruded, smooth, mill finish stainless steel with lip to extend under floor finish, shoulder flush with top of adjacent floor finish.

PART 3 - EXECUTION

3.1 PREPARATION

.1 Ensure that paint, varnish, oils, release agents, waxes, sealers and curing and hardening compounds not compatible with adhesives employed have been removed.
.2 Test new and existing exposed concrete for moisture using ASTM F 1869, *Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride* test method and provide written results. Moisture emission not to exceed 1 kg/70 m^2 in 24 hours.
.3 Test new exposed concrete for alkalinity and neutralize if required in accordance with NFPA recommendations without using acid.

3.2 SUBFLOOR TREATMENT

.1 Remove subfloor ridges and bumps. Fill low spots, cracks, joints, holes and other defects using subfloor filler.

3.3 APPLICATION FLOORING

.1 Provide high ventilation rate, with maximum outside air, during installation, and for 48 to 72 hours after installation. If possible, vent directly to outside. Do not let contaminated air recirculate through district or whole building air distribution system. Maintain extra ventilation for at least one month following building occupation.
.2 Apply adhesive uniformly using recommended trowel. Do not spread more adhesive than can be covered by flooring before initial set takes place.
.3 Lay flooring with seams parallel to building lines to produce a minimum number of seams. Border widths minimum 1/3 width of full material.
.4 Run sheets in direction of traffic.
.5 Heat weld seams of sheet flooring in accordance with manufacturer's printed instructions.
.6 As installation progresses, roll flooring with 45 kg minimum roller to ensure full adhesion.
.7 Cut flooring around fixed objects.
.8 Continue flooring over areas which will be under built-in furniture.
.9 Terminate flooring at centreline of door in openings where adjacent floor finish or colour is dissimilar.
.10 Install metal edge strips at unprotected or exposed edges where flooring terminates.

3.4 APPLICATION: STAIR TREAD AND RISER

.1 Comply with manufacturer's written instructions for installing resilient accessories.
.2 Use manufacturer’s recommended Epoxy Caulking Compound to strengthen nosing and fill irregularities in substrates to conform to tread nosing.
.3 Tightly adhere to substrates throughout length of each piece.
.4 For treads installed as separate, equal-length units, install to produce a flush joint between units.

3.5 APPLICATION: BASE

.1 Lay out base to keep number of joints at minimum.
.2 Clean substrate and prime with one coat of adhesive.
.3 Apply adhesive to back of base.
.4 Set base against wall and floor surfaces tightly by using 3 kg hand roller.
.5 Install straight and level to variation of 1:1000.
.6 Scribe and fit to door frames and other obstructions. Use premoulded end pieces at flush door frames.
.7 Cope internal corners. Use premoulded corner units for right angle external corners. Use formed straight base material for external corners of other angles.
.8 Heat weld base in accordance with manufacturer's printed instructions.

.

3.6 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.
.2 Remove excess adhesive from floor, base and wall surfaces without damage.
.3 Clean, floor and base surface to flooring manufacturer's printed instructions.

3.7 PROTECTION

.1 Protect new floors from time of final set of adhesive after initial waxing until final waxing final inspection.

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

END OF SECTION 09 65 00

PART 1 - GENERAL

1.1 RELATED WORK

.1	Concrete Finishing:	Section 03 35 00
.2	Finish Carpentry:	Section 06 20 00
.3	Resilient Flooring:	Section 09 65 00

1.2 REFERENCES

.1 CAN/CGSB 4.129 Carpets for Commercial Use.
.2 CAN/CGSB-4.155, Flammability of Soft Floor Coverings for all carpets.
.3 CAN/ULC-S102.2, Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Covering and Miscellaneous Materials and Assemblies.
.4 Floor Covering Reference Manual issued by the National Floor Covering Association of Canada (NFCA)
.5 Carpet and Rug Institute (CRI), Carpet Installation Standard.
.6 Canada Consumer Product Safety Act (S.C. 2010, c. 21)
.7 Health Canada / Workplace Hazardous Materials Information System (WHMIS), Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
.2 Product Data:
  .1 Submit manufacturer's instructions, printed product literature and data sheets for each carpet tile undercushion adhesive carpet protection subfloor patching compound and include product characteristics, performance criteria, physical size, finish and limitations.
  .2 Submit 2 copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements 01 35 43 - Environmental Procedures.
.3 Shop Drawings:
  .1 Submit drawings indicate:
    .1 Nap: direction, open edges, special patterns.
    .2 Cutouts: show locations where cutouts are required.
    .3 Edgings: show location of edge moldings and edge bindings.
.4 Samples:
  .1 Submit for review and acceptance of each unit.
  .2 Samples will be returned for inclusion into work.
  .3 Submit duplicate samples of each type of carpet tile specified and duplicate tiles for each colour selected, 150 mm length binder bars base divider strips.
.5 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
.6 Test and Evaluation Reports:
  .1 Certified test reports showing compliance with specified performance characteristics and physical properties.
.7 Manufacturer's Instructions: submit manufacturer's installation and storage instructions.
.8 Manufacturers Reports:
  .1 Manufacturer's Field Reports: submit manufacturer's written reports within 3 days of review, verifying compliance with specifications.

1.4 CLOSEOUT SUBMITTALS

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

1.5 MAINTENANCE MATERIAL

.1 Extra stock materials: deliver to Owner 2% extra materials from same production run as products installed. Package products with protective covering and identify with descriptive labels. Comply with Section 01 78 00 - Closeout Submittals.

1.6 QUALITY ASSURANCE

.1 Comply with National Floor Covering Association (NFCA) Floor Covering Reference Manual for all product and installation requirements.
.2 Perform all work in strict accordance with NFCA Reference Manual requirements using Provincially qualified tradesmen fully experienced in carpet flooring installations and conditions of work that apply.
.3 Carpet tile flooring installer shall be recommended by the carpet tile flooring supplier as qualified for installation of carpet tile flooring with a minimum of five (5) years experience.

1.7 PRODUCT DELIVERY, HANDLING, AND STORAGE

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
.2 Deliver carpet tile in original labelled and unopened containers with colour / pattern and registration numbers clearly marked on each container.
.3 Deliver all other materials (e.g. adhesives, accessories, etc.) in wrapped / sealed and clearly labelled unopened containers.
.4 Prevent damage to and store all materials in strict accordance with manufacturers written requirements in a secure dry space on site at locations designated by the Departmental Representative.
.5 Deliver all materials to work areas when required and a minimum of 24 hours before installation to condition materials to site temperature and humidity conditions.
.6 Safety: comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials.

1.8 SITE CONDITIONS

.1 Prepare moisture testing and provide report to Departmental Representative.
.2 Moisture and alkalinity tests shall be conducted using testing methods and devices in accordance with NFCA requirements carpet tile manufacturer's recommendations.
.3 Vapour emissions shall not exceed a rating of 3 lbs./ 1000 ft2 over a twenty-four (24) hour period.
.4 Alkalinity results shall not exceed a maximum pH rating of 7.
.5 Do not install flooring materials until testing results indicate that substrate surfaces are acceptable for covering. Report any unsatisfactory conditions to the Departmental Representative.
.6 Ventilation:
  .1 Departmental Representative will co-ordinate operation of ventilation system during installation of carpet. Ventilate area of work as directed by Departmental Representative by use of approved portable supply and exhaust fans.
  .2 Ventilate enclosed spaces in accordance with Section 01 51 00 - Temporary Utilities.

1.9 WARRANTY

.1 Manufacturer's warranty: submit, for Departmental Representative's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to and does not limit other rights Owner may have under Contract Documents.
.2 Warranty period: 1 year, commencing on date of substantial performance of work.

.1 Warranty covers labour and repair or replacement of defective components for 1 year after date of substantial performance.

PART 2 PRODUCTS

2.1 FABRICATION

.1 Product Size: 50 cm x 50 cm
.2 Backing: PVC free cushion
.3 Construction: Tufted, Textured Loop
.4 Weight: 3,214 g/m²
.5 Gauge: 1/12
.6 Stitches Per Inch: 9.16 stitches / inch
.7 Finished Pile Thickness: 2.13 mm
.8 Nominal Total Weight: 3,214 g/m²
.9 Fiber System: Nylon
.10 Dye Method: solution dyed
.11 Fluorine-Free Soil Protection
.12 Flammability (Radiant Panel ASTM-E-648) 0.45 (Class I)
.13 Smoke Density (NFPA-258-T or ASTM-E-662) 450
.14 Static Electricity (AATCC-134) 20% R.H.,70 ‹ F 3.5 KV, Permanent Conductive Fiber

2.2 ACCESSORIES

.1 Base: in accordance with Section 09 65 00 - Resilient Flooring.
.2 Subfloor Filler (for patching, filling and leveling): pre-mixed filler with Portland cement and polymeric modifiers (white latex) with minimum compressive strength of 20 MPa (2900 psi) at 28 days, type as recommended by carpet tile flooring manufacturer.
.3 Primers and Sealers: as recommended by carpet tile flooring manufacturer.
.4 Adhesives: solvent-free, waterproof release type as recommended by carpet tile flooring manufacturer to suit carpet backing, grade level as well as subfloor and usage conditions. Adhesive to have acceptable low level emissions as follows:
  .1 Total VOC concentration less than 0.5 mg/m^3/hour.
  .2 Formaldehyde: must be less than 1 part per billion (1-PPB).
  .3 4 Phenycyclohexane (4-PCH): must be less than 1 part per billion (1-PPB).
  .4 Submit evidence of adhesive meeting the above requirements.
.5 Edge Strips: Metal, designed for carpet being installed. Clear anodic coating

PART 3 EXECUTION

3.1 EXAMINATION

.1 Examine conditions, substrates and work to receive work of this Section, co-ordinate with Section 01 71 00 - Examination and Preparation.
.2 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for carpet tile installation in accordance with manufacturer's written instructions.
  .1 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

3.2 PREPARATION

.1 Test concrete for moisture using RMA referenced test method and provide written results. Moisture emission shall not exceed 1 kg / 70 m^2 in 24 hours with maximum allowable limits established by the carpet tile manufacturer.

.2 Test concrete for alkalinity and neutralize if required in accordance with NFPA recommendations without using acid.
.3 Type, location, condition and surface tolerances of sub-floor, must be in complete accordance with NFCA requirements and carpet tile manufacturers recommendations.
.4 Fill substrate low spots, cracks, joints and holes with substrate filler to the extent required by scope of work and ensure substrates are free from all bumps, ridges and other imperfections. Feather filler to allow for difference in adjacent floor materials as required. Rough grind to eliminate all irregularities and sweep and vacuum substrate clean.
.5 Seal and prime substrate surfaces in accordance with carpet tile and adhesive manufacturer's recommendations.
.6 Review all site conditions, installation requirements and timetable for work and ensure substrate, environmental conditions and work by other trades is acceptable prior to commencing installation of all materials and to ensure that schedule can be maintained.
.7 Ensure that temperature requirements for installation of materials is within appropriate range prior to, during, and after installation.

3.3 INSTALLATION

.1 Install carpet tile in strict accordance with manufacturer's directions,
.2 Use carpet tile from same dye lot/production run throughout for each colour required. Ensure colour, pattern and texture match within each area.
.3 Finish installations to present smooth wearing surface free from conspicuous joints.
.4 Cut carpet tile neatly around fixed objects. Continue carpet tile under casework items.
.5 Terminate carpet tile at centreline of door in openings where adjacent floor finish or colour is dissimilar.
.6 Protect exposed carpet tile edges at transition to other flooring materials with suitable transition strips.

3.4 PROTECTION OF FINISHED WORK

.1 Protect all surfaces and work in progress from damage and maintain protection for a minimum of 48 hours or until the adhesive has set and cured thoroughly. Avoid static and rolling loads on newly installed carpet tile.
.2 Protect surrounding surfaces from soiling. Make good on defects caused to other trades work if fault of carpet tile installation.
.3 Install carpet protection to satisfaction of Departmental Representative.
.4 Provide additional carpet tiles and place at entry doors so that they can be used as doormats by other trade personnel entering the carpeted area if entry is permitted.
.5 The Contractor shall ensure that:
  .1 carpet tile is protected from foot traffic damage by providing and maintaining a suitable covering acceptable to the carpet tile manufacturer until it has been reviewed and accepted by the Owner at Substantial Performance and until ready for use.
  .2 carpet tile is protected against damage from rolling loads where rolling traffic will occur (e.g. moving of equipment, appliances, etc.) by covering it with plywood or hardboard.

END OF SECTION 09 68 13

PART 1 - GENERAL

1.1 RELATED WORK

.1	Metal Fabrications:	Section 05 50 00
.2	Architectural Woodwork:	Section 06 40 00
.3	Metal Doors and Frames	Section 08 10 00
.4	Gypsum Board	Section 09 29 00
.5	Plumbing:	Division 22
.6	HVAC:	Division 23

1.2 REFERENCE STANDARD

.1 Master Painters Institute (MPI), Architectural Painting Specification Manual of the Master Painters and Decorators Association (MPDA), referenced as MPI Manual.
.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS): Material Safety Data Sheets (MSDS).
.3 Society for Protective Coatings (SSPC): Systems and Specifications, SSPC Painting Manual.

1.3 QUALITY ASSURANCE

.1 All materials, preparation and workmanship shall conform to requirements of the latest edition of the Architectural Painting Specification Manual by the Master Painters Institute (MPI) (hereafter referred to as the MPI Painting Manual) as issued by the local MPI Accredited Quality Assurance Association having jurisdiction.
.2 All paint manufacturers and products used shall be as listed under the Approved Product List section of the MPI Painting Manual.
.3 All painting and decorating work shall be inspected by a Paint Inspection Agency (inspector) acceptable to the Departmental Representative and the local MPI Accredited Quality Assurance Association. The painting contractor shall notify the Paint Inspection Agency a minimum of one week prior to commencement of work and provide a copy of the project painting specification, plans and elevation drawings (including pertinent details) as well as a Finish Schedule.
.4 All surfaces requiring painting shall be inspected by the Paint Inspection Agency who shall notify the Departmental Representative in writing of any defects or problems, prior to commencing painting work, or after the prime coat shows defects in the substrate.
.5 Retain purchase orders, invoices and documents to prove conformance with noted MPI requirements when requested by Departmental Representative.

1.4 SCHEDULING

.1 Submit work schedule for various stages of painting to Departmental Representative for approval. Submit schedule minimum of 48 hours in advance of proposed operations.
.2 Obtain written authorization from Departmental Representative for changes in work schedule.

1.5 SUBMITTALS

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

.2 Product Data:
  .1 Submit manufacturer's printed product literature, specifications and data sheets.
  .2 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures. Indicate VOCs during application and curing.
.3 Upon completion, submit records of products used. List products in relation to finish system and include the following:
  .1 Product name, type and use.

.2 Manufacturer's product number.
.3 Colour numbers.
.4 Manufacturer's Material Safety Data Sheets (MSDS).

.4 Provide samples in accordance with Section 01 33 00 Submittal Procedures.
.1 Submit duplicate mm sample panels of each paint with specified paint or coating in colours, gloss/sheen and textures required to MPI Painting Specification Manual standards submitted on the following substrate materials:
.1 3 mm plate steel for finishes over metal surfaces.
.2 13 mm plywood for finishes over wood surfaces.
.3 13 mm gypsum board for finishes over gypsum board and other smooth surfaces.
.2 When approved, samples shall become acceptable standard of quality for appropriate on site surface with one of each sample retained on site.
.3 Submit full range of available colours where colour availability is restricted

1.6 QUALITY CONTROL

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

1.7 MAINTENANCE

.1 Extra Materials:
.1 Submit maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
.2 Submit one, one litre can of each type and colour of finish coating. Identify colour and paint type in relation to established colour schedule and finish system

1.8 DELIVERY, STORAGE, AND HANDLING

.1 Delivery and Acceptance Requirements:
.1 Deliver materials in sealed original labelled containers bearing manufacturer's name, type of material, brand name, colour designation, and where applicable, instructions for mixing and reducing.
.2 Labels: to indicate:
.1 Manufacturer's name and address.
.2 Type of paint or coating.
.3 Compliance with applicable standard.
.4 Colour number in accordance with established colour schedule.
.2 Storage and Handling Requirements:
.1 Store paint and other materials in a single heated and well ventilated area with a minimum ambient temperature of 7°C.
.2 Take precautionary measures to prevent fire hazards or spontaneous combustion.
.3 Provide one 9 kg Type ABC fire extinguisher adjacent to storage area.
.3 Waste Management and Disposal:
.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction Waste Management and Disposal.
.2 Separate for reuse and recycling and place in designated containers in accordance with Waste Management Plan.
.3 Place materials defined as hazardous or toxic in designated containers.
.4 Handle and dispose of hazardous materials in accordance with Regional and

Municipal regulations.

.5 Ensure emptied containers are sealed and stored safely.

.6 Unused paint materials must be disposed of at official hazardous material collections site.

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

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

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

.10 To reduce the amount of contaminants entering waterways, sanitary/storm drain systems or into ground follow these procedures:

.1 Retain cleaning water for water-based materials to allow sediments to be filtered out.

.2 Retain cleaners, thinners, solvents and excess paint and place in designated containers and ensure proper disposal.

.3 Return solvent and oil soaked rags used during painting operations for contaminant recovery, proper disposal, or appropriate cleaning and laundering.

.4 Dispose of contaminants in approved legal manner in accordance with hazardous waste regulations.

.5 Empty paint cans are to be dry prior to disposal or recycling (where available).

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

1.9 ENVIRONMENTAL CONDITIONS

.1 In accordance with (Exterior) Chapter 2, Section 3, Item 1.1 and (Interior) Chapter 3, Section 3, Item 1.1 of the MPI Manual.

.2 Do not apply paint finish in areas where dust is being generated.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Use only MPI approved products from the MPI Approved Product Lists corresponding to the specified finishing systems.

.2 Use paint materials of single manufacturer for each paint system.

PART 3 - EXECUTION

3.1 PREPARATION OF SURFACES

.1 Prepare exterior and interior surfaces to receive paint per Chapter 2 - Section 3 and Chapter 3 - Section 3 of the MPI manual.

3.2 COLOURS

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

.2 Colour schedule will be based upon selection of five base colours and three accent colours. No more than eight colours will be selected for entire project and no more than three colours will be selected in each area.

.3 Selection of colours will be from manufacturers full range of colours.
.4 Where specific products are available in restricted range of colours, selection will be based on limited range.
.5 Second coat in three coat system to be tinted slightly lighter colour than top coat to show visible difference between coats.

3.3 APPLICATION

.1 Sand and dust between each coat to remove defects visible from distance up to 1.5 metres.
.2 Finish closets and alcoves as specified for adjoining rooms.
.3 Continue paint finishes through behind wall mounted items.

3.4 MECHANICAL AND ELECTRICAL EQUIPMENT

.1 Paint exposed conduits, pipes, hangers, ductwork and other mechanical and electrical equipment occurring in finished areas as well as inside cupboards and cabinet work. Colour and texture to match adjacent surfaces, except as noted otherwise. Coordinate with mechanical trades applying banding and labelling after pipes have been painted.
.2 Paint gas piping gas standard yellow where visible in service spaces.
.3 Paint surfaces inside of ductwork and elsewhere behind grilles where visible using primer and one coat of matte black paint.
.4 Paint both sides and edges of plywood backboards for equipment before installation.
.5 Leave equipment in original finish except for touch-up as required, and paint conduits, mounting accessories and other unfinished items.

3.5 PAINT SYSTEMS

.1 System references listed are based on Exterior Systems Chapter 2 - Section 2 and Interior Systems Chapter 3 - Section 2 of MPI Manual, and are MPI Premium Grade, unless noted otherwise.
.2 Use systems referenced for interior and exterior finishes listed.

3.6 EXTERIOR SYSTEMS

.1 Structural steel and metal fabrications: columns, beams, joists, etc.
  .1 EXT 5.1C - WB Light Industrial Coating, (G5).
.2 Galvanized metal: doors, frames, pipes, handrails, ducts etc.
  .1 EXT 5.3J: W.B. Light Industrial Coating, Prime with MPI #134- W.B. Galvanized primer, follow with 2 coats of MPI #163- W.B. Light industrial Coating - Semi-gloss

3.7 INTERIOR SYSTEMS

.1 Structural steel and metal fabrications:
  .1 INT 5.1B WB Light Industrial Coating. (G5)
.2 Galvanized metal:
  .1 INT 5.3M High performance architectural latex finish.
.3 Gypsum board:
  .1 INT 9.2B: high performance latex, gloss level 3.

END OF SECTION 09 90 00

PART 1 - GENERAL

1.1 RELATED WORK

.1 Non-Structural Metal Framing: Section 09 22 16

1.2 MAINTENANCE DATA

.1 Provide maintenance data for tackboards for incorporation into maintenance manual described in Section 01 33 00.
.2 Affix removable maintenance instruction labels to tackboards.

1.3 GUARANTEE

.1 Provide manufacturer's written guarantee that tackboard panels will not delaminate for 5 years, from date of Substantial Performance of Work.

PART 2 - PRODUCTS

2.1 BASIC MATERIALS

.1 Laminating adhesive: manufacturer's standard.
.2 Aluminum extrusions: Aluminum Association alloy AA6063-T5, minimum 1.5 mm wall thickness.

2.2 PANEL COMPONENTS

.1 Core: CSA A247 Type II fibreboard.
.2 Backing sheets: tempered aluminum foil and sheet aluminum as required.

2.3 TACKBOARD MATERIALS

.1 Tackboard Panels
  .1 Product: colour cork tackboard
  .2 Colours: as selected by Consultant
  .3 Size: 4' 'Wide x longest practical lengths.
  .4 Thickness: 6 mm tackboard on 15/16" particle board
.2 All panels must be flat and true on delivery to job site.
.3 Perimeter trim or frame: aluminum extrusion channel assembly.
.4 Finish exposed surfaces of aluminum components in accordance with Aluminum Association Designation System for Aluminum Finishes, clear anodized, Class 2.
.5 Fabricate and install panels mounted on 15/16" particleboard for continuos lengths minimizing seam joints that will allow reasonable handling and installation.
.6 Make finished panels flat and rigid.

2.4 TRIM / FRAMING

.1 Aluminum extrusion channel perimeter trim or frame to fit over and enclose full surface-core-backer assembly.

2.5 FINISHES

.1 Finish exposed surfaces of aluminum components in accordance with Aluminum Association Designation System for Aluminum Finishes.
  .1 Clear anodic finish: designation AA-M12 C22 A31.
.2 Finish steel mounting system components using gloss black enamel paint.

2.6 FABRICATION

.1 Fabricate board panels to sizes that will allow reasonable handling and installation without field joining.
.2 Factory laminate tackboards, consisting with tempered foil backing sheet or 0.4 mm thick sheet aluminum backing as applicable.
.3 Make finished panels flat and rigid.

2.7 FACTORY INSTALLED TRIM

.1 Install trim on panels in factory.
.2 Make mitres and intersecting joints to hairline fit, free of rough edges. Use brackets to reinforce and hold joints tight and flush. No exposed fasteners permitted.
.3 Overlap trim 6 mm onto panels.

2.8 MOUNTING SYSTEMS

.1 Fixed components: Provide semi-concealed edge fixing with clips to secure panels in place.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install stationary panels using semi-concealed edge fixing with clips to secure panels in place. Do not through drill perimeter trim or face fix.
.2 Mechanical attachment:
.1 To stud framing, use screws; secure through wall finish into studs.

3.2 CLEANING

.1 Clean all surfaces after installation using manufacturer's recommended cleaning procedures.

END OF SECTION 10 11 26

PART 1 - GENERAL

1.1 RELATED WORK

.1 Non-Structural Metal Framing: Section 09 22 16
.2 Gypsum Board Assemblies: Section 09 21 16

1.2 REFERENCES

.1 ASTM International:
  .1 ASTM A240/A240M-15a: Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
.2 Product Data:
  .1 Submit manufacturer's instructions, printed product literature and data sheets for wall and corner guards and include product characteristics, performance criteria, physical size, finish and limitations.
  .2 Submit 2 copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements.
.3 Installation Shop Drawings:
  .1 Indicate on shop drawings large scale details, materials, finishes, dimensions, anchorage and assembly.

1.4 QUALITY ASSURANCE

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

1.5 DELIVERY, STORAGE AND HANDLING

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

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Corner Guards: 75 mm x 75 mm and 40 mm x 40 mm x 1200 mm surface mounted; type 304 stainless steel with No. 4 finish, 90° square corner, sizes and configurations as indicated in the Finish Schedule, lengths to be minimum 1200 mm unless indicated otherwise, Adhesive applied.

.2 Adhesive: water resistant type as recommended by the corner guard manufacturer for the applicable substrate

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 MANUFACTURER'S INSTRUCTIONS

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

3.3 INSTALLATION

.1 Install units on solid backing and erect with materials and components straight, tight and in alignment.
.2 Adhere corner guards to substrate at locations indicated.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  .1 Leave Work area clean at end of each day.
.2 Perform cleaning after installation to remove construction and accumulated environmental dirt.
.3 Clean surfaces after installation using manufacturer's written recommended cleaning procedures.
.4 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.
.5 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.
.2 Repair damage to adjacent materials caused by wall and corner guards installation.

END OF SECTION 10 25 00

PART 1 - GENERAL

1.1 RELATED WORK

.1 Non-Structural Metal Framing: Section 09 22 16

1.2 REFERENCES

.1 ASTM International
- .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.

1.3 SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
.2 Product Data:
- .1 Provide manufacturer's printed product literatureand data sheets and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings
- .1 Submit shop drawings or catalogue illustrations. Indicate size and description of components, base material, surface finish inside and out, hardware and locks, attachment and wall blocking requirements.

.4 Tools:
- .1 Provide special tools required for assembly, disassembly or removal for toilet and bath accessories in accordance with requirements specified in Section 01 78 00 - Closeout Submittals.
- .2 Deliver special tools to Departmental Representative.

1.4 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for toilet and bath accessories for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 GUARANTEE

.1 Provide mirror manufacturer's written guarantee for mirrors of this section against failure of silvering detrimental to reflection for 10 years from date of Substantial Performance of Work.

1.6 DELIVERY, STORAGE AND HANDLING

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

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Sheet steel: commercial grade, stretcher levelled sheet steel to ASTM A525 with Z275 designation zinc coating.
.2 Stainless steel sheet: to ASTM A666-72 type 304 minimum 0.8 mm thick.
.3 Fasteners: screws and bolts hot dip galvanized where concealed, stainless steel tamper resistant security screws where exposed. Expansion shields fibre, lead or rubber as recommended by fixture manufacturer for component and its intended use.

2.2 FINISHES

.1 Chrome and nickel plating: to ASTM B456 polished finish.
.2 Stainless steel: to ASTM A167, No. 4 satin lustre finish.

2.3 COMPONENTS

.1 Toilet paper dispenser: Cast aluminum, satin finish. Plastic spindles, concealed locking device; theft-resistant. Holds two rolls up to 150 mm diameter (2000 sheets). Unit 320 mm wide, projects 125 mm from wall. No controlled delivery
.2 Soap dispensers: Vertical tank is satin-finish stainless steel. Valve dispenses all-purpose hand soaps. Capacity: 1.2-L. Soap refill window. Concealed wall fastening. Hinged filler-top requires special key to open. Vandal resistant. Unit 120 x 205mm; wall to push-button, 90 mm.
.3 Paper towel dispensers: Recessed convertible folded paper towel module and 12-gallon waste receptacle. Satin-finish stainless steel. Seamless beveled flange. Dispenses 600 C-fold or 800 multifold towels. Removable waste receptacle locked into cabinet. Receptacle shall be 205 mm deep with capacity of 45.5-L; extends 105 mm from wall. Rough Wall Opening: 405 x 1390 x 100 mm.
.4 Mirrors: One-piece, 13 x 13 x 9.5 mm channel-frame. Type 430 stainless steel with bright-polished finish. Mitered corners. Frame screw to permit easy replacement of glass. No. 1 quality, 6 mm glass mirror; warranted against silver spoilage for 15 years. Galvanized steel back. Secured to concealed wall hanger with theft-resistant mounting.
.5 Hat and Coat Hook: Bright-polished stainless steel. 50 x 50 mm flange. 25 x 165 mm hook; projects 80 mm from wall. Concealed wall plate.
.6 Stainless Steel Shelf: 455 mm long x 125 mm wide, 18-gauge, type 304 stainless steel, satin finish. 19 mm return edge; hem front edge. 16-gauge brackets.
.7 Vertical Grab Bars: 300 mm x 32 mm dia. tubing. Constructed of 18-ga, type 304 satin-finish stainless steel tubing. Concealed mounting flange 3 mm thick, type 304 stainless steel plate, 50 mm W x 80 mm H, with screw holes for concealed anchors. Cover: 22-ga., type 304 stainless steel with satin finish, 85 mm diameter. Cover snaps over mounting flange to conceal screws. all designed to withstand 2.2 kN downward pull. Satin finish with peened gripping surface.
.8 Horizontal Grab Bars: 1000 mm and 600 mm x 32 mm dia. tubing. Constructed of 18-ga, type 304 satin-finish stainless steel tubing. Concealed mounting flange 3 mm thick, type 304 stainless steel plate, 50 mm W x 80 mm H, with screw holes for concealed anchors. Cover: 22-ga., type 304 stainless steel with satin finish, 85 mm diameter. Cover snaps over mounting flange to conceal screws. all designed to withstand 2.2 kN downward pull. Satin finish with peened gripping surface.

2.4 FABRICATION

.1 Weld and grind joints of fabricated components flush and smooth. Use mechanical fasteners only where approved.
.2 Wherever possible form exposed surfaces from one sheet of stock, free of joints.
.3 Brake form sheet metal work with 1.5 mm radius bends.
.4 Form surfaces flat without distortion. Maintain flat surfaces without scratches or dents.

.5 Hot dip galvanize ferrous metal anchors and fastening devices to CSA G164.
.6 Shop assemble components and package complete with anchors and fittings.
.7 Deliver inserts and rough-in frames to job site at appropriate time for building-in. Provide templates or rough-in measurements as required.
.8 Provide steel anchor plates and components for installation on studding and building framing.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrates and surfaces to receive toilet and bathroom accessories previously installed under other Sections or Contracts are acceptable for product installation in accordance with manufacturer's instructions prior to toilet and bathroom accessories installation.
.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval from Departmental Representative.

3.2 INSTALLATION

.1 Install and secure accessories rigidly in place as follows:
  .1 Stud walls: install steel back plate to stud prior to plaster or drywall finish. Provide plate with threaded studs or plugs.
  .2 Use tamper proof screws/bolts for fasteners.
. .3 Fill units with necessary supplies shortly before final acceptance of building.

3.3 ADJUSTING

.1 Adjust toilet and bathroom accessories components and systems for correct function and operation in accordance with manufacturer's written instructions.
.2 Lubricate moving parts to operate smoothly and fit accurately.

3.4 CLEANING

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

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.
.2 Repair damage to adjacent materials caused by toilet and bathroom accessories installation.

END OF SECTION 10 28 00

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes materials and requirements for water and chemical fire extinguishers and cabinets.

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 SUBMITTALS

.1 Shop Drawings:

.1 Submit shop drawings for each type of fire extinguisher and cabinet.

.2 Closeout Submittals

.1 Provide maintenance data for incorporation into Operational and Maintenance manual.

PART 2 - PRODUCTS

2.1 MULTI-PURPOSE DRY CHEMICAL EXTINGUISHERS

.1 4.5 kg [10 lbs] Extinguisher: Multipurpose stored pressure rechargeable fire extinguisher, squeeze grip positive on/off operation, heavy duty glossy enamel finish steel cylinder, pull pin safety lock, forged valve, rating for 4-A, 60-B, C with universal wall mounting bracket..

2.2 EXTINGUISHER BRACKETS

.1 Universal wall mounting bracket as recommended by extinguisher manufacturer.

2.3 CABINETS

.1 FE1 - Semi-recessed with Bubble Canopy - 100 mm [4” wall]:

.1 Cabinet constructed of 1.19 mm [18 ga] steel tub and 2 mm [14 ga] steel door with transparent bubble canopy and trim with 25 mm [1”] return frame, full length semi-concealed piano hinge and flush stainless steel door latch. Front section to have a full 50mm [2”] adjustment to wall. Baked enamel finish, colour to Architect’s choice.

.2 4.5 kg [10 lbs] extinguisher.

.1 FE2 - Surface Mounted

.1 Constructed of 1.19 mm [18 ga] baked white enamel steel with cylinder lock keyed alike, scored clear full acrylic access beak panel and break glass bar.

.2 4.5 kg [10 lbs] extinguisher.

2.4 IDENTIFICATION

.1 Identify extinguishers in accordance with the recommendations of NFPA 10.

.2 Attach a tag or label to extinguishers, indicating the month and year of installation, which provides space for subsequent service date recording.

.3 Identify extinguishers in accordance with recommendations of ANSI/NFPA 10.

.4 Attach tag or label to extinguishers, indicating month and year of installation. Provide space for service dates.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install or mount extinguishers in cabinets or on brackets as indicated.

END OF SECTION 10 44 20

PART 1 - GENERAL

1.1 REFERENCE

.1 Canadian General Standards Board (CGSB) - CAN/CGSB-44.40 Steel Clothing Locker
.2 ASTM A167 - Specification for Stainless and Heat Resisting Chromium Nickel Steel Plate, Sheet and Strip
.3 ASTM A653/ A653M - Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process
.4 ASTM A924 /A924M - Specification for General Requirements for Steel Sheet, Metallic Coated by the Hot Dip Process

1.2 SUBMITTALS

.1 Submit samples in accordance with Section 01 33 00.
.2 Provide manufacturer's printed product literatureand data sheets for metal lockers and include product characteristics, performance criteria, physical size, finish and limitations.
.3 Submit duplicate 50 x 50 mm samples of colour and finish on actual base metal. Samples will be returned for inclusion into work.
.4 Shop Drawings
  .1 Submit shop drawings in accordance with Section 01 33 00.
  .2 Indicate locker construction, door hardware, features and accessories; layouts, arrangements and dimensions; finishes and colours.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
.2 Delivery and Acceptance Requirements:
  .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
.3 Storage and Handling Requirements:
  .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  .2 Store and protect metal lockers from nicks, scratches, and blemishes.
  .3 Replace defective or damaged materials with new.
.4 Packaging Waste Management: remove for reuse packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.4 WARRANTY

.1 Lockers shall be warranted for a period of two years against defective parts and workmanship, excluding vandalism and improper installation.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Lockers: to CAN/CGSB-44.40, Type: single tier full-height locker freestanding.
  .1 Size: 305 mm wide x 457 mm deep x 1829 mm high, steel thickness, No .24 MSG body.
  .2 Assembly: welded construction.
  .3 Top: sloped.
  .4 Doors: one-piece double-wall envelope construction, steel thickness No .20 MSG, door swing.
  .5 Door handle: recessed handle stainless steel.

2.2 ACCESSORIES

.1 Locking system: padlocks
.1 Three prong wall hooks, resilient rubber bumper, metal base, door louvres, sloped tops.

2.2 SHOP FINISHING

.1 Clean, degrease and neutralize steel components using phosphate or chromate treatment.
.2 Powder coating, baked on to provide a uniform, smooth, protective finish.

2.3 LOCKER BENCH

.1 PEDESTAL:
  .1 Powder-coated cold-rolled steel.
  .2 25 mm x 25 mm, 16 Ga tubing, welded into A-Frame shape, overall size 282 mm wide x 387 mm high.
  .3 Black PVC tube cap on bottom.
.2 SEAT:
  .1 Clear S4S kiln-dried cedar.
  .2 Maple: 254 mm wide x 31.75 mm thick. Edges rounded and all surfaces sanded. Finish is clear lacquer, one coat sealer and one top coat.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Assemble and install new lockers.
.2 Set plumb, level and true to line of building. Fix in place to remain permanent and secure.
.3 Install trim and fillers required to complete bank installations, to produce custom fitted installations, free of sharp and unfinished edges, using hidden fasteners. Reinforce and fasten fillers to prevent buckling and distortion.
.4 Test and adjust doors for proper function.

END OF SECTION 10 51 13

Part 1 GENERAL

1.1 REFERENCES

.1 American Society for Testing and Materials International (ASTM)

.1 ASTM A490M, Standard Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints [Metric].

.2 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated, (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.81, Air Drying and Baking Alkyd Primer for Vehicles and Equipment.

.2 CAN/CGSB-1.88, Gloss Alkyd Enamel, Air Drying and Baking.

.3 CGSB 31-GP-107Ma, Non-inhibited Phosphoric Acid Base Metal Conditioner and Rust Remover.

.3 Canadian Standards Association (CSA International)

.1 CSA-G40.20-[04]/G40.21, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.2 CSA W59, Welded Steel Construction (Metal Arc Welding).

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

.1 Material Safety Data Sheets (MSDS).

1.2 DESIGN REQUIREMENTS

.1 Design and construct metal storage shelving to support maximum load per bay.

.2 Design shelving to accommodate vertical adjustment of shelves in 50 mm increments and to permit easy assembly, expansion, dismantling and re-use of shelving component parts.

1.3 SUBMITTALS

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

.2 Submit shop drawings:

.1 Indicate shelving layouts, number of bays, number of shelves, number and size of drawers, bins, number of dividers, system of bracing and anchoring devices.

.3 Samples:

.1 Submit [representative sample bay of specified shelving showing finish colour and including accessories] [___].

.4 Quality control submittals: submit following in accordance with Section 01 45 00 - Quality Control.

.1 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Packing, shipping, handling and unloading:

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

.2 Waste Management and Disposal:

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

1.5 MAINTENANCE/EXTRA MATERIALS

.1 Provide maintenance materials, special tools and spare parts in accordance with Section 01 78 00 - Closeout Submittals.

.2 Provide tools for assembly and disassembly, standard with metal storage shelving manufacturer.

Part 2 PRODUCTS

2.1 MATERIALS

.1 Galvanized steel sheet: commercial grade to ASTM A653/A653M with Z275 zinc coating.

.2 Steel sections and plates: to CSA-G40.20/G40.21, Type 400 W.

.3 Steel bolts, nuts and washers: to ASTM A490M.

.4 Welding materials: to CSA W59.

2.2 COMPONENTS

.1 Uprights:

.1 Roll formed steel angles or tees with perforations to accommodate shelves and other components.
.2 Size and thickness of angles or tees to support specified total load.

.2 Shelves:

.1 Brake formed sheet metal, reinforced to carry specified loads.
.2 Punch holes in shelves to accommodate dividers and other components.

.3 Kickplates: formed sheet metal to close opening between bottom shelf and floor on front of shelving bay.

.4 Back: 0.6 mm core thickness steel sheet to enclose shelving bay extending from bottom shelf to top shelf.

.5 Side panels: 0.6 mm core thickness steel sheet panels to close ends of shelving bays or sections and as partitions between adjacent bays.

.6 Dividers:

.1 Reinforced sheet metal plates for subdividing shelves into bins.
.2 Provide for attachment of dividers to shelves immediately above and below dividers.

.7 Bin fronts: formed sheet metal, attached to front edge of shelf to prevent small parts from falling over edge of shelf.

.8 Gusset plates: heavy gauge metal plates to reinforce corner connections of shelving components.

.9 Braces:

.1 Provide sway braces for open type shelving.

.2 Use side sway braces on two exposed sides of each rack and at alternate bays.

.3 Use back sway braces on two end sections of each bank and on alternate bays.

.10 Label holders: attachable to front edge of shelf with provision to hold paper or plastic label.

.11 Base plates: metal or plastic plates to take uprights and to protect floor surfaces.

2.3 FINISH

.1 Finish shelving system painted in standard cream-beige colour.

.2 Condition metal by applying one coat of metal conditioner to CGSB 31-GP-107Ma.

.3 Apply one coat type 2 primer to CAN/CGSB-1.81 and bake.

.4 Apply two coats of type 2 enamel to CAN/CGSB-1.88 and bake to hard durable finish.

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 Do metal storage shelving work except where specified otherwise.

.2 Install metal storage shelving in accordance with reviewed layout.

.3 Brace, secure and anchor shelving units in place.

.4 Make good baked enamel surfaces damaged during shipment or installation.

3.3 CLEANING

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

END OF SECTION 10 56 13

PART 1 - GENERAL

1.1 REFERENCES

.1 National Fire Protection Association (NFPA):
  .1 NFPA 701: Standard Methods of Fire Tests for Flame Propagation of Textiles and Films.
.2 American Society for Testing and Materials (ASTM)
  .1 ASTM: G21 Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
  .2 ASTM G22, Standard Practice for Determining Resistance of Plastics to Bacteria. (Withdrawn 2001)

1.2 SUBMITTALS

.1 Samples:
  .1 Submit samples in accordance with Section 01 33 00.
  .2 Submit 75 mm x 130 mm shade fabric sample swatches indicating full range of colours, densities and weaves available for initial selection.
  .3 Submit full range colour samples of steel and aluminum components for colour selection use.
.2 Product Data
  .1 Product Literature: Manufacturer's product data sheets, specifications, performance data, physical properties and installation instructions for each item required.
  .2 Provide additional information for fabric; including size limitations, fire resistance information and toxicity information. Identify available shade fabric colours, densities and weaves.
.3 Maintenance Data
  .1 Provide maintenance data for cleaning and maintenance of roller shades for incorporation into maintenance manual described in Section 01 78 00 - Closeout Submittals and include the following:.
    .1 Methods for maintenance of roller shades and finishes.
    .2 Precautions about cleaning materials and methods that could be detrimental to fabrics, films finishes and performance.
    .3 Operating hardware.
.4 Shop Drawings
  .1 Submit shop drawings in accordance with Section 01 33 00.
  .2 Indicate dimensions in relation to window jambs, operator details, head anchorage details, hardware and accessory details.

1.3 QUALITY ASSURANCE

.1 Obtain products specified in this Section from a single manufacturer.
.2 Installer Qualifications: Minimum 3 years documented experience; demonstrating previously successful work of the type specified herein; approved by window shade manufacturer.
.3 Take field measurements before preparation of shop drawings and fabrication, where possible, to ensure proper fitting of window shade system.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver prefabricated shades to site in manufacturer's original, labelled and unopened protective packaging. Labels to be intact and legible; identifying manufacturer and contents; uniquely identified for each intended location.
.2 Store products off ground, under cover, protected from elements and construction activities. Schedule delivery to prevent delays, but minimize on-site storage.

1.5 WARRANTY

.1 Warrant roller shade components and labour for a period of one (1) year and roller shade fabrics for a period of five (5) years from date of substantial performance.

PART 2 - PRODUCTS

2.1 CONTROL SYSTEM COMPONENTS

.1 Clutch: Adjustment free clutch operated by a one piece drive pulley shall be comprised of multi-banded steel springs that create the pressure necessary to keep the shade in the desired position. All plastic components shall be made of glass reinforced polyester thermopolymer. The clutch shall develop no more than ½ lbs. lifting drag.
.2 A spring assist assembly shall ensure even lift and lowering forces of approximately 6 lbs or less on any weight fully assembled shade up to the maximum shade weight of 30 lbs.
.3 Roller Tube (axle): 6061-T6 extruded aluminum tube designed to preclude centre deflection greater than 7 mm. Tube wall thickness and diameter shall be designed by manufacturer to suit application.
.4 End Plug: Heat stabilized wear resistant fibre reinforced plastic outside sleeve rotating freely on a centre shaft, providing the bearing surfaces on which the rollers ride.
.5 Bead Chain: Qualified #10-3/16" (4.8 mm) diameter stainless steel ball chain c/w 8 mm diameter ball stop and chain connectors as required. Lengths to suit application.
.6 Brackets: Reversible 1.8 mm cold rolled steel c/w lock down retainer device.
.7 Fascia: extruded 6063-T5 aluminum fascia c/w 1.8 mm cold rolled steel mounting brackets, reversible for right or left hand installation. Finishes: clear anodized.
.8 Hem Bar: 4.8 mm x 25 mm 6061-T6 aluminum flat bar inserted into sonically welded hem pocket and secured with VHB (very high bond) adhesive
.9 Safety Tension Device: The tension device when installed, will hold the chain taut and close to the mounting surface in a manner that makes the tension device's position fixed and immobile.

2.2 SHADE MATERIAL (FABRIC)

.1 Fabric: basket-weave design.
  .1 100% thermoplastic olefin (TPO) both core yarn and jacket,
  .2 Single thickness, 0.457mm opaque coated reinforced yarn, non-raveling 0.762 mm thick fabric.
  .3 Openess: 3%
  .4 Colour: as selected.
  .5 Shade fabric shall conform to NFPA 701: Standard Methods of Fire Tests for Flame Propagation of Textiles and Films and NFPA 10 (ClassA).

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER SHADE INSTALLATION

.1 Install roller shades level, plumb, square, and true according to manufacturer's written instructions, and located so shade band is not closer than 50 mm to interior face of glass. Allow clearances for window operation hardware.

3.3 ADJUSTING

.1 Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

.1 Clean roller shade surfaces after installation, according to manufacturer's written instructions.
.2 Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer that ensure that roller shades are without damage or deterioration at time of Substantial Completion.
.3 Replace damaged roller shades that cannot be repaired, in a manner approved by Department Representative, before time of Substantial Completion.

END OF SECTION 12 24 13

PART 1 - GENERAL

1.1 RELATED WORK

.1	Structural Drawings	
.2	Insulated Metal Roof Panels:	Section 07 41 00
.2	Insulated Metal Wall Panels:	Section 07 42 13
.3	Metal Doors and Frames:	Section 08 10 00
.4	Sectional Doors:	Section 08 36 13
.5	Glazed Aluminum Curtain Wall:	Section 08 44 13
.6	Aluminum Windows:	Section 08 51 13

1.2 REFERENCES

.1 Building Codes
- .1 National Building Code 2015 (NBC)
- .2 British Columbia Building Code 2012 (BCBC).
- .3 Local or municipal Building By-laws.

.2 ASTM International
- .1 ASTM A325M-10, Standard Specification for Structural Bolts, Steel, Heat Treated 120/105 Ksi Minimum Tensile Strength.
- .2 ASTM A490M-12, Standard Specification for High Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints [Metric].
- .3 ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc-Coated(Galvanized) or Zinc Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .4 ASTM A792/A792M-10, Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
- .5 ASTM D523-08, Standard Test Method for Specular Gloss.
- .6 ASTM D822-01(2006), Standard Practice for Filtered Open-Flame Carbon-ArcExposures of Paint and Related Coatings.
- .7 ASTM F1554-07 Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
- .8 ASTM F2329-11 Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners.
- .9 ASTM A193/A193M-16, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature or High-Pressure Service and Other Special Purpose Applications.
- .10 ASTM F1554, Standard Specification for Anchor Bolts, Steel 36, 55 and 105 ksi Yield Strength

.3 CSA International
- .1 CSA A660-10, Certification of Manufacturers of Steel Building Systems.
- .2 CSA G40.20/G40.21-04(R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .3 CAN/CSA-S16-09, Design of Steel Structures.
- .4 CAN/CSA-S136-07, North American Specification for the Design of Cold Formed Steel Structures Members.
- .5 CSA W59-03(R2008), Welded Steel Construction (Metal Arc Welding).

.4 Canadian Sheet Steel Building Institute (CSSBI)
- .1 CSSBI 30M-06, Standard for Steel Building Systems.
- .2 CSSBI, Design in Cold Formed Steel-2006.
- .3 CSSBI Bulletin B15-07, Snow, Wind and Earthquake Load Design Criteria for Steel Building Systems.

.5 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)
.1 SMACNA - IAQ Guideline for Occupied Buildings under Construction, [2007].

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
.2 Early Submittals:
.1 Submit schematic general arrangement drawings showing primary framing for the gravitational and lateral systems for review and approval prior to design.
Refer to indicative drawings from architects for guidance and reference.
.3 Product Data:
.1 Submit manufacturer's instructions, printed product literature and data sheets for metal building materials and include product characteristics, performance criteria, physical size, finish and limitations. Products to include the following:
.1 Wall system
.2 Roof system
.3 Finishes
.4 Sheet metal flashing and trim
.5 Man door
.6 Overhead door
.4 Shop Drawings:
.1 Submit drawings stamped and signed by professional engineer registered or licensed in British Columbia, Canada.
.2 Indicate on drawings related provisions required for mechanical, electrical and other work.
.3 Submit complete calculated thermal design analysis based on ASHRAE zone method or tests certified by independent analysis signed and sealed by professional engineer registered or licensed in [Territory] [Province], Canada.
.4 Submit erection drawings in accordance with CSSBI 30M as follows:
.1 Erection drawings showing foundation loads, anchor bolt setting details, part numbers, connections and assembly details.
.2 Submit description of methods and sequence of erection and type of equipment proposed for use in erecting structural frame.
.5 Indicate details including cuts, copes, connections, holes, threaded fasteners, rivets and welds. Indicate welds by CSA welding symbols.
.5 Certificates:
.1 Submit certification that building is in accordance with contract requirements.
.2 Submit structural Letter of Assurance (Schedule S).
.3 Submit certification stating design criteria used and loads assumed in design, which places sole responsibility for design of building components with steel building systems manufacturer.

1.4 QUALITY ASSURANCE

.1 Single-source Assurance: To ensure building integrity one system manufacturer is responsible for all of the separate components that make up the entire metal building systems structure.
.2 Perform work in accordance with CSSBI-Standard for Steel Building Systems. Maintain one copy on site.
.3 Manufacturer qualifications: Company specializing in manufacturing the Products specified in this section with minimum 5 years experience. Manufacturer is certified in accordance with the requirements of CSA A660.
.4 Erector qualifications: Company specializing in performing the Work of this section.
.5 Installer qualifications: Company specializing in performing the Work of this section with minimum 5 years documented experience and approved by manufacturer.

.6 Design all primary and secondary structural components, develop shop drawings, and perform shop and site work under direct supervision of professional structural engineer experienced in design of this Work and licensed in Province of British Columbia, Canada.

.7 Design envelope, develop shop drawings and perform shop and site work under direct supervision of registered professional or building envelope engineer experience in design of this Work and licensed in Province of British Columbia, Canada.

.8 Site Meetings: as part of Manufacturer's Services described in PART 3 - FIELD QUALITY CONTROL, schedule site visits, to review Work, at stages listed.

.1 After delivery and storage of products, and when preparatory work is complete but before installation begins.

.2 During progress of Work after primary structural framing complete.

.3 Upon completion of Work, after cleaning is carried out.

.9 Develop shop drawings and perform shop and site work under direct supervision of a registered professional experienced in Design of this work and licensed in Province of British Columbia, Canada.

1.5 DELIVERY, STORAGE AND HANDLING

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

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

.3 Storage and Handling Requirements:

.1 Handle and protect galvanized materials from damage to zinc coating.

.1 During storage space surfaces of galvanized materials to permit free circulation of air.

.2 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.3 Store and protect metal building materials from nicks, scratches, and blemishes.

.4 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to Work of this Section and in accordance with Section 01 74 21.

1.6 WARRANTIES

.1 Manufacturer’s Warranty: On manufacturer’s standard form, in which manufacturer agrees to repair or replace metal building system components that fail in materials and workmanship within one year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

.1 Primary framing:

.1 Lateral load resisting system to be proposed by Manufacturer’s structural engineer. Moment resisting rigid frames of continuous rafter beams and columns shall be used except where braced frames may be used where braces do not interfere with the functional space.

.2 All columns shall be designed as a pin connected base.

.3 Seismic force resisting system shall comply with British Columbia Building Code BCBC 2012 and National Building Code 2015.

.2 Secondary framing: engineered as necessary for roof support, overhead doors, mandoors, etc.

.3 Roof slope: as indicated on drawings.

.4 Door jambs for overhead doors to be designed using 200 C channel sections and to be coordinated with the track of the overhead doors. Bent steel plate closer (12 gauge) to be installed over the C channel to frame the door opening and protect the end of the exterior wall. See architectural drawings for details.

2.2 DESIGN REQUIREMENTS

.1 Foundations have been designed for the loads shown on the drawings based on a preliminary design and an assumed super-structure configuration. Foundations have been designed for the seismic loads multiplied by Rd = 1.5, assuming conventional construction. If a higher ductility system is utilized (Rd greater than or equal to 2.0), foundation loads based on the moment-resisting and braced frame capacities are to be provided. Final loads from pre-engineered building manufacturer to be reviewed by Departmental Representative with respect to the foundation and anchor bolt design. The Departmental Representative will revise the foundation and anchor bolt design to suit the final design of the pre-engineered building. The assumed super-structure is as follows:
  .1 Moment-resisting frames on grids 2, 3, 4, 5, 6, and 7.
  .2 Moment-resisting frame on grid 7 provides lateral support for level 2 floor.
  .3 Braced frames on grids 1 and 8.
  .4 Braced frame on grid 8 provides lateral support for level 2 floor.
  .5 Portal frames on grids a and c between grids 1 - 2 and grids 7 - 8.
  .6 Braced frame on grid a+8580mm between 7+4000mm and 8 providing lateral support of level 2 floor.
.2 Design steel building system to withstand dead loads and live loads including cranes, ceilings, mechanical systems, and electrical systems.
.3 Design steel building system in accordance with 2015 National Building Code of Canada. Site specific design parameters are as follows:
  .1 Building Importance Category: Normal
  .2 Roof Snow: Ss = 0.9 kPa, Sr = 0.4 kPa, S = 1.12 kPa + accumulation
  .3 2nd Level Floor: Live Load = 2.4 kPa, Partition Load = 1.0 kPa
  .4 Exit Stairs and Corridors: Live Load = 4.8 kPa
  .5 Mechanical or Electrical service rooms: Live Load = 3.6 kPa
  .6 Wind: q1/50 = 0.52 kPa, Terrain = open, Internal Pressure Category = 3
  .7 Seismic: Site Class = C, Sa(0.2) = 0.700, Sa(0.5) = 0.659, Sa(1.0) = 0.447, Sa(2.0) = 0.272, S(5.0) = 0.091, PGA = 0.320, PGV = 0.543
.4 Maximum deflection:
  .1 Roof cladding vertical deflection due to snow or wind load: 1/240 of span.
  .2 Roof joists vertical deflection due to snow or wind load: 1/360 of span.
  .3 Roof joists vertical deflection due to total load: 1/300 of span.
  .4 Roof beams vertical deflection due to snow or wind load: 1/480 of span.
  .5 Roof beams vertical deflection due to total load: 1/360 of span.
  .6 Floor vertical deflection due to live load: 1/480 of span.
  .7 Floor vertical deflection due to total load: 1/360 of span.
  .8 Wall cladding lateral deflection due to specified wind loads: 1/180 of span.
  .9 Building sway frames or braced frames lateral deflection under crane or wind loads: 1/400 of height.
  .10 Building sway frames or braced frames lateral deflection under seismic loads: 1/40 of height.
.5 Limit floor vibrations to acceptable levels in accordance with Design Guide 11: Vibrations of Steel-Framed Structural Systems Due to Human Activity (Second Edition).

2.3 MATERIALS

.1 Structural steel: to CSA G40.21 as shown on approved shop drawings.
.2 Anchor rods: to ASTM F1554 grade 36, galvanized to ASTM F2329.
.3 Bolts: to ASTM A325M complete with nuts and washers.
.4 Welding materials: to CSA W59.
.5 Shrinkage compensating grout: premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents to CSA A23.1/A23.2 as required and shown on approved shop drawings.
.6 Screws: corrosion resistant purpose made, head colour to match finish.

.7 Anchor bolts: to ASTM F1554 Grade 36 or 55, or CSA-G40.20/G40.21, Grade 300W.
.8 High strength anchor bolts: to ASTM A193/A193M, Grade B7.

2.4 FABRICATION

.1 Fabricate structural members in accordance with shop drawings to CAN/CSA-S16.
  .1 Tolerance to CSSBI 30M.
.2 Provide holes for attachment of other work, as indicated.
.3 Reinforce openings to maintain design strength.

2.5 FINISHES

.1 Clean, prepare surfaces and shop prime structural steel to CAN/CSA-S16 except where members are zinc coated or zinc-aluminum alloy coated or are to be encased in concrete.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for metal building installation in accordance with manufacturer's written instructions.
  .1 Visually inspect substrate in presence of Contractor.
  .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  .3 Proceed with installation only after unacceptable conditions have been remedied.
.2 Coordinate: coordinate with other work having a direct bearing on Work of this section.

3.2 ERECTION

.1 Do work in accordance with CSSBI 30M except where specified otherwise.
.2 Erect structural frame in accordance with shop drawings and to CAN/CSA-S16.
  .1 Erection tolerances not to exceed those specified in CSSBI 30M.
.3 Prepare galvanized structural steel surfaces for field welding by removing zinc before welding.
  .1 After welding, chip away flux and prime with MPI #79.
.4 Obtain written permission from Departmental Representative prior to field cutting or altering of structural members.
.5 Touch up with shop primer bolts, rivets, welds and burned or scratched surfaces where exposed at completion of erection.

3.3 FIELD QUALITY CONTROL

.1 Manufacturer's Services:
  .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
  .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
  .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.4 CLEANING

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

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

.3 Waste Management: separate waste materials for reuse or recycling in accordance with Section 01 74 21 - Construction Waste Management and Disposal.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by metal building system installation.

END OF SECTION 13 34 19

PART 1 - GENERAL

1.1 REFERENCE

.1 CMAA Crane Manufacturer's Association of America
- .1 Specifications for Top Running Bridge & Gantry Type Multiple Girder Electric Overhead Traveling Cranes - No. 70 (2004)
- .2 Specifications for Top Running and Under Running Single Girder Electric Overhead Cranes Utilizing Under Running Trolley Hoist - No. 74 (2004)

.2 ANSI / ASME American National Standards Institute / American Society of Mechanical Engineers
- .1 ANSI / ASME HST-4 - 1999 Performance Standard For Overhead Electric Wire Rope Hoists
- .2 ANSI / ASME B30.16 - 2003 Overhead Hoists (Underhung)
- .3 ANSI / ASME B30.2 - 2001 Overhead and Gantry Cranes (Top Running Bridge, Single Or Multiple Girder, Top Running Trolley Hoist)
- .4 ANSI / ASME B30.11 - 2004 Monorails and Underhung Cranes
- .5 ANSI / ASME B30.17 - 2003 Overhead and Gantry Cranes (Top Running Bridge, Single Girder, Underhung Hoist)

.3 American Society for Testing and Materials International, (ASTM)
- .1 ASTM B 30.2-05, Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist).
- .2 ASTM A 325-09a, Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
- .3 ASTM A 325M-09, Specification for High-Strength Bolts for Structural Steel Joints (Metric).
- .4 ASTM 490M-09a, Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric).
- .5 ASTM ASTM A 307-07b, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.

.4 Canadian Standards Association (CSA International)
- .1 CAN/CSA G40.20-04/G40.21-04 (R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .2 CSA S16-09, Limit States Design of Steel Structures.
- .3 CSA W47.1-09, Certification of Companies for Fusion Welding of Steel Structures.
- .4 CSA W59-03 (R2008), Welded Steel Construction (Metal Arc Welding).
- .5 CSA C22.1-09, Canadian Electrical code, Part I Safety Standard for Electrical Installations.
- .6 CSA S478-95 (R2001), Guideline on Durability in Buildings

.5 National Research Council Canada
- .1 National Building Code of Canada 2010 (NBCC).

.6 NEMA - National Electric Manufacturer's Association

.7 WorkSafe BC, Occupational Health and Safety Regulation - Part 14: Cranes and Hoists.

1.2 QUALITY ASSURANCE

.1 Installation is to be done by an established firm having at least five (5) years of proven, satisfactory experience in this trade and employing skilled personnel. The firm is to be authorized by the equipment Manufacturer to install the equipment specified

.2 Installation firm is to submit proof of qualification and certification in writing to the Departmental Representative prior to commencement of Work.

1.3 DESIGN CRITERIA

.1 Crane safe lifting capacities to be based on the maximum lift requirements for the area and tasks being serviced.
.2 Horizontal hoisting travel limits and vertical hoisting height to be maximized.
.3 If applicable, design the crane walkways to facilitate building maintenance such as servicing light fixtures. Walkways to have a guard railing conforming to requirements of NBCC. Design access points to the walkways.
.4 Full fall protection and fall restraint system shall be designed as required for maintenance and inspection activities on the crane.
.5 Coordinate electrical power requirements with the electrical design: supply, circuit breaker protection and safety disconnect switch. All electrical protection required for crane components to be provided as part of the crane assembly.
.6 The design and installation of wiring, conduits, control panels, and grounding shall be in accordance with the requirements of Division 26, Electrical.
.7 Structural steel design shall conform CSA S16 and to Section 05 12 01 - Structural Steel for Buildings. Design the craneway girders for live load deflection conforming to requirements in CSA S16.
.8 Structures to be designed for wind loading and impact loading from crane operations in accordance with the NBCC, Part 4.
.9 Summary:

.1	Span:	21 metres
.2	Capacity:	3 Tonnes
.3	Crane type:	top running
.4	Classification:	Crane shall be designed and constructed to CMAA Specification # 70 or #74, as applicable, for Class "C" service requirements and operation in a non-hazardous environment.
.5	Crane speed:	0 - 0.508 MPS, infinitely variable
.6	Crane drive:	Dual motor drive
.7	Trolley speed:	0 - 0.33 MPS, infinitely variable
.8	Trolley drive:	Motorized
.9	Hoist speeds:	0.10 and 0.02 MPS, two speed
.10	Hoist type:	Electric wire rope
.11	Hoist lift required:	6 metres
.12	Control:	Pendant from independent track on bridge

1.4 SUBMITTALS

.1 Submit shop details and erection drawings in accordance with Section 01 33 00 - Submittal Procedures.
.2 Submit drawings stamped and signed by a qualified Professional Engineer registered in the Province of B.C..
.3 Submit maintenance data for crane maintenance; incorporate into operation and maintenance manual.
.4 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
.5 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
.6 Instructions: submit manufacturers installation instructions.
.7 Manufacturers Field Services: submit copies of manufacturers field reports
.8 Closeout Submittals:
    .1 Submit the following in accordance with Section 01 78 00 - Closeout Submittals.
    .2 Project Record Documents:
        .1 Record actual locations of equipment, names of equipment manufacturers and suppliers, concealed conduit and boxes, concealed devices, disconnects.

.3 Operation and Maintenance Data:
- .1 Include description of crane system's method of operation and control including equipment function, normal operating characteristics, and limiting conditions.
- .2 Assembly, installation, alignment, and maintenance instructions.
- .3 Lubrication and maintenance instructions.
- .4 Guide to "troubleshooting".
- .5 Provide parts catalogues with complete list of equipment replacement parts with equipment description and identifying numbers.
- .6 Legible schematic wiring diagrams covering electrical equipment installed,

1.5 DELIVERY, STORAGE AND HANDLING

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

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

.3 Storage and Handling Requirements:
- .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect metal lockers from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.6 WARRANTY

.1 Provide one-year equipment warranty.

PART 2 - PRODUCTS

2.1 MATERIALS

.1

Components:	Material:
Bridge beams	Steel, ASTM A36 or A992
End trucks	Steel, ASTM A36 (or equal)
Trolley	Steel, ASTM A36 (or equal)
Wheels	Cast iron or steel
Hooks	Forged steel

2.2 LABELLING

.1 Hoist and bridge beam shall be labeled with load rating.

.2 A corrosion-resistant nameplate shall be fixed to the bridge with the following information:
- .1 Name of manufacturer
- .2 Mfg.'s model number and serial number
- .3 Capacity
- .4 Date of manufacture (month and year)

2.3 PAINTING

.1 Hoist and trolley shall be factory painted (2-part epoxy) per manufacturer's standards.

.2 Bridge shall be shop cleaned, primed, and painted per manufacturer's standards.

.3 The following items shall not be painted:
- .1 Rail surfaces in contact with wheels
- .2 Wheel running surfaces

.3 Hoist wire rope
.4 Conductor bar, festoon cables and supports

PART 3 - EXECUTION

3.1 INSTALLATION AND INSPECTION

.1 Inspect structure and crane rail erection for conformance with reviewed shop drawings and contract documents prior to installation of equipment. Bring nonconforming work to the attention of the Departmental Representative prior to proceeding with crane installation. Non-conforming runway structure or installation must be corrected prior to load testing of crane system. .
.2 Bridge crane shall be installed in conformance with manufacturer's instructions and inspected by a manufacturer's representative.
.3 Provide all necessary accessories to make bridge crane complete, usable, and capable of meeting the operating requirements specified in the Operating Requirements.
.4 Test, adjust and clean equipment for acceptance by Departmental Representative .

3.2 TESTING

.1 All crane equipment shall be operated through a complete lift and lowering cycle and through a complete travel of the bridge and trolley to determine that the equipment shall perform smoothly and safely and that pendant cable length is sufficient to permit operation from desired floor levels.
.2 All tests shall be carried out with the bridge crane equipment loaded at 125 percent of capacity. The bridge crane provider shall provide the test weight loads. Any defects shall be corrected by the bridge crane provider without any expense to the Owner.

.

END OF SECTION 14 60 00

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes common work results for fire suppression systems - Division 21.

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 DESCRIPTION OF WORK

.1 This Section pertains to the fire protection systems and fire protection water supply to a point 900 mm [36"] beyond the exterior face of the building.

.2 All equipment, elbows, fittings, nipples, drains, test connections and all accessory pipework for a complete and operational fire protection system is included in this Section of the work within the basic Tender price.

.3 No extra cost will be considered based on failure of Contractor to allow for all required equipment, piping and fittings. This shall include extra fittings and pipework as required during construction to avoid existing structure, ductwork or other obstacles whether shown on drawings or not.

1.4 SYSTEM DESIGN

.1 Arrange and pay for the services of a BC registered Professional Engineer. This Engineer shall provide all required engineering services related to the fire protection systems as indicated below.

.2 The Fire Protection Engineer shall:

.1 Produce the fire protection working shop drawings in CAD format. Drawings shall be of the same size as the Contract Drawings.

.2 Perform hydraulic calculations. Software shall meet NFPA calculation requirements.

.3 Seal all documents submitted for construction and permits.

.4 Assume full responsibility for the detailed fire protection system design, and submit Schedules (for Detailed Design).

.5 Provide assistance to the Fire Protection Contractor as required.

.6 Witness sprinkler testing.

.7 Inspect the completed installation.

.8 On project completion, submit a sealed statutory declaration to the Departmental Representative stating that the fire protection system is installed in accordance with the fire protection engineer drawings, instructions and the regulatory requirements.

1.5 SUBMITTALS

.1 Shop Drawings:

.1 Shop drawings shall indicate all the information required by NFPA, and the Authority Having Jurisdiction.

.2 Indicate essential building construction features such as direction and size of concrete beams, partitions and lighting.

.3 Bring to the attention of the Departmental Representative any sprinkler head, pipe, valve or system component in a location different from where specifically shown on the project Fire Protection Drawings. These alternate locations shall be reviewed during the shop drawing review.

.4 Indicate piping and sprinkler head elevations, the sprinkler temperature rating, the spacing and types of hangers; seismic bracing details; drain test and flushing connections; type of sprinkler alarm; location and type of sprinkler control valve; and all other essential features of the piping system.

.5 Submit shop drawings to the Departmental Representative, which have been approved and stamped by the Authority Having Jurisdiction and sealed by the Fire Protection Engineer. Allow a minimum of three weeks for review by Departmental Representative. Submit a minimum of six [6] copies. Allow for resubmission(s) of drawings to reflect the Departmental Representative's review comments.

.6 Submit a copy of the sprinkler shop drawings for review to the Owner's insurance agency.

.7 Submit shop drawings for the following items:

.1 General:

.1 Fire protection sprinkler system.

.2 Fire department connections.

.3 Flow switches.

.4 Pressure switches.

.5 Supervisory switches.

.6 Valves, fittings and couplings.

.2 Wet sprinklers:

.1 Sprinkler heads and escutcheon plates.

.2 Riser manifolds.

.3 Alarm Valves.

.2 Record Drawings

.1 Refer to Section 23 0300 - Common Work Results for Mechanical.

.2 Provide "Record Drawings", Record Drawings shall include revised CAD drawings files on disk.

.3 Provide a CAD disk to the Consultant for his records.

.3 Closeout Submittals

.1 Provide maintenance data for incorporation into Operational and Maintenance manual.

1.6 SEISMIC PROTECTION

.1 Supply and install sway-bracing hangers on fire protection systems in accordance with NFPA requirements. Generally this shall apply to:

.1 All cross mains 50 mm [2"] and larger.

.2 All feed mains.

.3 All standpipe risers.

.4 Horizontal piping shall be 2-way bracing and vertical piping shall include 4-way bracing at the tops of all risers.

.5 On floor loops, sway-braces are also required at the corners of all loops.

PART 2 - PRODUCTS

2.1 HANGERS AND SUPPORTS

.1 All hangers and supports shall conform to the appropriate NFPA standards.

.2 Toggle hangers are unacceptable.

2.2 MISCELLANEOUS METALS RELATED TO FIRE PROTECTION SYSTEM

.1 All miscellaneous metal related to the fire protection systems including all metal back up plates and supports for all ceiling or wall supported equipment is part of this section of the work.

2.3 BACKFLOW PREVENTION STATIONS

.1 Backflow prevention stations for fire service shall be listed by Underwriters' Laboratories Canada (ULC).

.2 Double check valve (DCV) assembly complete with OS&Y Inlet and outlet valves.

PART 3 Execution

3.1 GRADING AND DRAINING OF PIPING

.1 Grade all fire protection piping so that it can be drained through drain cocks.

.2 All main drains shall be directed to the outside of the building wherever possible.

3.2 PIPING EXPANSION

.1 All piping systems, including all take-offs shall be so installed within the building that the piping and connected equipment will in no way be distorted by expansion, contraction or settling.

.2 If circumstances on the job require additional changes in direction from those shown on the drawings, the configuration shall be adjusted to suit at no extra cost.

.3 Anchors shall be installed where necessary to control expansion.

3.3 PIPE SLEEVES AND ESCUTCHEONS

.1 Supply and installation of pipe sleeves is included in this section of the specification.

3.4 BACKFLOW PREVENTION STATIONS

.1 Pipe differential relief outlet to drain.

.2 Installation shall comply with CSA B64.10.

.3 Test all backflow prevention devices and submit signed declarations to that effect prior to Substantial Completion.

3.5 MISCELLANEOUS METALS RELATING TO FIRE PROTECTION SYSTEMS

.1 Prime coat after fabrication with two coats of red primer.

.2 See separate division of specification for finish painting requirements.

3.6 TESTS AND INSPECTION

.1 Furnish all labour, materials, instruments, etc. necessary for all required tests. All work shall be subject to inspection by the local plumbing inspector or design authority. At least forty-eight (48) hours notice shall be given in advance of making the required tests.

.2 Tests on Fire Protection systems shall consist of pressure tests and shall conform to standards of Inspection Authority as listed in separate clauses of this section of specification. Test connections for fire pumps and siamese connection lines shall also be hydrostatically tested.

.3 Responsibility for completing "Contractor's Materials and Test Certificate" in accordance with inspection authority test procedure is included in this section.

END OF SECTION 21 05 05

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes materials and installation for wet pipe fire protection and sprinkler systems for heated areas.

.2 This is a performance specification clarified in this Section and on the Project sprinkler drawings to establish a minimum standard of equipment, design and installation.

.3 The specification describes the basic system and design required but not all of the details or components.

.4 This Trade shall have the experience to design the sprinkler system. Materials and work necessary to achieve the specification requirements will not be considered an extra to the Contract.

.5 The system design shall meet the requirements of the building, based on the Contract Drawings and Specifications.

.6 Provide hydraulically calculated suppression systems for the entire building project to NFPA 13.

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 ENGINEERING DESIGN CRITERIA

.1 The design criteria for the building shall be:

.1 Make water distribution uniform throughout the area in which sprinkler heads will open.

.2 The design criteria for the building shall be:

.1 Make water distribution uniform throughout the area in which sprinkler heads will open.

.2 Light hazard occupancy with a density of 4.1 (L/min)/m2 [0.10 gpm/ft2] for the most remote 278 m2 [3000 ft2] in all unless indicated otherwise.

.3 Ordinary Hazard Group 1 occupancy with a density of 6.1 (L/min)/m2 [0.15 gpm/ft2] for the most remote 139 m2 [1500 ft2] in the following areas:

.1 Mechanical Room.

.4 Ordinary Hazard Group 2 occupancy with a density of 8.2 (L/min)/m2 [0.2 gpm/ft2] for the most remote 139 m2 [1500 ft2] in the following areas:

.1 Vehicle Garage.

.2 POL and Battery Storage Rooms.

.5 Include allowance in hydraulic calculations for outside hose streams.

.3 Include with each system materials, accessories, and equipment inside and outside building to provide each system complete and ready for use.

.4 Design and provide each system to give full consideration to blind spaces, piping, electrical equipment, ducts, and other construction and equipment in accordance with detailed shop drawings. Locate sprinkler heads in consistent pattern with ceiling grid, lights, and air supply diffusers.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Devices and equipment for fire protection service shall be to NFPA 13, ULC listed, FM approved for use in wet pipe sprinkler systems.

.2 All piping shall be to NFPA 13.

2.2 PIPE

.1 Black steel pipe to ASTM A53 and ANSI Standard B36.10:

.1 Schedule 40 standard wall pipe for pressure to 2070 kPa [300 psi].

.2 Schedule 30 pipe in sizes 200 mm [8"] and larger for pressure to 2070 kPa [300 psi].

.3 "Light wall" pipe for welded or roll grooved pipe only shall conform to the following wall thicknesses:

.1 Up to 125 mm [5"]: Schedule 10.

.2 150 mm [6"]: 3.40 mm [0.134"].

.2 Hot dipped galvanized steel to ASTM A53 and ANSI Standard B36.10:

.1 To be used within the Vehicle Bays and associated storage rooms.

.2 Schedule 40 standard wall pipe for pressure to 2070 kPa [300 psi].

.3 Schedule 30 pipe in sizes 200 mm [8"] and larger for pressure to 2070 kPa [300 psi].

.4 "Light wall" pipe for welded or roll grooved pipe only shall conform to the following wall thicknesses:

.1 Up to 125 mm [5"]: Schedule 10.

.2 150 mm [6"]: 3.40 mm [0.134"].

.3 High strength low carbon steel Tube: to ASTM A795, grade A, type E.

.1 Pipe with mechanical roll grooved or locking lug type fittings.

.4 Steel tubing: to ASTM A135, A795 or A53

.1 Schedule 5 pipe with cold drawn steel fittings with integral "O" rings.

2.3 FITTINGS AND JOINTS

.1 Compatible with piping material.

.2 Suitable for maximum pressures in system but not less than 1210 kPa [175 psi] working pressure.

.3 Welding fittings shall comply with the latest edition of the following standards: ANSI B16.9 and B16.25 and ASTM A234.

.4 All grooved end fittings shall be of one manufacturer.

.5 Flexible connections shall be ULC listed.

2.4 VALVES

.1 Gate - 1210 kPa [175 psi]:

.1 Open by counter-clockwise rotation.

.2 Butterfly - 1210 kPa [175 psi]:

.1 12 mm [1/2”] - 50 mm [2”]: Slow closing with indicator and integral supervisory switch.

.2 50 mm [2”] - 75 mm [3”]: Groove end with integral supervisory switch.

.3 100 mm [4”] - 200 mm [8”]: Groove end with integral supervisory switch.

.4 100 mm [4”] - 300 mm [12”]: Tapped lug end design. Gear operated and indicator.

.3 Check - 1210 kPa [175 psi]: Provide spool piece to ensure full check valve opening where adjacent an alarm or gate valve.

.4 Drain Valve: 25 mm [1”] complete with hose end adaptor, cap and chain.

.5 Solenoid valves shall be ULC listed.

.6 Groove end valves shall be used wherever groove end pipe is employed. All groove end valves shall be of one manufacturer.

2.5 SPRINKLER HEADS

.1 Sprinkler heads shall be ULC listed for use in occupancies and hazard type for which they are installed.

.2 Temperature rating on fusible links shall suit the specific hazard they serve.

.3 Provide wire guards on sprinkler heads in Mechanical and Electrical Rooms and in areas susceptible to mechanical damage or vandalism.

.4 Provide sheet metal sheets, to prevent cold soldering of sprinkler head, as indicated on drawings and as required by NFPA 13. Colour of shields as per Architects direction. Size and install as per NFPA 13 requirements.

.5 Sprinkler deflector elevations shall be within 12 mm [1/2"] of each other in the same room.

.6 All sprinklers except where noted shall be in satin chrome finish with polished chrome escutcheons except natural bronze finish may be used in the following areas:

.1 Mechanical rooms

.2 Electrical rooms

.3 Service spaces

.7 Escutcheons used on T-bar ceilings shall allow ceiling panel removal without removing the sprinkler head.

.8 Escutcheons shall be provided by the sprinkler manufacturer to suit the model of sprinkler and maintain the approvals.

.9 Wet System sprinkler head finishes:

.1 Upright - Glass bulb, brass finish.

.2 Pendent - Glass bulb, brass finish.

.3 Pendent Recessed - Glass bulb, chrome plate finish.

.4 Horizontal Sidewall (finished areas) - Glass bulb, chrome plate finish.

.5 Horizontal Sidewall (unfinished areas) - Glass bulb, brass body.

.6 Window Sprinkler - Glass bulb, chrome plate finish.

.10 Baffles: Baffles to be located and installed as per NFPA 13 requirements.

2.6 ALARM CHECK VALVES

.1 1210 kPa [175 psi]:

.2 Manufacturers alarm check valve trim.

2.7 SUPERVISORY SWITCHES

.1 Mechanically attached to valve body.

.2 24V DC contact rating unless noted otherwise.

.3 Two sets of SPDT contacts or one set normally open and one set normally closed contacts.

.4 Looped cable devices are not acceptable

.5 Approved valves with integral supervisors are acceptable alternatives.

2.8 FLOW SWITCHES

.1 ULC listed for mounting pipe size in sprinkler system.

.2 24V DC contact rating unless noted otherwise.

.3 Two sets of SPDT contacts or one set normally open and one set normally closed contacts.

.4 Time delay feature and paddle indicator.

.5 Provide a sight glass in accordance with NFPA with drain connection.

2.9 PRESSURE SWITCHES

.1 24V DC contact rating unless noted otherwise.

.2 Two sets of SPDT contacts or one set normally open and one set normally closed contacts.

2.10 FIRE DEPARTMENT CONNECTION (SIAMESE CONNECTION)

.1 Flush mount type with double clapper valves (optional surface mounted unit).

.2 Integral ball drip.

.3 Escutcheon marked "sprinklers" with plugs and chains.

.4 Bronze finish.

.5 Confirm threads with local fire department.

2.11 PIPE HANGERS

.1 All hangers and supports shall be ULC listed for fire protection services.

.2 Toggle hangers are unacceptable.

2.12 PRESSURE GAUGES

.1 Maximum limit of not less than twice normal working pressure at point where installed.

2.13 ESCUTCHEONS AND PLATES

.1 Provide on pipes passing through walls, partitions, floors and ceilings in finished areas.

.2 Plates shall be stamped steel, split type, chrome plated or stainless steel, concealed hinge, complete with springs, suitable for external dimensions of piping/insulation. Secure to pipe or finished surface. Outside diameter shall cover opening or sleeve.

.3 Where pipe sleeve extends above finished floor, escutcheons or plates shall clear sleeve extension.

.4 Do not install escutcheons and plates in concealed locations.

2.14 SPARE SPRINKLERS AND PARTS CABINET

.1 Provide metal cabinet with extra sprinkler heads and sprinkler head wrench in the Mechanical Room.

.2 Spare Sprinkler Heads

.1 Number and types of extra sprinkler heads as specified in NFPA 13 (minimum 6 heads).

.2 Provide a minimum of two spare sprinklers for each type installed.

.3 Provide a special sprinkler wrench to be kept in the cabinet for maintenance use in the removal and installation of sprinklers.

2.15 SIGNS

.1 Attach properly lettered and approved metal signs to each valve and alarm device to ANSI/NFPA 13.

.2 Permanently fix hydraulic design data nameplates to riser of each system.

PART 3 - EXECUTION

3.1 DESIGN

.1 Perform on site flow tests to obtain required water data.

.2 Hydraulically calculate the sprinkler systems in accordance with this specification and NFPA 13 requirements.

.3 Hydraulic calculations shall be based upon the flow test data, which has been reduced by 10%.

.4 Hydraulic calculations shall not be based on the largest room area as indicated in NFPA 13.

.5 Confirm with the Departmental Representative any interpretive aspects of the listed Codes, Standards or approvals that differ from the Contract Documents. Such interpretations shall not be used without the Departmental Representative's approval.

3.2 MANUFACTURER'S INSTRUCTIONS

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

3.3 INSTALLATION

.1 Install, inspect and test to acceptance in accordance with NFPA 13.

.2 All grooved end valves, fittings and couplings etc. shall be of one manufacturer.

.3 For roll or cut grooved systems a factory trained field representative (direct employee) shall provide on-site training for Contractor’s field personnel in the proper use of grooving tools, application of groove, and installation of grooved piping products. The representative shall periodically visit the job site and review installation to ensure best practices in grooved joint installation are being followed. Contractors shall show the Departmental Representative proof of training as requested.

.4 Pipe Installation:

.1 Galvanized piping and fittings shall be used within the Vehicle Bays and associated storage rooms.

.2 Install piping straight and true to bear evenly on hangers and supports. Do not hang piping from plaster ceilings.

.3 Keep interior and ends of new piping and existing piping thoroughly cleaned of water and foreign matter.

.4 Keep piping systems clean during installation by means of plugs or other approved methods. When work is not in progress, securely close open ends of piping to prevent entry of water and foreign matter.

.5 Inspect piping before placing into position.

.6 All welding shall be performed off site using welding fittings. Field welding is not permitted.

.7 Adjust sprinkler piping up or down if conflicts occur between structure, lighting, electrical, plumbing piping or ductwork.

.8 Arrange piping routing to provide sufficient access to mechanical and electrical equipment.

.9 A wrap around hanger or other approved means shall be provided at the end of each branch sprinkler line to prevent excessive movement.

.5 Flow Switches:

.1 Install flow switches with a tight pipe drain connection to open discharge outside the building at grade level or other acceptable discharge point as approved by the Departmental Representative.

.2 Install a 25 mm [1"] flow switch test drain valve with a 25 mm [1"] brass ball plug. Immediately downstream of flow switch for each flow switch. This is in addition to the normal inspector's test connections required by NFPA.

.3 Locate flow switches where shown.

.6 Supervisory Switches - Valves:

.1 Install supervisory switches on all valves supplying the sprinkler and standpipe system inside the building. Switches shall be compatible with the valve supervised.

.7 Sprinkler Heads:

.1 Locate heads in relation to ceiling and spacing of sprinkler heads not to exceed that permitted by NFPA 13.

.2 All sprinkler head locations shall be coordinated with the Architectural and Electrical ceiling plans and with existing site conditions.

.3 Do not install any sprinkler heads until all piping systems have been flushed of all contaminants.

.4 Provide dry pendent or sidewall heads on all wet sprinkler systems where heads are piped into cold areas.

.8 Provide inspector's test valves and pipes at all remote points in the system.

.9 Flanged fittings shall be used at valve stations and at fire department connections.

.10 Install monitored valves and flow switches for all zones. Electrical Division shall wire monitored valves and flow switches to the central fire alarm system. Identify which portion of the system each valve controls.

.11 Protection of Electrical Equipment from Water:

.1 Responsibility for water damage to electrical equipment from the sprinkler system installation whether due to testing or leakage shall be the responsibility of this section.

.2 Provide and install in this section of the work minimum 20 gauge metal protective hoods, individually located over all electrical equipment susceptible to water damage upon release of sprinkler heads in electrical areas. Such electrical equipment shall include all transformers and all equipment with ventilation grilles that will allow water entry into the electrical equipment. Protective hoods shall be sloped to allow shedding for water, shall project horizontally beyond the equipment perimeter and shall not be mounted on the equipment unless prior approval is obtained from the electrical authorities. Holes through protective hoods shall be sealed watertight.

3.4 FLUSHING

.1 Provide flushing connections on all sprinkler systems.

.2 Flush all underground mains and siamese supply lines before connecting to sprinkler systems.

.3 Flush all pipelines so effluent is clear and free of debris.

.4 Rate of flushing flows shall be as per NFPA 13 requirements.

.5 Provide proper drainage for this flushing operation.

END OF SECTION 21 13 13

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes materials, requirements and installation for plumbing pumps.

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 SUBMITTALS

.1 Shop Drawings:

.1 Submit shop drawings for all pumps and accessories.

.2 Indicate, at minimum, the following:

.1 Equipment, including connections, fittings, control assemblies and ancillaries. Identify whether factory or field assembled.

.2 Wiring and schematic diagrams.

.3 Dimensions and recommended installation.

.4 Pump performance and efficiency curves showing point of operation.

.2 Closeout Submittals:

.1 Provide maintenance data for incorporation into Operational and Maintenance manual.

PART 2 - PRODUCTS

2.1 DOMESTIC HOT WATER RECIRCULATION PUMP (P-DHWR)

.1 CSA approved, in-line circulator pump suitable for a maximum working pressure of 860 kPa [125 psig] and maximum temperature of 107°C [225°F].

.2 Suitable for domestic water.

.3 Casing: Stainless steel or bronze construction radially split, with Flanged or union connections. Supplied with matching companion flanges.

.4 Maintenance-free construction.

.5 Impellor: Stainless steel or bronze construction.

.6 Shaft: Stainless steel with bronze sleeve bearing, integral thrust collar.

.7 Seal Assembly: Mechanical.

.8 Motor: Resilient mounted, drip proof, sleeve bearing.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Recirculation Pump:

.1 Coordinate the manual disconnect requirement with the Electrical Division.

3.3 FIELD QUALITY CONTROL

.1 Site Tests/Inspection:

.1 Check power supply.

.2 Check starter protective devices.

.2 Start-up, check for proper and safe operation.

.3 Check settings and operation of hand-off-auto selector switch, operating, safety and limit controls, audible and visual alarms, over-temperature and other protective devices.

END OF SECTION 22 10 10

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes materials, requirements and installation for copper domestic water service used in the following:

.1 This section applies to domestic hot water, domestic cold water and domestic hot water recirculation systems inside the building to a point 900 mm [36"] upstream of the point where the water service passes through or under the perimeter foundation of the building.

.2 Refer to "Fire Protection General Requirements", Section 21 0505 - Common Work Results for Fire Protection as the domestic water supply and the supply to the fire protection systems are combined into one incoming supply service.

.3 Include for the underground portion of the Fire Department connection.

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 SUBMITTALS

.1 Shop Drawings:

.1 Submit a list of all valves, manufacturer and model number, of all types used.

.2 Closeout Submittals:

.1 Provide maintenance data for incorporation into Operational and Maintenance manual.

PART 2 - PRODUCTS

2.1 PIPING

.1 Pipe and fittings below ground:

.1 75 mm [3”] and smaller.

.1 Type 'K' seamless soft copper tubing to ASTM B88.

.2 Copper pipe to ASTM B42.

.3 Piping shall be protected in a polyethylene sleeve.

.2 100 mm [4”] and larger.

.1 Ductile iron pipe, Class 50 or 52, rubber seal gasket joints, working pressure 1380 kPa [200 psi] to AWWA C151 and CSA B131, cement mortar lining to AWWA C104 and CSA B131.

.2 PVC Pressure Water Pipe, elastomeric seal gasket joints, working pressure 1380 kPa [200 psi] to AWWA C900 and CSA B137 (e.g. Blue Brute).

.2 Pipe and fittings above ground:

.1 Copper tubing type 'L' hard drawn, seamless, CSA or Warnock Hersey certified to ASTM B88.

.2 Copper pipe type ‘L’ to ASTM B42.

2.2 FITTINGS

.1 Bronze pipe flanges and flanged fittings to ANSI/ASME B16.24.

.2 Cast bronze threaded fittings to ANSI/ASME B16.15.

.3 Cast copper, solder type to ANSI/ASME B16.18.

.4 Wrought copper and copper alloy, solder type to ANSI/ASME B16.22.

.5 All below ground fittings shall be provided with integral tie lugs. Weld on lugs are not acceptable.

.6 Cast bronze or wrought copper roll grooved pressure fittings with grooved mechanical pipe connector couplings complete with angle bolt pad to provide a rigid joint.

.7 Compression fittings shall conform to ANSI B16.

2.3 PIPE JOINTS

.1 All flanged adaptors used on copper to iron connections shall be brass.

.2 Rubber gaskets, latex-free 1.6 mm thick: to AWWA C111.

.3 Bolts, nuts, hex head and washers to ASTM A307, heavy series.

.4 Solders and fluxes shall not contain lead.

.5 Teflon tape for threaded joints.

.6 Grooved couplings: designed with angle bolt pads to provide rigid joint, complete with EPDM flush seal gasket.

.7 Provide dielectric couplings in lieu of unions between interconnected dissimilar metals.

2.4 VALVES - GENERAL

.1 All valves shall be rated for 860 kPa [125 psi] service unless noted otherwise.

2.5 GATE VALVES

.1 50 mm [2”] and smaller:

.1 Non-rising stem, bronze body, solid wedge disc, bronze trim or stainless steel to MSS-SP-80, Class 125, 860 kPa.

.2 65 mm [2-1/2”] and larger:

.1 Rising stem, outside screw and yoke, flanged ends, cast iron body, solid wedge disc, bronze trim or stainless steel to MSS-SP-70, Class 125, 860 kPa.

2.6 GLOBE VALVES

.1 50 mm [2”] and smaller:

.1 Bronze body with bronze or stainless steel trim, bronze bevel or composition disc.

.2 65 mm [2-1/2”] and larger:

.1 Rising stem, outside screw and yoke, flanged ends, cast iron body, bronze or cast iron bevel-type disc, bronze trim or stainless steel.

.3 Balance Type: 30 mm [1-1/4”] and smaller:

.1 Domestic hot water recirculation applications

.2 Locksheild type for maximum system temperature, bronze body and trim, Teflon or PTFE disc, union connection, 690 kPa 100psi rating.

.4 Balance Type: 40 mm [1-1/2”] and larger:

.1 Plug type for maximum system temperature, wrench adjustable stop, semi-steel body, resilient plug seals, EPT or RS 55.

.2 Threaded ends, flanged on 65 mm [2-1/2”] and larger.

2.7 BALL VALVES

.1 50 mm [2”] and smaller:

.1 Lever handle, brass two piece body, blow-out proof stem, PTFE seats, brass ball chrome plated.

2.8 BUTTERFLY VALVES

.1 65 mm [2-1/2”] and larger:

.1 Cast iron body, threaded lug, EPDM seat, bronze disc, 403 stainless steel stem, 1380 kPa [200 psi] to MSS-SP-67, Class 200.

.2 65 to 100 mm [2-1/2” to 4”]: Ten position lever lock.

.3 150 mm [6”] and over: Hand wheel worm gear operator.

2.9 AUTOMATIC FLOW CONTROL VALVES

.1 Domestic hot water recirculation mains applications.

.2 Piston in a housing type.

.3 Factory set all stainless steel cartridge.

.4 Body Material: forged or cast brass.

.5 Seals: BPDM O-rings.

.6 Body Tappings: 1/4” NPT with P/T test valves.

.7 Flow control to within plus/minus five percent.

.8 Five year manufacturers warranty

2.10 DRAIN VALVES

.1 Ball type with bronze body and trim, suitable for maximum system operating pressure, c/w cap and chain.

2.11 SWING CHECK VALVES

.1 50 mm [2”] and smaller:

.1 Bronze body, bronze or stainless steel disc holder and Teflon disc.

.2 65 mm [2-1/2”] and larger:

.1 Cast iron body, bronze or cast iron swing disc, bronze or stainless steel trim to MSS-SP-71, Class 125, 860 kPa.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install in accordance with Building Code and local Authority Having Jurisdiction.

.2 Install pipe work in accordance with Section 23 05 05, Installation of Pipework, supplemented as specified herein.

.3 Assemble piping using fittings manufactured to ANSI standards.

.4 Install DCW piping below and away from DHW and DHWR and other hot piping so as to maintain temperature of cold water as low as possible.

.5 Concealed water piping to plumbing fixtures and fittings shall utilize cast brass drop ear elbows and tees as required to rigidly secure the piping. Provide blocking within the concealed space and secure the drop ear fittings using brass screws.

.6 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.

.7 Pipe Joints:

.1 Install dielectric couplings at copper piping connections to plumbing equipment of dissimilar material.

.2 At the water service entry to the building provide a flexible standard sleeve transition coupling with stainless steel nuts and bolts, below grade at the building perimeter excavation.

.8 Buried tubing:

.1 Lay in well compacted washed sand in accordance with AWWA Class B bedding.

.2 Bend tubing without crimping or constriction. Minimize use of fittings.

.9 For roll or cut grooved systems a factory trained field representative (direct employee) shall provide on-site training for Contractor’s field personnel in the proper use of grooving tools, application of groove, and installation of grooved piping products. The representative shall periodically visit the job site and review installation to ensure best practices in grooved joint installation are being followed. Contractors shall show the Departmental Representative proof of training as requested.

3.2 VALVES

.1 Disassemble all sweat end valves prior to soldering. Where disassembly is not feasible special attention shall be given not to damage valve during soldering.

.2 Balance recirculation system using lockshield globe valves. Mark settings and record on as-built drawings on completion.

.3 Isolation Valves:

.1 Install isolation valves as indicated on the drawings and in the following locations:

.1 At each main branch supply point.

.2 At each group of plumbing fixtures.

.3 At each plumbing fixture individually.

.4 At each piece of equipment.

.5 As required by the Codes and bylaws governing this project.

.2 Where butterfly valves are used for isolation they shall be suitable for dead end isolation at full rated pressure with the downstream flange removed and be suitable while under pressure for reassembly of the downstream flange. Otherwise a separate downstream spool piece not flanged to the butterfly valve shall be provided.

.4 Balancing Valves:

.1 Install balancing valves as indicated on the drawings and in the following locations:

.1 Hot water recirculating branch connections to return mains.

.5 Automatic Flow Control Valves:

.1 Install automatic flow control valves as indicated on the drawings and in the hot water recirculating mains.

.2 Valve size shall match the pipe size it serves

.3 Valve flows shall be set as follows:

.1 12 mm [1/2”] - 0.14 l/sec [2.18 gpm]

.2 20 mm [3/4”] - 0.29 l/sec [4.53 gpm]

.3 25 mm [1”] - 0.49 l/sec [7.72 gpm]

.4 All valves shall operate with a nominal control range differential of 6.9 kPa [1 psi]

.6 Drain Valves:

.1 Provide a hose-end adapter with cast brass cap and chain on all drain valves not piped directly to drain.

.2 Drain valves shall be 20 mm [3/4”] minimum but line size up to 40 mm [1-1/2”] unless noted otherwise.

3.3 PRESSURE TESTS

.1 Conform to requirements of Section 23 03 00 - Common Work Results - Mechanical.

.2 Perform a hydrostatic test on all domestic water piping at 1380 kPa [200 psi] for 8 hours.

.3 Comply with all requirements of the Building Code and local Authority Having Jurisdiction.

3.4 FLUSHING AND CLEANING

.1 Flush entire system for 8 h. Ensure outlets flushed for 2 hours.

.2 Let stand for 24 hours, then draw one sample off longest run. Submit to testing laboratory to verify that system is clean to potable water guidelines.

.3 Let system flush for additional 2 hours, then draw off another sample for testing.

3.5 DISINFECTION

.1 Flush out, disinfect and rinse system to the Building Code and local Authority Having Jurisdiction

.2 Upon completion, provide laboratory test reports on water quality for Departmental Representative’s review.

END OF SECTION 22 11 18

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes the installation of drainage waste and vent piping.

.2 Building perimeter drainage system.

.3 Building sanitary waste and vent piping to 1 m [3 ft] beyond the foundation of the building.

.4 Building storm drainage piping and rainwater leaders to 1 m [3 ft] beyond the foundation of the building.

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

PART 2 - PRODUCTS

2.1 PERIMETER DRAINS

.1 Pipe and Fittings:

.1 Polyvinyl Chloride (PVC) series 100 perforated building sewer pipe and fittings conforming to CSA-B137.3.

.2 Perimeter drainage shall be nominal diameter 150 mm [6”] unless noted otherwise on the contract drawings.

.2 Cleanouts:

.1 Cleanouts shall be 100 mm [4”] minimum on pipe up to 150 mm [6”].

.2 For exterior cleanouts in traveled areas:

.1 Heavy-duty epoxy coated cast iron construction with a 12 mm [1/2"] thick cover, terminated at grade.

.3 For interior cleanouts refer to Section 22 4201 - Plumbing Specialties and Accessories.

.3 Drain Gravel: 100% granular material of 14 mm to 17 mm [9/16" to 11/16"] diameter.

.4 Pea Gravel: 100% granular material of 12 mm to 25 mm [1/2" to 1"] diameter.

.5 Filter Cloth: 2.2 mm [0.0866”] thick polyester filter cloth.

2.2 DRAIN, WASTE AND VENT PIPE AND FITTINGS

.1 Below ground:

.1 Class 4000 cast iron mechanical joint pipe to CAN/CSA-B70.

.1 Mechanical joints: Neoprene or butyl rubber compression gaskets to ASTM C564 or CAN/CSA-B70.

.2 Stainless steel clamps.

.2 Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Drain Waste and Vent Pipe Fittings.

.1 Conforming to CSA/CAN 3-B181.1 and ASTM F628.

.2 Joints: solvent weld to ASTM D2235.

.3 Additional requirements:

.1 Plastic (ABS) piping where used underground shall adapt to approved non-plastic material prior to penetration above the building slab; where such above slab piping will not be concealed within drywall or a non-flammable plumbing fixture.

.2 Pressure waste piping from pumping stations and other equipment shall be pressure piping and fittings as specified for domestic water.

.2 Above ground:

.1 DWV copper drainage pipe to ASTM B306

.1 Cast brass or wrought copper drainage pattern fittings to CAN/CSA-B125.

.2 Solder: 50/50 Sn/Pb recessed solder joints to ASTM B32.

.2 Class 4000 cast iron mechanical joint pipe to CAN/CSA-B70.

.1 Mechanical joints (up to 200 mm [8"]): Neoprene or butyl rubber compression gaskets to ASTM C564 or CAN/CSA-B70.

.2 Stainless steel clamps.

.3 Additional requirements:

.1 Copper to cast iron joints shall be male brass adaptors with tapped fittings.

.2 Nipples shall be cast iron or heavy brass.

.3 Class 4000 mechanical joint cast iron soil pipe and mechanical joint couplings shall be of one manufacturer.

.4 Plastic (ABS) piping where used underground shall adapt to approved non-plastic material prior to penetration above the building slab; where such above slab piping will not be concealed within drywall or a non-flammable plumbing fixture.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install in accordance with Building Code and local Authority Having Jurisdiction.

.2 Install pipe work in accordance with Section 23 05 05, Installation of Pipework, supplemented as specified herein.

3.2 TESTING

.1 Pressure test buried systems before backfilling.

.2 Hydraulically test to verify grades and freedom from obstructions.

.3 Tests on the sanitary waste and storm drainage systems shall consist of hydraulic pressure testing of 3000 mm [118"] for 8 hours.

3.3 PERIMETER DRAINS

.1 Any unstable areas or unsatisfactory conditions i.e. poor compaction slopes shall be reported to the Departmental Representative.

.2 Ensure foundation wall waterproofing has been inspected and approved by the Architect.

.3 Installation of perimeter drainage shall not begin until subgrade and foundation wall deficiencies have been corrected.

.4 Pipe and Fitting Installation:

.1 Prior to pipe placement ensure sub-grade complies with the required drainage pattern.

.2 Pipe joints spigots shall face downstream of flow.

.3 Install so perforations are on the bottom half of the pipe.

.4 Use manufacturer's recommended fittings only.

.5 Shims to establish pipe slope is not acceptable.

.6 Pipe bedding shall be drain gravel to 150 mm [6"] minimum below pipe, 300 mm [12"] minimum above pipe and 500 mm [20"] wide. Backfill above the drain gravel shall be 300 mm [12”] minimum above the drain gravel.

.7 Perforated pipe and drain gravel shall be covered with filter cloth.

.8 Connect drainage piping to the sediment sump.

.9 Take note that the water from the dewatering of the site by pumping or gravity shall not be permitted to drain directly into the permanent sewers. Only clear, clean water may be discharged and only into the storm sewer.

.10 Pipe and fittings cast in walls shall be schedule 40 ABS or cast iron.

.11 ABS and cast iron fittings shall adapt to PVC Pipe with recommended manufacturer's adapters.

.12 Prior to backfilling, the Departmental Representative shall approve the piping installation.

.5 Cleanouts:

.1 Provide cleanouts as indicated on the contract drawings, at the start of all runs and at 15 m [50 ft] intervals.

.2 Cleanouts will be rejected if not accessible for maintenance.

.3 Location of all cleanouts shall be clearly recorded on the as-built drawings.

.4 Cleanouts shall be brought to grade and set in an irrigation type box in landscaped areas or in traveled areas anchored in a concrete collar.

.5 Cleanouts on interior piping shall be as specified under Section 22 4201 - Plumbing Specialties and Accessories.

.6 Excavation and Backfill:

.1 Excavation for perimeter drainage shall be a minimum of 150 mm [6"] below invert of pipe unless otherwise stated in the contract document.

.2 Backfill material above the pipe shall be drain gravel and above drain gravel shall be pea gravel.

.7 Inspection:

.1 Do not backfill until pipe grade and alignment is inspected and accepted by the Departmental Representative.

.2 Provide a minimum of 2 working days notice to the Departmental Representative for field inspections prior to backfilling.

END OF SECTION 22 13 17

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes the installation of domestic water heaters.

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 SUBMITTALS

.1 Shop Drawings:

.1 Submit shop drawings for all domestic water heaters and tanks.

.2 Closeout Submittals

.1 Provide maintenance data for incorporation into Operational and Maintenance manual.

1.4 WARRANTY

.1 Provide an extended warranty for the Work of this Section, over and above the 12 month warranty period, to the number of years specified for each product.

PART 2 - PRODUCTS

2.1 TANKS - DOMESTIC HOT WATER - ELECTRIC (T-DHW)

.1 Commercial grade porcelainized glass-lined tank, electric hot water heater, CSA certified, maximum hydrostatic working pressure 1034 kPa [150 psi].

.2 Rigid R-16 polyurethane foam, mineral wool or fibreglass insulation.

.3 Enameled steel jacket.

.4 Fully automatic controls, manually adjustable thermostat, 120 volt control circuit with fused transformer.

.5 3 year extended warranty certificate.

2.2 EXPANSION TANK (ET-DHW)

.1 Provide a diaphragm type expansion tank for protection of the hot water tank complete with dielectric coupling on connections.

.2 Suitable for domestic water installation, maximum hydrostatic working pressure 1034 kPa [150 psi].

.3 Identification plate showing:

.1 Manufacturer's name.

.2 Capacity in litres [Imperial gallons].

.3 Hydraulic test pressure.

.4 Working pressure.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install in accordance with manufacturer's recommendations, Building Code and local Authority Having Jurisdiction.

.2 Install the domestic hot water tank in the location shown on the drawings.

.3 Provide design and install seismic restraint of tanks.

.4 Install a drain valve in the tank drain connection and pipe to drain.

.5 Pipe relief valve at full size to drain.

.6 Provide vacuum relief valve on cold water supply.

.7 Provide isolating valves at tank connections.

.8 Provide a drain pan piped to drain for installations other than slab on grade.

3.2 EXPANSION TANK - DIAPHRAGM TYPE

.1 Install expansion/contraction tanks as shown on the drawings and as scheduled.

.2 Install a gate or ball valve in the system connection.

END OF SECTION 22 30 05

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes materials and installation for plumbing specialties and accessories.

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 SUBMITTALS

.1 Shop Drawings:

.1 Submit shop drawings for all plumbing specialties and accessories.

.2 Closeout Submittals

.1 Provide maintenance data for incorporation into Operational and Maintenance manual.

PART 2 - PRODUCTS

2.1 FLOOR DRAINS

.1 All floor drains to CSA B79 and shall be complete with:

.1 Trap primer connections.

.2 Other than slab-on-grade drains: Flashings, 300 mm [12"] beyond edge of cast iron fittings, securely fix to membrane clamp.

.2 Floor Drain FD1 (finished areas):

.1 Cast iron floor drain with membrane clamp and 130 mm [5”] diameter nickel bronze strainer. Cast iron non-plated parts to be epoxy coated.

.3 Floor Drain FD2 (unfinished areas):

.1 Cast iron floor drain with secondary drainage flange, 225 mm [9"] top, round cast iron grate. Cast iron parts to be coated for rust prevention.

.4 Floor Drain FD3 Funnel Floor Drain:

.1 Cast iron floor drain with secondary drainage flange and 130 mm [5"] diameter adjustable cast iron strainer with 90 mm x 230 mm [3-1/2 " x 9"] cast iron oval funnel. Cast iron non-plated parts to be epoxy coated

2.2 TRENCH DRAIN

.1 Pre-sloped trench drain system, 160 mm [6-1/4”] wide.

.2 Sections of polymer concrete with tongue-and-groove ends to allow for precise fit and straight channel runs.

.3 Minimum Slope: 0.65 percent.

.4 Grate locking devices.

.5 Systems shall be complete with installation chairs or integral rebar supports.

.6 Each trench section shall be complete with end caps and drainage sump (bottom outlet).

.7 Trench Drain TD1:

.1 Load rating: DIN C - Heavy duty vehicular traffic - distributed loading of 250 kN [56,200 lbs].

.2 Depth: Shallow as possible drain at one end.

.3 Grate: Cast iron slotted.

2.3 CLEANOUTS

.1 Cleanouts shall be full size for pipe sizes up to 100 mm [4"] and not less than 100 mm [4"] on larger sizes complete with a clamping collar other than outside or slab on grade type.

.2 Cleanouts in inside finished areas shall all be round. Covers shall be scoriated.

.3 All interior of building covers shall be nickel bronze.

.4 Pipe manufacturers' cleanouts are acceptable for vertical installation at the base of soil and waste stacks or rainwater leaders only.

.5 Make cleanouts with Barrett type fitting that has a bolted cover plate and gasket, fitting that has a threaded plug, or a cleanout ferrule that is installed in a wye or extended wye.

.6 Outside area cleanouts shall be of heavy duty construction, with scoriated cast iron covers.

.7 Unfinished concrete area cleanouts shall be of heavy duty construction and have a fully exposed scoriated cover.

.8 Lino or lino tiled area cleanouts shall have the centre portion of cover recessed to receive a piece of tile that matches the adjoining tile.

.9 Ceramic tile floor area cleanouts shall have a fully exposed nickel bronze scoriated cover.

.10 Carpet area cleanouts shall be fully concealed with a small raised marker.

2.4 WALL HYDRANTS AND HOSE BIBBS

.1 Hose Bibb (HB1) - Exterior Non-freeze:

.1 Encased non-freeze self-draining wall hydrant.

.2 Removable "T" type lockshield handle.

.3 Integral vacuum breaker.

.4 Nickel bronze box and cover.

.2 Hose Bibb (HB2) - Interior Use:

.1 Faucet with hose end spout in chrome plate finish.

.2 Removable "T" type lockshield handle.

.3 Chrome plated vacuum breaker on outlet.

2.5 WATER HAMMER ARRESTORS

.1 Piston style with stainless steel casing or bellows style with welded stainless steel nesting bellows, ANSI approved and PDI certified.

2.6 BACKFLOW PREVENTION STATIONS

.1 Backflow preventers shall meet the requirements of the latest edition of CAN/CSA - B64.10-01/CAN/CSA-B64.10.1-01 Manual for the Selection and Installation of Backflow Prevention Devices/Manual for the Maintenance and Field Testing of Backflow Prevention Devices.

.2 Double check valve (DCV), factory assembled station complete with inlet and outlet isolation valves to CSA B64.

.3 Reduced pressure principle device (RPPD) c/w inlet and outlet isolation valves, double check valve, differential relief outlet to CSA B64.10.

2.7 PRESSURE REGULATORS

.1 6 mm to 50 mm [1/4" to 2"], 860 kPa [125 psi] rating.

.2 65 mm [2-1/2"] and larger:

.1 Domestic incoming water service valve shall be sized at 3.79 l/s [60 USgpm] at 68.9 kPa [10 psi] pressure differential.

2.8 WATER MAKE-UP ASSEMBLY

.1 Pressure reducing valve shall have screwed, bronze or cast iron body, suitable to 1380 kPa [200 psig], composition seat.

.2 Each reducing station to include:

.1 Ball valve, strainer, union, backflow preventer, union, ball valve.
.2 Ball valve, union, pressure reducing valve, union, ball valve.
.3 Bypass with globe valve.
.4 20 mm [3/4"] relief valve.

2.9 VACUUM BREAKERS

.1 For pressure applications provide a 12 mm [1/2"] unit on pipe sizes up to 25 mm [1"].

.2 For pressure applications provide a 20 mm [3/4"] unit on pipe sizes up to 40 mm [1-1/2"].

.3 For pressure applications provide a 25 mm [1"] unit on pipe sizes up to 75 mm [3"].

.4 For atmospheric applications provide a unit size to match the pipe size it serves.

.5 Pressure Applications: Vacuum breakers shall meet the requirements of the latest edition of CAN/CSA B64.

.6 Atmospheric Applications: Vacuum breakers shall meet the requirements of the latest edition of CAN/CSA B64.

2.10 VACUUM RELIEF VALVES

.1 20 mm [3/4"] and smaller: Domestic hot water tank relief.

2.11 TEMPERATURE AND PRESSURE RELIEF VALVES

.1 Minimum requirements:

.1 All water exposed parts shall be stainless steel or copper.

.2 A.S.M.E. rated.

2.12 WATER METERS

.1 Solid state, digital, electromagnetic flow measurement system with a hermetically sealed, glass covered, electronic register.

.2 Thermal plastic external casing. The systems shall have the size and direction of water flow through the system imprinted on the external housing.

.3 The measuring element shall be made of a noncorrosive, lead-free glass fiber reinforced, composite alloy material. The measuring element will have no moving parts and will be specific for each size.

.4 Provide an interface with the meter so that it may be monitored by the BAS.

2.13 TRAP SEAL PRIMING DEVICES - EMCS

.1 Provide RPBD(s), solenoid valve(s) and manifold(s) in the Mechanical Room(s) piped to all traps requiring priming.

.2 Solenoid Valves:

.1 Slow closing solenoid valve, forged brass body, Buna "N" disc, stainless steel parts, enclosure to suit environmental conditions, UL and CSA approved, 24 volt.

.3 Refer to Division 25, EMCS.

2.14 STRAINERS

.1 50 mm [2”] and smaller:

.1 Threaded ends, bronze body, 'Y' pattern, 304 stainless steel screen, 1034 kPa [150 psi] rating.

.2 65 mm [2-1/2”] and larger:

.1 Flanged ends, cast iron body, epoxy coated, 304 stainless steel screen, 860 kPa [125 psi].

.2 FDA epoxy coating inside and out.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Comply and install to manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheet.

.2 Install in accordance with Building Code and local Authority Having Jurisdiction.

3.2 FLANGES AND UNIONS

.1 Provide an all bronze union with ground seat for pipe sizes 50 mm [2”] and smaller.

.2 Provide grooved or flanged connections for pipe sizes 65 mm [2-1/2”] and larger.

.3 Union and flanges shall be 1035 kPa [150 psi] rated.

.4 Provide on connections to all fixtures and appliances, at pumps, control valves and reducing valves.

3.3 FLOOR DRAINS

.1 Install floor drains set low to provide proper drainage.

.2 Water piping from trap primer to floor drain to be protected in a polyethylene sleeve where buried below slab.

3.4 CLEANOUTS

.1 Install cleanouts at the following locations:

.1 Building drain leaving building on the upstream side of exterior wall.

.2 Changes of direction of more than 45 degrees in drainage piping.

.3 Nominally horizontal branch or building drain at intervals of not more than 15 m [50 ft] for 100 mm [4"] and smaller and 30 m [100 ft] for 150 mm [6"] and larger.

.4 Fixture drain of a sink, kitchen piping at intervals not exceeding 7.5 m [25 ft] for pipe all sizes.

.5 Base of soil or waste stacks.

.6 As called for by the Building Code.

.2 Cleanouts which are located low on walls shall be located 75 mm [3"] minimum above the top of the baseboard or minimum 200 mm [8"] above finished floor level where there is no baseboard.

.3 Cleanouts shall be coordinated with all millwork and with all other obstructions, shall be placed in readily accessible locations and shall have sufficient clearance for rodding and cleaning.

.4 Extend cleanouts to the finished floor or wall.

.5 Cleanouts in wet floor areas shall extend above the floor in walls or be provided with gasketted waterproofed tops.

.6 Cleanouts passing through a waterproofed floor or a slab on grade shall possess a clamping collar which shall be clamped to the floor membrane or lead flashing.

.7 Cleanouts on outside drains shall be brought to grade and anchored in a concrete collar or in a plastic box in landscaped areas.

3.5 SAFES, FLASHING AND VENT TERMINALS

.1 All cleanouts passing through walls or floors subject to hydrostatic pressure and waterproofed by means other than a membrane shall be provided with clamping collars and flashings of 25 kg/m2 [5 lb/ft2] lead.

.2 Supply and fix 25 kg/m2 [5 lb/ft2] sheet lead flashings to all cleanouts, floor drains. Securely fix to flashing clamps and extend 300 mm [12"] beyond edge of cast iron fittings.

.3 Vent flashing minimum 450 x 450 mm [18" x 18"] base dimension shall terminate flush with the top of 300 mm [12"] high vent pipe and the gap between the flashing and pipe shall be closed to a 25 kg/m2 [5 lb/ft2] separate lead cap 75 mm [3"] high. The main flashing shall not be turned over the pipe.

.4 Coordinate with the Roofing Contractor to locate roof flashings away from ridges in steel deck roofing.

3.6 WALL HYDRANTS AND HOSE BIBBS

.1 Provide operating keys to the Owner prior to substantial completion.

.2 Provide an accessible isolation valve upstream of hose bibbs.

.3 Provide access panel as required.

3.7 WATER HAMMER ARRESTORS

.1 Comply with the Plumbing and Drainage Institute PD1-WH-201 sizing procedures.

.2 Install on branch lines serving all quick closing devices i.e. flush valves, solenoid valves, self-closing faucets and appliances.

3.8 BACKFLOW PREVENTION STATION

.1 Installation shall comply with the manual "Cross Connection Control" First Edition, published by the B.C. Section of the American Water Works Association.

.2 Provide backflow preventers at each fixture or appliance where domestic water contamination can occur.

.3 Locate at suitable height to allow maintenance.

.4 Pipe differential relief outlet to drain.

.5 Test all backflow prevention devices and submit a signed declaration to that effect prior to substantial completion.

.6 A Certified Backflow Preventer Tester shall submit a test report to the Cross Connection Control Officer.

.7 Locate the Backflow Preventer Test Report tag on or immediately adjacent to the backflow prevention assembly. The Test Report shall indicate the required details of the assembly and initial testing information.

3.9 WATER MAKE-UP ASSEMBLY

.1 Install water make-up station for each hot water system where shown on the drawings.

.2 Pipe relief valve to drain.

3.10 PRESSURE REDUCING VALVES

.1 Pressure reducing valve stations minimum requirements:

.1 Pressure reducing valve, strainer, shut off valve on the inlet and outlet.

.2 A bypass around the pressure reducing valve with a globe valve at one size less than the incoming service size and pressure gauges upstream and downstream of the valve.

.2 Set the pressure-reducing valve serving the main incoming water service to an initial setting of 415 kPa [65 psi].

3.11 VACUUM BREAKER

.1 Installation shall comply with the manual "Cross Connection Control" First Edition, published by the B.C. Section of the American Water Works Association.

.2 Provide vacuum breakers at each fixture or appliance where domestic water contamination can occur.

.3 Atmospheric vacuum breakers shall be installed a minimum of 300 mm [12”] above the flood level rim of the fixture or appliance served.

.4 Test all vacuum breakers and submit a signed declaration to that effect prior to substantial completion.

3.12 TRAP SEAL PRIMING DEVICES - EMCS

.1 In the Mechanical Room provide a solenoid control valve(s) (CV-TRAP PRIME1, CV-TRAP PRIME2, etc.) off the domestic cold water main. Install manifold(s) and solenoid valve(s) in an area that are readily accessible.

.2 Pipe from the control valve(s) to priming manifold(s).

.3 Pipe from the priming manifold(s) to all sanitary floor drains. Provide isolation valves on all piping to trap seal primers.

.4 Refer to Section 25 9001 EMCS: SEQUENCE OF OPERATION for trap priming control.

3.13 STRAINERS

.1 Install with sufficient room to remove basket.

.2 Provide strainer blow down capabilities as follows:

.1 Cold water strainer - plug at the blow-down connection.

.2 Hot water strainer 50 mm [2”] and smaller - nipple and cap

.3 Hot water strainer 65 mm [2-1/2”] and larger - nipple, globe valve, nipple, cap.

3.14 WATER METERS

.1 Install water meter as indicated.

3.15 TESTING AND ADJUSTING

.1 General:

.1 In accordance with Section 01 91 13, GENERAL COMMISSIONING (CX) REQUIREMENTS, supplemented as specified.

.2 Tests on the sanitary waste drainage systems shall consist of hydraulic pressure testing of 3000 mm [118"] for 8 hours.

.2 Floor Drains:

.1 Verify operation of trap seal primer.

.2 Prime, using trap primer. Adjust flow rate to suit site conditions.

.3 Check operations of flushing features.

.4 Check security, accessibility, and removability of strainer.

.5 Clean out baskets.

.3 Vacuum Breakers, Backflow Preventers:

.1 Test tightness, accessibility for O&M of cover and of valve.

.2 Simulate reverse flow and back-pressure conditions to test operation of vacuum breakers, backflow preventers.

.3 Verify visibility of discharge from open ports.

.4 Access Doors:

.1 Verify size and location relative to items to be accessed.

.5 Cleanouts:

.1 Verify covers are gas-tight, secure, yet readily removable.

.6 Water Hammer Arrestors:

.1 Verify proper installation of correct type of water hammer arrester.

.7 Hose Bibbs:

.1 Verify complete drainage, freeze protection.

.2 Verify operation of vacuum breakers.

.8 Pressure regulators, PRV assemblies:

.1 Adjust settings to suit locations, flow rates, pressure conditions.

.9 Strainers:

.1 Clean out repeatedly until clear.

.2 Verify accessibility of cleanout plug and basket.

.3 Verify that cleanout plug does not leak.

END OF SECTION 22 42 01

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes the supply and installation of plumbing fixtures and trim.

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 SUBMITTALS

.1 Shop Drawings:

.1 Submit shop drawings for all plumbing fixtures.

.2 Closeout Submittals:

.1 Provide maintenance data for incorporation into Operational and Maintenance manual.

1.4 FINISHES

.1 Stainless steel fixtures shall be satin and/or mirror finish or a combination thereof.

.2 Exposed plumbing fittings and metal work shall be extra heavy chrome plated.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

.1 Provide brand new fixtures and fittings, CSA approved, free from flaws and blemishes. All surfaces shall be clear, smooth, bright and be dimensionally stable.

.2 Accessible fixtures and fittings shall comply with the Building Code, Building Requirements for Persons with Disabilities, unless otherwise noted.

.3 Fixtures and fittings of the same type shall be the product of one manufacturer.

.4 Protect all fixtures and fittings against use and damaged during construction.

.5 Be responsible for plumbing rough-in of appliances or equipment supplied by others.

.6 Provide an individual stop or valve on each domestic water service serving a plumbing fixture.

2.2 SINKS

.1 S1 - Single Compartment, Ledge-Back, 200 mm [8”] Deep

.1 Stainless steel, single bowl, undercoating, basket strainer, tail piece, clamps, confirm punchings. Compartment size: 410 x 460 x 200 mm [16" x 18" x 8"], overall size: 520 x 510 mm [20-1/2" x 20"].

.2 Single handle deck mounted, 5.7 l/m at 414 kPa [1.5 gpm at 60 psi].

.3 40 mm [1-1/2”] cast brass P-trap. Provide dishwasher trap.

.4 12 mm [1/2”] hot and cold supplies with stops.

.2 S2 (Laundry Sink) - Single Compartment, Wall Mounted, 265 mm [10”] Deep

.1 Stainless steel, single bowl, undercoating, basket strainer, tail piece, clamps, confirm punchings. Compartment size: 420 x 710 x 265 mm [16-1/2" x 28" x 10-1/2"], overall size: 510 x 785 mm [20" x 31"].

.2 Wall mounted faucet with hot and cold 100 mm [4”] lever handles, 5.7 l/m at 414 kPa [1.5 gpm at 60 psi].

.3 40 mm [1-1/2”] cast brass P-trap.

.4 12 mm [1/2”] hot and cold supplies with stops.

.3 S3 (Shop Sink) - Single Compartment, Wall Mounted

.1 Stainless steel, single bowl, basket strainer, tail piece, clamps, confirm punchings. Compartment size: 330 x 370 x 130 mm [13" x 14-1/2" x 5"], overall size: 530 x 545 mm [21" x 21-1/2"].

.2 Deck mounted faucet with hot and cold 100 mm [4”] lever handles, 5.7 l/m at 414 kPa [1.5 gpm at 60 psi].

.3 40 mm [1-1/2”] cast brass P-trap.

.4 12 mm [1/2”] hot and cold supplies with stops.

2.3 DISHWASHER

.1 Install each dishwasher.

.2 Pipe 12 mm [1/2”] hot with stop to dishwasher.

.3 Pipe drain to sink dishwasher drain connection.

2.4 JANITORS SINKS

.1 SS1 - Mop Sink

.1 609 x 609 mm [24”x24”] moulded stone mop service basin with stainless steel drain.

.2 Wall faucets with stops, vacuum breakers, cross handles.

.3 Vinyl bumper guards, mop holder, hose and holder.

.4 Provide hot hose bibb above basin for service cart.

.5 12 mm hot and cold water supply.

2.5 CLOTHES WASHER

.1 Automatic washing machine valve with 50 mm [2”] drain. Unit shall be recessed and mounted to facilitate easy access.

.2 50 mm [2”] P-trap with standpipe.

.3 12 mm [1/2”] hot and cold with stops.

2.6 EMERGENCY EQUIPMENT

.1 Emergency devices: to ANSI Z358.1.

.2 EW1 - Emergency Eye Wash – Wall Mounted

.1 Wall mounted eye/face wash, stainless steel 279 mm [11"] round bowl, eye/face wash head with inverted directional laminar flow with zero vertical velocity supplied by an integral flow control, chrome-plated brass stay-open ball valve with stainless steel ball and stem and chrome-plated brass in-line 50 x 50 mesh water strainer. Eyewash shall include cast-aluminum chromate protected wall bracket, yellow plastic pop-off dust cover for eyewash head, tailpiece and trap, universal sign, 12mm [1/2"] supply, and 40 mm [1-1/2”] P-trap / waste.

.2 Provide eye wash tempering valve (EW-MV). 12 mm [1/2”] hot and cold supplies with stops, 12 mm [1/2”] tempered water to eyewash.

.3 Eyewash Mixing Valve (EW-MV):

.1 Thermostatic mixing valve to supply tempered water to a single emergency eye/face wash fixture requiring a minimum flow of 22.7 l/min [6 gpm].

.2 Cold water bypass flow rate of 14.4 l/min [3.8 gpm].

.3 The modular brass design with internal check stops, oversized valve seats. Lime and calcium resistant components are used throughout. 12 mm [1/2”] hot and cold inlets, 12 mm [1/2”] tempered outlet.

.4 Provide dial thermometer minimum 500 mm [20"] downstream of valve.

.5 The outlet temperature factory setting shall be 29°C [85°F]. Adjust to 22°C [72°F].

.6 Provided unions before and after the EW-MV to allow it to be removed for servicing.

.7 Provide recessed SS cabinet and panel kit.

.3 ES1 - Emergency Shower/Eyewash

.1 All 304 stainless steel floor mounted combination shower and eye/face wash.

.2 Eyewash: Stainless steel 279 mm [11"] round bowl, stainless steel eye/face wash head with inverted directional laminar flow with zero vertical velocity supplied by an integral flow control, stainless steel stay-open ball valve with stainless steel ball and stem and stainless steel in-line 50 x 50 mesh water strainer. Eyewash shall include stainless steel dust cover for eyewash head, tailpiece and trap.

.3 Drench shower: Hydrodynamic designed stainless steel showerhead supplied by an integral flow control, stainless steel stay-open ball valve with stainless steel ball and stem and stainless steel in-line 50 x 50 mesh water strainer and stainless steel pull rod with triangular handle.

.4 Support/Stand: Stainless steel pipe and fittings, stainless steel 229 mm [9"] diameter floor flange, high visibility safety green and bright yellow stripes, universal sign and 30 mm [1-1/4”] supply.

.5 Provide eye wash tempering valve (ES-MV). 30 mm [1-1/4”] hot and cold supplies with stops, 30 mm [1-1/4”] tempered water to shower/eyewash.

.6 Emergency Shower Mixing Valve (ES-MV):

.1 Thermostatic mixing valve, 117.3 l/min [31 gpm], paraffin filled thermostatic mixing element. Cold water bypass flow rate of 75.7 l/min [20 gpm]. The modular brass design with internal check stops, oversized valve seats. Lime and calcium resistant components are used throughout. 30 mm [1-1/4”] hot and cold inlets, 30 mm [1-1/4”] tempered outlet.

.2 The outlet temperature factory setting shall be 29°C [85°F]. Adjust to 22°C [72°F].

.3 Provide dial thermometer minimum 500 mm [20"] downstream of valve.

.4 Provide recessed SS cabinet and panel kit.

2.7 CHAIR CARRIERS

.1 Factory manufactured floor-mounted carrier systems for all wall-mounted fixtures.

PART 3 - EXECUTION

3.1 FIXTURE INSTALLATION

.1 Provide all hangers, supports, brackets, reinforcement, steel back-up plates and floor flanges to set fixtures level and square. Mount fixtures so that 90 kg [200 lb.] mass will not loosen or distort mounting.

.2 Sinks

.1 Control handles for all two handle mixing faucets shall be positioned with the cold control on the right and the hot control on the left.

.2 Faucets shall be complete with nuts and tailpieces.

.3 Plastic control handles and spouts are unacceptable.

.4 Sink P-traps shall be complete with either a cleanout or possess slip joint connections.

3.2 FIXTURE TRIM HOLES OR PUNCHINGS

.1 Fixtures shall not contain more punchings than necessary for the specified trim.

.2 Drilling holes and cutting cutouts for the installation of plumbing fixture trim and faucets including the forming of recesses or grooves in the underside of countertops or the provision of extension pieces for faucet nipples is the responsibility of the General Contractor.

3.3 WALLS AND FLOORS

.1 Where plumbing fixtures come in contact with walls and floors, joints shall be sealed with anti-mildew building sealant, made watertight and beaded smooth in a neat and workmanlike manner.

3.4 WATER HAMMER ARRESTORS

.1 Provide water hammer arrestors or shock absorbers on fixtures with flush valves and/or quick closing valves.

3.5 ACCESSIBLE FIXTURES

.1 Confirm mounting heights with the Architect.

3.6 CLEAN-UP

.1 All fixtures and trim shall be left in a clean and polished condition.

3.7 ADJUSTING

.1 Conform to water conservation requirements specified this section.

.2 Adjustments:

.1 Adjust water flow rate to design flow rates.

.2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.

.3 Checks:

.1 Aerators: operation, cleanliness.

.2 Vacuum breakers, backflow preventers: operation under all conditions.

.4 Thermostatic controls: Verify temperature settings, operation of control, limit and safety controls.

END OF SECTION 22 42 02

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes the supply and installation of washroom fixtures and trim.

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 SUBMITTALS

.1 Shop Drawings:

.1 Submit shop drawings for all washroom fixtures.

.2 Closeout Submittals:

.1 Provide maintenance data for incorporation into Operational and Maintenance manual.

1.4 FINISHES

.1 Vitreous china fixtures shall be white unless otherwise noted.

.2 Exposed plumbing fittings and metal work shall be extra heavy chrome plated.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

.1 Provide brand new fixtures and fittings, CSA approved, free from flaws and blemishes. All surfaces shall be clear, smooth, bright and be dimensionally stable.

.2 Accessible fixtures and fittings shall comply with the Building Code, Building Requirements for Persons with Disabilities, unless otherwise noted.

.3 Fixtures of the same type shall be the product of one manufacturer.

.4 Fittings of the same type shall be the product of one manufacturer.

.5 Protect all fixtures and fittings against use and damaged during construction.

.6 Be responsible for plumbing rough-in of appliances or equipment supplied by others.

.7 Provide an individual stop or valve on each domestic water service serving a plumbing fixture.

2.2 WATER CLOSETS

.1 WC1 - Floor Mounted, Ultra-low Flush Valve

.1 Floor mounted, vitreous china, elongated rim, 4.8 lpf [1.28 gpf], 40 mm [1-1/2”] top spud, 381 mm [15”] high rim, floor flange, seal, china bolt caps.

.2 4.8 lpf [1.28 gpf] manual flush valve with vacuum breaker.

.3 White open front seat less cover. Seat shall be compatible with the fixture.

.4 25 mm [1”] cold water supply.

.2 WC2 - Floor Mounted, Ultra-low Flush Valve - Accessible

.1 Floor mounted, vitreous china, elongated rim, 4.8 lpf [1.28 gpf], 40 mm [1-1/2”] top spud, 445 mm [17-1/2”] high rim, floor flange, seal, china bolt caps.

.2 4.8 lpf [1.28 gpf] manual flush valve with vacuum breaker.

.3 White open front seat with cover. Seat shall be compatible with the fixture.

.4 25 mm [1”] cold water supply.

2.3 URINALS

.1 U1 - Wall-Mounted, Flush Valve

.1 Wall hung, vitreous china, syphon jet flush action, 1.28 lpf [0.5 gpf], top spud, wall hangers, connecting flange with gasket and bolts.

.2 1.28 lpf [0.5 gpf] manual flush valve with vacuum breaker.

.3 20 mm [3/4”] cold water.

2.4 LAVATORY BASINS

.1 LB1 - Counter Mounted - Accessible

.1 Counter mounted, enameled steel with 100 mm [4”] punching to suit trim.

.2 Deck mounted faucet with single lever handle, accessible, 1.92 l/min at 414 kPa [0.5 gpm at 60 psi].

.3 CP offset waste cast brass with CP open grid strainer.

.4 CP P-trap.

.5 CP Speedway supply with lockshield stop.

.6 12 mm [1/2”] hot and cold supplies with stops.

.2 LB2 - Wall Mounted - Accessible

.1 Wall hung, vitreous china, accessible lavatory basin. Punching to suit 100 mm [4”] centre set, hangers.

.2 Deck mounted faucet with single lever handle, accessible, 1.92 l/min at 414 kPa [0.5 gpm at 60 psi].

.3 CP offset waste cast brass with CP open grid strainer.

.4 CP P-trap.

.5 CP Speedway supply with lockshield stop.

.6 12 mm [1/2”] hot and cold supplies with stops.

2.5 P-TRAP INSULATION

.1 Provide P-trap insulation to all offset wastes include also supply covers.

2.6 CHAIR CARRIERS

.1 Factory manufactured floor-mounted carrier systems for wall-mounted fixtures.

PART 3 - EXECUTION

3.1 FIXTURE INSTALLATION

.1 Provide all hangers, supports, brackets, reinforcement, steel back-up plates and floor flanges to set fixtures level and square. Mount fixtures so that 90 kg [200 lb.] mass will not loosen or distort mounting.

.2 Water Closets:

.1 Provide brass or cast iron floor flanges with lead stub or mechanical joint connections and wax seals.

.2 Flush valves on accessible toilets shall be arranged to be accessible from the open side of the toilet and be high enough to not be obstructed by the seat cover.

.3 Urinals:

.1 Piping, fittings and P-traps from urinals shall not be copper; vents above the urinal rim may be copper.

.2 Urinals shall have individual wastes; double waste fittings are unacceptable.

.4 Lavatories:

.1 Double waste fittings for lavatories and sinks shall be a double sanitary tee.

.2 Control handles for all two handle mixing faucets shall be positioned with the cold control on the right and the hot control on the left.

.3 Faucets shall be complete with nuts and tailpieces.

.4 Plastic control handles and spouts are unacceptable.

.5 Lavatory P-traps shall be complete with either a cleanout or possess slip joint connections.

3.2 FIXTURE TRIM HOLES OR PUNCHINGS

.1 Fixtures shall not contain more punchings than necessary for the specified trim.

.2 Drilling holes and cutting cutouts for the installation of plumbing fixture trim and faucets including the forming of recesses or grooves in the underside of countertops or the provision of extension pieces for faucet nipples is the responsibility of the General Contractor.

3.3 WALLS AND FLOORS

.1 Fixtures mounted on glazed tile surfaces shall have ground faces to finished surface.

.2 Where plumbing fixtures come in contact with walls and floors, joints shall be sealed with anti-mildew building sealant, made watertight and beaded smooth in a neat and workmanlike manner.

3.4 WATER HAMMER ARRESTORS

.1 Provide water hammer arrestors or shock absorbers on fixtures with flush valves and/or quick closing valves.

3.5 ACCESSIBLE FIXTURES

.1 Offset P-traps shall be installed with the run of the P-trap parallel to and close to wall.

.2 Supplies on accessible lavatories shall be offset to accommodate the offset P-trap.

.3 Offset waste lines and P-traps at all accessible fixtures shall be insulated with 12 mm [1/2"] of fiberglass insulation and finished with a polyvinyl chloride jacket in a neat and workmanlike manner.

.4 The flush valve for accessible water closets shall be mounted 1100 +/- above finished floor.

3.6 CLEAN-UP

.1 All fixtures and trim shall be left in a clean and polished condition.

3.7 ADJUSTING

.1 Conform to water conservation requirements specified this section.

.2 Adjustments:

.1 Adjust water flow rate to design flow rates.

.2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.

.3 Adjust flush valves to suit actual site conditions.

.4 Adjust urinal flush timing mechanisms.

.3 Checks:

.1 Water closets, urinals: flushing action.

.2 Aerators: operation, cleanliness.

.3 Vacuum breakers, backflow preventers: operation under all conditions.

END OF SECTION 22 42 03

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes the supply and installation of showers.

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 SUBMITTALS

.1 Shop Drawings:

.1 Submit shop drawings for all showers.

.2 Closeout Submittals

.1 Provide maintenance data for incorporation into Operational and Maintenance manual.

1.4 FINISHES

.1 Exposed plumbing fittings and metal work shall be extra heavy chrome plated.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

.1 Provide brand new fixtures and fittings, CSA approved, free from flaws and blemishes. All surfaces shall be clear, smooth, bright and be dimensionally stable.

.2 Accessible fixtures and fittings shall comply with the British Columbia Building Code, Building Requirements for Persons with Disabilities, unless otherwise noted.

.3 Fixtures and fittings of the same type shall be the product of one manufacturer.

.4 Protect all fixtures and fittings against use and damaged during construction.

.5 Be responsible for plumbing rough-in of appliances or equipment supplied by others.

.6 Provide an individual stop or valve on each domestic water service serving a plumbing fixture.

2.2 SHOWERS

.1 SH1 - Accessible Shower Stall

.1 Acrylic shower, 2134 high x 1740 wide x 914 mm deep [84” x 68” x 36”], fold up seat - confirm handing, 25 mm [1”] stainless steel curtain rod, recessed pot light, four (4) grab bars in lengths and locations as detailed on the Architectural drawings, backing for hand shower slide/ grab bar.]

.2 Pressure balancing valve with lever handle, 0.95 l/s at 414 kPa [1.5 gpm at 60 psi], hand shower and 900 mm [36”] stainless steel slide/grab bar, 1500 mm [60”] vinyl hose integral stops and checks, vacuum breaker supply elbow and flange. Locate the valve and showerhead as detailed in the Architectural drawings.

.3 Stainless steel or brass drain. P-trap.

.4 12 mm [1/2”] hot and cold supply.

PART 3 - EXECUTION

3.1 FIXTURE INSTALLATION

.1 Provide all hangers, supports, brackets, reinforcement, steel back-up plates and floor flanges to set fixtures level and square. Mount fixtures so that 90 kg [200 lb.] mass will not loosen or distort mounting.

3.2 FIXTURE TRIM HOLES

.1 Fixtures shall not contain more punchings than necessary for the specified trim.

.2 Drilling holes and cutting cutouts for the installation of plumbing fixture trim and faucets including the forming of recesses or grooves in the underside of countertops or the provision of extension pieces for faucet nipples is the responsibility of the General Contractor.

3.3 WALLS AND FLOORS

.1 Fixtures mounted on glazed tile surfaces shall have ground faces to finished surface.

.2 Where plumbing fixtures come in contact with walls and floors, joints shall be sealed with anti-mildew building sealant, made watertight and beaded smooth in a neat and workmanlike manner.

3.4 WATER HAMMER ARRESTORS

.1 Provide water hammer arrestors or shock absorbers on fixtures with flush valves and/or quick closing valves.

3.5 ACCESSIBLE FIXTURES

.1 Confirm all mounting heights of trim and grab bars with the Architect.

3.6 CLEAN-UP

.1 All fixtures and trim shall be left in a clean and polished condition.

3.7 ADJUSTING

.1 Conform to water conservation requirements specified this section.

.2 Adjustments:

.1 Adjust water flow rate to design flow rates.

.2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.

.3 Checks:

.1 Aerators: operation, cleanliness.

.2 Vacuum breakers, backflow preventers: operation under all conditions.

.4 Thermostatic controls: Verify temperature settings, operation of control, limit and safety controls.

END OF SECTION 22 42 20

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes common work results for Divisions 21, 22, 23 and 25.

1.2 RELATED SECTIONS

.1 These common works apply for Divisions 21, 22, 23 and 25. Should there be any conflict between any requirement of this Section and the General Conditions, Supplements and Amendments, the more stringent shall apply.

.2 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 DEFINITIONS

.1 Provide means supply and install.

.2 Departmental Representative means Public Works and Government Services Canada (PWGSC).

.3 Work means material and labour.

.4 The specification sections are titled and divided under the headings of General, Products and Execution and under clause headings. These titles and headings are for general organization only and shall in no way limit or restrict the specification requirements.

1.4 GENERAL SCOPE

.1 Provide the work indicated in the Contract Documents and as required to provide complete, tested and fully operational systems including all work not normally indicated but necessary for a complete and operational installation.

.2 The Contractor is expected to be experienced and competent and knowledgeable about the trades and applicable codes, ordinances and industry standards and shall perform the work accordingly, on schedule and fully coordinated with all other trades.

.3 Except where precisely indicated, the Contract Documents are diagrammatic and generally indicating the scope of work, general arrangement, and establishing minimum quality and performance requirements. Where there are conflicting requirements the Contractor shall allow for and provide the better quality and/or greater quantity unless the conflicting requirements are interpreted otherwise in writing by the Departmental Representative.

.4 The Contract Documents for this Division are an integral part of the complete Contract Documents for the project and will be interpreted in conjunction with all other Divisions.

1.5 CODES, REGULATIONS AND STANDARDS

.1 Mechanical work shall conform to the following codes, regulations and standards, and all other codes in effect at the time of award of Contract, and any others having jurisdiction. The revision of each code and standard and their amendments which are adopted by the Authority Having Jurisdiction shall apply unless otherwise specified in the Contract Documents:

.1 Bylaws

.1 Local Building Bylaws.

.2 Canadian Gas Association

.1 National Standard of Canada CAN/CGA-B149.1-00. Natural Gas and Propane Installation Code.

.3 National Fire Codes
- .1 NFPA 10 Portable Fire Extinguishers.
- .2 NFPA 13 Sprinkler System Installation.

.4 National Research Council of Canada
- .1 National Building Code of Canada.
- .2 National Fire Code of Canada.

.5 Province of British Columbia
- .1 BC Industrial Health & Safety Regulations, WorkSafeBC.

.6 SMACNA Publications
- .1 HVAC Duct Construction Standards.
- .2 Fire, Smoke and Radiation Damper Installation Guide.
- .3 Guidelines for seismic restraints of mechanical systems.

.2 All specification references to the Building Code refer to the National Building Code.

1.6 PERMITS AND FEES

.1 Obtain all required permits and pay all fees including service connection fees as applicable to the mechanical work. Comply with all Provincial, Municipal and other legal regulations and bylaws applicable to the work.

.2 Arrange for inspection of all Work by the Authorities Having Jurisdiction. On completion of the Work, furnish final unconditional certificates of approval by the inspecting authorities.

1.7 DRAWINGS AND MEASUREMENTS

.1 Drawings are generally diagrammatic and are intended to indicate the scope and general arrangement of work. They are not detailed installation drawings.

.2 Do not scale the drawings.

.3 Obtain accurate dimensions from the Architectural and Structural Drawings.

.4 Consult the Architectural drawings for exact locations of fixtures and equipment. Obtain this information from the Departmental Representative where not obtainable from the drawings.

.5 Field measure as required to size and locate services and equipment.

1.8 SITE VISIT

.1 Visit the site before tendering.

.2 Examine all local and existing conditions on which the work is dependent. No consideration will be granted for any misunderstanding of work to be done where the necessary information could have reasonably been obtained by an examination of the site.

1.9 TENDER PERIOD ADDENDA

.1 Bidding Contractors may forward queries to the Departmental Representative during the tender period. Only issues included in issued, written addenda will affect the content of the tendered documents. No verbal information will be binding for the Contract.

.2 It is incumbent on the bidding contractors during the tender period to bring to the Departmental Representative's attention any discrepancies, conflicts, obscurities, omissions or lack of sufficient information in the Contract Documents. Where these are not clarified or corrected by addendum, allow for the most expensive interpretation.

1.10 PROGRESS CLAIMS

.1 Submit a single figure for a Progress Claim showing total contract, previous approved claims total, amount of current claim and remaining amount, all both in dollar value and as a percent of the total.

.2 To assist and enable the Departmental Representative to review the Progress Claim amount, provide along with the claim a separate breakdown of the claim in the same categories as required under Price Breakdown showing the total, previous, current and remaining amounts in dollars and percent for each category. Also show the claims for each Change Order being progressed.

.3 The Departmental Representative's review is of the single figure total claim-to-date only. The Departmental Representative bears no responsibility for review of the breakdown portions.

.4 Progress Claims beyond 95% of the mechanical work may not be certified for payment until the commissioning is complete. This is to allow for holdback for deficiencies which are identified during commissioning.

1.11 WARRANTY

.1 Use of installed equipment during construction shall not shorten or alter the warranty period as specified in the General Conditions.

.2 Take note of and submit written information for any extended warranties specified.

1.12 WORKMANSHIP

.1 Workmanship shall be in accordance with well-established practice and with standards accepted and recognized by the Departmental Representative and the Trade.

.2 The Departmental Representative may reject any work not conforming to the Contract Documents or to accepted standards of performance, quietness of operation, finish or appearance.

.3 Employ only tradesmen with valid Provincial Trade Qualification Certificates. Tradesmen shall perform only work permitted by their certificates. Certificates shall be available for review by the Departmental Representative.

1.13 ACCESSIBILITY

.1 All work shall be readily accessible for adjustment, operation and maintenance. Supply access doors where required in building surfaces for installation by building trades.

1.14 SUBMITTALS

.1 Shop Drawings:

.1 Process:

.1 Shop drawings/product data shall be submitted as elsewhere specified.

.2 Shop drawings/product data shall be reviewed, signed and processed as described in the General Conditions and as further described by the Mechanical Contractors Association of British Columbia.

.2 Content:

.1 Shop drawings submitted title sheet (Mechanical Contractors Association of British Columbia).

.2 Data shall be specific and technical.

.3 Identify each piece of equipment.

.4 Information shall include all scheduled data.

.5 Advertising literature will be rejected.

.6 The project shall be identified on each document.

.7 Information shall be given in S.I. units consistent with the system of units in the Contract Documents.

.8 The shop drawings/product data shall include:

.1 Dimensioned construction drawings with plans and sections showing size, arrangement and necessary clearances, with all equipment weights and mounting point loads.

.2 Mounting arrangements.

.3 Capacity and performance characteristics indicated on performance curves for fans and pumps.

.4 Sound Power Data, where requested.

.5 Detailed drawings of bases, supports and anchor bolts.

.6 Control explanation and internal wiring diagrams for packaged equipment.

.7 Electrical control system drawings.

.8 Interlock wiring control schematic diagrams including details of all component parts in order that the function of each is displayed.

.9 A written description of control sequences relating to the schematic diagrams.

.9 Clearly indicate selected options and accessories. Cross out any items that do not apply. Add any additional specified features such as finishes, high temperature seals, etc.

.3 Format:

.1 Black line print 216 mm x 280 mm [8-1/2" x 11"] or 280 mm x 430 mm [11" x 17"].

.2 An assembly of related components, e.g. grilles, registers and diffusers or radiation with sheet metal cabinets, etc. between covers with the contents [identified by model number] listed on the front cover with item identification numbers.

.3 A brochure for plumbing fixtures between covers with the contents named with model numbers listed on the front cover with item identification numbers

.4 Number of copies: Provide a minimum of 3 copies for the Departmental Representative.

.5 Coordination: Where mechanical equipment requires electrical connections, power or other services, the shop drawings shall also be circulated through the Electrical Contractor prior to submission to the Departmental Representative.

.6 Keep one (1) copy of shop drawings and product data, on site, available for reference

.7 Review or non-review of shop drawings does not alter the requirements of the equipment and materials provided to conform to the specification.

.2 Closeout Submittals:

.1 Operation and Maintenance Manuals

.1 Provide maintenance data for incorporation into Operational and Maintenance manual.

.2 Employ the Balancing Agency to prepare the manuals.

.3 Allow sufficient time to provide the final reviewed manuals to the Owner before Substantial Performance.

.4 Provide one draft copy of the manuals to the Departmental Representative for review. Make all required changes and resubmit to the Departmental Representative. Repeat until accepted. Then submit the following, identical to the accepted copy, to the Owner:

.1 Four (4) hard copies – organized in binders, refer to below.

.2 Two (2) PDF electronic copies of full binder contents on CD, DVD, or flash drive.

.5 Obtain a receipt and send a copy to the Departmental Representative. Allow ten days for the first submittal review by the Departmental Representative and seven days for each subsequent review.

.6 If the manuals are not accepted and submitted to the Owner by the time of Substantial Performance, submit at Substantial Performance a draft copy to the Owner with clear indication that it is a draft copy, not a final copy, for interim use by the Owner. When the final copies are submitted to the Owner, retrieve the draft copy and modify it to match the other final copies.

.7 Manual hard copies in suitably sized 3-ring binder with suitable label with all required materials inside.

.8 Provide an index and tab each section.

.9 The manual shall include:

.1 Layman's description of all systems and their operation.

.2 List of local source of supply.

.3 Maintenance, lubrication and filter schedules.

.4 Air balance report.

.5 Water balance report.

.6 Commissioning report.

.7 Copy of any required approvals, certifications, acceptance by Authorities Having Jurisdiction.

.8 All shop drawings.

.9 Manufacturer’s operating and maintenance literature and wiring and control diagrams.

.2 Site Records:

.1 Keep a set of contract prints on site for the sole purpose of keeping an up-to-date record marked in red of the installation of the mechanical work and site services where they vary from the drawings.

.2 Changes for all mechanical work and piped site service trades, including sketches for Change Orders and Site Instructions shall be kept on this set of drawings.

.3 For all buried new services and all existing services exposed by the work indicate the inverts and dimensioned locations at all connections and changes in direction.

.4 Services shall not be buried or concealed until the Record Drawings are up-to-date for the services.

.5 All inaccessible concealed services shall be accurately located.

.6 Minor changes in the routing of services within a space which are readily observable and obvious after all construction is complete, need not be recorded.

.7 Identify each drawing in lower right hand corner in letters at least 10 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" and under this add the Contractor’s name, an authorized signature and the date.

.8 Submit the prints for review by the Departmental Representative. Make any additional changes identified by the Departmental Representative including returning to the site if necessary to make measurements and/or to confirm installation locations and details. Resubmit to the Departmental Representative.

.3 Record Drawings:

.1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.

.2 Upon completion of the Departmental Representative's review, submit final Record Drawings to the Departmental Representative. Final record drawings shall include revised CAD files and one set of PDF files to be prepared by a qualified draftsperson to the same standards as the original drawings.

1.15 DIMENSIONS AND UNITS

.1 The Contract Documents are generally in metric units and in places are followed by non-metric equivalents in square brackets.

.2 Generally the conversions for the equivalents are not exact but close enough that both are sufficiently accurate to be used.

.3 Many sizes or capacities shown are an indication of a nominal size, not an exact dimension, and these are as generally understood by the trade.

.4 Pipe sizes are nominal pipe sizes. Neither the metric size in mm or the often used Imperial sizes in inches are either equal to the inside or outside diameter of the pipe.

.5 Duct sizes are intended to be the actual size shown. However, some duct products are premanufactured in standard sizes or a sheet metal shop may be set up to work in standard sizes (generally Imperial based sizes) in which case a size shown in metric shall be soft converted to the Imperial inch size which is slightly larger e.g.:

.1 300 mm shall be 12".

.2 600 mm shall be 24".

.3 1200 mm shall be 48".

.6 Equipment dimensions are nominal sizes but are close to actual size. A 600 x 600 diffuser shall be close to 600 x 600 mm in overall dimension but where it is in a T-bar grid ceiling it shall be sized to lay in the grid whether it is a metric grid at 600 mm centres or an Imperial grid at 609 mm centres. A 600 x 600 mm surface mounted diffuser will be larger overall than 600 x 600 mm depending on the flange width.

PART 2 - PRODUCTS

2.1 MAINTENANCE

.1 Obtain signed receipt from the Owner when spare parts are handed over.

.2 Provide the following spare parts:

.1 One set of matched V-belts for each V-belt drive.

.2 Provide two (2) sets of filter media (for each filter) or filter bank installed - one for installation and one for hand over to the Owner as a spare.

2.2 PRODUCT QUALIFICATION

.1 Standard of Acceptance means that the item named and specified by manufacturer and/or model or catalogue number forms part of the specification and sets standards regarding performance, quality of material and workmanship and when used in conjunction with a referenced standard, shall be deemed to supplement the standard.

.2 The product indicated Standard of Acceptance was used in preparing the design. Tenders may be based on the Standard of Acceptance or on any Acceptable Product provided that they meet every aspect of the drawings and specifications including efficiency and energy consumption.

.3 Where multiple manufacturers and or models are named but no single one is indicated as Standard of Acceptance, any one of those named shall be acceptable provided they meet the specified requirements.

.4 Where other than the Standard of Acceptance is selected or approved, include for the cost of any resulting work (both under this Division and other Divisions) and any necessary redesign of installation or structure. Submit redesign drawings for review with Shop Drawings. Maintain installation, access and servicing clearances. Redesign drawings shall be to scale and of a standard equal to the Project Drawings.

.5 Multiple items of equipment material of the same type shall be of the same manufacturer.

.6 Install and test all equipment and material in accordance with the detailed instructions and recommendations of the manufacturer.

.7 A visible nameplate shall indicate manufacturer's name, model number, serial number, capacity data, electrical characteristics and approval stamps.

2.3 ASBESTOS

.1 All material/products provided shall be free of asbestos.

2.4 ACCESS DOORS

.1 Provide in accordance with Section 08 3119 - Access Doors - Mechanical.

2.5 FASTENING TO BUILDING STRUCTURE

.1 Do not use inserts in base material with a compressive strength less than 13.79 MPa [2000 psi].

.2 All inserts supporting piping shall have a factor of safety of 5. All other inserts shall have a factor of safety of 4.

.3 All drilling for inserts shall be performed using the appropriate tool specifically designed for the particular insert. The diameter and depth of each drilled hole shall be to the exact dimensions as specified by the insert manufacturer.

.4 Refer to manufacturer's recommendations for tightening torques to be applied to inserts.

2.6 MISCELLANEOUS METAL

.1 Be responsible for all miscellaneous steel work relative to the mechanical work of the Specifications, including but not limited to:

.1 Support of equipment.

.2 Hanging, supporting, anchoring, guiding and related work as it applies to piping, ductwork and mechanical equipment.

.3 Earthquake restraint devices.

.2 All exterior miscellaneous steel shall be hot-dipped galvanized.

.3 All steelwork not galvanized shall be prime and undercoat painted ready for finish under Painting Division. On galvanized materials that are subsequently welded apply galvicon. Refer to drawings for details.

2.7 ELECTRIC MOTORS

.1 Provide premium efficiency motors for mechanical equipment as specified. Motors efficiencies shall be as measured by IEEE Standard 112 Method B.

.2 Unless noted otherwise, provide open drip-proof, ball bearing, continuous duty motors of EEMAC class B, suitable for 40°C [104°F] ambient and for 40°C [72°F] temperature rise, for all mechanical equipment.

.3 Motors shall have standard voltage ratings consistent with the project distribution voltages. Motors less than 1/2 HP to be 120 volt, 60 cycle, single-phase power. Motors 1/2 HP and larger to be 3 phase power and for the scheduled voltage.

.4 All motors to be standard 1800 RPM unless specifically scheduled otherwise.

.5 Provide all motors with terminal boxes, suitable for power connections.

.6 Provide screw adjustable bases on all belt connected motors.

.7 Motors to be of the capacitor start type when they may be manually cycled from a starting switch, which is located in the finished space.

.8 Unless otherwise noted starters and protection devices will be included under the Electrical Division of the Specification.

.9 Assist Electrical Division to ensure proper connection, correct thermal overload protection and correct motor controls.

.10 Where starters are included in this Division as an integral part of packaged equipment, they shall contain thermal overload protection in all ungrounded lines.

.11 Equipment, which has more than one voltage rating, shall be fed from a single power source through a disconnect switch.

2.8 BELT DRIVES

.1 Provide V-belt drives to the following requirements:

.1 Provide steel, cast iron or aluminum sheaves keyed to shaft for motors less than 3/4 HP.

.2 Provide steel or cast iron sheaves keyed to shafts, for motors 3/4 HP. and larger.

.3 For motors less than 10 HP provide standard adjustable pitch drive sheaves having +/- 10% range. Use mid-position of range for specified RPM.

.2 V-belts shall conform to the American Belt Manufacturers standards. Multiple belts shall be matched sets.

.3 Match drive and driven sheaves

.4 A minimum of two belts is required for each drive for motors 3/4 HP. and larger.

.5 Minimum drive rating shall be 150% of nameplate rating of motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.

.6 Motor slide rail adjustment baseplate with double draw bolt, shall allow for centre line adjustment.

.7 Tension belts to manufacturers recommendations before start up and after 100 hours of operation using calibrated belt tensioning gauge.

.8 The Contractor is responsible to provide drives to achieve the specified equipment performance. Often drives must be changed from those initially supplied. It is suggested that where synchronous belt drives are indicated the equipment be initially supplied with V-belt drives until the proper operating rpm is determined and then the correct synchronous drives be provided.

.9 Provide one spare set of belts for each piece of equipment with each belt separately identified for the equipment item to be served.

PART 3 - EXECUTION

3.1 COORDINATION

.1 Examine all Contract Drawings to verify space and headroom limitations for the required work. Coordinate the work with all trades and modify without changing the design intent to facilitate a satisfactory installation. Make no changes to the design intent involving extra cost to the Owner, without the Departmental Representative's prior written approval.

.2 The drawings indicate the general location and route to be followed by the piping and ductwork. Where details are not shown on the drawings or are only shown diagrammatically, the pipes and ductwork shall be installed in such a way as to conserve headroom and interfere as little as

possible with the free use of space through which they pass. Service lines shall run parallel to building lines. All ducts and pipes in the ceiling shall be kept as tight as possible to beams or other limiting members at high level. All pipes and ducts shall be coordinated in elevation to ensure that they are concealed unless indicated otherwise.

.3 Work out jointly all interference problems on the site and coordinate all work before fabricating, or installing any material or equipment. No consideration of payment will be made for additional work due to fabricating or installing materials before a coordination issue was identified and resolved. Where necessary produce interference drawings showing exact locations of mechanical equipment within service areas, shafts and the ceiling space. Ensure that all materials and equipment fit into the allotted spaces and that all equipment can be properly 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 the work that all equipment installed can be properly, safely serviced and replaced, if and when required.

3.2 CONCEALMENT

.1 Conceal all tubing, piping, ductwork and conduit in partitions, walls, crawlspaces, and ceiling spaces, unless otherwise noted.

.2 Do not install tubing, piping and conduit in outside walls or roof construction unless specifically directed, in which case, make provision to ensure that the building insulation is between them and the outside face of the building.

3.3 PROTECTION OF WORK

.1 Protect equipment and materials, stored or installed, from the weather, moisture, dust and physical damage.

.2 Mask machined surfaces. Secure temporary covers over equipment openings and open ends of piping, ductwork and conduits, as required to keep them clean.

.3 Rusting, pitting or physical damage will be cause for rejecting equipment.

.4 Make good damaged or marred factory finish.

.5 Air systems must have air filters installed before fans are operated. Air filters must be clean at Substantial Completion.

3.4 EQUIPMENT INSTALLATION

.1 Provide unions and flanges to permit equipment maintenance, disassembly or removal, to minimize disturbance to piping and duct systems and to avoid interfering with building structure or other equipment.

.2 Provide means of access for servicing equipment including permanently lubricated bearings.

.3 Pipe equipment drains to floor drains.

.4 Align equipment, rectangular cleanouts and similar items with building lines wherever possible.

.5 Ensure that equipment does not transmit noise or vibration to other parts of the building as a result of poor installation practices.

3.5 PIPING EXPANSION

.1 Install piping with all necessary changes of direction, expansion loops, anchors and guides to prevent overstressing the piping and equipment piping connections from thermal expansion and contraction.

.2 Expansion loops shall be of all welded construction with long radius elbows and be located between anchors. Cold spring 50% of maximum calculated expansion.

.3 Anchors shall be fabricated from mild steel plate and structural steel sections, in accordance with ANSI B.31.

3.6 ANCHORS AND TEMPLATES

.1 Supply anchors and templates for installation by other Divisions.

3.7 CUTTING, PATCHING, DIGGING, CANNING AND CORING

.1 Lay out all cutting, patching, digging, canning and coring required to accommodate the mechanical services. Coordinate with other Divisions. The performance of actual cutting, patching, digging, canning and coring is specified under other Divisions. Be responsible for correct location and sizing of all openings required under the mechanical work, including pipe sleeves and duct openings. Allow oversized openings for fire dampers and for pipe penetrations where continuous insulation is specified.

.2 Verify the location of service runs and structural components within concrete floors and walls prior to core drilling and/or cutting. The Contractor is responsible to repair services and structural components damaged as a result of core drilling and cutting.

.3 Openings through structural members of the building shall not be made without the approval of the Departmental Representative.

3.8 FIRESTOP MATERIALS

.1 Firestopping and Smoke Seal Systems: Install assembly capable of maintaining an effective barrier against flame, smoke and gases in compliance with requirements of ULC CAN4-S115-M85, or ULI 1479 and ASTM 814, and not to exceed opening sizes for which they are intended.

.2 Fire resistance rating of installed firestopping assembly shall be not less than the fire resistance rating of surrounding floor and wall assembly.

3.9 SERVICE PENETRATIONS IN RATED FIRE SEPARATIONS

.1 All piping, tubing, ducts, wiring, conduits, etc. passing through rated fire separations shall be smoke and fire proofed with ULC approved materials in accordance with CAN4-S115 and ASTM E814 standards and which meet the requirements of the Building Code in effect. This includes new and existing services passing through existing rated separations and new and existing services passing through new rated separations or existing separations whose rating is being upgraded.

.2 Fire resistance rating of installed firestopping assemblies shall not be less than fire resistance rating of the surrounding assembly.

.3 All smoke and fire stopping shall be installed by a qualified Contractor who shall submit a letter certifying that all work is complete and in accordance with this specification.

.4 Install fire stopping and smoke seal material and components in accordance with ULC certification and manufacturer's instructions in formed, sleeved or cored penetrations.

.5 Submit shop drawings for each type of pipe and separation type combination showing the approved materials and installation data.

3.10 SERVICE PENETRATIONS OF NON-RATED SEPARATIONS

.1 All piping, tubing, ducts, wiring, conduits, etc. passing through non-rated fire separations and non-rated walls and floors shall be tightly fitted and sealed on both sides of the separation with silicon sealant to resist the passage of smoke and/or transmission of sound.

3.11 DUCT AND PIPE MOUNTED CONTROL EQUIPMENT

.1 The following automatic control equipment will be supplied by the controls trade but installed by the appropriate trade sections of mechanical work:

.1 Automatic control valves.

.2 Temperature control wells.

.3 Pressure tappings.

.4 Flow switches.

.5 Automatic control dampers.

3.12 LUBRICATION OF EQUIPMENT

.1 Lubricate all new and re-used equipment prior to being operated, except sealed bearings, which shall be checked.

.2 Use the lubricant recommended by the manufacturer for the service for which the equipment is specified.

.3 Extend lubricating connections and sight glasses to the outside of housings, where lubricating positions are not readily accessible.

.4 Submit a checklist, showing that all operated equipment has been lubricated prior to and during any operation.

3.13 START-UP

.1 Before starting the plant, provide confirmation in writing to the Departmental Representative that the plant is ready for start-up and the following conditions have been met. These include:

.1 All safety controls are installed and fully operational.

.2 Qualified personnel will be provided to operate the plant.

.3 Permanent electrical connections have been made to all equipment.

.4 Boilers have been started up and adjusted by manufacturer's representatives.

.5 All air filters are installed.

.6 All mechanical equipment rooms, including plenums, have been vacuum cleaned.

3.14 PAINTING REPAIRS AND RESTORATION

.1 Apply a coat of rust inhibiting primer to all exposed, bare steel provided under the mechanical work. Clean and prepare the surfaces first in accordance with the paint manufacturer’s recommendations.

.2 Apply the primer before or immediately after installation where the steel will be exposed to moisture.

.3 Make good any damage to factory finishes on equipment supplied under the mechanical work.

.4 Any finish painting of the equipment and materials provided under the mechanical work is by Painting Division (except where specifically indicated otherwise). Coordinate with Painting Division including identifying the various mechanical services for painting.

.5 Colours for equipment and materials in finished areas and outdoors shall be as directed by the Architect.

.6 Painting Division shall paint in accordance with the following Colour Schedule where equipment is installed in mechanical equipment rooms, and service areas and if required to be painted.

Item	Colour Finish
Piping (uninsulated)	
- fire lines (standpipes, sprinklers)	Red
- gas (propane)	Yellow
- services other than above	White

3.15 SUBSTANTIAL PERFORMANCE REQUIREMENTS

.1 Before the Departmental Representative is requested to make an inspection for substantial performance of the work:

.1 Commission all systems.

.2 Submit a letter certifying that all work (including calibration of instruments and balancing of systems) is complete, operational, clean and all required submissions have been completed.

.2 The work will not be considered to be ready for use or substantially complete until the following requirements have been met:

.1 All reported deficiencies have been corrected.

.2 Testing and balancing completed.

.3 Operation and Maintenance Manuals completed.

.4 Record Drawings ready for review.

.5 System Commissioning has been completed and verified.

.6 All demonstrations to the Owner have been completed.

3.16 DEFICIENCY HOLDBACKS AND DEFICIENCY INSPECTIONS

.1 Work under this Division which is still outstanding when substantial performance is certified will be considered deficient and hold-back will be established equal to at least twice the Departmental Representative's cost estimate of completing that work.

.2 It is expected that outstanding work will be completed in an expeditious manner and the entire holdback sum will be retained until the requirements for Total Performance of the mechanical work have been met and verified.

END OF SECTION 23 03 00

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes materials and requirements for installation of mechanical pipework systems in Divisions 21, 22 and 23.

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

PART 2 - PRODUCTS

.1 Not Used.

PART 3 - EXECUTION

3.1 CONNECTIONS TO EQUIPMENT

.1 In accordance with manufacturer's instructions unless otherwise indicated.

.2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.

.3 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.

3.2 CLEARANCES

.1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer.

.2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment, components.

3.3 DRAINS

.1 Install piping with grade in direction of flow except as indicated.

.2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.

.3 Pipe each drain valve discharge separately to above floor drain. Discharge to be visible.

.4 Drain valves: 20 mm [3/4”] gate or globe valves unless indicated otherwise, with hose end male thread, cap and chain.

3.4 DIELECTRIC COUPLINGS

.1 Compatible with system, to suit pressure rating of system.

.2 Provide dielectric couplings on all systems except closed loop systems wherever pipes of dissimilar metals are joined.

.3 Provide insulating unions for pipe sizes 50 mm [2”] and under and flanges for pipe sizes over 50 mm [2”].

.4 Provide felt or rubber gaskets to prevent dissimilar metals contact.

3.5 PIPEWORK INSTALLATION

.1 Screwed fittings jointed with Teflon tape.

.2 Protect openings against entry of foreign material.

.3 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.

.4 Assemble piping using fittings manufactured to ANSI standards.

.5 Saddle type branch fittings may be used on mains if branch line is no larger than half the size of main. Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.

.6 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.

.7 Install concealed pipework to minimize furring space, maximize headroom, conserve space.

.8 Slope piping, except where indicated, in direction of flow for positive drainage and venting.

.9 Install, except where indicated, to permit separate thermal insulation of each pipe.

.10 Group piping wherever possible.

.11 Ream pipes, remove scale and other foreign material before assembly.

.12 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.

.13 Provide for thermal expansion as indicated.

.14 Valves:

.1 Install in accessible locations.

.2 Remove interior parts before soldering.

.3 Install with stems above horizontal position unless otherwise indicated.

.4 Valves accessible for maintenance without removing adjacent piping.

.5 Install globe valves in bypass around control valves.

.6 Use ball valves at branch take-offs for isolating purposes except where otherwise specified.

.15 Check Valves:

.1 Install silent check valves on discharge of pumps and in vertical pipes with downward flow and elsewhere as indicated.

.2 Install swing check valves in horizontal lines on discharge of pumps and elsewhere as indicated.

3.6 ESCUTCHEONS AND PLATES

.1 Provide on pipes passing through walls, partitions, floors and ceilings in finished areas.

.2 Plates shall be stamped steel, split type, chrome plated or stainless steel, concealed hinge, complete with springs, suitable for external dimensions of piping/insulation. Secure to pipe or finished surface. Outside diameter shall cover opening or sleeve.

.3 Where pipe sleeve extends above finished floor, escutcheons or plates shall clear sleeve extension.

.4 Do not install escutcheons and plates in concealed locations.

END OF SECTION 23 05 05

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes materials and requirements for thermometers and pressure gauges in piping systems.

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 SUBMITTALS

.1 Shop Drawings:

.1 Submit shop drawings for:

.1 Thermometers.

.2 Pressure gauges.

.3 Wells.

.2 Closeout Submittals:

.1 Provide maintenance data for incorporation into Operational and Maintenance manual.

1.4 REQUIRED COMPLIANCE

.1 All thermometers shall comply with the Canadian General Standards Board Requirements.

.2 All gauges shall comply with ANSI B40.1 Grade "A" level.

.3 Gauges used on fire protection systems shall be ULC listed.

.4 Gauges and separable sockets on liquid systems to be registered with Provincial Boiler and Pressure Vessel Safety Branches with CRN number.

.5 Select thermometers and pressure gauges so that the operating range is at the midpoint of the scale or range.

PART 2 - PRODUCTS

2.1 THERMOMETERS - LIQUID SYSTEMS

.1 Variable angle stem type:

.1 Pipe mount with separable socket.

.2 Cast aluminum, high heat or ABS plastic casing.

.3 225 mm [9”] scale length.

.4 White background, black numerals and red reading mercury.

.5 Dual Celsius and Fahrenheit scale.

2.2 PRESSURE GAUGES - LIQUID SYSTEMS

.1 Case stainless steel, size 115 mm [4-1/2”] diameter with gasketted clear window.

.2 Phosphor bronze bourdon tube, silver brazed tip and socket 6 mm [1/4"] lower connection.

.3 Rotary type bushed movement, silicone dampened to prevent pointer oscillation.

.4 White background with black numerals.

.5 Dual kPa and psig scale.

.6 Accurate within 1% of scale range.

2.3 SEPARABLE SOCKETS

.1 For installation in copper pipe socket shall be copper or bronze. For installation in steel pipe socket shall be brass.

.2 20 mm [3/4”].

PART 3 - EXECUTION

3.1 GENERAL

.1 Design point to be at mid point of scale or range.

.2 Install thermometers and gauges so they can be easily read from floor.

.3 Install engraved lamicoid nameplates identifying medium under remote reading thermometers and gauges.

3.2 THERMOMETERS

.1 Install the separable socket so as to minimize any flow restriction. If necessary, install in a section of oversized pipe.

.2 Install wells where indicated for use with test thermometers.

.3 Install as indicated on the drawings and in the following locations:

.1 On the inlet and outlet pipes of:

.1 DHW tanks.

.2 Heat Pumps - primary and secondary water.

.3 Water boilers.

.4 Inlet and outlet of waterside of coils (excluding terminal unit coils).

.2 Water system headers.

.4 Use extensions where thermometers are installed through insulation.

3.3 PRESSURE GAUGES

.1 Install a needle valve ahead of each gauge.

.2 Install as indicated on the drawings and on the inlet and outlet pipes in the following locations:

.1 Inlet and outlet of waterside of coils (excluding terminal unit coils).

.2 Suction and discharge of pumps.

.3 Upstream and downstream of PRV's.

.4 Outlet of boilers.

.3 Use extensions where pressure gauges are installed through insulation.

.4 Where a single gauge is used to measure multiple points provide needle valves to isolate each point, including pressure gauge.

3.4 NAMEPLATES

.1 Install engraved lamicoid nameplates as specified in Section 23 05 54 - Mechanical Identification.

END OF SECTION 23 05 21

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes concrete housekeeping pads, hangers and supports for mechanical piping, ducting and equipment.

.2 It is the entire responsibility of equipment manufacturers to design their equipment so that the strength and anchorage of the mounting points and internal components of the equipment exceeds the force level used to restrain and anchor the unit to the supporting structure during a seismic event of code design magnitude.

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 SUBMITTALS

.1 Shop Drawings:

.1 Shop drawings shall be stamped and signed by Professional Engineer registered or licensed British Columbia for seismically rated hangers and supports.

.2 Submit shop drawings and product data for:

.1 Bases, hangers and supports.

.2 Connections to equipment and structure.

.3 Structural assemblies.

.3 Submit manufacturer’s name and model number for all hanger components.

.2 Closeout Submittals:

.1 Provide maintenance data for incorporation into Operational and Maintenance manual.

1.4 SYSTEM DESCRIPTION

.1 Design Requirements:

.1 Fabricate and construct pipe hangers, supports and sway braces to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.

.2 Base maximum load ratings on allowable stresses prescribed by ANSI B31.1 or MSS SP58.

.3 Design hangers and supports to support systems under all conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipe work or connected equipment and to maintain grade.

.4 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment to be in accordance with MSS SP58.

.5 Where possible use cast-in-place concrete inserts.

.6 Support from structural members, not from metal decking.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP58.

.2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.2 PIPE HANGERS

.1 Finishes:

.1 Pipe hangers and supports: electroplated galvanized, cadmium plated or painted with zinc-rich paint after manufacture in corrosive locations and in all mechanical rooms and trenches.

.2 All steel hangers in contact with copper piping shall be copper plated or plastic dipped.

.2 Attachment to TJI joist:

.1 Nail 2x10 wood filler piece on both sides of joist web at location of hanger.

.2 Bolt or lag iron side beam bracket to wood filler pieces.

.3 Refer to SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems for detail.

.3 Upper attachment structural:

.1 Suspension from lower flange of steel beam channel or angle.

.1 Cold piping 50 mm [2”] and smaller:

.1 Ductile iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.

.2 Cold piping 65 mm [2-1/2”] or larger all hot piping:

.1 Malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, to MSS-SP58 and MSS-SP69.

.2 Suspension from upper flange of steel beam, channel or angle.

.1 Cold piping 50 mm [2”] and smaller:

.1 Ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, to MSS-SP69.

.2 Cold piping 65 mm [2-1/2”] or larger, all hot piping:

.1 Malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut.

.4 Attachment to steel joist:

.1 Cold piping 50 mm [2”] and smaller:

.1 Steel washer plate with double locking nuts.

.2 Cold piping 65 mm [2-1/2”] and larger and all hot piping:

.1 Steel washer plates with double locking nut, carbon steel clevis and malleable iron socket.

.5 Upper attachment to concrete:

.1 Ceiling:

.1 Carbon steel welded eye rod clevis plate, clevis pin and cotters with weldless forged steel eye nut.

.2 Concrete cast-in-place inserts:

.1 Galvanized steel wedge shaped body ULC listed to MSS-SP69.

.6 Shop and field-fabricated assemblies:

.1 Supports and sway braces may be shop or field fabricated but must be in accordance with the requirements of ANSI B31.1 and MSS-SP58.

.2 Sway braces for seismic restraint systems: to Section 23 0548 - Vibration and Seismic Controls for HVAC Piping and Equipment.

.7 Hanger rods: threaded rod material to MSS-SP58.

.1 Ensure that hanger rods are subject to tensile loading only.

.2 Provide linkages where lateral or axial movement of pipework is anticipated.

.3 Do not use 22 mm or 28 mm rod.

.8 Pipe attachments:

.1 Material to MSS-SP58.

.2 Attachments for steel piping: carbon steel.

.3 Attachments for copper piping: copper plated black steel.

.4 Use insulation shields for cold piping and oversize pipe hangers to surround the insulation on cold piping.

.9 For piping with less than 25 mm [1”] movement or more than 300 mm [12"] long hanger rod length, use adjustable clevis:

.1 Material to MSS-SP69, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.

.10 For piping with more than 25 mm [1"] movement or hot piping with less than 300 mm [12"] long hanger rod length:

.1 Use pipe rollers with cast iron roll and roll stands with carbon steel rod to MSS-SP69.

2.3 WALL SUPPORTS

.1 Welded angle for iron brackets with hangers as specified for horizontal pipe.

.2 Manufactured channel supports for vertical pipe support.

.3 For lateral movement restraint of exposed vertical piping.

2.4 RISER CLAMPS

.1 Steel or cast iron pipe: finish as per pipe hangers, carbon steel to MSS-SP58.

.2 Copper pipe: carbon steel copper plated to MSS-SP58 type 42.

.3 Bolts to ASTM A307.

.4 Nuts to ASTM A563.

2.5 INSULATION PROTECTION SHIELDS

.1 Insulated cold piping: Insulation with uninterrupted vapour barrier plus insulation protection shield to: MSS-SP69, galvanized sheet carbon steel. Insulation shall be high-density type for 65 mm [2-1/2”] and larger.

.2 Insulated hot piping 100 mm [4”] and larger: Curved plate 300 mm [12"] long, with edges turned up, carbon steel to comply with MSS-SP69. Insulation fitted between saddle and pipe.

2.6 CONSTANT SUPPORT SPRING HANGERS

.1 Springs: allow steel to ASTM A125, shot peened, magnetic particle inspected, with +/-5% spring rate tolerance, tested for free height, spring rate, laded height and provided with Certified Mill Test Report (CMTR).

.2 Load adjustability: 10% minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.

.3 Provide upper and lower factory set travel stops.

.4 Provide load adjustment scale for field adjustments.

.5 Total travel to be actual travel + 20%. Difference between total travel and actual travel 25 mm [1"] minimum.

.6 Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.

2.7 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

.1 Provide templates to ensure accurate location of anchor bolts.

2.8 EQUIPMENT SUPPORTS

.1 Provide stands and supports for equipment and materials supplied.

.2 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of Section 05 12 23, Structural Steel for Buildings.

.3 Submit calculations with shop drawings.

2.9 HOUSEKEEPING PADS

.1 "Bases" includes "housekeeping pads”.

.2 Lay out concrete bases required under Mechanical Division. Coordinate with Structural Division. All concrete work is under Structural Division. Concrete: to Section 03 30 00, Cast-in-place Concrete.

.3 Concrete bases shall be a minimum of 100 mm [4”] thick, or as noted and shall project at least 150 mm [6”] outside the bedplate, unless otherwise directed. Bases shall be keyed to the floor and incorporate reinforcing bars and/or steel mesh. Chamfer top and corner edges of bases at 45 degrees.

.4 Equipment with bedplates shall have metal wedges placed under the edges of the bedplates to raise them 25 mm [1”] above the base after levelling. The wedges shall be left permanently in place. Fill the space between the bedplate and the base with non-shrink grout - Embeco or In-Pakt.

.5 Construct equipment supports of structural steel or steel pipe. Securely brace. Employ only welded construction. Bolt mounting plates to the structure.

.6 Support ceiling hung equipment with rod hangers and/or structural steel.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install in accordance with:

.1 Manufacturer’s instructions and recommendations

.2 Clamps on riser piping:

.1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.

.2 Bolt tightening torques to be to industry standards.

.3 Steel pipes: Install below coupling or shear lugs welded to pipe.

.4 Cast iron pipes: Install below joint.

.3 Clevis plates:

.1 Attach to concrete with minimum of 4 concrete inserts, one at each corner.

.4 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

.5 Use approved constant support type hangers where:

.1 Vertical movement of pipework is 12 mm [1/2"] or more.

.2 Transfer of load to adjacent hangers or connected equipment is not permitted.

.6 Vibration Control Devices:

.1 Install on piping systems at pumps, boilers, chillers, cooling towers, and as indicated.

3.3 HANGER SPACING

.1 Plumbing piping: most stringent requirements of Building Code, Canadian Plumbing Code or Authority Having Jurisdiction.

.2 Fire protection: to applicable Fire Code (no toggle hangers).

.3 Propane gas piping to CAN/CGA-B149.1, Natural Gas and Propane Installation Code.

.4 Copper piping: up to 12 mm [1/2”] every 1.5 m [5 ft].

.5 Flexible joint roll groove pipe: in accordance with spacing specified, but not less than one hanger at each joint.

.6 Within 300 mm [12"] of each horizontal elbow.

.7 Rod Diameter:

.1 10 mm [3/8"] for 50 mm [2”] and smaller.
.2 12 mm [1/2"] for 65 mm to 100 mm [2-1/2”, 3”, 4”].
.3 22 mm [7/8"] for 125 mm to 200 mm [5”, 6”, 8”].

.8 Maximum spacing for

.1 Steel pipe:
.1 1.8 m [6 ft] for 12 mm [1/2”].
.2 2.4 m [8 ft] for 20 mm, 25 mm [3/4”, 1”].
.3 3.0 m [10 ft] for 30 mm [1-1/4”] and larger.
.2 Maximum spacing for copper pipe.
.1 1.5 m [5 ft] for 12 mm [1/2”].
.2 1.8 m [6 ft] for 20 mm, 25 mm, 30 mm, 40 mm [3/4”, 1”, 1-1/4”, 1-1/2”].
.3 3.0 m [10 ft] for 50 mm [2”] and larger.

3.4 HANGER INSTALLATION

.1 Install hanger so that rod is vertical under operating conditions.

.2 Adjust hangers to equalize load.

.3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

3.5 HORIZONTAL MOVEMENT

.1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.

.2 Where horizontal pipe movement is less than 12 mm [1/2”], offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.6 FINAL ADJUSTMENT

.1 Adjust hangers and supports:

.1 Ensure that rod is vertical under operating conditions.
.2 Equalize loads and provide grades.

.2 Adjustable clevis:

.1 Tighten hanger load nut securely to ensure proper hanging performance.
.2 Tighten upper nut after adjustment.

.3 C-Clamps: Follow manufacturer’s recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.

.4 Beam clamps: Hammer jaw firmly against underside of beam.

END OF SECTION 23 05 29

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes vibration isolation materials and components, seismic control measures and their installation.

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 SUBMITTALS

.1 Shop Drawings:

.1 Submit shop drawings and product data for all vibration isolators and of all seismic restraint components, assemblies, and attachments.

.2 Shop drawings of seismic restraint devices including those integral with vibration isolators shall either bear a pre-approval number by an independent testing agency (tested to OSHPD pre-approval standards) with certification to meet the application and location requirements as per Code which shall be reviewed, signed and sealed by the Seismic Engineer. This includes all components and instructions for set-up and attachment to the equipment and building structure. Include the maximum seismic rated load, the maximum calculated actual seismic load, the materials of construction, and the magnification factor.

.3 Vibration isolation drawings shall include for each isolator, the location, the load, the calculated actual static deflection, the deflection to solid, the lateral to axial stiffness, spring colour, dimensions, spring constant, neoprene durometer. For each vibration isolator with integral seismic restraint also include the maximum rated seismic load, the maximum calculated actual seismic load, the materials of construction, the magnification factor.

.4 Shop drawings shall include the colour coding for all seismic anchor bolts for installation in concrete.

.5 Shop drawings for steel bases and concrete inertia bases shall include all dimensions, material specifications, weights and calculated clearance from floor (or pad) when under static load.

.6 Where specific restraints are to be installed to the SMACNA Guidelines include a list of all such points of restraint and reference the appropriate SMACNA detail including attachments. No further shop drawing submittal for those specific points of restraint will be required.

.7 Shop drawings shall include the Seismic Engineer's requirements for any additional members required for attachment to the structure.

.8 Shop drawings shall indicate the calculated maximum forces at the points of attachment to the building structure during a seismic event.

.2 Closeout Submittals:

.1 Provide maintenance data for incorporation into Operational and Maintenance manual.

1.4 REGULATORY CODES, GUIDELINES

.1 British Columbia Building Code referred to in this section as the Building Code.

.2 SMACNA "Seismic Restraint Manual Guidelines for Mechanical Systems" referred to in this section as SMACNA Guidelines.

1.5 DEFINITIONS

.1 Actual static deflection is the difference in height of the isolation between its free (unloaded) height and its installed height under the normal operating conditions and loads of this project.

.2 Seismic event means a seismic event of any magnitude up to the Building Code design magnitude for the specific location.

1.6 GENERAL SCOPE

.1 Provide vibration isolation for the equipment specified in Mechanical Division as required to prevent unacceptable levels of vibration isolation or noise from being transmitted to the building structure or to services attached to the equipment.

.2 Provide seismic restraints for the piping and ductwork systems and all equipment specified in Mechanical Division to meet the requirements of the Building Code, to be in general conformance to SMACNA Guidelines, to keep the equipment in place during a seismic event, to minimize damage to the systems and equipment from a seismic event, to prevent systems and equipment from causing personal injury during a seismic event. Do not provide seismic restraint where it is identified in the SMACNA Guidelines as not required.

1.7 VIBRATION ISOLATION - GENERAL

.1 Unless the equipment manufacturer certifies that the vibration isolators may be directly attached to the equipment, provide a structural steel base for each piece of equipment designed:

.1 For mounting the equipment on it.

.2 To be rigid under the design operating and seismic loads.

.3 Wide and long enough for the distance between any two corner isolators to be greater than the height of the centre of gravity above the bottom of the isolators.

.4 For the attachment of the vibration isolators and any required seismic snubbers.

.2 Provide a minimum of four isolators for a piece of equipment as a designed set. The average actual static deflection under load must be at least 90% of the specified static deflection and no individual isolator may have an actual static deflection less than 75% of specified. Each isolator shall be colour coded to easily cross-reference with the shop drawings its location on the equipment.

.3 All neoprene elements used in or in conjunction with vibration isolators shall be bridge bearing quality. Elastomers shall not exceed 60 durometer.

.4 Springs shall be stable. The lateral spring constant shall be between 1.0 and 1.5 times the axial spring constant.

.5 Actual static deflection shall be between 0.4 and 0.65 times solid deflection.

.6 Provide durable protective finish on all vibration isolator components located where conditions may cause corrosion.

.7 Coordinate with relevant trades to ensure that pipe, duct and electrical connections to equipment are sufficiently flexible to prevent stressing the connections and to prevent transmission of vibration back along the service.

.8 The equipment installed on the vibration isolators shall not have a natural frequency higher than one third of the lowest disturbing frequency generated by the operating equipment.

.9 Ensure that the vibration isolation is not “short-circuited” or bridged.

.10 Provide spring thrust restraints with adjustable limit stops for start and stop to control fan movement due to differential pressure. Provide on fans developing in excess of 750 Pa [3” W.G.] differential pressure and on horizontal axial fans with more than 30 kg [66 lbs.] thrust.

1.8 SEISMIC RESTRAINT - GENERAL

.1 Seismic restraint may either be factory manufactured assemblies or custom field fabricated assemblies. All factory manufactured assemblies shall be tested and pre-approved by an independent testing agency to OSHPD test and pre-approval standards and bear the pre-approved number.

.2 Arrange and pay for the services of a Structural Professional Engineer registered in British Columbia referred to here as the Seismic Engineer. The Seismic Engineer shall review, seal and sign all submittals required for all components, assemblies, attachments and installation procedures for the seismic restraint of all piping, ductwork and equipment installed under Mechanical Division. The Seismic Engineer shall provide all necessary direction to the contractor during installation of the seismic restraint installation and submit a statutory declaration that the final seismic restraint installation conforms to the submittal documents sealed by the Seismic Engineer and satisfies all regulatory requirements.

.3 The Seismic Engineer shall submit Letters of Assurance Schedule B and Schedule C-B for the seismic restraint of the Mechanical Division installation.

.4 The Seismic Engineer shall coordinate attachment to the equipment with the equipment manufacturer to ensure the method and location of attachment of the seismic restraint to the equipment does not compromise the structural integrity of the equipment.

.5 The Seismic Engineer shall be responsible for coordinating all attachments for seismic restraint to the building structure with the structural documents and as necessary with the structural consulting engineer responsible for the design of the building structure. Ensure that the method and location of attachment of seismic restraint to the structure does not compromise the structure and that the structure can withstand the connected design seismic forces. The Seismic Engineer's responsibility includes clear instructions as to the point of attachment (e.g., top cord of OWSJ, concrete wall, bottom of joist, bottom of beam, etc). Where additional members are required for attachment the Seismic Engineer shall designate their size, location and method of attachment (e.g., 40 x 40 x 3 steel angle with three anchors (sized) to concrete wall) and they shall be provided under this Section.

.6 For piping and ductwork, the Seismic Engineer shall indicate the maximum spacing between slack cables of SMACNA design. Depending on the code design seismic magnitudes, the space between restraints may need to be shorter than the SMACNA Guidelines for Seismic Level A. (e.g., 9.1 m [30 ft] between the transverse pipe restraints instead of 12.2 m [40 ft]).

.7 Seismic anchor bolts for concrete shall be colour coded and so identified on the shop drawings to allow inspection to confirm the correct anchors have been installed without requiring removal to check bolt lengths.

.8 Seismic restraints shall provide restraint from seismic forces in all directions.

.9 All seismic restraints shall be provided with suitably selected connectors and anchors for attaching to the equipment and building structure. They shall meet or exceed the requirements for restraining the code prescribed force (e.g., 3 g in Victoria) through the centre of gravity of the isolated equipment.

.10 The greater the range of unrestricted motion, the longer the equipment will accelerate in a seismic event. The longer the acceleration and the "harder" the interface between the equipment and seismic restraint, the higher the deceleration (and therefore the forces) will be. Limit the range of unrestricted motion without causing interference with the operation of any vibration isolators and optimize the contact area and stiffness of the restraint padding to minimize the magnification (deceleration rate divided by seismic acceleration rate) of forces. The magnification shall be 10 or less.

1.9 COMBINATION VIBRATION ISOLATION AND SEISMIC RESTRAINT

.1 A single supplier shall supply all vibration isolation equipment and all seismic restraint equipment for vibration isolated equipment.

.2 Where available and where capable of meeting the required level and performance of seismic restraint, vibration isolators with integral seismic restraint may be provided.

.3 Where vibration isolators do not have any or adequate integral seismic restraint, separate seismic restraints shall be provided.

.4 Seismic restraints shall not interfere with the operation of the vibration isolators under all normal operating conditions.

1.10 EQUIPMENT REQUIREMENTS

.1 The requirements of this section shall apply to vibration isolation and seismic restraint that are factory supplied integral with the equipment.

.2 The requirements of this section shall apply to vibration isolation and seismic restraints that are factory supplied integral with the equipment.

.3 It is the responsibility of the manufacturer of equipment which is to be vibration isolated and/or for seismically restrained to ensure that:

.1 The equipment is designed to internally withstand without damage the increased forces on the equipment due to its being vibration isolated

.2 The attachment points for vibration isolators and seismic restraints will withstand without damage the forces generated by vibration isolation and seismic restraint or else ensure that notification is given to provide a suitable structural steel base.

.3 The equipment has sufficient integral strength to ensure that all components will remain attached after a seismic event.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Size and shape of bases type and performance of vibration isolation as indicated.

.2 Except for factory installed isolators supplied integral with equipment and except for field constructed seismic restraints, all vibration isolation and seismic restraints shall be supplied by a single supplier.

2.2 TYPE 1 ISOLATORS - ELASTOMER PADS

.1 Neoprene-steel-neoprene. Select and size for an actual static deflection of 2.0 mm to 3.0 mm [0.08" to 0.125"]. Use Type 7 neoprene grommets for anchor bolts through the pads.

2.3 TYPE 2 ISOLATORS - ELASTOMER MOUNTS

.1 Rubber or neoprene-in-shear in seismically rated casing designed to prevent short-circuiting of equipment mounting bolt to casing. Select for 5 mm [3/16"] minimum actual static deflection. Protect any rubber element from contact with oil.

2.4 TYPE 3 ISOLATORS - SPRING MOUNT

.1 Type 3A spring isolator with leveling capability and minimum 6 mm [1/4"] thick ribbed neoprene pad. Spring enclosed in seismically rated housing designed to meet the seismic requirements and including built-in resilient seismic stops and designed to avoid short-circuiting. Anchor bolts and neoprene grommets.

.2 Type 3B Where Type 3A can not meet the required seismic restraint provide spring isolator with leveling capacity and minimum 6 mm [1/4"] thick ribbed neoprene pad. (Seismic snubbers are required in conjunction with these isolators.) Anchor bolts and neoprene grommets

2.5 TYPE 4 ISOLATORS - HANGERS

.1 Type 4A - Neoprene-shear element in hanger box designed to avoid short-circuiting with rod misalignment up to 15°.

.2 Type 4B - Stable spring with minimum 6 mm [1/4"] thick neoprene pad in hanger box designed to avoid short-circuiting with rod misalignment up to 15°.

2.6 TYPE 7 ISOLATORS - GASKETS, GROMMETS

.1 12 mm [1/2"] thick closed cell foam plastic.

.2 Select for nominal 21 kPa [3 psi] loading.

.3 Isolate anchor bolts with neoprene hemi-grommets sized for snug fit.

2.7 SEISMIC RESTRAINTS

.1 Slack cable restraints may be as detailed in the SMACNA Guidelines or as provided by Vibra-Sonic Control, Mason SCB and accessories.

.2 Rigid restraints may be as detailed in the SMACNA Guidelines for the appropriate Seismic Hazard Level.

.3 SMACNA Guidelines restraints modified by the Seismic Engineer.

.4 Custom restraints designed by the Seismic Engineer.

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 GENERAL

.1 All work shall be in accordance with manufacturer’s instructions and recommendations and shall be done by workers experienced in the installation of vibration isolation and seismic restraint.

.2 Block equipment in its final operating position for making service connections before installing vibration isolation. Install, level and adjust all vibration isolators. Where operation of the equipment affects equipment position, operate and balance equipment and adjust vibration isolators before determining exact location of seismic anchors.

.3 Ensure 50 mm [2"] clearance all around vibration isolated equipment.

.4 Ensure flexible service connections are not stressed and operate freely when vibration isolated equipment is operated.

.5 Fill any space between anchor bolt and the attachment bolt hole with Mason 0.5 Fast Epoxy Putty to prevent movement.

.6 Hangers shall not buckle under vertical seismic movement. Where the rod length is 50 times or more than the rod diameter it shall be reinforced in accordance with SMACNA Guidelines or with Mason SRC clamps.

.7 Where threaded nuts secure vibration isolators or seismic restraints use double nuts, locking nuts or Loctite.

.8 Ensure vibration from piping and ductwork does not transfer to floors, structure or walls. Provide resilient protection as required.

.9 Slack cables shall be as tight as possible without supporting the weight of the pipe, duct or equipment and, where used on vibration isolated pipe, duct or equipment, shall be as tight as possible without transmitting vibration.

3.3 PIPING AND DUCTWORK ISOLATION AND RESTRAINT

.1 Provide flexible pipe and ductwork connectors where indicated in other Sections and/or on drawings.

.2 Where connected to vibration isolated equipment the first three supports on 100 mm [4”] or smaller pipe (four supports on 150 and 200 mm [6” and 8”] pipe, six supports on 250 mm [10”] and larger pipe shall be Type 4A or 4B isolators with static deflection equal to or greater than that specified for the equipment.

.3 Restraint of fire protection piping where included in NFPA 13 is not included in this Section of the specification.

.4 Restraint of propane gas piping shall be in accordance with this section or National Standard of Canada CAN/CGA-B149.1-00 whichever is more restrictive. For example, gas piping 30 mm to 65 mm [1-1/4” to 2-1/2”] shall be seismically restrained as for 65 mm [2-1/2”] piping in the SMACNA Guidelines.

.5 Piping and ductwork exempted by the SMACNA Guidelines for restraint does not need to be seismically restrained, for example:

.1 Gas piping 25 mm [1”] and smaller.

.2 Piping in Mechanical Rooms smaller than 30 mm [1-1/4”] and smaller.

.3 Piping outside of Mechanical Rooms smaller than 65 mm [2-1/2”] and smaller.

.4 Piping and ducts with hangers less than 300 mm [12”].

.5 Rectangular duct less than 0.55 square metres [6 sq. ft] in cross-section.

.6 Round duct less than 700 mm [28"] in diameter.

.7 For above exemptions refer for specifics to the SMACNA Guidelines.

.6 Provide transverse and longitudinal restraints as per SMACNA Guidelines except that maximum spacings shall be as per Seismic Engineer’s requirements. Note requirements of restraints for pipes or ducts to act as restraints for smaller branch pipes. Provide restraints as close as practical to vertical changes of direction.

.7 Where ducts or pipes are grouped in trapeze hangers, restraints shall be sized for the combined weight and all ducts and pipes shall be secured to the trapeze.

.8 A duct penetration of a wall or partition may act as transverse brace. For stud walls provide framed opening.

3.4 RESTRAINT OF NON-ISOLATED EQUIPMENT

.1 Floor or wall mounted equipment shall be anchored to the structure. Anchors shall be designed for seismic acceleration in all directions acting through the centre of gravity. If the equipment is subject to resonances (e.g., internal isolation, partially filled tanks) increase the seismic acceleration to 9 times the ground acceleration.

.2 Suspended equipment may have rigid or slack cable restraints.

.3 Vertical tanks shall be anchored at the bottom and have restraint for horizontal movement in all directions located above the centre of gravity.

3.5 EQUIPMENT ISOLATION AND RESTRAINT

.1 Unless otherwise specifically indicated provide vibration isolation on all motor driven equipment with motors of 1/2 hp and greater. For motor driven equipment with motors less than 1/2 hp, provide isolating neoprene grommets or neoprene-in-shear at all supports.

.2 Isolate and seismically restrain equipment mounted on the floor, on housekeeping pads or on the roof with Type 3A or Type 3B isolators. Actual static deflection shall be 25 mm [1"] minimum unless otherwise specifically indicated.

.3 Isolate and seismically restrain pumps with impeller speeds in excess of 1100 rpm on Type 2 isolators.

.4 Isolate and seismically restrain all equipment mounted on slab on grade on Type 2 isolators. Provide seismic snubbers if the Type 2 isolators do not have adequate seismic restraint capacity.

.5 Isolate and seismically restrain suspended equipment with Type 4B isolators and slack cable restraint. Actual static deflection shall be 25 mm [1"] minimum unless otherwise specifically indicated.

.6 Provide Type 5 Isolators (spring thrust restraints) on all fans scheduled for 750 Pa [3" W.G.] static pressure or more and on axial fans developing 30 kg [66 lbs.] thrust or more or on any fan requiring them for stable operation.

.7 Arrange seismic cable restraints to be approximately 90° to each other in plan, to rise at about 30° to 45° from horizontal and so that their projected extension passes through the centre of gravity of the restrained equipment.

.8 Each grille and diffuser shall be secured directly to sheet metal ductwork with a minimum of three sheet metal screws or shall be secured to the structure with a minimum of two 12 ga. galvanized steel wires connected to opposite corners of the grille or diffuser.

3.6 INSPECTION

.1 The vibration isolation supplier's representative shall inspect the completed installation, issue instructions to the Contractor for any required correction or adjustment, re-inspect until satisfactory and submit a signed declaration to the Departmental Representative stating that the final installation meets the specified performance and that the installation is in accordance with the instructions and recommendations of the isolation manufacturer.

END OF SECTION 23 05 48

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes materials and requirements for the identification of piping systems, duct work, valves and controllers, including the installation and location of identification systems.

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 SUBMITTALS

.1 Closeout Submittals:

.1 Provide maintenance data for incorporation into Operational and Maintenance manual.

.2 Samples:

.1 Samples to include nameplates, labels, tags, lists of proposed legends.

PART 2 - PRODUCTS

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

.1 Each piece of manufactured equipment shall have a metal nameplate, with embossed letters, mechanically fastened to the equipment.

.2 Manufacturer's nameplates shall indicate:

.1 Manufacturer’s name.
.2 Equipment.
.3 Model, size.
.4 Serial number.
.5 Electrical characteristics.
.6 Motor: voltage, Hz, phase, power factor, duty, frame size.
.7 Other services characteristics.

.3 Include ULC, CSA and other agency registration logos that apply.

.4 Nameplates shall be easily read.

2.2 SYSTEM NAMEPLATES

.1 Painted identification letters shall be 50 mm [2"] high black letters on a white background.

.2 Lamicoid labels (black background white letters) shall be 35 x 200 mm [1-1/2"x 8"] with 20 mm [3/4"] high letters or proportionally smaller as appropriate to fit equipment.

.3 Identify systems, and areas or zones of building being serviced.

2.3 PIPING SYSTEMS GOVERNED BY CODES

.1 Propane gas: to CSA/CGA B149.1 and Authority Having Jurisdiction.

.2 Sprinklers: to NFPA 13.

2.4 IDENTIFICATION OF PIPING SYSTEMS

.1 Each system shall be labelled including directional flow arrows in accordance with the Pipe Identification Schedule and to CAN/CGSB 24.3 except where specified otherwise.

.2 Arrows showing direction of flow:

.1 Outside diameter of pipe or insulation less than 75 mm [3”]: 100 mm long x 50 mm high [4” long x 2” high].

.2 Outside diameter of pipe or insulation 75 mm [3”] and greater: 150 mm long x 50 mm high [6” long x 2” high].

.3 Use double-headed arrows where flow is reversible.

.3 Extent of background colour marking:

.1 To full circumference of pipe or insulation.

.2 Length to accommodate pictogram, full length of legend and arrows.

.4 Materials for background colour marking, legend, arrows:

.1 Identification labels may be stencilled or be vinyl cloth (Brady B500) or vinyl film (Brady B946), with adhesive compatible with the surface temperature.

.2 Identification colour bands shall overlap a minimum of 150 mm [6"]. Ends to be stapled.

.5 Colours and Legends:

.1 Where not listed, obtain direction from Departmental Representative.

.2 Colours for legends, arrows: to following table:

Background colour:	Legend, arrows:
Yellow	BLACK
Green	WHITE
Red	WHITE

.6 Pipe Identification Schedule:

Service	Identification Lettering	Primary Colour	Secondary Colour
Domestic Cold Water Service	DCW	Green	--
Domestic H.W. Supply	DHW	Yellow	Black
Domestic H.W. Recirc.	DHWR	Yellow	Black
Fire lines - Sprinkler (Wet)	SPR	Red	White
Heating Water Return	HWR	Yellow	Black
Heating Water Supply	HWS	Yellow	Black
Propane	LP Gas	Yellow	Orange

2.5 IDENTIFICATION DUCTWORK SYSTEMS

.1 Where not otherwise obvious, identify plenum access doors as to accessed item, e.g. Filter F-1, Supply Fan SF-1, Heating Coil HC-1.

.2 50 mm [2”] high stencilled letters and directional arrows 150 mm long x 50 mm high [6” long x 2” high].

.3 Colours: back, or coordinated with base colour to ensure strong contrast.

.4 Identify automatic control dampers concealed in ductwork. Identify the 'open' and 'closed' position of the operator arm where clearly visible on the outside of the duct.

.5 Identification letters shall be 50 mm [2"] high black letters on white background. Flow arrows shall be 50 mm [2"] wide by 150 mm [6"] long black arrows on a white background. Stencil over final finish only.

2.6 VALVES, CONTROLLERS

.1 Provide valve identification tags appropriately secured.

.2 Tags may be of brass, aluminum, metalphoto, lamicoid or fibreglass, stamped or engraved, 25 mm [1"] minimum diameter.

.3 Valves to be tagged include:

.1 Valves on all main piping circuits.

.2 Valves on all major branch lines.

.3 Valves on minor branch lines in horizontal service spaces, vertical service spaces and mechanical equipment rooms.

.4 Do not tag valves on control valve stations, fixture stops, system drains valves or any isolating valves for individual pieces of equipment where in clear sight of that equipment.

.5 Control valves.

.4 Schedule the valve numbers using a sequential numbering system.

.5 Provide a valve tag list indicating valve number, system, location, normal operating position (open or closed) and the area it serves.

.6 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

2.7 CONTROLS COMPONENTS IDENTIFICATION

.1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this Section.

.2 Inscriptions to include function and (where appropriate) fail-safe position.

PART 3 - EXECUTION

3.1 TIMING

.1 Provide identification only after painting has been completed.

3.2 NAMEPLATES

.1 Locations:

.1 Each piece of equipment shall be identified with its equipment schedule identification, e.g. B-2, P-3, RF-1

.2 In conspicuous location, on cool surfaces, to facilitate easy reading and identification from operating floor.

.2 Standoffs: Provide for nameplates on hot and/or insulated surfaces.

.3 Protection: Do not paint, insulate or cover.

3.3 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

.1 Identify piping adjacent to valves. Identify piping at least once in each room and at 15 m [50 ft.] maximum spacing in open areas

.2 Identify piping both sides where piping passes through walls, partitions and floors.

.3 Identify piping at each access opening.

.4 Adjacent to each change in direction.

.5 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.

.6 At beginning and end points of each run and at each piece of equipment in run.

.7 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.

.8 Identification easily and accurately readable from usual operating areas and from access points: Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

.9 Label the outlet end of the drain from the automatic air vents with a lamicoid label. AAV, LOCATION.

.10 Duct Access: Paint or secure 50 mm [2"] high, Gothic style self-adhesive stick on-letters, (Letrasign or Brady Quick-Align) on duct access panels to identify their usage, according to the following schedule:

Equipment	Colour	Letters
Controls	Black	C.
Dampers	Black	D.
Fire dampers	Red	F.D.

3.4 VALVES AND CONTROLLERS

.1 Valves and operating controllers: Secure tags with non-ferrous chains or closed "S" hooks.

.2 Do not provide tags at plumbing fixtures, radiation, or where in plain sight of equipment they serve:

.3 Number valves in each system consecutively.

3.5 IDENTIFICATION SCHEDULES

.1 Submit schedules of the following for review, prior to laminating.

.1 Pipe Identification

.2 Valve Tag List.

.3 Ceiling Access Identification Colours

.4 Duct Access Identification Colours.

.2 Schedules will be required in each major mechanical room. Laminate in clear plastic. Punch a hole in top corner and hang.

.3 Include one copy of schedules in each operating and maintenance manual.

END OF SECTION 23 05 54

PART 1 - GENERAL

1.1 SUMMARY

.1 TAB is used throughout this Section to describe the process, methods and requirements of testing, adjusting and balancing for HVAC.

.2 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 QUALIFICATIONS OF TAB PERSONNEL

.1 Employ Flotech Mechanical Systems Specialists, KD Engineering Co. or Western Mechanical Services as the TAB and Building Commissioning Agent.

.2 Submit names of personnel to perform TAB to the Departmental Representative within 90 days after award of the Contract.

.3 Provide documentation confirming qualifications, successful experience.

1.4 PURPOSE OF TAB

.1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads.

.2 Adjust and regulate equipment and systems to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.

.3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

1.5 EXCEPTIONS

.1 TAB of systems and equipment regulated by Codes, Standards to satisfaction of Authority Having Jurisdiction.

1.6 BALANCING - AIR SYSTEMS

.1 Adjust duct and terminal balance dampers, and adjust or change drive sheaves to balance supply, return and exhaust air systems to provide the design air quantities (within +10%/-5%) at each outlet and inlet and to maintain the design relationship between the supply, return and exhaust air system quantities.

.2 Adjust air terminals to optimize the air distribution pattern while minimizing drafts and noise.

.3 Permanently mark the final balance position on all balance dampers and adjustable air turning devices.

.4 Submit a report to the Departmental Representative indicating final fan speed, motor operating amperages, system static pressure, filter static pressure, design air quantities and final air quantities obtained.

1.7 BALANCING - LIQUID SYSTEMS

.1 Balance liquid systems using a surface pyrometer. Adjust balance valves and balance fittings to obtain uniform temperature differences across coils and heating/cooling elements acknowledging the different design temperature drops/rises.

.2 Permanently mark the final balance position on balance valves and balance fittings.

.3 Submit a report to the Departmental Representative indicating design water flows and temperatures and final water flows and temperatures obtained.

1.8 COMMISSIONING AND DEMONSTRATION

.1 Be responsible for the performance and commissioning of all equipment supplied under the HVAC Sections of Mechanical Division. Commissioning is the process of advancing the installation from the stage of static completion to full working order in accordance with the Contract Documents and design intent. It is the activation of the completed installation.

.2 The commissioning shall be executed in accordance with the intent of the following standards:

.1 PWGSC Commissioning Manual CP.1, 4th Edition.

.2 CSA Z320-11 Building Commissioning.

.3 In consultation with the General Contractor, ensure that sufficient time is allowed and fully identified on the construction schedule for the proper commissioning of all mechanical systems.

.4 Submit a schedule for the commissioning phase of the work. This schedule shall show:

.1 Equipment start-up schedule.

.2 Submission dates for the various documents required prior to substantial completion.

.3 Timing of the various phases of the commissioning, testing, balancing and demonstration process.

.5 Commissioning is concluded when air and water systems have been balanced and the installation is in full working order and acceptable for use. The work will include the following:

.1 Balancing of the air systems as specified in this section.

.2 Balancing of the liquid systems as specified in this section.

.3 Set up air diffusers, registers and grilles for optimum distribution/comfort.

.4 Plug all air pressure and flow measuring holes.

.5 Adjust vibration isolators and earthquake restraints for optimum performance.

.6 Verification and certification of the sealing of all HVAC penetrations through fire separations (rated & non-rated) and sound separations.

.7 Verification of water tightness of all roof and exterior wall penetrations.

.8 Set up all automatic control valves/dampers and automatic temperature control devices.

.9 Testing and debugging of BAS (Building Automation System).

.10 Set up and test all alarm and protective devices.

.11 Power failure test with emergency generator start-up.

.6 At the conclusion of commissioning, provide certified personnel to verify, demonstrate and to instruct operating staff on operation of mechanical equipment and systems. Provide maintenance specialist personnel to instruct operating staff on maintenance and adjustment of mechanical equipment and any changes or modification in equipment made under terms of guarantee.

.7 The verification process shall include the demonstration of the following:

.1 The ease of access that has been provided throughout for servicing coils, motors, drives, fusible link fire dampers, control dampers and damper operators.

.2 Location of and opening and closing of all access panels.

.3 Operation of all automatic control dampers and automatic temperature control devices.

.4 Operation of all alarm and protective devices.

.5 Operability of randomly selected fire dampers.

.6 Operation of all equipment and systems under each mode of operating, and failure, including:

.1 BAS (Building Automation System) control features.

.2 Automatic controls.

.3 Boilers and associated propane fuel systems.

.4 Packaged air conditioners.

.5 Heat recovery system.

.6 Pumps.

.7 Cabinet unit heaters.

.8 Unit heaters.

.9 Fans.

.10 Coils.

.11 Tanks - domestic hot water and expansion.

.8 Provide instruction during regular work hours prior to acceptance and turnover to operating staff for regular operation.

.9 Use Operating and Maintenance manuals for instruction purposes.

.10 Submit the proposed instructional agenda for approval.

.11 Finalize demonstration and instructions by obtaining a signed statement from the Owner that the demonstration and instructions have been given satisfactorily.

.12 At the completion of the commissioning, testing, balancing and demonstration submit the following to the Departmental Representative:

.1 A letter certifying that all work specified under this Contract is complete, clean and operational in accordance with the specification and drawings.

.2 Completed copies of all commissioning check lists plus copies of start-up reports from specialty contractors and vendors.

.3 Record Drawings, as specified.

.4 A list of all alarm and protective devices tested, with the final operating settings.

.13 Contractor shall allow for one return to site for post-commissioning review during peak heating season.

PART 2 - PRODUCTS

.1 NOT APPLICABLE

PART 3 - EXECUTION

.1 NOT APPLICABLE

END OF SECTION 23 05 93

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes materials, requirements and installation for thermal insulation for ductwork and accessories in a commercial type application.

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 SUBMITTALS

.1 Shop Drawings:

.1 Submit shop drawings for insulation and accessories.

.2 Closeout Submittals:

.1 Provide maintenance data for incorporation into Operational and Maintenance manual.

1.4 DEFINITIONS

.1 "CONCEALED" describes insulated mechanical services above suspended ceilings, in trenches, chases, furred spaces and shafts.

.2 "EXPOSED" - will mean not concealed.

1.5 QUALITY ASSURANCE

.1 Installer: Journeyman insulation applicators, skilled in this trade, shall perform the work.

.2 The latest edition of the "BC Insulation Contractors Association (BCICA) Quality Standards Manual", shall apply except where exceeded in this specification.

1.6 ASBESTOS

.1 All material/products provided shall be free of asbestos.

PART 2 - PRODUCTS

2.1 FIRE AND SMOKE RATING

.1 In accordance with Building Code, NFPA 90A and CAN/ULC-S102.

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.2 INSULATION

.1 External Insulation - Flexible:

.1 Maximum thermal conductivity per 25 mm [1"]: 0.040 W/m-°C at 24°C [0.27 Btu-in/(hr-ft2-°F) at 75°F].

2.3 JACKETS

.1 Thermocanvas:

.1 Cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.

.2 Lagging adhesive: compatible with insulation.

2.4 SCOPE OF INSULATION

.1 Scope 1: External Insulation - Flexible.

	Thickness	
	mm	[ins]
.1 Outdoor air ductwork.	50	[2]

PART 3 - EXECUTION

3.1 PRE-INSTALLATION REQUIREMENTS

.1 Apply external insulation to ductwork after successful pressure tests have been made.

.2 Apply insulation and accessories so that the finished product is smooth and neat and with longitudinal seams concealed from view.

.3 Apply insulation, accessories and finishes in accordance with the manufacturer's recommendations.

.4 Insulation and vapour barrier shall be continuous through all non-rated separations.

.5 Surfaces clean, dry, free from foreign material.

3.2 INSTALLATION

.1 Manufactured insulation thickness shall not be altered. (i.e. finished insulation cannot be compressed).

.2 Application of External Insulation - Flexible

.1 Adhere insulation with insulation adhesive applied in 150 mm [6"] wide strips on 300 mm [12"] centres.

.2 On rectangular ductwork and plenums, over 610 mm [24"] in width, spot weld pins 6 mm [1/4"] longer than the insulation thickness, one per 0.1 sq. m [1.0 sq ft] minimum. Impale the insulation over the pins, and hold in place using metal or nylon clips (washers). Alternatively, use welded pins with integral head washers welded in place through the insulation.

.3 Adhere foil faced vapour barrier tape over all butt joints, raw edges, holding washers and other points of penetration of the vapour barrier jacket on all exposed hot and cold ducts and concealed cold ducts.

3.3 DUCTWORK INSULATION FINISHES

.1 "Concealed" insulation will require no further finish except in damp locations where it shall have a vapour barrier continuously sealed.

.2 "Exposed" insulation inside the building shall be finished as follows:

.1 Apply thermocanvas jacket with fabric adhesive.

.2 Finish fabric with one (1) coat of fabric coating.

END OF SECTION 23 07 13

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes materials, requirements and installation for thermal insulation for piping and accessories in commercial type applications.

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 SUBMITTALS

.1 Shop Drawings:

.1 Submit shop drawings for insulation and accessories.

.2 Closeout Submittals:

.1 Provide maintenance data for incorporation into Operational and Maintenance manual.

1.4 DEFINITIONS

.1 "CONCEALED" describes insulated mechanical services above suspended ceilings, in trenches, chases, furred spaces and shafts.

.2 "EXPOSED" - will mean not concealed.

1.5 QUALITY ASSURANCE

.1 Installer: Journeyman insulation applicators, skilled in this trade, shall perform the work.

.2 The latest edition of the "BC Insulation Contractors Association (BCICA) Quality Standards Manual", shall apply except where exceeded in this specification.

1.6 ASBESTOS

.1 All material/products provided shall be free of asbestos.

PART 2 - PRODUCTS

2.1 FIRE AND SMOKE RATING

.1 In accordance with Building Code, NFPA 90A and CAN/ULC-S102.

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.2 INSULATION

.1 Mineral Fibre - Low and Medium Temperature:

.1 Maximum thermal conductivity per 25 mm [1"]: 0.033 W/m-°C at 24°C [0.23 Btu-in/(hr-ft2-°F) at 75°F].

2.3 INSULATION SECUREMENT

.1 16 ga galvanized, stainless steel or copper wire as commercially available.

.2 Tape shall be self-adhesive, aluminum, reinforced, 50 mm [2”] wide minimum.

2.4 CEMENT

.1 Thermal insulating and finishing cement:

.1 Hydraulic setting or Air drying on mineral wool, to ASTM C449/C449M.

2.5 VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.

2.6 COATINGS

.1 Vapour barrier coating on reinforcing membrane or on insulating cement:

2.7 JACKETS

.1 All Service Jacket:

.1 Securement: Staples (flare type), compatible jacket finishing tape, contact adhesives recommended by the jacket manufacturer.

.2 Thermocanvas:

.1 Cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.

.2 Fastenings: Staples (flare type), compatible jacket finishing tape, contact adhesives recommended by the jacket manufacturer.

.3 Lagging adhesive: compatible with insulation.

2.8 PIPING INSULATION SCHEDULES

.1 Thickness of insulation as listed in following table (to ASHRAE 90.1).

		Pipe Size in mm [inch]		
Service	Temperature	Up to 20 [3/4]	25 to 30 [1 to 1-1/4]	40 to 75 [1-1/2 to 3]
Domestic Cold Water	5°C	12	12	25
Domestic Hot Water Supply and Recirculation	41-60°C	25	25	40
Hot Water Heating	61 to 93°C	40	40	50
Rainwater Storm Drainage (buried & exterior)	5°C	None	none	none

2.9 SCOPE OF INSULATION

.1 Warm and Hot Piping Systems:

.1 Insulate the following systems, unless otherwise noted:

.1 Hot water heating supply and return piping.

.2 Domestic hot water and hot water recirculation piping.

.3 Traps on accessible lavatories.

.2 Do not insulate the following, unless otherwise noted:

.1 Piping inside heating fixture cabinets.

.2 Relief piping.

.3 Drain lines.

.4 Small branch risers from just below the floor to heating fixtures just above the floor.

.5 Interconnecting piping between ceiling radiant heating panels.

.6 Condenser water piping inside building.

.3 Insulate the following valves and fittings if the pipe is insulated:

.1 Elbows, tees, reducers.

.2 Valve bodies on valves and check valves, 65 mm [2-1/2"].and larger.

.3 Flanges (except on interior condenser or heat pump water piping).

.4 Strainers (terminate insulation to allow basket removal.)

.4 Do not insulate the following fittings, even if pipe is insulated:

.1 Valves, smaller than 65 mm [2-1/2"].

.2 Valve bonnets.

.3 Unions.

.4 Flexible connections.

.5 Expansion joints.

.6 Check valve covers.

.2 Cool and Cold Piping Systems:

.1 Insulate and vapour seal the following systems, unless otherwise noted:

.1 Domestic cold water system including:

.1 Meter body

.2 PRV's, backflow preventers.

.3 Interior piping to a hose bibb or for irrigation.

.2 Sprinkler system from domestic water connection point to 5 m [16 ft.] downstream or to the inlet of a backflow preventer or alarm valve, whichever is shorter.

.2 Insulate and vapour seal the following, if the pipe is insulated:

.1 Elbows, tees, reducers.

.2 Valves, (bodies and bonnets) except check valve covers.

.3 Strainers (with removable insulation plug for basket removal).

.4 Flanges

.5 Unions

.3 Do not insulate the following, unless otherwise noted:

.1 Fire protection piping (except in unheated spaces).

.2 Soil stacks, vents.

.3 Flexible connections or expansion joints.

.4 Flexible fixture connections.

.4 Pipe penetrations through walls and floors:

.1 All material for the stuffing, sealing and caulking of the pipe penetration shall be supplied and installed under this section.

PART 3 - EXECUTION

3.1 PRE-INSTALLATION REQUIREMENT

.1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.

.2 Surfaces clean, dry and free from foreign material.

3.2 INSTALLATION

.1 Install in accordance with TIAC National Standards and National Energy Code 2015, Part 5.2.5.3. The insulation thickness used to determine compliance with Table 5.2.5.3. shall be the thickness of the insulation after installation. (i.e. finished insulation cannot be compressed).

.2 Apply materials in accordance with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet and this specification.

.3 Apply insulation and accessories so that the product is smooth and neat and with the longitudinal seams concealed from view. Apply insulation, accessories and finishes in accordance with manufacturer's recommendations.

.4 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm [3”].

.5 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

.6 Install hangers, supports outside vapour retarder jacket.

.7 Supports, Hangers: Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

.8 Maintain vapour barrier without interruption at sleeves, fittings and supports.

.9 Insulation and vapour barrier shall be continuous through all non-rated separations

3.3 INSULATION TERMINAL POINTS

.1 Where exposed, terminate insulation 75 mm [3"] back from all uninsulated fittings for working clearance and bevel insulation at 45° and finish with a hard coat insulating cement to match the adjacent insulation.

.2 Where concealed, terminate insulation 75 mm [3”] back from all uninsulated fittings, with heavy coat of insulation coating to secure glass fibres.

.3 Cut back insulation at 45° and finish with a hard coat of insulating cement around the base of thermometer wells, pressure gauges, flow switches and pressure and control sensors.

3.4 VERTICAL RISERS

.1 On vertical pipe larger than 75 mm [3”] provide insulation supports welded or bolted to pipe, directly above lowest pipe fitting and at 4.5 m [15 ft] intervals.

3.5 APPLICATION TO WARM AND HOT PIPING (ABOVE 27°C [80°F])

.1 Piping:

.1 Install medium temperature pipe insulation with integral jacket on pipe and hold in place with spreading staples at 75 mm [3"] centres

.2 Install strip of tape over each butt joint. Overlap minimum 25 mm [1”] and secure with spreading staples.

.2 Fittings:

.1 Insulate fittings to thickness of adjacent pipe insulation with sections of the pipe insulation mitred to fit tightly, or with preformed insulation fittings, or with tightly wrapped flexible insulation to full thickness with PVC fitting cover.

.3 Valves, Strainers:

.1 Insulate valve bodies and strainers with fitted pipe insulation, or mitred blocks all to thickness of adjacent pipe insulation or insulate with preformed insulation fittings. Drains, blowoff plugs and caps shall be left uncovered.

3.6 APPLICATION TO COOL AND COLD PIPING SYSTEMS - (BELOW 11°C [52°F])

.1 Piping:

.1 Install low/medium temperature pipe insulation with integral vapour barrier jacket on pipe and secure and seal flaps with vapour barrier adhesive and spreading staples at 75 mm [3"] centres.

.2 Install strip of vapour barrier jacket over each butt joint. Overlap minimum 25 mm [1”] and secure with vapour barrier adhesive and spreading staples.

.2 Fittings:

.1 Insulate fittings to thickness of adjacent pipe insulation with sections of the pipe insulation mitred to fit tightly, or preformed insulation fittings, then apply reinforcing membrane embedded in barrier coating or with tightly wrapped flexible insulation to full thickness with PVC fitting covers. Apply vapour barrier adhesive and tape on all joints and overlaps.

.2 Alternatively insulate fittings with tightly placed flexible insulation and apply premoulded 25/50 rated PVC fitting covers. Apply vapour-barrier adhesive and tape on all joints and overlaps.

.3 Valves, Strainers:

.1 Insulate valve bodies, bonnets and strainers with fitted pipe insulation, or mitred blocks all to thickness of adjacent pipe insulation, then apply reinforcing membrane embedded in barrier coating or insulate with preformed insulation fittings covered with reinforcing membrane, stapled in place and covered with a barrier coating. Drains, blow-off plugs and caps shall be left uncovered.

.4 Unions, Flanges and Victaulic Fittings:

.1 Insulate with oversized pipe insulation or mitred blocks to the thickness of the adjacent pipe insulation, then apply reinforcing membrane embedded in barrier coating.

3.7 PIPE INSULATION FINISHES

.1 "Concealed" insulation will require no further finish except in damp locations where it shall have a vapour barrier jacket continuously sealed.

.2 "Exposed" insulation inside the building shall be finished as follows:

.1 Apply thermocanvas jacket with fabric adhesive.

.2 Over insulating fittings apply hard coat cement and finish with thermocanvas or apply PVC fitting covers. Over all other insulated components apply thermocanvas jacket with fabric adhesive.

.3 Finish fabric with one (1) coat of fabric coating.

3.8 INSULATION PACKING OF PIPE SLEEVES

.1 Tightly pack the space between all pipe sleeves and pipe or between pipe sleeve and pipe insulation with mineral wool insulation, Thermal Ceramics "Cerafiber" or Carborundum "Fiberfax", to full depth of sleeve to prevent transmission of sound and/or passage of smoke.

END OF SECTION 23 07 20

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes materials, requirements and installation for piping, valves and fittings for propane gas fired equipment.

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 SUBMITTALS

.1 Shop Drawings:

.1 Submit shop drawings for all propane gas equipment.

.2 Closeout Submittals:

.1 Provide maintenance data for incorporation into Operational and Maintenance manual.

1.4 PROPANE GAS INSPECTION

.1 Submit to the Provincial Gas Inspection Department, drawings, applicable sections of specifications and detailed drawings as required to obtain approval for the propane gas installation before the work commences.

.2 Approvals must be received prior to commencing work.

1.5 QUALITY ASSURANCE

.1 Qualifications:

.1 Welders certified in accordance with CSA W47.1, CSA W47.1S1, API 1104.

.1 Assign identification number to welder[s].

.2 Submit records of welder's certification and test results to Departmental Representative.

.2 Inspectors:

.1 Weld inspectors certified in accordance with CSA W178.2.

.2 Inspectors to submit records of inspections and test results to Departmental Representative.

PART 2 - PRODUCTS

2.1 PIPE

.1 Below Ground Piping

.1 Polyethylene pipe, CSA certified.

.2 Above Ground Piping

.1 Schedule 40 seamless Carbon Steel to API5L.

.2 Copper tube to ASTM B837.

2.2 FITTINGS

.1 Above Ground Piping

.1 Steel pipe fittings, screwed, flanged or welded:

.1 Malleable iron: screwed, banded, Class 150.

.2 Steel pipe flanges and flanged fittings: to ASME B16.5.

.3 Welding: butt-welding fittings.

.4 Unions: malleable iron, brass to iron, ground seat, to ASTM A47/A47M.

.5 Bolts and nuts: to ASME B18.2.1.

.6 Nipples: schedule 40, to ASTM A53/A53M.

.2 Copper pipe fittings, screwed, flanged or soldered:

.1 Cast copper fittings: to ASME B16.18.

.2 Wrought copper fittings: to ASME B16.22.

2.3 JOINTING MATERIAL

.1 Screwed fittings: Pulverized lead paste.

.2 Teflon tape is unacceptable.

.3 Welded fittings: to CSA W47.1.

.4 Flange gaskets: Full faced gasket materials, flanged steel weld neck, raised face type, carbon steel (ASTM A307) square headed bolts with hexagon nuts, bolts bull diameter of bolt holes.

2.4 VALVES

.1 Provincial Gas Department approved and suitable for temperature to which they are exposed.

2.5 PRESSURE REGULATOR

.1 Constant pressure type, ductile iron, with SS trim.

.2 Size and capacity: as indicated. Pressure range: as indicated.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 PIPING

.1 Install in accordance with Section 23 05 01, Installation of Pipework, BC Building Code, CAN/CSA B149.1, CAN/CSA B149.2 and Authorities Having Jurisdiction.

.2 Install drip points:

.1 At low points in piping system.

.2 At connections to equipment.

3.3 BELOW GROUND PIPING

.1 Support underground piping on, and backfill with, minimum 300 mm [12”] washed graded sand.

.2 Exterior propane service - weld all sizes except for polyethylene pipe which shall have no joints other than those allowed in NSC CAN/CGA-B149.1.

.3 Piping, tubing, or fittings laid underground shall be protected against corrosion in accordance with good engineering practice or in accordance with the Manufacturer’s instructions.

.4 A watertight seal shall be provided at any point where piping or tubing passes through an outside wall below ground level.

.5 Plastic piping or tubing shall be accompanied by a tracing wire or other electronically detectable tracing media.

3.4 ABOVE GROUND PIPING

.1 Allow for expansion with suitable anchors, guides and expansion loops to prevent undue stress on any part of the system. Such anchors and guides shall be rigidly fastened to structural members

through the roof deck. Supports shall be set in sheet metal gum pans wrapped into the roofing. Coordinate with roofing subtrade.

.2 All piping shall be welded with approved flexible connectors at point of connection to gas fired equipment.

.3 Apply one coat of Rust-Oleum 769 damp proof red primer, one coat of Rust-Oleum 960 zinc chromate and one finish coat of Rust-Oleum 850 grey to piping.

3.5 PIPE JOINTING

.1 Interior propane service - screw or weld up to 50 mm [2"], weld 65 mm [2-1/2"] and larger.

.2 Interior propane service in unvented space, in supply or return air ceiling plenum, or operating at 35 kPa [5 psi] pressure - weld all sizes.

.3 All branch connections except those less than half diameter of main shall be made with welding tees.

.4 Branch connections less than half diameter of main may be made with weldolets or threadolets.

.5 Remake all leaking joints.

.6 Do not paint dielectric isolating couplings.

3.6 VALVES

.1 Install propane shut-off valves complete with handle at the following locations:

.1 At the service entry point to each building immediately prior to entry.

.2 At each branch to an individual item of equipment or appliance.

3.7 EQUIPMENT CONNECTIONS

.1 Install unions or flanges in connections to all equipment and specialty components.

.2 Arrange piping connections to allow ease of access and for removal of equipment.

.3 Align and independently support piping connections to prevent piping stresses being transferred to equipment.

3.8 VENT TERMINALS

.1 Terminate vent outlets to atmosphere at the following minimum lateral distances:

.1 1.5 m [5 ft] from any door, operable window or building opening.

.2 3.0 m [10 ft] from any forced air intake.

3.9 FIELD QUALITY CONTROL

.1 Testing:

.1 Prior to testing, remove foreign matter, flush piping and equipment using same petroleum product as one being transported.

.2 Dispose of testing and flushing liquid to approval of authority having jurisdiction.

.3 In accordance with the National Standard of Canada "Natural Gas and Propane Installation Code" CAN/CGA-B149.1.

.4 Isolate tanks from piping system pressure tests.

.5 Should there be loss of pressure, soap test each weld or use tracer gas with compressed air as directed by Departmental Representative.

3.10 CLEANING

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

END OF SECTION 23 11 26

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes materials, requirements and installation for hydronic specialties equipment.

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 SUBMITTALS

.1 Shop Drawings:

.1 Submit shop drawings for all hydronic specialties equipment.

.2 Closeout Submittals:

.1 Provide maintenance data for incorporation into Operational and Maintenance manual.

1.4 REQUIRED COMPLIANCE

.1 Provide all specialty components in compliance with ANSI/ASME B31 Codes for Building Services Piping.

.2 Provide all hydronic specialty components in compliance with the Regulations and Requirements of the Province of British Columbia "Power Engineers Boiler and Pressure Vessel Safety Act and Regulations".

1.5 SYSTEM PRESSURE RATINGS

.1 Piping systems 860 kPa [125 psig] or less operating pressure - 860 kPa [125 psig] rating.

PART 2 - PRODUCTS

2.1 AIR VENTS

.1 Automatic High Capacity Type - Serviceable Type:

.1 Casing and internal parts suitable for system operating pressure and temperature.

.2 Automatic float type.

.3 Replaceable float, linkage, plug and seat.

.4 517 kPa [75 psig] maximum operating.

.2 Manual High Capacity - Globe Type:

.1 Bronze body, union bonnet, screwed, 450 brinell hardened stainless steel trim and plug type disc.

.2 Class 125 (860 kPa).

.3 Manual High Capacity - Needle Type:

.1 Bronze body and bonnet, screwed, bronze stem, needle type.

.2 Class 200 (1380 kPa).

.4 Radiator - Needle Type

.1 Bronze or steel body, screwed, needle valve.

.2 Manual key operator.

.3 860 kPa [125 psig] maximum operating pressure and 121°C [250°F] maximum operating temperature.

2.2 EXPANSION TANKS - DIAPHRAGM TYPE

.1 Expansion tanks with a working pressure up to 207 kPa [30 psig] and less than 610 mm [24"] in diameter.

.1 Steel construction with sealed-in elastomer diaphragm suitable for up to 116°C [240°F].

.2 Welding performed by certified, qualified welders.

.3 Factory tested hydraulically to 510 kPa [75 psig].

.4 Identification plate showing:

.1 Manufacturer's name.

.2 Expansion tank operating pressure, 207 kPa [30 psig].

.3 Hydraulic test pressure 510 kPa [75 psig].

.4 Date of manufacture.

.5 Pre-charge via air charging valve to a pressure of 93 kPa [12 psig].

.6 Seismically rated saddles for horizontal installation or base mount for vertical installation. Shop drawings shall be signed and sealed by a structural Professional Engineer registered in British Columbia.

2.3 WATER MAKE-UP ASSEMBLY

.1 Pressure reducing valve shall have screwed, bronze or cast iron body, suitable to 1380 kPa [200 psig], composition seat.

.2 Each reducing station to include:

.1 Gate or ball valve, strainer, union, backflow preventer, union, gate or ball valve.

.2 Gate or ball valve, union, pressure reducing valve, union, gate or ball valve.

.3 Bypass with globe valve.

.4 20 mm [3/4”] relief valve.

2.4 PRESSURE RELIEF VALVES - WATER

.1 Screwed, bronze body or cast iron body with expanded outlet.

.2 ASME rated.

.3 Coordinate capacity with Heat Exchangers Schedules.

2.5 STRAINERS

.1 50 mm [2”] and smaller: bronze body, screwed connections.

.2 65 mm [2-1/2”] and larger: cast iron body, flanged connections.

.3 50 mm [2”] and larger: Y or T type strainer with grooved ends with ductile iron body or malleable iron body.

.4 Suitable for maximum system operating pressure. Where system pressure exceeds 860 kPa [125 psig], use 1725 kPa [250 psig] strainer bodies.

.5 Basket Screen:

.1 Bronze, stainless steel or monel perforated screen.

.2 35 holes/cm2 [225 holes/in2] 1.2 mm [0.05"] diameter perforations, 36% open area.

PART 3 - EXECUTION

3.1 GENERAL

.1 Install as indicated and to manufacturer's recommendations.

.2 Maintain proper clearance to permit service and maintenance.

.3 Check Shop Drawings for conformance of all tappings for ancillaries and for equipment operating weights.

3.2 AIR VENTS

.1 Automatic High Capacity Type:

.1 Install automatic high capacity air vents at each high point in the piping systems and where shown on the drawings.

.2 Install on tees and not on horizontal pipe runs or elbows.

.3 Install a 12 mm [1/2"] minimum isolating gate valve ahead of each air vent, unless air vent has an integral shut-off valve.

.4 Fit all vents on top of an air collecting chamber.

.5 Pipe all air vent discharge connections, separately, to the nearest building drain in a service room (Mechanical Room, Janitor Room) using 6 mm [1/4"] hard drawn copper tube where exposed and soft copper where concealed. Provide a 16 ga soldered copper funnel or drain pan if required. The drain ends shall be visible so any draining is easily observed. Label ends with permanent labels.

.2 Manual High Capacity:

.1 Install manual air vents at high points in the piping systems where shown on the drawings.

.2 Install on tees and not on horizontal pipe runs or elbows.

.3 Install isolating gate or ball valve ahead of each vent valve.

.4 Pipe air vent discharge connections to nearest building drain.

.5 When using needle valves, run 6 mm [1/4"] vent line down to needle valve at low level, complete with nipple and cap.

.3 Manual Radiator Type:

.1 Install manual/automatic low capacity air vents on the return side of each water heating/cooling/heat recovery terminal element installed above the connection mains piping.

.2 Fit air vent on top of an air collecting chamber of 20 mm [3/4”] pipe, 150 mm [6"] high.

.3 Arrange air vents so that screwdriver slots or key openings are easily accessible.

.4 Drill access holes through radiation enclosures, where necessary.

3.3 EXPANSION TANK - DIAPHRAGM TYPE

.1 Install expansion/contraction tanks at each location shown on the drawings and as scheduled.

.2 Install a 20 mm [3/4”] pressure relief valve on the tank.

.3 Install a gate or ball valve in the system connection.

.4 Install a drain valve in the tank drain connection.

3.4 PRESSURE REDUCING STATIONS - COLD WATER

.1 Install water make-up station for each hot water, chilled water, treated water, heat recovery water and other closed water system where shown on the drawings.

.2 Pipe relief valve to drain.

3.5 PRESSURE RELIEF VALVES - WATER

.1 Install pressure relief valve(s) on each heat exchanger to prevent over pressuring.

.2 Select relief valves to relieve full heat input.

.3 Pipe relief valve to drain.

3.6 STRAINERS

.1 Install pipe line strainers where shown on the drawings.

.2 Provide isolation valves to permit cleaning without draining the system.

.3 Install ahead of each pump.

.4 Ensure clearance for removal of basket.

.5 Blowdown connections:

.1 Strainers, 50 mm [2”] and smaller - hot services: nipple and cap.

.2 Strainers, all sizes - cold services: plug.

END OF SECTION 23 21 14

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes materials, requirements and installation for copper piping valves and fittings for hydronic systems.

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 SUBMITTALS

.1 Shop Drawings:

.1 Submit a list of manufacturer and model number of all valve types used.

.2 Closeout Submittals:

.1 Provide maintenance data for incorporation into Operational and Maintenance manual.

1.4 SYSTEM PRESSURE RATINGS

.1 Pipe Fittings:

.1 Piping systems 860 kPa [125 psig] or less operating pressure - 860 kPa [125 psig] rating.

.2 Valves: Suitable for maximum system operating temperature and pressure.

PART 2 - PRODUCTS

2.1 GENERAL

.1 All products shall be registered with the regulatory authority in accordance with CSA B51.

2.2 PIPE

.1 Steel Pipe: to ASTM A53/A53M Grade B

.1 250 mm [10”] and smaller: Schedule 40.
.2 300 mm [12”] and larger: 9.5 mm [0.375"] wall thickness.
.3 For the following systems:
.1 Hot water heating.
.2 Relief valve vents.

.2 Copper Pipe: to ASTM B88M:

.1 Type L, hard drawn.
.2 For the following systems:
.1 Domestic cold water.
.2 Domestic hot water.
.3 Pressure drains, 50 mm [2”] and smaller.
.4 As an alternative to steel piping for the following systems:
.1 Hot water heating.
.3 Type K, hard drawn for: Air vent overflow where exposed.
.4 Type K, soft drawn for: Air vent overflow where concealed.

2.3 PIPE FITTINGS

.1 Steel Pipe fittings - screwed, flanged or welded:

.1 Cast iron pipe flanges: Class 125 to ANSI B16.1.

.2 Cast iron screwed fittings: Class 125 to ANSI B16.4.

.3 Steel pipe flanges and flanged fittings: to ANSI B16.5.

.4 Steel butt-welding fittings: to ANSI B16.9a.

.5 Malleable iron unions, ground joint type: To ASTM A47/A47M and ASME B16.3; Class 150 for 30 mm [1-1/4"] and smaller; Class 250 for 40 mm and 50 mm [1-1/2", 2"].

.6 Malleable iron screwed fittings: to ASME B16.3, Class 150.

.2 Copper Pipe Fittings:

.1 Cast bronze threaded fittings to ANSI/ASME B16.15.

.2 Wrought copper and copper alloy solder joint pressure fittings to ANSI/ASME B16.22.

.3 Cast copper alloy solder joint pressure fittings to ANSI B16.18.

2.4 FLANGES

.1 Steel Pipe:

.1 Cast iron: to ASME B16.1, Class 125.

.2 Steel: to ASME B16.5.

.2 Copper Pipe:

.1 Brass or bronze: Threaded to ANSI B16.15.

.2 Cast iron: Threaded to ANSI B16.4.

.3 Orifice flanges: slip-on, raised face, 2100 kPa.

.4 Flange Gaskets:

.1 Up to 860 kPa [125 psig] system pressure - non-asbestos gaskets for mating surfaces.

.2 Over 860 kPa [125 psig] system pressure - stainless steel spiral wound non-asbestos gaskets.

2.5 PIPE JOINTS

.1 Steel Pipe Joints:

.1 50 mm [2"] and smaller: screwed fittings, except where otherwise noted, with teflon tape or lead-free pipe dope.

.2 65 mm [2-1/2"] and larger: welded fittings and flanges to CSA W48.

.3 Flanges: raised face, steel weld neck, lap or back-welded slip on type. Use flat face for attachment to cast iron valves.

.2 Copper Pipe Joints:

.1 Solder, tin-antimony, 955 to ASTM B32.

.2 Silver solder BCUP to ANSI/AWS A5.8.

.3 Brazing as indicated.

2.6 VALVES

.1 General:

.1 Include lock shield handles where shown or noted.

.2 Include chain wheel and chain where shown or noted.

.3 Use non-rising stem valves where there is insufficient clearance for stem to rise.

.4 Wherever possible all valves shall be of one manufacturer.

.2 Connections:

.1 Steel 50 mm [2”] and smaller: screwed ends.

.2 Copper 50 mm [2”] and smaller: ends for soldering.

.3 Steel 65 mm [2-1/2”] and larger: flanged or grooved ends.

.4 Copper 65 mm [2-1/2”] and larger: flanged or grooved ends.

.3 Ball valves:

.1 50 mm [2”] and smaller, screwed, Class 600 (4140 kPa) and
50 mm [2”] and smaller, soldered, Class 500 (3450 kPa):

.1 Forged brass body, chrome plated ball, PTFE seats, blow out proof stem.

.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 Gate valves: to MSS-SP70 to MSS-SP80:

.1 50 mm [2”] and smaller, screwed, Class 125 (860 kPa):

.1 Bronze body, rising stem, solid wedge disc, union or screwed bonnet.

.2 50 mm [2”] and smaller, soldered, Class 200 (1380 kPa).

.1 Bronze body, rising stem, solid wedge disc, screwed bonnet.

.3 65 mm [2-1/2”] and larger, flanged, Class 125 (860 kPa).

.1 Cast iron body, rising stem, O.S. & Y, solid wedge disc, bronze trim, bolted bonnet.

.5 Globe valves: to MSS-SP80, MSS-SP85 Application: Throttling, flow control, emergency bypass:

.1 50 mm [2”] and smaller, screwed, Class 125 (860 kPa):

.1 Bronze body, rising stem, renewable composition or bronze disc, union bonnet.

.2 50 mm [2”] and larger, soldered, Class 200 (1380 kPa):

.1 Bronze body, rising stem, renewable composition or bronze disc, screwed bonnet.

.6 Balance Fittings and Valves:

.1 30 mm [1-1/4”] and smaller, valve, Class 100 (690 kPa):

.1 Bronze body and bronze trim, rising stem, renewable composition disc, globe type with memory stop, lockshield, male union connection, angle and straight type.

.2 40 mm [1-1/2”] and larger, fitting Class 175 (1210 kPa):

.1 Screwed connections up to 50 mm [2”].

.2 Flanged connections 65 mm [2-1/2”] and larger.

.3 Cast iron body, non-lubricated eccentric plug with resilient coating EPT or RS 55, suitable for 121°C [250°F] operating temperature, stainless steel bearings, adjustable memory stop, plug type suitable for wrench adjustment.

.7 Balancing Valves - Flow Measuring:

.1 Suitable for maximum pressure of 1715 kPa [250 psig] and maximum temperature of 121°C [250°F].

.2 Calibrated balancing valve with memory, positive shut-off, inlet and outlet pressure measuring connections.

.3 50 mm [2”] and smaller - screwed copper alloy body.

.4 65 mm [2-1/2”] and larger - ductile iron body.

.5 Calibration charts shall be provided.

.6 Removable preformed rigid polyurethane insulation.

.8 Swing Check Valves: to MSS-SP71:

.1 50 mm [2”] and smaller, screwed, Class 125 (860 kPa) and
50 mm [2”] and smaller, Class 200 (1380 kPa):

.1 Bronze body, bronze swing disc, screw in cap, regrindable seat.

.2 65 mm [2-1/2”] and larger, Class 125 (860 kPa):

.1 Cast iron body, renewable or regrindable seat, bronze swing disc, bolted cap.

.9 Silent Check Valves (Spring Type):

.1 50 mm [2”] and smaller, screwed, Class 125 (860 kPa):

.1 Bronze body, bronze trim, stainless steel spring, (heavy-duty spring in vertical down flow application).

.2 65 mm [2-1/2”] and larger, Class 125 (860 kPa):

.1 Cast steel, wafer style, bronze trim, stainless steel spring (heavy duty spring in vertical down flow application).

.10 Radiator Valves:

.1 Screwed bronze body with bronze trim, wheel handle, rising stem, renewable composition disc, male union connections, angle and straight type, Class 100 (690 kPa).

.11 Drain Valves:

.1 Class 250 (1724 kPa), screwed

.2 Brass ball valve, lockshield in public areas.

.3 20 mm [3/4”] size shall have threaded hose end with forged cast brass cap and chain.

2.7 HEATING UNITS AUTOMATIC FLOW CONTROL AND STRAINERS

.1 Combination Strainer and Isolation Valve.

.1 Cast or forged Brass to ASTM B283-06.

.2 End Connections: Brass, NPT or sweat.

.3 Body Tapings: Boss for CPTA and drain valve.

.4 Ball Valve: Stainless steel ball with Teflon seals.

.5 Strainer: 20 mesh stainless steel

.6 Provide combination P/T test valve and drain valve.

.2 Combination Automatic Flow Control and Isolation Valve.

.1 Cast or forged Brass to ASTM B283-06.

.2 End Connections: Brass, NPT or sweat.

.3 Body Tapings: Two combination P/T test valve and manual air vent

.4 Ball Valve: Stainless steel ball with Teflon seals.

.5 Cartridge: AISI type 304 stainless steel, stainless steel spring.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 PIPING INSTALLATION

.1 Install pipework in accordance with Section 23 05 01 - Installation of Pipe Work.

.2 Ream pipe ends. Clean scale and dirt, inside and outside before assembly.

.3 During construction, protect all openings in piping and equipment, by capping or plugging to prevent entry of dirt.

.4 Install piping to conserve headroom and space. Run exposed piping parallel to walls. Group piping wherever practical.

.5 Maintain a minimum of 25 mm [1"] space between adjacent flanges or pipe insulation, whichever has the larger diameter.

.6 Provide clearance for installation of insulation and access for maintenance of equipment, valves and fittings.

.7 Use long radius elbows.

.8 Install all required thermometer wells and immersion sensor wells. Where wells will restrict flow in pipes 40 mm [1-1/2”] and smaller install a section of oversized pipe 50 mm [2”] or larger.

.9 Screw or weld (unless otherwise specified) all steel piping systems up to 50 mm [2”].

.10 Weld (unless otherwise specified) all steel piping 65 mm [2-1/2”] and over.

.11 Remake leaking joints using new materials, do not caulk or cement leaking threaded joints.

.12 Use eccentric reducers at pipe size changes, to allow positive venting and drainage.

.13 Do not use thread protection couplings, close nipples, running nipples or street elbows.

.14 Do not run piping in exterior walls unless specifically indicated and in which case ensure the piping is on the interior side of the building insulation and vapour barrier.

.15 Do not use bullhead tees for converging flows.

.16 Do not run piping in unheated areas unless specifically indicated and in which case ensure the piping is electrically heat traced.

.17 Contractor shall verify that the chemical treatment and/or service are suitable for all elastomers in the piping system, i.e. pump seals, gaskets, diaphragms, valve discs.

3.3 PIPE GRADING

.1 Grade all piping 1:480 [1” in 40 ft.] to provide positive drainage and venting.

3.4 SOLDERING AND BRAZING

.1 Pressure fluid systems: with chemical treatment (heating), braze with silver base brazing alloy, 538°C [1000°F] melting point.

.2 Non-pressure systems (drains): solder with 50/50 tin/lead.

3.5 CONNECTIONS TO EQUIPMENT AND PIPING

.1 Install unions or flanges at connections to all equipment and specialty components and at all connecting points to existing systems which, for reasons of separation for testing, will require to be blank flanged or capped.

.2 Connect to equipment in accordance with manufacturer's instructions unless otherwise noted.

.3 Arrange piping connections to allow ease of access and for removal of equipment.

.4 Align and independently support piping connections adjacent to equipment to prevent piping stresses being transferred.

.5 Do not reduce equipment connection sizes by bushing.

3.6 DRAIN CONNECTIONS

.1 Pipe the discharge from the following to the nearest building drain. Install a brass, bronze or copper receiving funnel on the drain where shown.

.1 Liquid relief valves.

.2 Liquid safety valves.

.3 High capacity air vents.

.4 Overflows.

.2 Drains from drain pans shall be DWV copper ASTM B306 32 mm [1-1/4"] minimum size.

.3 Drain and vent piping shall be of the same material as the piping system to which it is connected, except where otherwise specified.

.4 Where a drain from a pressure system is shown piped to drain, provide a ball valve.

.5 Pipe the discharge from all liquid relief valves, liquid safety valves, high capacity air vents, overflows and piping system drains (unless indicated to be a capped off drain valve) to the nearest building drain. Install a brass, bronze or copper receiving funnel on the drain where shown.

3.7 EXPANSION OF PIPING

.1 Install all piping systems with due regard and provision for expansion avoiding strain or damage to equipment and building.

.2 Only major expansion configuration and fittings have been shown on the drawings. Provide all required additional compensators, loops and swing connections.

.3 Provide anchors, where shown. Anchors shall be fabricated from mild steel plate and structural steel angle and channel sections, in accordance with ANSI B.31.

.4 Expansion loops shall be of all welded construction with long radius elbows.

.5 Install expansion loops, cold sprung 50% of the calculated expansion.

.6 Install at least three (3) elbows in all branch connections. Where space does not permit 3 elbows, install braided flexible pipe connectors in accordance with manufacturers recommendations. Three (3) elbow branch connections shall have sufficient developed length to ensure that excessive stresses are not generated in the piping and in no case less than 900 mm [36"].

3.8 VALVE INSTALLATION

.1 Install valves with stems upright or horizontal. Do not install valve stems below horizontal unless specifically indicated.

.2 Install control valves with their stems upright and with adequate clearance for removal of actuators.

.3 Use ball valves to shut off branch takeoffs and to isolate equipment.

.4 Install balance valve or fitting in each return branch main and where shown. Install balance valve - flow measuring type where shown on drawings.

.5 Install balance fitting or valve in the return piping connection to each terminal heating units - eg. radiators, unit heaters, fan coil units, heating coils.

.6 Balance valves may double as isolating valves.

.7 Balance fittings require separate isolating valves.

.8 Install radiator valve in the supply connection to each convection heating element.

.9 Use swing check valves in horizontal pipes.

.10 Use silent check valves in vertical pipes.

3.9 DRAIN VALVES

.1 Install drain valves at each low point in the piping system unless a piped drain is shown and at specific drain locations shown on the drawings.

.2 Install a 20 mm [3/4"] drain valve at each down fed terminal heating unit.

3.10 PIPING TESTS

.1 Notify the Departmental Representative and the Inspection Authority Having Jurisdiction, a minimum of 48 hours in advance of intended test dates.

.2 Before testing piping, isolate all equipment which cannot withstand the test pressure.

.3 Do not insulate, backfill or conceal until tests have been completed and approved by the Inspection Authorities.

.4 Examine all systems under test for leaks.

.5 Joints shall remain dry during the test. Any moisture around a weld shall be reason for rejection.

.6 Remake all leaking connections and joints.

.7 Tests shall be limited to new piping only.

.8 Initial Hydrostatic test: 150% of working pressure, but not less than 860 kPa [125 psig] for 1 working day.

.9 Final Hydrostatic test: 150% of working pressure, after piping connections to all equipment are complete, maintain until all parts of piping systems have been inspected.

3.11 FLUSHING AND CLEANING

.1 Flushing and cleaning shall commence only after all piping tests have been completed.

.2 Chemically clean the following piping systems as recommended by an approved professional chemical cleaning and treatment agency who shall supervise the work:

.1 Hot water heating.

.3 Flush out all traces of chemicals with clean water after chemical cleaning is complete.

.4 Remove, clean and reinstall all strainer baskets.

.5 Submit a report signed by a principal of the Agency that certifies that the cleaning has been satisfactorily completed.

3.12 CHEMICAL TREATMENT

.1 Chemically treat water systems in accordance with Section 23 2500 - HVAC Water Treatment Systems.

.2 Verify treatment is suitable for elastomers in the system, i.e. pump seals, valve discs, diaphragms, coupling gaskets, etc.

END OF SECTION 23 21 15

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes materials, requirements and installation for hydronic system pumps.

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 SUBMITTALS

.1 Shop Drawings:

.1 Submit shop drawings for all pumps and accessories.

.2 Indicate, at minimum, the following:

.1 Equipment, including connections, fittings, control assemblies and ancillaries. Identify whether factory or field assembled.

.2 Wiring and schematic diagrams.

.3 Dimensions and recommended installation.

.4 Pump performance and efficiency curves showing point of operation.

.2 Closeout Submittals:

.1 Provide maintenance data for incorporation into Operational and Maintenance manual.

PART 2 - PRODUCTS

2.1 IN-LINE CIRCULATOR PUMPS

.1 Suitable for a maximum working pressure of 860 kPa [125 psig] and maximum temperature of 107°C [225°F]. The pumps shall be capable of operating continuously at 95°C [203°F].

.2 The pump shall be a standard product of a single pump manufacturer. The pump and motor shall be designed and built by the same manufacturer.

.3 The wet rotor circulator pump shall be certified and listed by CSA (Water Circulating Pump) for conformance to Canadian Standards to operate at maximum 230°F and minimum 35°F water.

.4 The sound pressure level of the pump shall be lower than 38dB(A)

.5 Casing: Cast iron EN-JL-1040 (35B-40B) or Stainless Steel 1.4408 (CF8M), with flanged connections. Supplied with matching companion flanges.

.6 Impellor: 304 Stainless Steel or Composite PES 30% GF.

.7 Shaft: 303 Stainless Steel with Tungsten Carbide thrust bearing, integral thrust collar.

.8 Seal Assembly: Mechanical.

.9 Coupling: Flexible self-aligning.

.10 Motor: Integrated Variable Frequency Drive motors:

.1 Provide integrated VFD as scheduled.

.2 Motor shall be 4- or 8-pole, synchronous, permanent-magnet (PM motor) and tested with the pump as one unit by the same manufacturer.

.3 Motor shall be of the Integrated Variable Frequency Drive design consisting of a motor and a Variable Frequency Drive (VFD) built and tested as one unit by the same manufacturer.

.4 The stator housing shall be made of pressure die cast aluminum. The stator housing shall have 3 drain holes to enable condensed water to escape.

.5 The motor shall be cooled by the pumped fluid.

.6 Motor shall be self-ventilating. The stator housing shall have nickel plated brass inspection screw.

.7 Minimum insulation class for the motors shall be Class F.

.8 The integrated VFD control shall utilize an energy optimization algorithm to minimize energy consumption by reducing the factory-set set point and adjust to actual system characteristics.

.9 VFD shall accept external control inputs, through the building DDC system, to maintain constant supply pressure.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Do Work in accordance with CAN/CSA-B214.

.2 Ensure that pumps are installed and aligned such that no piping or equipment loads are imposed on the pump body. Provide stanchions or hangers for this purpose. Refer to manufacturer's installation instructions for details.

.3 Check rotation prior to start-up.

.4 "Start-up" strainer baskets in strainer/suction guides must be removed prior to final commissioning of systems.

.5 Install volute venting pet cock in accessible location.

.6 Install pressure gauge test cocks.

.7 In-line Circulators:

.1 Install as indicated by flow arrows.

.2 Install with shaft horizontal.

.3 Support at inlet and outlet flanges or unions.

.4 Install with bearing lubrication points accessible.

END OF SECTION 23 21 23

□

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes materials, requirements, components, equipment and chemicals for installation of complete HVAC water treatment system.

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 SUBMITTALS

.1 Shop Drawings:

.1 Submit proposed chemical treatment program including chemicals and equipment.

.2 Closeout Submittals:

.1 Provide maintenance data for incorporation into Operational and Maintenance manual.

1.4 MAINTENANCE

.1 Obtain signed receipt from the Owner when spare parts are handed over.

.2 Provide the following spare chemicals:

.1 Provide one spare pail (20 L) of biocide for each open system requiring treatment.

.2 Provide one spare pail (20 L) of chemicals for each closed system requiring treatment.

PART 2 - PRODUCTS

2.1 MANUFACTURER

.1 Equipment, chemicals, service provided by one supplier.

2.2 POT FEEDER

.1 Heavy iron casting with removable cap.

.2 Minimum 20 mm [3/4"] system drain and fill connections.

2.3 CHEMICAL FEED PIPING

.1 Resistant to chemicals employed, Schedule 40 black steel.

2.4 CHEMICAL TREATMENT - PIPING SYSTEMS

.1 After the cleaning of the various piping systems has been completed, employ the professional Chemical Cleaning and Treatment Agency, which supervised the cleaning, to supervise the chemical treatment for the following new systems:

.1 Hot water heating system.

.2 Chemically treat the above mentioned piping systems during the construction and temporary heat period and employ the agency to check the treatment of piping system prior to handing over the systems to the Owner. Finally treat the systems to the requirements of the treatment agency.

.3 All chemicals, feed systems and test equipment shall be provided by the Chemical Treatment Agency.

.4 Treatment chemicals shall not contain hydrazene.

.5 Treatment chemicals shall be non-foaming.

2.5 SIDE STREAM FILTER

.1 The Chemical Treatment Agency shall provide permanent side stream filters across the following pump sets to actively clean the heating and chilled water systems.

.1 Pumps P-HW1 and P-HW2.

.2 Provide two sets of spare filters for each pump set.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install HVAC water treatment systems in accordance with ASME Boiler Code Section VII, and requirements and standards of authorities having jurisdiction, except where specified otherwise.

.2 Ensure adequate clearances to permit performance of servicing and maintenance of equipment.

3.3 CHEMICAL FEED PIPING

.1 Install crosses at changes in direction. Install plugs in unused connections.

3.4 WATER TREATMENT SERVICES

.1 The Chemical Treatment Agency shall provide supervision of installations, set-up and adjustment and shall submit a written report on system operations.

.2 The Chemical Treatment Agency shall instruct the maintenance personnel before substantial completion. Written instructions of the treatment, dosages, control charts and test procedures shall be included in the maintenance manuals.

.3 The Chemical Treatment Agency shall provide water treatment monitoring and consulting services for a period of one year after system start-up.

.4 Service to include:

.1 Initial water analysis and treatment recommendations.

.2 System start-up assistance.

.3 Operating staff training.

.4 Provide necessary laboratory and technical assistance.

.5 Provide clear, concise, written instructions and advice to operating staff.

END OF SECTION 23 25 00

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes materials, requirements and installation of low-pressure metallic ductwork, joints and accessories where working static pressure does not exceed 500 Pa [2" w.g.].

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 SUBMITTALS

.1 Closeout Submittals:

.1 Provide maintenance data for incorporation into Operational and Maintenance manual.

PART 2 - PRODUCTS

2.1 GALVANIZED STEEL

.1 Galvanized steel shall be lock forming quality with galvanizing coat both sides to ASTM A653/A653M, G90 zinc coating.

.2 Thickness, fabrication and reinforcement: to SMACNA.

.3 Joints: to SMACNA.

2.2 DUCTS - FLEXIBLE

.1 Flexible ductwork shall not be used on this project.

2.3 DUCTS - GALVANIZED STEEL

.1 All ductwork shall be constructed and sealed to withstand without damage or permanent deformation at least 150% of the working static pressure.

.2 Construct rectangular ducts in accordance with Section I of the SMACNA Duct Standards.

.3 Construct round ducts in accordance with Section III of the SMACNA Duct Standards.

.4 500 Pa [2" w.g.] working static pressure.

2.4 FITTINGS

.1 Construct rectangular duct fittings in accordance with Section II of the SMACNA Duct Standards.

.2 Sheet metal gauge of fittings and elbows shall be not less than the thickness of that specified for longitudinal seam straight duct of the equivalent size.

.3 Square throated - radius heel elbows shall not to be used.

.4 Adjustable elbows are not permitted.

.5 Radiused elbows.

.1 Rectangular: Centreline radius of a rectangular duct elbow at least equal to 1.5 times the duct width, measured in the direction of the radius. If it is not possible to install a full radius elbow, use a square elbow with multi-blade turning vanes.

.2 Round: Centreline radius of 1.0 times duct diameter.

.6 Mitred elbows, rectangular: Construct with single wall turning vanes.

.7 Branches:

.1 Rectangular main and branch: 45 degrees entry on branch.

.2 Round main and branch: enter main duct at 45 degrees with conical connection.

.3 Provide volume control damper in branch duct near connection to main duct.

.4 Main duct branches: with splitter damper.

.8 Transitions: In accordance with SMACNA Duct Standards:

.1 Maximum taper of diverging transitions shall be 20°.

.2 Maximum taper of converging transitions shall be 30°.

.3 Maximum divergence upstream of equipment shall be 30°.

.4 Maximum convergence downstream of equipment shall be 45°.

.5 Maximum divergence of evase from centrifugal fan scroll outlet shall be 7°.

.9 Offsets: Full radiused elbows.

2.5 HANGERS AND SUPPORTS

.1 Support ductwork to SMACNA using:

.1 Galvanized steel straps.

.2 Cadmium plated threaded rods.

.3 Flat bar or angle hangers.

.2 Attachments to the structure shall be compatible with the structure and selected for the load of the ductwork.

.3 Install ductwork hangers in accordance with Section IV of the SMACNA Duct Standards.

.4 Support duct risers at their base and at each floor and at not greater than 3.7 m [12 ft] intervals.

2.6 WIRE MESH SCREENS

.1 Provide wire mesh screens in all air intake openings where noted on the drawings.

.2 Screens shall be constructed from 16 ga aluminum wire.

.3 Screen mesh shall be 12 mm [1/2"] grid.

.4 Mount screens in 20 ga folded aluminum frames.

2.7 SEALANT

.1 SMACNA Seal Classification B for ductwork 500 Pa [2” w.g.] and under working static pressure.

.2 Class B: longitudinal seams, transverse joints and connections made airtight with sealant.

.3 Oil resistant, water borne, polymer type flame resistant duct sealant. Temperature range of -30°C to 93°C.

PART 3 - EXECUTION

3.1 GENERAL

.1 The project drawings are diagrammatic. Effort has been made to indicate offsets and transitions, but not all are necessarily shown. Changes may be required to ductwork to avoid interference with structure and other services. Determine all required adjustments prior to fabrication and provided the adjustments without additional cost to the Contract.

.2 Working static pressure means the maximum pressure that could be created by the equipment when operating at the speed required to achieve the specified performance, by the closure (including closure due to failure) of any specified devices in the ductwork.

.3 Ductwork means ducts and plenums.

.4 Where a duct is to be internally insulated, size the duct so as to provide the free area duct dimensions shown on the drawings.

.5 Plenum sizes are the sheet metal plenum dimension.

.6 Flash and counterflash ducts through roofs and exterior walls.

.7 Arrange openings for ductwork through floors and walls to accommodate insulation, packing, sleeves, and fire dampers as appropriate.

.8 During construction, protect ductwork openings from the entry of dirt, dust and debris with suitable covers.

.9 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.

.10 Where ductwork is required to pass through open web steel joists, coordinate with the joist fabricator before fabricating ductwork.

3.2 DUCTWORK INSTALLATION

.1 Square throated - radius heel elbows shall not to be used.

.2 Where a duct contains a fire damper, construct the duct so that the free area of the duct is maintained through the fire damper unless otherwise indicated.

.3 Install tie rods to limit the maximum unsupported vane length to 914 mm [36"]. Refer to SMACNA Duct Standards.

.4 Install duct necks before grilles, registers and diffusers and cushion heads after diffuser take-offs.

.5 Cross-break or bead all metal ductwork panels unless otherwise noted.

.6 Arrange ductwork so that equipment can be easily serviced and removed.

.7 Ductwork passing through non-rated fire separations, sound insulated walls and through walls and floors which are not fire separations shall be tightly fitted and sealed on both sides of the separation with silicon sealant to prevent passage of smoke and/or transmission of sound (ULC approved fire stop sealant is not a requirement). Where ducts are externally insulated provide a 24 ga thick galvanized steel band tightly fitted around the insulation and then caulk from band to wall or floor.

.8 Install breakaway joints in ductwork on sides of fire separation.

.9 To avoid a conflict with structure or other services a duct may be reduced up to 10% in cross-sectional area for up to 2 meters [6’-8”] in length. Also, to assist installation any duct may be changed in dimension by up to 50 mm [2”] with a corresponding change in the other dimension to maintain the cross-sectional area. Notify the Departmental Representative of the change. Any other changes in duct dimensions must first be reviewed and accepted by the Departmental Representative.

3.3 SEALING

.1 Apply sealant to outside of joint to manufacturer's recommendations.

.2 Where accessible, apply sealer to inside of joints on ductwork under positive pressure.

.3 Apply sealer to outside of joints on ductwork under negative pressure.

.4 Duct tape is not a permitted sealing method.

3.4 DUCTWORK CLEANING

.1 It is the intent that the ductwork system shall be clean. No dirt, debris or dust shall be evident in a visual examination.

.2 Protect ductwork from fabrication to the completion of the project to keep it clean. Any dust, dirt or debris in the systems shall be removed.

.3 If in the opinion of the Departmental Representative the systems are not clean, provide cleaning as required including, if necessary, retaining a Cleaning Agency to do the work.

.4 Cleaning shall be to the satisfaction of the Departmental Representative.

.5 Submit a letter signed by a principal of the ductwork installing company certifying that all ductwork systems are clean.

END OF SECTION 23 31 14

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes materials, requirements and installation for duct accessories including flexible connections, access doors, vanes.

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 SUBMITTALS

.1 Shop Drawings:

.1 Submit shop drawings for:

.1 Flexible connections.

.2 Duct access doors.

.2 Closeout Submittals:

.1 Provide maintenance data for incorporation into Operational and Maintenance manual.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.

2.2 FLEXIBLE CONNECTIONS

.1 Frame: 24 ga galvanized sheet metal frame with fabric clenched by means of double locked seams.

.2 Material: Fire resistant, self extinguishing, neoprene coated glass fabric, suitable for use from -40°C to +90°C [-40°F to 194°F], density of 1.3 kg/m2 [0.26 lb.ft2].

2.3 ACCESS DOORS IN DUCTS

.1 Non-insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 24 ga complete with sheet metal angle frame.

.2 Insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 24 ga complete with sheet metal angle frame and 25 mm [1"] thick rigid glass fibre insulation.

.3 Gaskets: neoprene or foam rubber.

.4 Hardware:

.1 Up to 300 x 300 mm [12” x 12”]: 2 sash locks.

.2 Up to 300 x 450 mm [12” x 18”]: 4 sash locks.

.3 Up to 450 x 1000 mm [18” x 40”]: piano hinge and minimum 2 sash locks.

2.4 TURNING VANES

.1 Factory or shop fabricated galvanized steel, 22 ga minimum.

.2 Vanes shall be spaced at 40 mm [1-1/2"] centres and shall turn through 90 degrees, with a radius of 50 mm [2"].

.3 Vanes shall not include a straight trailing edge.

.4 Refer to SMACNA Duct Standards.

.5 Vanes and runners in aluminum ducts shall be constructed from aluminum. Aluminum vanes shall be 18 ga.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 FLEXIBLE CONNECTIONS

.1 Install where indicated.

.2 Length of connection: 100 mm [4”].

.3 Minimum distance between metal parts when system in operation: 75 mm [3"].

.4 Install in accordance with recommendations of SMACNA.

.5 Install in following locations:

.1 Inlets and outlets to supply air units and fans.

.2 Inlets and outlets of exhaust and return air fans.

.3 As indicated.

.6 When fan is running:

.1 Ducting on each side of flexible connection to be in alignment.

.2 Ensure slack material in flexible connection.

.3 Ensure flexible connection does not restrict airflow to suction side of fan.

3.3 DUCT ACCESS INSTALLATION

.1 Size to suit required access.

.2 Location:

.1 At fire dampers.

.2 At control dampers.

.3 At devices requiring maintenance.

.4 At locations required by Code.

.5 At coils, upstream side.

.6 At base of duct risers.

.7 Elsewhere as indicated.

3.4 TURNING VANES

.1 Install in accordance with recommendations of SMACNA and as indicated.

END OF SECTION 23 33 00

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes materials, requirements and installation for balancing dampers for mechanical forced air ventilation and air conditioning systems.

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Manufacture to SMACNA standards.

2.2 SINGLE BLADE DAMPERS

.1 Fabricate from same material as duct but one sheet metal thickness heavier 16 ga, with V-groove stiffened.

.2 Size and configuration to recommendations of SMACNA, except maximum height 300 mm [12”] on rectangular ducts.

.3 Locking quadrant with shaft extension to accommodate insulation thickness.

.4 Inside and outside end bearings. Nylon on dampers up to 300 mm [12”] high, oilite bronze on dampers over 300 mm [12"] high or diameter.

.5 Channel frame of same material as adjacent duct, complete with angle stop.

2.3 MULTI-BLADED DAMPERS

.1 Factory manufactured of material same as duct, 16 ga.

.2 Opposed blade configuration. Metal thickness and construction to recommendations of SMACNA.

.3 Maximum blade height: 200 mm [8”].

.4 Bearings: bronze oilite bushings.

.5 Linkage: shaft extension with locking quadrant.

.6 Channel frame of same material as adjacent duct, complete with angle stop.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install where indicated and where required by the Balancing Agent for balancing.

.2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer’s instructions.

.3 Runouts to registers and diffusers: install as far as possible from registers and diffusers.

.4 All dampers shall be vibration free and have no free play when set.

.5 The lever of quadrant operators shall be parallel with the blades.

.6 Provide sheet metal bridge for operators on round ducts over 300 mm [12”] diameter and to raise operator above insulation on insulated ducts.

.7 Ensure damper operators are observable and accessible.

END OF SECTION 23 33 14

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes materials, requirements and installation for fire dampers.

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 SUBMITTALS

.1 Shop Drawings:

.1 Submit shop drawings for fire dampers.

.2 Closeout Submittals:

.1 Provide maintenance data for incorporation into Operational and Maintenance manual.

PART 2 - PRODUCTS

2.1 GENERAL

.1 ULC listed and labelled or Warnock Hersey tested.

.2 Fire damper assembles to be fire tested in accordance with CAN4-S112.

.3 Meet requirements of:

.1 Building Code.

.2 Fire Commissioner of Canada (FCC).

.3 ANSI/NFPA 90A.

.4 Authorities Having Jurisdiction.

2.2 FIRE DAMPERS

.1 Type A, B and C:

.1 Typical arrangement shall be Type B. Type A or C may be used where specifically indicated.

.2 All fire dampers shall be listed and labelled for dynamic closure except where specifically noted otherwise.

.3 Where a single fire damper opening exceeds the maximum size for a dynamic shutter-type fire damper, provide a dynamic multi-blade type fire damper.

.4 Mild steel, factory fabricated for fire rating requirement to maintain integrity of firewall and/or fire separation.

.5 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical airflow.

.6 Install retaining angle, on full perimeter of fire damper, on both sides of fire separation being pierced to meet SMACNA guidelines.

.7 Fusible links shall have 71°C [160°F] melting point except 141°C [286°F] melting point on return and exhaust used for smoke venting.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install in accordance with SMACNA Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems, ANSI/NFPA 90A and in accordance with conditions of ULC listing.

.2 Maintain integrity of fire separation.

.3 After completion and prior to concealment obtain approvals of complete installation from Authority Having Jurisdiction.

.4 Install access door adjacent to each damper, located to test and reset the damper. See Section 23 33 00 - Air Duct Accessories.

.5 Install access door adjacent to each damper.

.6 Coordinate with installer of firestopping.

.7 Ensure access doors/panels, fusible links, damper operators are easily observed and accessible.

.8 Install break-away joints of approved design on each side of fire separation.

END OF SECTION 23 33 16

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes materials, requirements and installation for acoustic duct lining.

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 SUBMITTALS

.1 Shop Drawings:

.1 Submit shop drawings for acoustic duct lining.

.2 Closeout Submittals:

.1 Provide maintenance data for incorporation into Operational and Maintenance manual.

PART 2 - PRODUCTS

2.1 FIRE AND SMOKE RATING

.1 In accordance with Building Code, NFPA 90A and CAN/ULC-S102.

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.2 DUCT LINER - FLEXIBLE

.1 Minimum Noise Reduction Criteria (NRC): 0.70 at 25 mm [1"] thickness based on Type A mounting to ASTM C423.

.2 Maximum thermal conductivity per 25 mm [1"]: 0.040 W/m-°C at 24°C [0.28 Btu-in/(hr-ft2-°F) at [75]°F].

2.3 ACCESSORIES

.1 Insulation Adhesive: Water-based fire retardant type. Acceptable Products: Foster 85-20, Robson Ticki-Tuff, 3M 4230, United UNI-GRAB.

.2 Insulation Sealer: Acceptable Products: Childers CP-50, Foster 30-36, Robson's Mastic RJ-10.

2.4 SCOPE OF INSULATION

.1 Scope 1: Internal Duct Liner - Flexible.

	Thickness	
	mm	[ins]
.1 All ductwork where indicated by single hatching.	25	[1]

PART 3 - EXECUTION

3.1 GENERAL

.1 Where a duct is to be internally insulated, size the duct so as to provide the free area duct dimensions shown on the drawings.

3.2 APPLICATION OF INTERNAL DUCT LINER - FLEXIBLE

.1 Adhere insulation with insulation adhesive applied to the entire metal surface, with the coating side of insulation exposed to the air stream.

.2 Ducts 610 mm [24”] in width and less require no further adhesion.

.3 Seal all transverse joints, raw edges, and other points of penetration of the coating with reinforcing membrane and insulation coating/sealer.

.4 Seal all longitudinal joints with insulation coating sealer.

.5 No raw edges of internal insulation material shall be exposed to the moving air stream.

.6 Duct size shown is dimension inside the insulation. Metal duct sizes shall be increased to allow for the internal acoustic insulation thickness.

3.3 INSULATION TERMINATION

.1 Terminate insulation short of all control, and fire dampers so as not to interfere with their operation.

.2 Seal butt joints, exposed edges, weld pin and clip penetrations and damaged areas of liner with sealer.

.3 Replace damaged areas of liner at discretion of the Departmental Representative.

.4 Protect leading and trailing edges of duct sections with sheet metal nosing having 15 mm overlap and fastened to duct.

END OF SECTION 23 33 53

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes materials, requirements and installation for fans, motors, accessories and hardware for commercial use.

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 SUBMITTALS

.1 Shop Drawings:

.1 Submit shop drawings for all fans.

.2 Indicate, at minimum, the following:

.1 Sound rating data.

.2 Fan curves showing operating point plotted on curves.

.3 Motor efficiencies.

.4 Motors, sheaves, bearings, shaft details.

.5 Sound rating data at point of operation.

.2 Closeout Submittals:

.1 Provide maintenance data for incorporation into Operational and Maintenance manual.

1.4 PERFORMANCE REQUIREMENTS

.1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.

.2 Capacity: flow rate, total static pressure, BHP, W, efficiency, RPM, power, model, size, sound power data and as indicated on schedule.

.3 Fans: statically and dynamically balanced, constructed in conformity with AMCA 99. Dynamically balance fans to 1.5 mm/s [0.06 in/s] vibration amplitude, maximum measured on bearing housings. Provide fan shafts with critical speed at least 1.5 times operational speed.

.4 Submit fan sound power levels with shop drawings, measured to AMCA 300 and calculated to AMCA 301, or other data acceptable to the Departmental Representative. Provide test data if requested. Fans exceeding design levels may be rejected.

.5 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210 and ASHRAE 51. Units shall bear AMCA certified rating seal.

.6 If fan power levels exceed design levels, provide the location of a similar existing fan installation with Tender. Coordinate with Departmental Representative to obtain access for acoustical measurements. These measurements, with corrections for volume, static pressure, efficiency, blade passage tone and room effect will form a basis of evaluation of the fans. The corrections will be based on the ASHRAE Guide and an ILG RSS comparison of room effect. Approval will be based on fans being similar to the fans evaluated, not on submitted fan sound power levels.

1.5 MAINTENANCE

.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

.2 Obtain signed receipt from the Owner when spare parts are handed over.

.3 Provide the following spare parts:

.1 Matched sets of belts for each fan.

PART 2 - PRODUCTS

2.1 FANS GENERAL

.1 Refer to drawings for motor position, rotation and discharge arrangements.

.2 Motors:

.1 In accordance with Section 23 05 13 - Common Motors Requirements for HVAC Equipment supplemented as specified herein.

.2 Premium efficiency motors unless otherwise specified.

.3 Sizes as scheduled.

.3 Accessories and Hardware:

.1 In accordance with Section 23 05 13 - Common Motors Requirements for HVAC Equipment supplemented as specified herein.

.2 Matched sets of V-belt drives.

.3 Adjustable slide rail motor bases.

.4 Belt guards.

.5 Coupling guards.

.6 Fan inlet and/or outlet safety screens.

.4 Factory primed before assembly in colour standard to manufacturer.

.5 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.

2.2 CABINET FANS

.1 Steel cabinet arranged for ducted inlet and outlet connections with duct collars.

.2 Acoustically insulated cabinet.

.3 Centrifugal fan on rubber isolators.

.4 Access panel.

.5 Integral motor thermal overload protection.

.6 Motor disconnect plug and integral receptacle.

.7 Accessories:

.1 Motorized control damper.

2.3 CEILING EXHAUST

.1 Centrifugal blower, motor vibration isolated.

.2 Built-in backdraft damper.

.3 Aluminum exhaust grille.

.4 Adjustable hanger bracket.

.5 Pre-wired outlet box, plug-in receptacle.

.6 Accessories:

.1 Solid state speed control.

.2 Motorized control damper.

2.4 CENTRIFUGAL - TUBULAR IN-LINE

.1 Tubular In-Line centrifugal fan, motor on side.

.2 Spark resistance construction to AMCA A rating with shaft seals.

.3 Steel tubular casing with flanged ends and stationary guide vanes with corrosion resistant finish.

.4 Non-overloading airfoil wheel.

.5 Rotating parts factory statically and dynamically balanced.

.6 Drip-proof motor, belt driven.

.7 Heavy duty pillow block ball bearings. Extended lubricators.

.8 Accessories: Companion flanges; Ceiling brackets; Belt guard.

2.5 RANGE HOOD (RH1)

.1 760 mm [30"] wide.

.2 Aluminum washable filter.

.3 Lights and light switch.

.4 Solid state fan speed control.

.5 Suitable for horizontal or vertical ducting.

.6 Built-in backdraft damper and duct collar for use with 254 mm x 83 mm [10" x 3-1/4"] ducting.

.7 Baked enamel finish to Architect's colour choice.

.8 Accessories: Flush wall cap with aluminum grille.

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 FAN INSTALLATION

.1 Install fans as indicated, complete with vibration isolators and seismic restraints as specified in Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment, flexible connections.

.2 Install fans with flexible connections on inlet ductwork and on discharge ductwork in accordance with Section 23 33 00 - Air Duct Accessories. Ensure metal bands of connectors are parallel with minimum 25 mm [1"] flex between ductwork and fan during running.

.3 Install connectors on the suction side of axial fans in such a manner so that the connectors cannot be sucked into the air stream. Provide flange extensions as necessary.

.4 Bearings and extension tubes to be easily accessible.

.5 Provide safety screens where fan inlet or outlet is exposed.

.6 Provide belt guards on belt driven fans.

.7 Provide and install sheaves and belts required for final air balance.

END OF SECTION 23 34 00

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes materials, requirements and installation for supply, return and exhaust grilles and registers, diffusers and linear grilles, for commercial and residential use.

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 SUBMITTALS

.1 Shop Drawings:

.1 Submit shop drawings for diffusers, registers and grilles.

.2 Indicate, at minimum, following:

.1 Throw and terminal velocity.

.2 Noise criteria.

.3 Pressure drop.

.4 Neck velocity.

.2 Closeout Submittals:

.1 Provide maintenance data for incorporation into Operational and Maintenance manual.

1.4 PERFORMANCE REQUIREMENTS

.1 Catalogued or published ratings shall be those obtained from tests carried out by the manufacturer or those ordered by him from an independent testing agency signifying adherence to codes and standards.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

.1 Grilles, registers and diffusers of same generic type shall be the product of one manufacturer.

2.2 GENERAL

.1 Acceptable Products for grilles, registers and diffusers shall meet capacity, pressure drop, terminal velocity, throw, noise level and neck velocity of the Standard of Acceptance.

.2 Frames:

.1 Full perimeter gaskets.

.2 Plaster frames where set into plaster or gypsum board.

.3 Concealed fasteners.

.3 Concealed manual volume control damper operators where scheduled.

.4 Coordinate with ceiling type and grid size.

.5 Means of attachment for two seismic restraint wires unless screwed to sheet metal duct.

.6 Refer to Air Terminal schedules for terminal details and to drawings for sizes, air quantities and location.

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 AIR TERMINAL INSTALLATION

.1 Install in accordance with manufacturer's instructions.

.2 Install with oval head, cadmium plated screws in countersunk holes where fastenings are visible.

.3 Bolt grilles, registers and diffusers, in place, in gymnasium and similar game rooms.

.4 Paint ductwork matte black behind terminals where internal surfaces are visible.

.5 Install ductwork as high as practical using offsets if necessary to obtain a duct neck length of minimum two diameters.

.6 Confer with the Departmental Representative in advance of ductwork construction where there are conflicts with light locations or where locations on mechanical drawings differ from the Architectural reflected ceiling plans.

END OF SECTION 23 37 13

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes materials, requirements and installation for louvres.

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 SUBMITTALS

.1 Shop Drawings:

.1 Submit shop drawings for louvres, intakes and vents.

.2 Indicate, at minimum, the following:

.1 Pressure drop.

.2 Face area.

.3 Free area.

.2 Test Reports:

.1 Submit certified data from independent laboratory substantiating acoustic and aerodynamic performance to ASTM E90.

.3 Closeout Submittals:

.1 Provide maintenance data for incorporation into Operational and Maintenance manual.

1.4 PERFORMANCE REQUIREMENTS

.1 Catalogued or published ratings shall be those obtained from tests carried out by the manufacturer or those ordered by him from an independent testing agency signifying adherence to codes and standards.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

.1 Louvres, intakes, vents and gooseneck hoods of same generic type shall be the product of one manufacturer.

2.2 FIXED LOUVRES - ALUMINUM (L1)

.1 Material: extruded aluminium alloy (6063-T5).

.2 Blades: 100 mm [4"] deep at 45° and 90 mm [3-1/2"] centres. Upturned rain stop at trailing edge, drip channel at leading edge.

.3 Frame, head, sill and jamb: 100 mm [4"] deep one piece extruded aluminium, minimum 12 ga. Channel type frame, no flange. Jamb drainage channel.

.4 Mullions: at 1.5 m [5 ft] maximum centres, continuous blade.

.5 Fastenings: stainless steel (Society of Automotive Engineers) SAE-194-8F with SAE-194-SFB nuts and resilient neoprene washers between aluminium and head of bolt, or between nut, SS washer and aluminium body.

.6 Screen: 12 mm [1/2"] mesh, 16 ga wire aluminium birdscreen on inside face of louvres in formed 20 ga aluminium U-frame, removable.

.7 Finish: Factory applied enamel, colour to Architect's approval.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 LOUVRE INSTALLATION

.1 Install in accordance with manufacture's and SMACNA's recommendations.

.2 Reinforce and brace air vents, intakes and goosenecks to withstand local wind loads.

.3 Provide all necessary flashing and counter flashing.

.4 Anchor securely into opening from inside. Seal with caulking all around to ensure weather tightness.

END OF SECTION 23 37 20

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes materials, requirements and installation for heating boilers.

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 SUBMITTALS

.1 Shop Drawings:

.1 Submit shop drawings for boilers and accessories.

.2 Indicate, at minimum, the following:

.1 General assembly drawing of the boiler including product description, model number, dimensions, clearances, weights, service sizes, etc.

.2 Schematic flow diagram of propane gas valve trains.

.3 Schematic wiring diagram of boiler control system of the ladder-type showing all components, interlocks, etc. Schematic wiring diagram shall clearly identify factory wiring and field wiring by others.

.4 Clearances for operation, maintenance, servicing, tube cleaning, tube replacement.

.5 Foundations with loadings, anchor bolt arrangements.

.6 Piping hook-ups.

.7 Equipment electrical drawings.

.8 Burners and controls.

.9 All miscellaneous equipment.

.10 Flame safety control system.

.11 Breeching and stack configuration.

.12 Manufacturer's Warranties: Manufacturer's printed warranties, as specified hereinafter, shall be submitted prior to final acceptance by the Departmental Representative.

.13 Manufacturer's Field Service: Manufacturer's printed field service procedures and reports, as specified hereinafter, shall be submitted prior to final acceptance by the Departmental Representative. Report forms shall contain all information as required to do start-up and testing as specified in the product section.

.14 Engineering data to include:

.1 Boiler efficiency at 25%, 50%, 75% and 100% of design capacity.

.2 Radiant heat loss at 100% design capacity.

.2 Closeout Submittals:

.1 Provide maintenance data for incorporation into Operational and Maintenance manual.

1.4 QUALITY ASSURANCE

.1 The equipment shall, as a minimum, be in strict compliance with the requirements of this specification and shall be the Manufacturer's standard commercial product unless specified otherwise. Additional equipment features, details, accessories, appurtenances, etc. which are not specifically identified but which are a part of the Manufacturer's standard commercial product, shall be included in the equipment being furnished.

1.5 WARRANTY DATA

.1 All warrantees shall be parts and labour.

.2 The pressure vessel shall be guaranteed against thermal shock for 20 years.

.3 The condensate collection box shall be guaranteed for 20 years.

.4 All parts not covered by the above warranties shall be guaranteed for 1 year. This shall include all electrical components and burner components.

PART 2 - PRODUCTS

2.1 BOILERS - CONDENSING

.1 Factory packaged hot water condensing boiler with stainless steel burner and heat exchanger, and integral digital controls.

.2 Boiler shall be ready for attachment of water supply, return and drain piping, propane gas piping, electrical connections, combustion air and venting connections.

.3 Boilers to be test fired before shipment and to be registered with the Provincial Authorities.

.4 Cabinet:

.1 The boiler enclosure shall be of a white powder-coated steel frame and front cover.

.2 Provide wall mounting bracket and hardware.

.5 Pressure Vessel

.1 The entire construction, heat exchanger, flue gas collector and condensate drain shall be constructed of stainless steel, SA240-316Ti. The radial heat exchanger and flue passages shall be welded completely, with water-cooled rear and front wall.

.2 The heat exchanger and flue gas collector box, including the gas burner, pressure switches, and high limit switches shall be encased in a sealed separate fresh-air receiver housing.

.6 Burner

.1 The forced draft propane gas burner shall be complete with variable-speed blower motor and air intake damper. It shall modulate between 25% and 100% of the stated maximum input and shall feature automatic flue gas adaptation and combustion chamber differential pressure control.

.2 Propane gas valve control shall include ionization electrode flame monitoring and electronic ignition.

.7 Safeties:

.1 Pressure relief valve.

.2 Auto air vent.

.3 Isolation valves for the heat exchanger.

.4 Low water pressure cut off or flow switch.

.5 Adjustable high limit switch.

.6 Burner fault display and rest.

.8 Boiler Controls:

.1 Boiler water temperature adjustment.

.2 Remote heating water supply temperature input from the DDC system.

.3 On board diagnostics. Frost control.

.4 LCD display.

.9 Condensate Neutralization

.1 Provide a condensate neutralizing unit complete with limestone granules shipped loose for field installation by contractor.

.2 Provide additional bag(s) of limestone granules sufficient for one additional fill.

.10 Accessories:

.1 100mm diameter low loss header.

.2 Factory provided concentric venting and combustion air intakes suitable for installation in British Columbia complete with boiler adaptor, vent terminations, protective screen, etc. Refer to drawings.

.3 0-10V input module.

.4 Boiler circulation pump: Provided with the boiler complete with integral check valve.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install equipment in strict compliance with Manufacturer's installation instructions. Do not deviate from required service and maintenance clearances.

.2 Provide required piping and interconnecting electrical control and power wiring.

.3 Pipe relief valves and air vent on hot water boilers to floor drain.

.4 Install components that were furnished loose with equipment for field installation.

.5 Provide all fuel gas vent and service piping.

.6 Provide all piping for boiler pipe connections.

.7 Mount unit level.

.8 Manufacturer’s representative to provide start-up and burner adjustment service and maintenance and operating instructions. Test reports to be submitted for review and inclusion in maintenance manuals.

3.3 TESTING, START-UP AND COMMISSIONING

.1 The Manufacturer’s representative shall be responsible for performance of inspections, testing, start-up and commissioning of the package boilers, accessory equipment and materials furnished under this Section. A detailed written record of the start-up performance, including burner setting data over the entire load range shall be furnished to the Departmental Representative before final acceptance. All labour, equipment, and test apparatus shall be furnished by the Contractor. All equipment defects discovered by the tests shall be rectified.

.2 Start-up and commissioning shall cover all components assembled and furnished by the Manufacturer whether or not of his own manufacture. Start-up and commissioning shall be conducted by experienced and factory authorized technician in the regular employment of the authorized service organization and shall include:

.1 Demonstrate that boiler, burner, controls, and accessories comply with requirements of this Section as proposed by the boiler and accessories supplier. Pre-test all items prior to scheduling the final testing.

.2 Readings at different firing rates of load for the modulating burner shall be taken with a written report of the tests submitted to the Departmental Representative. The reports shall include readings for each firing rate tested and include boiler efficiency.

.3 Auxiliary Equipment and Accessories: Observe and check all accessories and appurtenant equipment during the operational and capacity tests for leakage, malfunctioning, defects or overloading as applicable.

.4 Commissioning requirements:

.1 Fireside inspection

.2 Set up fuel train and combustion air system

.3 Set up operating set points

.4 Check all safeties.

.5 Set up and verify efficiencies.

.5 Training to include all safety procedures, maintenance procedures, control operations, and diagnostic procedures.

END OF SECTION 23 52 00

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes materials, requirements and installation for energy recovery equipment, accessories and hardware for commercial use.

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 SUBMITTALS

.1 Shop Drawings:

.1 Indicate, at minimum, the following:

.1 HRV details.
.2 Fan curves showing operating point plotted on curves.
.3 Motor efficiencies.
.4 Motors, sheaves, bearings, shaft details.
.5 Sound rating data at point of operation.
.6 Fan curves showing point of operation.
.7 Vibration isolation.
.8 Bearings.
.9 Filters.
.10 Electrical schematics.

.2 Closeout Submittals:

.1 Provide maintenance data for incorporation into Operational and Maintenance manual.

1.4 CERTIFICATION OF RATINGS

.1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards.

1.5 MAINTENANCE

.1 Obtain signed receipt from the Owner when spare parts are handed over.

.2 Provide the following spare parts:

.1 Matched sets of belts for each fan.

.2 Provide two (2) sets of filter media (for each filter) - one for installation and one for hand over to the owner as a spare.

1.6 QUALITY ASSURANCE

.1 Unit shall be constructed in accordance with industrial design practices.

.2 All units shall be factory tested before shipment.

PART 2 - PRODUCTS

2.1 HEAT RECOVERY VENTILATOR (HRV-1)

.1 Capacity: as scheduled.

.2 Unit shall consist of dual fans each airstream, aluminum heat recovery coil, positively draining pan (no standing water), automatic defrost function, in an acoustically insulated cabinet.

.3 Quality Assurance:

.1 The energy recovery cores used in these products shall be third party Certified by AHRI under its Standard 1060 for Energy Recovery Ventilators. AHRI published certifications shall confirm manufacture's published performance for airflow, static pressure, temperature and total effectiveness, purge air (OACF) and exhaust air leakage (EATR). Products that are not currently AHRI Certified will not be accepted.

.2 The HRV core shall be warranted to be free of manufacturing defects and to retain its functional characteristics, under circumstances of normal use, for a period of ten years from the date of purchase. The balance-of-unit shall be warranted to be free of manufacturing defects and to retain its functional characteristics, under circumstances of normal use, for a period of two years from the date of purchase.

.4 Core:

.1 The energy recovery component shall be:

.1 Material: Polymer with desiccant wheel technology.

.2 Type: Channel matrix wheel with removable segments.

.2 The HRV shall be capable of transferring both sensible and latent energy between airstreams. Latent energy transfer shall be accomplished by direct water vapour transfer from one air stream to the other, without exposing transfer media in succeeding cycles directly to the exhaust air and then to the fresh air.

.3 The HRV core shall perform without condensing or frosting under normal operating conditions (defined as outside temperatures above -23°C [-10°F] and inside relative humidity below 40%). Occasional more extreme conditions shall not affect the usual function, performance or durability of the core. No condensate drains will be allowed.

.4 Unit shall have the capacity to operate continuously without the need for bypass, recirculation, pre-heaters or defrost cycles under normal operating conditions.

.5 Airflow through the HRV core shall be laminar over the products entire operating airflow range, avoiding deposition of particulates on the interior of the energy exchange material.

.5 Construction:

.1 The unit case shall be constructed of G90 galvanized, 20-gauge steel, with lapped corners and zinc plated screw fasteners. The unit roof shall be one piece or have watertight standing seam joints and shall overlap wall panels and doors in order to positively shed water.

.2 Access doors shall provide easy access to blowers, HRV cores, and filters. Doors shall have an airtight compression seal using closed cell foam gaskets rated for outdoor exposure.

.3 Provide double wall construction with 24-gauge galvanized steel liner. Case walls and doors shall be insulated with 25 mm [1"], 4 pound density, foil/scrim faced, high-density fibreglass board insulation, providing a cleanable surface and eliminating the possibility of exposing the fresh air to glass fibres.

.4 The HRV cores shall be protected by a MERV 8 rated, 50 mm [2"] nominal, pleated, disposable filter in both airstreams. Provide one set of spare filters.

.5 Unit shall have single-point power connection and a single-point 24 VAC contactor control connection.

.6 Blower motors shall be EPACT compliant for energy efficiency and be thermally protected or supplied with external starters.

.7 Blowers shall be quiet running, forward curve type and be either direct drive or belt drive. Belt drive motors shall be provided with adjustable pulleys and motor mounts allowing for proper belt tensioning.

.8 Blowers shall be statically and dynamically balanced. Heavy duty shaft and pre-lubricated self-aligning bearings, rubber mounted, rubber isolated motor.

.9 Vibration Isolation: Unit shall be spring isolated and seismically restrained with flexible connection between fan and cabinet.

.6 Accessories:

.1 Provide factory installed fused disconnects.

.2 Provide factory installed transformer/relay package to supply a 24VAC power source.

.3 Provide factory installed filter monitors for each airstream.

.4 DDC system shall be able to control the operation of each fan separately.

PART 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

.2 Manufacturers field service representative shall approve installation and is present to supervise start up and to instruct operators.

3.2 INSTALLATION

.1 Ensure adequate clearances for servicing and maintenance.

.2 Provide flexible duct connections at unit duct flanges.

.3 Provide and install sheaves and belts required for final air balance.

END OF SECTION 23 72 00

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes materials, requirements and installation for forced air heaters.

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 SUBMITTALS

.1 Shop Drawings:

.1 Submit shop drawings for forced flow heaters.

.2 Indicate, at minimum, the following:

.1 Motor element.

.2 Mounting methods.

.3 kW rating, voltage, phase.

.4 Cabinet material thicknesses.

.5 Physical size.

.6 Finish.

.7 Thermostat, transformer, controls where integral.

.2 Closeout Submittals:

.1 Provide maintenance data for incorporation into Operational and Maintenance manual.

1.4 MAINTENANCE

.1 Obtain signed receipt from the Owner when spare parts are handed over.

.2 Provide the following spare parts:

.1 Matched sets of belts for each fan.

.2 Provide two (2) sets of filter media (for each filter) - one for installation and one for hand over to the owner as a spare.

PART 2 - PRODUCTS

2.1 FORCE FLOW UNITS (FF-_)

.1 Cabinet:

.1 Arrangement as scheduled.

.2 16 ga cold rolled steel suitably braced for rigidity.

.3 Easily removable front panels on floor or wall mounted units.

.4 Hinged front panel on ceiling mounted units.

.5 Inlet and outlet grilles or duct collars as scheduled.

.6 Aluminum inlet and outlet bar grilles as scheduled.

.7 Prime coat painted internally.

.8 Exterior colour to Architect’s choice.

.2 Coils: Aluminum fins mechanically bonded to seamless copper tubes.

.3 Fans: Centrifugal double width wheels, statically and dynamically balanced, direct driven, sleeve bearings, resiliently mounted.

.4 Motors: Multi-speed, tapped wound permanent split capacitor type with sleeve bearings, built-in thermal overload protection and resilient rubber isolation mounting.

.5 Accessories:

.1 3 speed switch mounted inside cabinet.

.2 Access door with screw or camlock fastener.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install heaters in accordance with manufacturer's instructions.

.2 Make power and control connections.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes materials, requirements and installation for commercial convectors.

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 SUBMITTALS

.1 Shop Drawings:

.1 Submit shop drawings for heaters and accessories.

.2 Closeout Submittals:

.1 Provide maintenance data for incorporation into Operational and Maintenance manual.

PART 2 - PRODUCTS

2.1 BASEBOARD HEATERS (BB-_)

.1 Heating Elements: 20 mm [NPS 3/4] seamless copper tubing mechanically expanded into flanged collars of evenly spaced aluminum fins.

.2 Element Brackets: Galvanized steel at 900 mm [36”] maximum spacing to support front panel, damper and element cradle. Provide for noiseless expansion of all components.

.3 Enclosure: 187 mm [7-1/2"] high, cold rolled steel, white semi-gloss prime coat. Front panel shall be removable.

.4 Accessories:

.1 Accessible valve enclosure.

.2 End boxes, flat ends, inside and outside corners and joiner pieces as required for complete continuous wall to wall installation.

.5 Capacity of 187 mm [7-1/2"] high unit: Output of 605 W/m [630 Btuh/ft] of active finned length at 55°C [130°F] entering water temperature with 11°C [30°F] water temperature drop and 18°C [65°F] entering air temperature.

.6 Dimensions for enclosures: For wall to wall installations measure site conditions. Do not scale drawings.

.7 Drawing designation indicates active finned length.

PART 3 - EXECUTION

3.1 HEATING UNITS INSTALLATION

.1 Install baseboard convector heaters, blank sections and controls.

.2 Provide for pipe movement during normal operation.

.3 Install in accordance with the manufacturer's installation drawings, recommendations and requirements.

.4 Verify electrical service work with characteristics stamped on unit.

.5 Venting:

.1 On up-fed units provide screw driver vent on convectors and standard air vent with cock on continuous wall convectors.

.2 Provide standard air vent with cock unless piping is installed above units and is self-venting into mains.

.3 Pitch heating elements to assist air venting.

.6 Check for correct element lengths in cabinets as work progresses. Scheduled length is actual finned length.

.7 Field measure for lengths of convector, wall fin or other cabinetry prior to manufacture.

.8 Touch up scratches in factory paint finishes on units.

.9 Install thermostats in locations indicated.

END OF SECTION 26 08 00

□

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes materials, requirements and installation for unit heaters.

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 SUBMITTALS

.1 Shop Drawings:

.1 Submit shop drawings for heaters.

.2 Indicate, at minimum, the following:

.1 Equipment, capacity and piping connections.

.2 Dimensions, internal and external construction details, recommended method of installation with proposed [structural steel] support, sizes and location of mounting bolt holes.

.2 Closeout Submittals:

.1 Provide maintenance data for incorporation into Operational and Maintenance manual.

PART 2 - PRODUCTS

2.1 UNIT HEATER (UH-_)

.1 Application: Vertical or horizontal arrangement as scheduled.

.2 Casing: 18 ga cold rolled steel, phosphatized, gloss enamel finish, with threaded connections for hanger rods.

.3 Coils: Seamless copper tubing, with evenly spaced aluminium fins mechanically bonded to tubing.

.4 Fan: Direct drive propeller type, factory balanced, with aluminium blades and fan guard on horizontal units.

.5 Motor: speed as indicated, continuous duty, built-in overload protection on all single phase motors, and resilient motor supports.

.6 Air Outlet:

.1 Vertical Unit: Adjustable multi-vane diffuser.

PART 3 - EXECUTION

3.1 HEATING UNITS INSTALLATION

.1 Provide for pipe movement during normal operation.

.2 Install in accordance with the manufacturer's installation drawings, recommendations and requirements.

.3 Verify electrical service work with characteristics stamped on unit.

.4 Venting:

.1 On up-fed units provide screw driver vent on convectors and standard air vent with cock on continuous wall convectors.

.2 Provide standard air vent with cock unless piping is installed above units and is self-venting into mains.

.3 Pitch heating elements to assist air venting.

.5 Check for correct element lengths in heating cabinets as work progresses. Scheduled length is actual finned length.

.6 Set unit heater discharge pattern required to suit application.

.7 Touch up scratches in factory paint finishes on units.

END OF SECTION 23 82 39

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes materials, requirements and installation for hydronic in-floor heating systems.

1.2 SCOPE OF WORK

.1 Performance Requirements: Furnish and install, in accordance with the recommendations of the manufacturer, a hydronic heat distribution system.

.2 System shall be complete and shall include system design, zone pumps, expansion tank, tubes, tube bend supports, tube tie-wires, isolation and control valves, fittings, manifolds, manifold supports, valve actuators, room thermostats and 120/24V AC (CSA approved) transformer(s).

.3 Examine all other portions of the subcontract documents for work of other terms and conditions related to the work of this section. Provide all work there under as required for the support and accommodation of related work.

1.3 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.4 SUBMITTALS

.1 Shop Drawings:

.1 Submit system design, control schematic and shop drawings indicating zone pump selection, expansion tank selection, loop layout, manifold locations, initial loop flow balance settings, floor profiles, floor coverings and product components, including anchorage, accessories and finishes.

.1 Include installation drawings of tubing layout indicating loop length, loop spacing, tube size and detail notes to aid in installation of system.

.2 Include control schematic indicating heat source, mechanical piping and accessories from heat source to manifolds, zone pump and zone controls. Also indicate supply water temperatures and flow rates to manifolds.

.3 No fabrication shall be performed until approval is given.

.2 Quality Assurance Submittals: Submit the following:

.1 Copy of certificate indicating that the installer is certified in the installation of the manufacturer's products.

.2 Installer shall provide in writing to the project owner that the PEX tubing and components furnished under this specification conforms to the material and mechanical requirements specified herein.

.2 Closeout Submittals:

.1 Provide maintenance data for incorporation into Operational and Maintenance manual.

1.5 SUBSTANTIAL COMPLETION

.1 Submit Operation and Maintenance Data:

.2 Warranty documents.

.3 Manufacturer's Field Reports.

.4 Final "As-Built" loop layout drawing.

.5 Control schematic.

.6 Commissioning checklists.

.7 Letter from manufacturer indicating that the project has been registered as a “Certified Project”.

1.6 WARRANTY

.1 Tubing shall carry a 25-year non-prorated parts and labour warranty against failure due to defect in material or workmanship.

.2 Manifolds and fittings shall carry a 5-year non-prorated parts and labour warranty against failure due to defect in material or workmanship.

.3 Controls and electrical components shall carry a 2-year non-prorated parts and labour warranty against failure due to defect in material or workmanship.

.4 Warranty shall provide for repair or replacement of any tube or fittings which are proven to be defective and pay for consequential damages.

.5 Warranty shall provide for twenty-five (25) years on the system design when the project is registered by the manufacturer as a “Certified Project” installed in accordance with the “Certified Project Checklist”.

.6 Warranty shall be transferable to subsequent owners.

.7 Warranty shall commence on Date of Project Substantial Completion.

PART 2 - PRODUCTS

2.1 TUBING

.1 Tube Materials: Tube shall be cross-linked polyethylene (PEX).

.1 Tubing shall be listed to a maximum 25 flame spread and maximum of 50 smoke developed per the requirements of CAN/ULC-S102.2-M88.

.2 Tubing penetrating a fire separation shall be sealed per CAN/ULC-S115-M95.

.3 Tubing contained within a CAN/ULC-S101 floor/ceiling assembly shall be listed per CAN/ULC-S101-M89.

.4 Tubing shall be manufactured in accordance with ASTM F876. The tube shall be listed to ASTM by an independent third party agency.

.5 Nominal 12 mm or 16 mm [1/2” or 5/8"] inside diameter cross-linked polyethylene tube. Tubes shall be rated 82°C at 689 kPa [180°F @ 100 psi].

.6 Oxygen Barrier: Tube shall have an oxygen barrier capable of limiting oxygen migration through the tube wall to no greater than 0.10 g/m3/day at 40°C [104°F] water temperature per the requirements of DIN 4726.

.7 Tubing shall have hydrostatic design and pressure ratings of 82°C [200°F] at 551 kPa [80 psi], 82°C [180°F] at 689 kPa [100 psi], and 23°C [73.4°F] at 1102 kPa [160 psi].

.8 Minimum bend radius for cold bending of the tubing shall not be less than 6 times the outside diameter. Bends with a radius less than stated shall require the use of a bend support as supplied by tube manufacturer.

2.2 MANIFOLD

.1 Fully assembled and mounted on a durable bracket with an end cap on the supply manifold and an end cap with vent and drain on the return manifold.

.2 Unions on the inlet side of the manifold to allow for various connection adapters.

.3 Inlet side temperature gauges with strainer and shutoff valve will provide full manifold isolation.

.4 Electronic flow and temperature balancing technology shall be provided via a flow and temperature nipple in conjunction with a hand-held instrument for precise balancing of the manifold.

.5 Integral manual air vents on return.

.6 Manufactured from brass.

.7 Flow and temperature balancing nipples.

2.3 FITTINGS

.1 Fittings shall be manufactured of polysulfone or dezincification resistant brass.

.2 The fitting assembly consists of a barbed insert, a compression ring and a compression nut.

2.4 ACCESSORIES

.1 Manifold Cabinet: Provide a cabinet to enclose the supply and return manifolds and the zone pump. Panels shall be recessed wall mounted, enamelled steel with hinged and key locked front door.

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 GENERAL

.1 Comply with manufacturer’s product data, including product technical bulletins, installation instructions and product carton instructions for installation.

.2 Install hydronic radiant heat tubing loops in accordance with tubing manufacturer’s recommendations and as indicated on Contract Drawings. Installation shall follow shop drawings for tube layout, tube spacing, manifold configuration, manifold location, and controls. Comply with notes on shop drawings.

.3 Manifolds supply and return piping shall be isolated with ball valves.

.4 Fittings and manifolds shall be accessible for maintenance.

.5 Install tubing loops without splices. It is acceptable to install a repair splice within the embedded loop should on-site damage occur and an emergency repair be authorized by the Departmental Representative.

.6 Ensure that no glues, solvents, sealants or chemicals come in contact with the tubing.

.7 Manufacturer’s bend supports shall be used where tubing enters and exits the slab.

.8 Pressurize tubing system with air or water in accordance with applicable codes or, in the absence of applicable codes, to a pressure of 413 kPa [60 psi] for 24 hours prior to encasement of tubing system. Tubing shall remain pressurized during encasement and for a period of 24 hours thereafter to ensure system integrity.

.9 System shall not be operated during panel concrete curing period.

3.3 ADJUSTING

.1 Initial Balancing: Adjust flow to all loops as indicated on shop drawings

.2 Final Balancing: Balance all loops to equal temperature drops after radiant floor heating system has been in operation and building temperature has stabilized to normal operating conditions.

END OF SECTION 23 83 05

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes methods and procedures for start-up, verification and controls commissioning, for building Energy Monitoring and Control System (EMCS) and includes:

.1 Start-up testing and verification of systems.

.2 Check out demonstration or proper operation of components.

.3 On-site operational tests.

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 SUBMITTALS

.1 Final Report: Submit report to Departmental Representative.

.1 Include measurements, final settings and certified test results.

.2 Bear signature of commissioning technician and supervisor.

.3 Report format to be approved by Departmental Representative before controls commissioning is started.

.4 Revise "AS-BUILT" documentation, controls commissioning reports to reflect changes, adjustments and modifications to EMCS as set during controls commissioning and submit to Departmental Representative.

.5 Recommend additional changes and/or modifications deemed advisable in order to improve performance, environmental conditions or energy consumption.

.2 Closeout Submittals:

.1 Provide documentation, Operational and Maintenance Manuals, and training of O&M personnel for review of Departmental Representative before interim acceptance.

1.4 COMPLETION OF CONTROLS COMMISSIONING

.1 Controls commissioning to be considered as satisfactorily completed when objectives of controls commissioning have been achieved and reviewed by Departmental Representative.

1.5 ISSUANCE OF FINAL CERTIFICATE OF COMPLETION

.1 Final Certificate of Completion will not be issued until receipt of written approval indicating successful completion of specified commissioning activities including receipt of commissioning documentation.

PART 2 - PRODUCTS

.1 NOT USED

PART 3 - EXECUTION

3.1 SYSTEM COMMISSIONING AND CALIBRATION

.1 Program each standalone EMCS panel immediately following installation.

.2 Set up and calibrate all control loops and sensors during the initial start-up of the systems and check, recalibrate and readjust as necessary during the Owner's Demonstration and Instruction period.

.3 Upon completion of the installation, perform all necessary testing and debugging operations satisfactorily.

.4 Perform all modifications and alterations as required to correct any deficiencies noted during these tests.

.5 Check sensor calibration and control system operation during the first heating season and prior to the first cooling season.

3.2 SUBSTANTIAL PERFORMANCE TEST PROCEDURES

.1 Overview: The successful completion of SEVEN [7] day acceptance test as described herein is a prerequisite to Substantial Performance.

.2 Before the SEVEN [7] day acceptance test may begin the CAS must be completely operational including the following:

.1 Every point shall be checked end to end to ensure accuracy and integrity of systems. Each point of the EMCS Points List shall be signed off by a representative of the Controls Contractor.

.2 Start up control strategies shall be written in Operator Control Language.

.3 Graphical displays shall be complete and operational.

.4 Each sensor shall be placed on a trend.

.5 Runtime totalizers shall be set.

.6 Load/save of panel programs must be demonstrated.

.7 All features of system shall be exercised.

.8 Operator shall be briefed on operation of system.

.9 A trend on one panel shall be set up for a point from every other panel. These points shall also be trended in their own panels for the same intervals. Comparison of the two groups of trends will indicate if any communication problems are occurring during SEVEN [7] day test.

.10 All alarms shall be operational.

.11 Calibration of all sensors.

.12 Review with the Contractor all tests to be performed during the Seven Day test. Add any tests the Departmental Representative sees necessary in order to demonstrate proper operation of the Mechanical and Controls system.

.3 During SEVEN [7] Day Test

.1 Power failure for building shall be simulated, system recovery monitored.

.2 Controls strategy sequences shall be initiated which will exercise as many features of the system as possible given the temperature conditions at the time of the test. Some sequences may require artificially loading the building in order to simulate conditions for the control sequences to respond properly.

.3 Demonstration of network operation will be required.

.4 Demonstration of hardware low limits and damper interlocks will be required.

.5 Spot checks of points end-to-end integrity will be carried out. If several problems are identified, a complete reconfirmation of system integrity will be required by Contractor.

.6 Results of all tests shall be documented, including written description of conditions during the test, any artificial conditions created in order to perform the test, and a one page trend chart showing the operation of relevant parts of the system during each test.

.4 Documentation: The following documentation must be in place before completion of SEVEN [7] day test and the granting of Substantial Performance:

.1 Panel layout sheets complete with point name, point address and wire identification number. One copy attached to each respective panel door.

.2 All points tagged with point name, point address and panel number.

.3 System generated Point Check-Out data sheets calibration information.

.4 As-Built control drawings.

.5 As-Built ladder wiring diagrams showing all hardware interlocks and panel input or output number.

.6 Operating and Maintenance Manual for all sensors, transducers, valves, operators, solid state relays, EMCS panels and controllers.

.7 On-line graphics with reduced floor plans showing sensors, terminals, and panel locations as well as mandatory graphic requirements.

3.3 ADJUSTING

.1 Final adjusting: upon completion of controls commissioning as reviewed by Departmental Representative, set and lock devices in final position and permanently mark settings.

3.4 DEMONSTRATION TO OWNER

.1 The Controls Programming Contractor shall demonstrate to designated personnel the adjustment, operation and maintenance, including pertinent safety requirements, of the equipment and system provided to the satisfaction of the Owner's representative. Provide a minimum of one day [7-1/2 hours] instruction.

.2 Demonstrations to include sequence of operations in regular and emergency modes, under normal and emergency conditions, start-up, shut-down interlocks and lock-outs.

END OF SECTION 25 01 11

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes requirements and procedures for training program, instructors and training materials for the building Energy Monitoring and Control System (EMCS).

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 SUBMITTALS

.1 Submit training proposal complete with hour-by-hour schedule including brief overview of content of each segment to Departmental Representative 30 days prior to anticipated date of beginning of training.

.1 List name of trainer and type of visual and audio aids to be used.

.2 Show co-ordinated interface with other EMCS mechanical and electrical training programs.

1.4 INSTRUCTIONS AND DEMONSTRATION TO OWNER

.1 The Controls Programming Contractor shall provide instruction and demonstrate to designated personnel the adjustment, operation and maintenance, including pertinent safety requirements, of the EMCS equipment and system provided to the satisfaction of the Owner's representative.

.2 Training to be project-specific.

1.5 TIME FOR INSTRUCTION

.1 Provide a minimum of one day [7-1/2 hours] instruction.

1.6 TRAINING MATERIALS

.1 Provide equipment, visual and audio aids and materials for classroom training.

.2 Supply manual for each trainee, describing in detail data included in each training program.

.3 Review contents of manual in detail to explain aspects of operation and maintenance.

PART 2 - PRODUCTS

.1 NOT USED.

PART 3 - EXECUTION

.1 NOT USED.

END OF SECTION 25 01 12

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes general requirements for building Energy Monitoring and Control System (EMCS).

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 SUBMITTALS

.1 Closeout Submittals:

.1 Provide maintenance data for incorporation into Operational and Maintenance manual.

1.4 GENERAL

.1 The control system shall be fully electric / electronic, modular, flexible and fully commissioned Energy Monitoring and Control System (EMCS). Controls not scheduled on the points list may be electric.

.2 Provide the controls system complete with all necessary control components and connections to achieve the specified functions and to permit the HVAC systems to perform properly in the manner described and as hereinafter specified.

.3 Provide all necessary wiring and components within the building to connect the EMCS, via modem and Internet, to allow remote monitoring of the building EMCS.

.4 Provide all necessary wiring and components within the building to connect the building EMCS to the Port Hardy Airport's Communications trunk. The Owner is responsible to provide the suitable network wiring from the building EMCS to the Airport's Automation System.

.5 Set up and adjust the new and existing control system (including adjustment of actuator linkage) to achieve optimum operation of the HVAC system. This includes sequencing, timing and readjustment, as required. Modifications to the sequence of operation using points indicated will not be considered as extra to the Contract. These modifications shall continue through the construction period, commissioning period and warranty period as required to achieve optimum operation of the mechanical system.

.6 Division 25 is a performance specification clarified in certain sections to establish minimum standard of equipment, installation or level of control. The specification describes the basic functions required but not all of the installation details or components. Both Controls Contractor and Programming Contractor are expected to have sufficient experience to be able to design and estimate the cost of an appropriate control system. Materials and work necessary to achieve a satisfactory result will not be considered extra to the Contract.

.7 The control system shall be installed and programmed by the Controls Contractor using competent personnel directly and regularly employed by that company.

1.5 DEMOLITION

.1 All controls conduit, wiring and equipment that becomes redundant and is no longer required due to the work shall be completely removed from the site.

PART 2 - PRODUCTS

2.1 EQUIPMENT

.1 The control system shall be Bacnet Testing Laboratories (BTL) certified. The Operator Workstation, Building Controller, Advanced Application Controllers and Application Specific Controllers shall all be BTL certified. All hardware shall be BACnet; gateways or interpreter devices are not acceptable.

.2 Acceptable controls system manufacturers are:

.1 Delta Controls Inc.

.2 Reliable Controls Corporation.

.3 All sensors and control system components shall be compatible. All control panels and components (except valves, dampers and sensors) shall be located in the Mechanical Room or Boiler Room where shown.

.4 The Controllers' outputs shall be equipped with HOA switches.

2.2 EQUIPMENT SUPPLIED FOR INSTALLATION UNDER OTHER SECTIONS

.1 The following equipment shall be supplied under this section but installed under the appropriate trade sections of Mechanical Division:

.1 Automatic control dampers.

.2 The Controls Subcontractor shall be responsible for arranging, coordinating and supervising the installation of the above devices in a suitable manner and readily accessible location.

PART 3 - EXECUTION

3.1 MANUFACTURER'S RECOMMENDATIONS

.1 Installation: to manufacturer's recommendations.

END OF SECTION 25 05 01

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes methods and procedures for shop drawings and submittals for building Energy Monitoring and Control System (EMCS).

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 SUBMITTALS

.1 Shop Drawings:

.1 Hard copy to be completely indexed and coordinated package to assure compliance with contract requirements and arranged in same sequence as specification and cross-referenced to specification section and paragraph number.

.2 Submit shop drawings for the complete EMCS.

.3 Provide five (5) copies of shop drawings of all equipment on the drawings and specifications to the Departmental Representative for review.

.4 Shop drawings shall include:

.1 Written description indicating Sequence of Operation.

.2 System graphics and a description of the methodology used to keep graphics files on various PC terminals updated and consistent with one another (remote computer graphics vs. site computer).

.3 Manufacturer's descriptive technical literature for all equipment and devices.

.4 An overall system interconnecting schematics showing all remote panels (PCs, Field Panels, and LAN devices), and power/surge protection locations.

.5 Distributed panel locations (building plan as appropriate to identify physical locations).

.6 Wiring and piping diagrams.

.7 One-line diagram from sensor and control points to Field Interface device and/or standalone EMCS panel including all components and cables.

.8 Terminal cabinets, including termination listing.

.9 All input/output points which shall include the following information associated with each point.

.1 Sensing element type and location.

.2 Details of associated field wiring schematics and schedules.

.10 Detailed block diagrams of transmission trunk routing and configuration.

.11 Damper schedules indicating size, configuration, capacity and locations.

1.4 SHOP DRAWING REVIEW

.1 Review or non-review of shop drawings does not alter the requirements of the equipment and materials provided to conform to the Specification.

.2 When submitting the controls shop drawings arrange a time to review these in detail in the Departmental Representative’s office.

PART 2 - PRODUCTS

.1 NOT USED

PART 3 - EXECUTION

.1 NOT USED

END OF SECTION 25 05 02

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes requirements and procedures for final control diagrams and Operation and Maintenance (O&M) Manual for building Energy Monitoring and Control System (EMCS).

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 SUBMITTALS

.1 Shop Drawings:

.1 Submit shop drawings for all control devices.

.2 Closeout Submittals:

.1 Provide maintenance data for incorporation into Operational and Maintenance manual.

PART 2 - PRODUCTS

2.1 OPERATING AND MAINTENANCE MANUALS

.1 Refer to Section 23 0300 - Common Work Results for Mechanical.

.2 The maintenance manual data is intended to cover the operation and maintenance of all control systems and equipment installed.

.3 Forward 4 copies of the Controls and Instrumentation section of the operating and maintenance manuals to the Balancing Agency to ensure the binding and format of material are compatible. Ensure sufficient time has been given to the Balancing Agency for the compiling of the complete operating and maintenance manuals by the commissioning deadline. One complete manual shall be furnished prior to the time that system or equipment tests are performed.

.4 The manuals shall include the name, address and telephone number of the Control Contractor and a list of emergency numbers for service personnel. The manuals shall have a table of contents and be assembled to conform to the table of contents with the tab sheets placed before instructions covering the subject.

.5 Also provide the controls Operation and Maintenance manual information in electronic form burned onto a CD.

2.2 RECORD DRAWINGS

.1 Refer to Section 23 0300 - Common Work Results for Mechanical.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes requirements and procedures for identification of devices, sensors, wiring, conduit and equipment, for building Energy Monitoring and Control System (EMCS) Work and nameplates materials, colours and lettering sizes.

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 SUBMITTALS

.1 Submit to Departmental Representative for approval samples of nameplates, identification tags and list of proposed wording.

.2 Closeout Submittals:

.1 Provide maintenance data for incorporation into Operational and Maintenance manual.

PART 2 - PRODUCTS

2.1 GENERAL

.1 All manual switches, unless they come with standard nameplates, shall be labelled with engraved lamicoid plastic nameplates to clearly indicate the service. Wording on nameplates shall be subject to approval by the Departmental Representative.

2.2 NAMEPLATES FOR PANELS

.1 Label and identify all panels and points with a numbering system consistent with the Owner's EMCS network numbering system.

.2 Identify all EMCS panels and associated devices with symbols relating directly to the control diagram. Provide plastic labels for each input and output point with the following information:

.1 Point descriptor.

.2 Point type and channel number.

.3 Corresponding EMCS panel number.

.3 Mount an input/output layout sheet within each EMCS panel. This sheet shall include the name of the points connected to each controller.

2.3 NAMEPLATES FOR FIELD DEVICES

.1 Identify all controls with symbols relating directly to the control diagram.

.2 Data to include: point name and point address.

.3 Use plasticized tags, engraved brass, aluminum, metalphoto or lamicoid labels and secure them to, or adjacent to, the control devices with key chains.

.4 Provide lamicoid label by each freeze stat. "LOW TEMP CUT-OUT. MANUAL RESET".

2.4 NAMEPLATES FOR ROOM SENSORS

.1 Identify by stick-on labels using point identifier.

.2 Location: as directed by Departmental Representative.

.3 Letter size: to suit, clearly legible.

2.5 WIRING

.1 Supply and install numbered tape markings on wiring at panels, junction boxes, splitters, cabinets and outlet boxes.

.2 Colour coding: to CSA C22.1. Use colour coded wiring in communications cables, matched throughout system.

.3 Power wiring: identify circuit breaker panel/circuit breaker number inside each EMCS panel.

.4 Use colour coded conductors, white for neutral.

2.6 CONDUIT

.1 Identify, with colour bands, all conduits at all junction and pullboxes, at both sides of wall and floors and at not more than 7.5 m [25 ft] intervals along the length.

.2 Identification bands to be sprayed on and not less than 100 mm [4"] wide. Bands to be pink in colour unless in conflict with Electrical Division colours.

.3 Identify all junction box covers with control company label. Paint junction box covers blue.

PART 3 - EXECUTION

3.1 NAMEPLATES AND LABELS

.1 Ensure that manufacturer's nameplates, CSA labels and identification nameplates are visible and legible at all times.

END OF SECTION 25 05 54

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes materials, requirements and installation for field installation of the EMCS.

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 SUBMITTALS

.1 Shop Drawings:

.1 Submit shop drawings for all control devices and equipment.

.2 Closeout Submittals:

.1 Provide maintenance data for incorporation into Operational and Maintenance manual.

1.4 SYSTEM DESCRIPTION

.1 Electrical:

.1 Provided by the Control Contractor (Mechanical Division):

.1 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.

.2 Refer to the electrical equipment schedule, the electrical drawings and the electrical specification, which describes the limits of the extent to the work in Electrical Division serving mechanical systems.

.3 Materials, equipment, connections and power not provided by Electrical Division but required for the Control System shall be provided under this Division.

.4 All control circuit transformers (120/1/60 or 24/1/60 and as designated).

.5 All control wiring and metallic conduit for mechanical system controls.

.6 Supply, installation and connection of all electric control items including: relays, outside sensors, sub-master control circuits, safety devices, electric thermostats, aquastats, wiring to terminal strips, proportional controllers, controllers, etc.

.7 All wiring and conduit from emergency power distribution system to any control devices needing power (including EMCS components).

.8 Hard wiring between field control devices and EMCS field panels.

.9 Communication wiring between EMCS field panels and OWS's including main Building Environmental Control Center.

.10 Modify existing starters to provide for EMCS as indicated in I/O Summaries and as indicated.

.11 Be responsible for coordinating with Electrical Division.

.12 Electrical work installed under Mechanical Division shall be to the standards specified under Electrical Division.

.2 Provided by the Electrical Division:

.1 All power wiring and conduit from power distribution system up to and including connection to all motors and starters.

.2 All disconnect switches required (unless specified in schedules as being integral with equipment).

.3 All motor protection switches, stop-start switches, magnetic starters, contactors and hand-off-automatic selector switches except those supplied as part of packaged equipment.

.4 Terminal strips within the motor control centers (MCC) for control connections.

.5 Fire alarm signals.

.3 Note: All magnetic starters for equipment shall have the following features supplied under Electrical Division:

.1 Hand-off-automatic selector or on-off selector, or start-stop buttons in cover with hand-automatic bridge if applicable.

.2 Pilot light.

.3 120 volt coils.

.4 120 volt control transformer.

.5 Four auxiliary dry contacts for interlocks; two normally open and two normally closed.

.4 The Controls Contractor is responsible for reading Electrical Division plans and specifications to determine scope of responsibility and standards.

PART 2 - PRODUCTS

2.1 WIRING AND CONDUIT

.1 Carrier System:

.1 All wiring for 24 volts or less in mechanical service spaces, in stud walls or where exposed to view shall be run in EMT conduit except the final 900 mm [3 feet] of wiring to all operators and to all sensors subject to vibration which shall be run in flexible metallic conduit.

.2 Provide conduit for all wiring between the fire alarm panel and the EMCS panels.

.3 All wiring for over 24 volts shall be run in EMT conduit.

.4 Provide steel fittings with nylon throats for all conduit connections.

.2 Wire:

.1 Line voltage power or switched power wiring - #12 gauge copper wire minimum.

.2 Line voltage control wiring - #14 gauge copper wire, length not to exceed 50 meters; #12 gauge copper wire, lengths exceeding 50 meters.

.3 Low voltage - minimum #20 gauge wire as directed by applicable electrical codes and requirements.

.3 Cable:

.1 Data transmission cable shall be minimum Category 5 cable.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.

3.2 ELECTRICAL COMPONENTS, WIRING AND CONDUIT

.1 Run carrier system and wire not in conduit parallel to building lines.

.2 Support carrier system to Electrical Division standards independent of piping, ductwork and equipment.

.3 Support wire not in a carrier system every one meter independent of piping, ductwork and equipment.

.4 Control wiring shall not be placed in the electrical cable tray.

.5 All wiring shall be concealed in finished spaces.

.6 Seal all penetrations through fire separations as per Code requirements.

.7 Adhere to all applicable electrical codes and regulations.

.8 Obtain electrical permit.

.9 For non CSA equipment, submit to Inspection Authorities and obtain approval prior to installation of equipment on site.

.10 Receptacles:

.1 Install vertically in gang type outlet box when more than one receptacle is required in one location.

.2 Cover plates:

.1 Install suitable common cover plate where wiring devices are grouped.

.2 Use flush type cover plates only on flush type outlet boxes.

END OF SECTION 25 05 60

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes requirements and procedures for warranty and activities during warranty period and service contracts, for building Energy Monitoring and Control System (EMCS).

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 SUBMITTALS

.1 Submit detailed inspection reports to Departmental Representative.

.2 Submit network analysis report showing results with detailed recommendations to correct problems found.

.3 Records and logs:

.1 Maintain records and logs of each maintenance task on site.

.2 Organize cumulative records for each major component and for entire EMCS chronologically.

.3 Submit records to Departmental Representative, after inspection indicating that planned and systematic maintenance have been accomplished.

.4 Revise and submit to Departmental Representative documentation and commissioning reports to reflect changes, adjustments and modifications to EMCS made during warranty period.

.5 Closeout Submittals:

.1 Provide maintenance data for incorporation into Operational and Maintenance manual.

1.4 WARRANTY

.1 Refer to General Conditions.

.2 The system including all hardware and software components shall be warranteed for a period of one year following the date of final acceptance. Any manufacturing defects arising during this warranty period shall be corrected without cost to the Owner.

.3 All applicable software as detailed in this specification shall be updated free of charge during the warranty period. This will ensure that all system software will be the most up-to-date software available. All future update to the software/hardware shall be made available to the Owner.

.4 Provide written assurance that a local service centre will be maintained with a complete stock of replacement parts, and is capable of servicing any and all troubles in the system.

.5 Use of installed equipment during construction shall not shorten or alter the warranty period as specified in the General Conditions.

.6 The warranty shall cover all costs for parts, labour, associated travel, any software sequence modifications, and expenses throughout the warranty period.

.7 Take note of and provide any extended warranties specified.

1.5 MAINTENANCE SERVICE DURING WARRANTY PERIOD

.1 The Controls Contractor shall provide all services, materials and equipment necessary for the maintenance of the entire Control System, for a period of one year concurrent with the warranty period. Any necessary material required for the maintenance work shall be provided by the Controls Contractor.

.2 The Controls Contractor shall provide one inspection per quarter or as required by the manufacturer and all service for the required maintenance.

.3 Systems Modification: recommendations for system modification shall be provided in writing to the Departmental Representative. No system modification, including operating parameters and control settings, shall be made without prior approval and necessary maintenance on printers.

.4 Provide services, materials, and equipment to maintain EMCS for specified warranty period. Provide detailed preventative maintenance schedule for system components as described in Submittal article.

.5 Emergency Service Calls:

.1 Repairs required by a total system failure or the malfunction of any priority portion of the system shall be considered an emergency repair and shall be performed within eight (8) hours of the report of the failure.

.2 Repairs of a non-emergency nature shall be promptly repaired on the next normal business day.

.3 Initiate service calls when EMCS is not functioning correctly.

.4 Qualified control personnel to be available during warranty period to provide service to "CRITICAL" components whenever required at no extra cost.

.5 Furnish Departmental Representative with telephone number where service personnel may be reached at any time.

.6 Perform Work continuously until EMCS restored to reliable operating condition.

.6 Operation: Foregoing and other servicing to provide proper sequencing of equipment and satisfactory operation of EMCS based on original design conditions and as recommended by manufacturer.

.7 Provide system modifications in writing. No system modification, including operating parameters and control settings, to be made without prior written approval of Departmental Representative.

PART 2 - PRODUCTS

.1 NOT USED.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

.1 Provide detailed written report to Departmental Representative as described in Submittal article.

.2 Perform inspections during regular working hours, 0800 to 1630 h, Monday through Friday, excluding statutory holidays.

.3 Following inspections are minimum requirements and should not be interpreted to mean satisfactory performance:

.1 Perform calibrations using test equipment having traceable, certifiable accuracy at minimum 50% greater than accuracy of system displaying or logging value.

.2 Check each field input/output device.

.3 Provide dated, maintenance task lists, as described in Submittal article, as proof of execution of complete system verification.

.4 Rectify deficiencies revealed by maintenance inspections and environmental checks.

.5 Continue system debugging and optimization.

.6 Contractor shall allow for one return to site for post-commissioning review during peak heating season.

.7 Test weather-sensitive systems twice: first at near winter design conditions and secondly under near summer design conditions.

END OF SECTION 25 08 20

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes hardware and software requirements for the Programs for the Building Control System (EMCS).

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 SUBMITTALS

.1 Shop Drawings:

.1 Submit shop drawings for all control devices.

.2 Closeout Submittals:

.1 Provide maintenance data for incorporation into Operational and Maintenance manual.

PART 2 - PRODUCTS

2.1 PROGRAM REQUIREMENTS

.1 All control software, graphics generation software, energy management software and maintenance software shall be provided. Provide licences for each of these software packages and install one (1) on a remote computer.

.2 All software shall be provided for the Owner to make any changes to the system without Control Contractor support (i.e. if the Owner needs to change a graphic, provide the graphic software that generated the original).

.3 Provide all hardware and software necessary to allow remote communications via internet to off-site locations. The off-site locations shall be able to communicate with the remote site system even if the remote PC is turned off or not functioning. If a gateway or key is required for any remote communication function what so ever, the Control Contractor shall provide to the Owner, at no cost, for as many remote sites present and future as the Owner desires.

.4 The Controls Contractor shall set and adjust the control system to achieve optimum operation of the system. This includes sequencing, timing and readjustment, as required. Modifications to the sequence of operation using points indicated will not be considered as extra to the Contract. These modifications shall continue through the construction period, commissioning period and warranty period as required to achieve optimum operation of all systems controls.

2.2 POINT NAMES

.1 All point names, real and virtual, shall be consistent with the naming system used in the Owner's other buildings.

.2 The Controls Contractor shall coordinate the proposed naming system with the Owner's representative and submit the list for review.

2.3 GRAPHICAL USER INTERFACE

.1 Graphical User Interface for this project shall be consistent with the graphics used in the Owner's other buildings.

.2 Operator workstation interface software shall optimize operator understanding through the use of English language prompting, English language point identification and industry standard PC application software.

.3 The software shall provide, as a minimum, the following functionality:

.1 Real-time graphical viewing and control of environment.

.2 Scheduling and override of building operations.

.3 Collection and analysis of historical data and dynamic data (trend plot).

.4 Definition and construction of dynamic colour graphic displays.

.5 Editing, programming, storage and downloading of global controller databases.

.6 Alarm reporting, routing, messaging, and acknowledgment.

.4 Provide a graphics, which shall minimize the use of keyboard through the use of a mouse and “point and click” approach to menu selection.

.5 Provide functionality such that any of the following may be performed simultaneously on-line, and in any combination, via user-sized windows:

.1 Dynamic colour graphics and graphic control.

.2 Alarm management, routing to designated locations, and customized messages.

.3 Week at a Glance Time-of-Day scheduling.

.4 Trend data definition and presentation.

.5 Graphic definition and construction.

.6 Program and point database editing on-line.

.6 Provide a security system that prevents unauthorized use unless the operator is logged on. Access shall be limited to the operator’s terminal functions unless the user is logged on.

.7 Each operator Terminal shall provide security for 50 users (minimum). Each user shall have an individual password. Each user shall be individually assigned which control functions and menu items the user has access to. All passwords, user names and access assignments shall be adjustable on-line, at the operator’s terminal. Each user shall also have a set security level that defines access to displays and also defines what individual points the user can control.

.8 As a minimum, the system shall allow the user to easily obtain the following types of reports:

.1 A general listing of all or selected points in the network.

.2 List of all points currently in alarm.

.3 List of all points currently in override status.

.4 List of all points currently locked out (manual report).

.5 List of user accounts and access levels.

.6 Excel reports.

.7 System diagnostic reports including, list of EMCS panels on line and communicating, status of all EMCS terminal unit device points.

.8 List of programs.

.9 Scheduling and Override:

.1 Provide a graphical spreadsheet-type format for simplification of time-of-day scheduling and overrides of building operations. Schedules reside in both the PC workstation and EMCS Global Controller to ensure time equipment scheduling when PC is off-line, PC is not required to execute time scheduling. Provide override access through menu selection or function key. Provide the following spreadsheet graphic types as a minimum:

.1 Display of Weekly schedules shall show all information in easy to read 7-day (week) format for each schedule. This includes all on/off times for each day along with all optimum start information.

.2 Holiday schedules shall show all dates that are to be holidays. Holidays shall be shown on the terminal in a graphical calendar format showing all scheduled days for a given month. User shall be able to easily scroll through the months for each

year. Each day assigned as a holiday shall display as "All Off" or show "Scheduled" for that day.

.3 Event schedules shall be shown in the same graphical calendar format and manner as Holiday schedules.

.2 Operator shall be able to change all information for a given Weekly, Holiday or Event schedule if logged on with the appropriate security access.

.10 Controller Status: Provide means for operator to view communication status of all controllers connected to the system. Display shall include controller and status. Status will show if controller is communicating or not.

.11 Configuration/Set up: Provide means for operator to display and change system configuration. This shall include but not be limited to system time, day of the week, date of day light savings set forward/setback, printer type and port addresses, modem port and speed, etc. Items shall be modified utilizing easy to understand terminology using simple mouse/cursor key movements.

.12 Dynamic Colour Graphic Displays

.1 Create Site Layout Colour graphic including icons which link to building equipment, building floor plan displays with room temperatures and other building sensors values dynamically displayed. Icons on the floor plans will allow links to the building Mechanical equipment. Provide System graphics for each piece of mechanical equipment and hot water systems as applicable, with dispersed dynamic data as indicated in the Points List. Points required by the sequence of operations shall also be displayed even if they are not defined by the Points List to optimize system performance analysis and speed alarm recognition.

.2 All points on the EMCS Points List and all related virtual points shall be included in the graphic screens.

.3 Provide as a minimum the following graphics.

.1 Main menu graphic.

.2 Building Floor plans which indicate:

.1 All spaces served by the systems.

.2 Room temperature sensors.

.3 Control dampers.

.3 Fans shall be shown on the floor plans, clicking on the device will display all data associated with the device.

2.4 GRAPHICS AND POINTS ACCEPTANCE PROCEDURES

.1 A copy of each graphical screen page shall be signed off and dated by the Controls Contractor and the Owner’s representatives. Any changes shall be noted. This signed set shall be left on site as the “RECORD DRAWINGS”.

.2 A summary print out generated by the supplied system of each group of point types for each panel shall be printed after commissioning and calibration. Each sheet shall be signed by the Controls Contractor’s commissioning person, and the Owner’s representatives. The print out will be stored in a binder by the Owner’s representatives for reference by all.

.3 If any changes are noted during spot checks they shall be manually written on the original print out with the date and signature of person noting changes.

2.5 BUILDING AUTOMATION SYSTEM POWER FAILURE AND SYSTEM RESTART

.1 Provide automatic power failure routine to accomplish orderly shutdown of the automation system when loss of power is detected. Do not place any equipment in an unacceptable or dangerous condition as a result of power failure or restart procedures.

.2 Restart the system automatically and in an orderly fashion once power is restored.

.3 Restart equipment based on priority to minimize in-rush currents as large loads are reintroduced.

.4 Restart only those systems or loads that are normally scheduled to operate at the time of the restart.

.5 Alarm any equipment that fails to restart when requested.

.6 Provide manual reset lockout capability.

2.6 ALARMS - GENERAL

.1 No alarm shall be triggered for a device until the device has been started and is in stable operation. Use software time delays to achieve this effect.

.2 Generate an alarm on the EMCS if any equipment is not in the intended operating condition or if any analog input is not within the intended operating range continuously for at least one minute.

.3 No alarm shall be triggered for a device until the device has been started and is in stable operation. Use software time delays to achieve this effect.

.4 Generate an alarm on the EMCS if any equipment is not in the intended operating condition or if any analog input is not within the intended operating range continuously for at least one minute.

PART 3 - EXECUTION

3.1 INSTALLATION REQUIREMENTS

.1 Provide necessary power as required from local 120 V emergency power panels for all controls equipment.

END OF SECTION 25 10 02

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes materials, requirements and installation for control devices integral to the Building Energy Monitoring and Control System (EMCS).

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 SUBMITTALS

.1 Shop Drawings:

.1 Submit shop drawings for all control devices.

.2 Closeout Submittals:

.1 Provide maintenance data for incorporation into Operational and Maintenance manual.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Provide all remote sensing points and instrumentation as required for the complete operational capability of the Control System. All sensors shall have the accuracies as stated hereinafter.

.2 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.

.3 All instruments of a particular category shall be of the same type and manufacture.

.4 All external trim material shall be completely corrosion resistant with all internal parts assembled in watertight, shockproof, vibration proof, heat resistant assembly.

.5 Use standard conduit box termination with screwdriver connector block unless otherwise specifically stated.

.6 Components shall be suitable for operating conditions from 0°C [32°F] to 60°C [140°F] with 10-90% RH (non-condensing) unless otherwise specifically stated.

.7 Transmitters and sensors to be unaffected by external transmitters including walkie talkies.

.8 Outdoor installations: use weatherproof construction in NEMA 4 enclosures.

.9 Devices installed in user occupied space not exceed Noise Criteria (NC) of 35. Noise generated by any device must not be detectable above space ambient conditions.

2.2 CARBON MONOXIDE AND NITROGEN DIOXIDE GAS DETECTION SYSTEM - VEHICLE BAY

.1 Provide two channel set point monitors for the monitoring of Carbon Monoxide and Nitrogen Dioxide as indicated on the drawings and as required to properly monitor the east and west sides of the Garage.

.2 Monitors shall be housed in a single rugged, wall mount, drip-proof PVC enclosure with hinged, secured door.

.3 System power shall be120 VAC of 220 VAC, provide all required transformers.

.4 The system shall have one integral electrochemical CO sensor and one integral electrochemical NO2 sensor.

.5 The system shall have a two (5 amp-240VAC rated) dry contacts relays.

.6 One relay to activate on Low Alarm from either sensor and the second relay to activate on High Alarm from either sensor.

.7 System relays are normally energized in non-gas alarm state so they act in fail-safe operation.

.8 The measurement range shall be 0 - 200 ppm CO in air and 0 - 10 ppm NO2 in air.

.9 The monitor shall be installed at 1.22 to 1.83 m [4' to 6'] from the floor.

.10 The monitor shall incorporate LED lights for power, low alarm, high alarm, fail condition and an audible alarm with internal on/off switch.

.11 System circuit design shall be "fail-safe" so that in the event of a failure, the fail LED illuminates, the audible alarm comes on and the exhaust fans fun continuously until the failure is corrected.

.12 The monitor shall provide a user selectable time delay "on" of 2 minutes for low alarm to prevent premature fan start and a user selectable time "off" of 10 minutes to keep the fans running for a minimum time.

.13 The monitor shall provide a user selectable time delay of 10 minutes after high alarm activation before the audible alarm is activated.

.14 The monitor shall incorporate a momentary test switch for each sensor circuit to allow gas alarm simulation for testing after installation.

.15 The system shall be sensitive enough to measure to government workplace hazardous gas exposure standards.

.16 System operation shall be as follows:

.1 System relays are normally energized in non-gas alarm state so they act in fail-safe operation.

.2 Upon detection of 25 ppm CO in air or 0.7 ppm NO2 in air the system shall:

.1 Illuminate the Low Alarm LED (amber).

.2 The low alarm relay shall START the exhaust fan.

.3 Upon detection of 100 ppm CO in air or 1.5 ppm NO2 in air the system shall:

.1 Illuminate the High alarm LED (red). Exhaust fan RUNNING.

.2 The system audible alarm shall activate. Audible alarm can be silenced from the front panel push button.

.17 The Controls Contractor shall provide all wiring, conduit and interconnection required for a successful installation.

.18 Provide a written report confirming an on-site commissioning of the gas detection system and its operation of fans and alarms.

2.3 CURRENT TRANSDUCERS

.1 Design: Best Coil D78009; Nelsen-Kulisan.

.2 Range: 0-120 amps.

.3 Accuracy: +/-1%.

.4 Interface care:

.1 +/-1% accuracy.

.2 Integral zero and span adjustment.

.3 1-5 VDC or 4-20 mA output for full range input.

2.4 HUMIDITY SENSOR

.1 Suitable for wall mounting.

.2 Sensing Element: Thermoset polymer based capacitive.

.3 Accuracy: ± 2% RH.

.4 Range: 0 - 100% RH, non-condensing.

.5 Resolution: 1% RH.

.6 Hysteresis: ± 3% RH.

.7 Stability: ± 1.2% RH typical @ 50% RH in 5 years.

2.5 LOW LIMIT TEMPERATURE SWITCHES (FREEZE PROTECTION)

.1 Provide high/low temperature switches for ranges as indicated on point schedule.

.2 Temperature sensing element shall be liquid, vapour or bimetallic type.

.3 Adjustable setpoint and differential.

.4 Snap action type rated at 120 volts, or 24 V DC as required.

.5 Sensors shall operate automatically and reset automatically. Sensors used for freeze detection or fire detection shall be manually reset type.

.6 Temperature accuracy shall be +/-1°C.

.7 Continuous element with insertion length of 6m [20 feet] minimum, suitable for duct mounting to detect the coldest temperature in any 30 mm [1-1/4”] section of its length.

2.6 PANELS

.1 Controllers, Relays to be installed in NEMA I enclosures.

.2 Panels to be either free standing or wall mounted enamelled steel cabinets with hinged and key locked front door.

.3 Panels shall be modular with multiple panels being used if required for capacity in any particular location. They shall handle all requirements with space to accommodate an additional 20% without adding further cabinets.

.4 All panels shall be lockable with same key.

.5 All wiring within panels to be located in trays or individually clipped to back of panel, and clearly identified.

2.7 RELAYS

.1 Provide double voltage DPDT relays for control and status indication of alarms and/or electrical starters and equipment.

.2 Relay coils shall be rated for 120V or 24V. Where other voltages occur provide transformer.

.3 Contacts rated at 5 amps at 120V AC.

.4 Relays to be plug in type with termination base.

2.8 SURGE SUPPRESSOR/FILTER

.1 UL 1449 and UL 1283 listed.

.2 Noise suppression minimum:

.1 20 dB at 50 kHz.

.2 40 dB at 150 kHz.

.3 80 dB at 1 MHz.

.4 30 dB at 6 to 1000 MHz.

.3 High voltage spike suppression between hot to neutral, hot to ground. Handles up to 13,000 amp spikes. 210 Watt-second capacity, 300 volt let-through, less than 5 nanoseconds response.

.4 Provide surge suppressor/filter for each EMCS Panel.

2.9 TEMPERATURE SENSORS

.1 Temperature sensors shall be thermistor or resistance type.

.2 The following shall apply to thermistor or resistance temperature sensors as applicable.

.1 RTDs shall be 1,000 ohm at 0°C (+/- .2 ohm) nickel or platinum element with strain minimizing construction and 3 integral anchored leadwires, coefficient of resistivity of 0.000385 ohms/ohm/°C.

.2 Sensing element to be hermetically sealed.

.3 Stem and tip construction to be copper or 304 stainless steel as noted.

.4 Sensors to have a time constant response of less than 3 seconds to a temperature change of 10°C.

.5 Sensors shall operate over the following ranges with the accuracies over the noted range of the sensor.

.1 -50°C to 50°C, +/- 0.5°C.

.2 0°C to 50°C, +/- 0.25°C.

.3 0°C to 25°C, +/- 0.1°C.

.4 0°C to 100°C, +/- 1°C.

.6 Temperature sensors on the four water connections to the heat exchanger shall have a temperature range of 50°C to 150°C and an accuracy of +/-1°C.

.7 Immersion wells shall be of stainless steel materials. Heat transfer compound to be compatible with sensor.

.3 Temperature sensors shall be of the following types:

.1 Room type - Suitable for wall mounting complete with momentary override switch, set point adjustment, and LCD display to show space temperature and temperature set point. Element length of 10-50 mm with ceramic tube or equivalent mode of mechanical protection.

.2 General purpose duct type - suitable for insertion into air ducts at any angle, insertion length shall be suitable for application. Copper sheathed construction.

.3 Spring-loaded thermowell type - spring loaded construction with compression fitting for 20 mm [3/4”] well mounting. Lengths shall be suitable for application. Stainless steel sheathed construction.

.4 Averaging duct type - continuous filament with immersion length of 6000 mm minimum. Probe to be bent, at field installation time, to a minimum radius of 100 mm at any point along the probe length without degradation in performance. Copper sheathed construction.

.5 Outside air type - complete with non-corroding shield designed to minimize solar and wind effects, threaded fitting for mating to 12 mm [1/2”] conduit, probe length of 100 to 150 mm [4” to 6”], weatherproof construction in NEMA 4 enclosure.

PART 3 - EXECUTION

3.1 GENERAL

.1 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.

.2 Install field control devices in accordance with manufacturers recommended methods, procedures and instructions.

.3 Testing: All field devices shall be properly calibrated and tested for performance and accuracy. A report detailing test performed and results to be submitted to the Departmental Representative for approval. The Departmental Representative will verify results at random. Provide all testing equipment necessary. Provide manpower necessary to assist Departmental Representative's verification.

.4 Fire stopping: provide space for fire stopping in accordance with Section 07 84 00 - Firestopping. Maintain fire rating integrity.

.5 Identification: Identify field devices in accordance with Section 25 05 54 - EMCS: Identification.

3.2 LOW LIMIT TEMPERATURE SWITCHES (FREEZE PROTECTION)

.1 All supply air systems containing coils shall have a non-recycling, manual reset, electric line voltage freeze protection controller (also referred to as low temperature controller) that will stop the system upon sensing 4°C [40°F].

.2 The freeze protection controllers shall contain an additional set of dry contacts that will close on freeze detection for remote alarm indication at the (EMCS).

.3 The freeze protection contacts shall be connected on the common line after the H.O.A. selector switch.

3.3 PANELS

.1 Arrange for conduit entry from top, bottom or either side.

.2 Wiring within panels: locate in trays or individually clipped to back of panel.

.3 Identify wiring and conduit clearly.

3.4 TEMPERATURE SENSORS

.1 All sensors shall be stabilized to such a level as to permit on-the-job installations that will require minimum field adjustments or calibration.

.2 Sensor assemblies shall be readily accessible and adaptable to each type of application in such a manner as to allow for quick, easy replacement and servicing without special tools or skills.

.3 Outdoor installation:

.1 Weatherproof construction in NEMA 4 enclosures.

.2 These installations shall be protected from solar radiation and wind effects by stainless steel shields.

.4 Install space instruments at a height of 1.5 m above the finished floor, unless otherwise indicated.

.5 Locate instruments in the same vertical centreline as light switches.

.6 Where instruments are indicated on an outside wall install on a stand-off wall bracket which provides an air space between the instrument and the wall; or on an insulating base (e.g. a cork pad).

.7 Duct installations:

.1 Shall be located to sense the correct temperature of the air only.

.2 Shall not be located in dead air spaces.

.3 The location shall be within the vibration and velocity limits of the sensor.

.4 Where an extended surface element is required to properly sense the average temperature it shall be securely mounted within the duct to measure the best average temperatures.

.5 Elements shall be thermally isolated from brackets and supports to respond to air temperature only.

.6 Sensor element to be supported separately and not connected to coils or filter racks.

.8 Wells shall be installed in the piping:

.1 At elbows where piping diameter is smaller than the length of the well to effect proper flow across the entire area of the well.

.2 Well shall not restrict flow area to less than 70 percent of line-size-pipe normal flow area.

.3 Use thermal conducting paste inside wells.

3.5 TESTING AND COMMISSIONING

.1 Calibrate and test field devices for accuracy and performance.

END OF SECTION 25 30 02

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes materials, requirements and installation for control valves, dampers and actuators integral to the Building Energy Monitoring and Control System (EMCS).

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 SUBMITTALS

.1 Shop Drawings:

.1 Submit shop drawings for control valves, dampers and actuators.

.2 Closeout Submittals:

.1 Provide maintenance data for incorporation into Operational and Maintenance manual.

PART 2 - PRODUCTS

2.1 CONTROL VALVES

.1 All characteristics of control valves shall be suited to the required application. Three-way mixing valves shall be linear for each port giving constant flow, and two-way valves shall have modified linear flow characteristics.

.2 All valves shall be plug type with stainless steel stems and EPT ring pads or teflon packing.

.3 Valve pressure / temperature rating - minimum ANSI Class 125.

.4 Plugs shall be brass with moulded composition discs.

.5 Discs (renewable) shall be bronze for media 110°C [230°F] or less and stainless steel for media above 110°C [230°F] operating temperature.

.6 Valve bodies for 12 mm [1/2”] shall be screwed cast brass with integral seat.

.7 Valves 20 mm [3/4”] to 50 mm [2”] shall have screened cast brass body and cast brass cage with integral seat.

.8 Valve bodies for 65 mm [2-1/2”] and up shall be cast iron, globe-type, flanged.

.9 All control valves supplied with positive positioning relay shall have a minimum of 27-76 kPa spring range.

.10 Clearly identify the control valve coefficient (Cv) rating on valve bodies.

.11 Sizing: Cv ratings shall be as scheduled on drawings.

.12 Control valves to be supplied by this trade for installation by others.

2.2 CONTROL VALVE ACTUATORS

.1 Valve operators shall allow smooth operation of the valve throughout its entire range and assure tight shut-off against system pressure.

.2 Valve actuator shall be easily removed from the valve body for replacement.

.3 The valve actuators shall be of the same manufacturer as the control valves.

.4 Proportional Control Valve Actuators

.1 The valve actuator shall modulate the control valve between the fully open and closed position based upon a 0-10 VDC or 4-20 mA control signal.

.2 The actuator shall remain in its position until the applied signal changes.

.3 In the event of a control signal loss, the actuator shall move to the zero voltage input position.

.4 The valve shall maintain its shutoff force even if power is lost.

2.3 CONTROL DAMPERS

.1 Opposed type blade for all modulating dampers unless otherwise indicated.

.2 Parallel type blade for all two position dampers unless otherwise indicated.

.3 Extruded aluminum or formed galvanized steel blades, frames, gussets and blade stops.

.4 Shafts - galvanized steel with keyways for securing blades to shafts.

.5 Hardware - keyed to prevent blade slippage and to provide smooth blade movement.

.6 Bearings - oil impregnated sintered bronze. Provide additional thrust bearings for vertical blades. Confirm in advance with Departmental Representative any vertical blade dampers.

.7 Assemblies - rigid and adequately braced with corner gussets.

.8 Maximum frame dimensions - 1220 mm [48"] wide and 1220 mm [48"] high, unless otherwise indicated. Multiple sections to have stiffening mullions.

.9 Bearings and seals - suitable for exposure to a minimum of -30°C [-22°F] and a maximum of 100°C [212°F].

.10 Maximum blade width - 200 mm [8"].

.11 Low leakage type with blade and frame seals.

.12 Maximum leakage in closed position shall be 50 L/s per square metre [10 CFM per square ft.] of face area at 1000 Pa [4" w.g.] pressure differential. For smoke control purposes dampers to be labelled to ULC Standard S112.1 (UL-555S) level 1 leakage.

.13 Galvanized coating on all sheared edges of galvanized steel frames and blades exposed to outside atmosphere.

.14 Indicated size is outside frame dimension. Confirm with installer before fabrication.

.15 Blades to be horizontal in vertical mounted dampers. Refer to drawings for orientation of dampers.

.16 Provide an additional drive shaft bearing if the drive shaft is longer than 75 mm [3"].

.17 Dampers shall be adequate for the maximum system pressure. Refer to the appropriate section of the specification.

2.4 DAMPER ACTUATORS

.1 Damper actuators for all control dampers including those supplied with the Air Handling Units shall be supplied by this trade.

.2 Spring return for "fail-safe" in Normally Open or Normally Closed position where required.

.3 Size actuators to control dampers against maximum pressure or dynamic closing pressure whichever is greater.

.4 Size damper actuators so that they will provide smooth and full travel of the dampers while stroking in both directions.

.5 Electric/Electronic Damper Actuators:

.1 Actuators for control dampers shall be provided by the Controls Contractor.

.2 Provide 120 or 24 volt damper actuators.

.3 Actuators shall be direct coupled enabling it to be mounted directly to the damper shaft without the need for connecting linkage.

.4 The actuators shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the rotation of the actuator.

.5 Proportional actuators shall accept a 2 to 10 VAC or 4 to 20 mA signal and provide a 2 to 10 VDC position feedback signal.

PART 3 - EXECUTION

3.1 CONTROL DAMPER INSTALLATION

.1 Hand over to and instruct the installer on damper installation.

.2 Check that dampers are installed square and true and that blades close tightly against seals and stops.

.3 Ensure that damper end-linkages are easily accessible (coordinate with installer).

.4 Do not install dampers within the thickness of any wall unless otherwise indicated (coordinate with installer).

.5 Where individual dampers are installed, provide a separate damper actuator for each damper.

.6 Where multi-section dampers are installed, provide a separate damper actuator for each section or pair of sections.

.7 Locate damper actuators so that they are easily accessible for testing and servicing.

.8 Where damper actuator operates outdoor or exhaust air dampers, pretension the damper drive linkage to ensure tight closure.

END OF SECTION 25 30 05

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes at minimum detailed narrative description of Sequence of Operation for the Building Energy Monitoring and Control System (EMCS).

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 SUBMITTALS

.1 Shop Drawings:

.1 Submit with the shop drawings a written description indicating Sequence of Operation.

PART 2 - PRODUCTS

.1 NOT USED

PART 3 - EXECUTION

3.1 OCCUPANCY SCHEDULE

.1 Provide a schedule to define OCCUPIED and UNOCCUPIED periods for each system and set up the specified related controls.

3.2 DEFINITIONS

.1 “Free cooling” refers to the cooling provided by the use of outdoor air.

3.3 MISCELLANEOUS SYSTEMS

.1 Outdoor Air

.1 Provide an outdoor air temperature sensor and monitor it.

.2 Domestic Water Trap Priming

.1 Provide 12 mm [1/2”] solenoid valve(s) on the domestic cold water system.

.2 This valve shall be piped to the traps of the floor drains.

.3 Open the solenoid valve on a regular schedule to provide trap priming to the drains.

.3 Fire Protection Systems

.1 Run wiring in EMT conduit from EMCS panel to alarm panel.

.2 Monitor the fire alarm panel for:

.1 Alarm signal.

.2 Trouble signal

3.4 DOMESTIC COLD WATER SYSTEM CONTROLS

.1 Monitor the following:

.1 Pressure on the cold water entering the building. Provide pressure sensor.

.2 Pressure on the cold water after the PRV. Provide pressure sensor.

.2 Domestic Water Meter

.1 Monitor the domestic water meter.

3.5 DOMESTIC HOT WATER SYSTEM CONTROLS

.1 The system consists of:

.1 Electric Domestic hot water tank, T-DHW.

.2 Domestic hot water circulation pump, P-DHWR.

.2 The internal controls of T-DHW shall control the operation of the system.

.3 Provide control to start and stop recirculation pump P-DHWR on an OCCUPIED/UNOCCUPIED schedule. Monitor the pumps current.

3.6 HEATING WATER - BOILER SYSTEM

.1 The system consists of:

.1 Boiler (B-1).

.2 Boiler Circulation Pump (P-B1).

.3 Building heating water pumps (P-HW1, P-HW2) with VFDs.

.4 Differential pressure sensor.

.5 Temperature sensors.

.2 Monitor the following:

.1 Heating Water Supply Temperature (T-HWS1) to the building.

.2 Heating Water Supply Temperature (T-HWS2) from the boiler to the low loss header.

.3 Heating Water Return Temperature (T-HWR1) from the building.

.4 Heating Water Return Temperature (T-HWR2) to the boiler from the low loss header.

.5 Differential pressure sensor across the heating mains to/from the building.

.6 Heating Water Supply Temperature (T-B1) from the boiler.

.7 Boiler (B-1) fault alarm contacts.

.8 Current through the VFD for P-HW1, P-HW2.

.3 Building Heating Water Pumps:

.1 The Building Heating Pumps, P-HW1 and P-HW2 shall operate as duty and standby. Provide automatic weekly alternation of the duty pump.

.2 If the duty pump fails to operate for more than one minute, start the standby pump.

.3 Modulate the speed of the heating water pumps such that there is a constant differential pressure between the supply and return piping.

.4 Integral Boiler Controls:

.1 Through the DDC system ENABLE/DISABLE the boiler system.

.2 When ENABLED:

.1 The boiler's cascade controller shall regulate the system/boiler water temperature and the flow temperature of the heating circuits subject to weather conditions.

.2 The cascade controller shall also operate each boiler's circulating pump. Provide a current sensor to monitor the operation of each pump.

.3 The boiler temperature set point shall be resettable by the DDC system.

.5 Building Heating Water Supply Temperature Set Point

.1 Schedule building heating water supply temperature set point proportionately between the outdoor air temperatures as follows.

Outdoor Air Temperature	Heating Water Supply Temperature
below -1°C [30ºF]	55°C [130ºF]

-1 to 15°C [30 to 60ºF]	55 to 38°C [130 to 100ºF]

.2 Calibrate the Boiler Temperature Set point to the Heating Water Supply Temperature, allowing for any temperature differences between the boiler temperature setting and the heating water supply temperature, so that the heating water supply temperature can be maintained using the Boiler Temperature setting control.

3.7 OFFICE AREA HVAC SYSTEMS CONTROLS

.1 The system consists of:

.1 Heat Recovery Ventilator (HRV-1):

.1 Exhaust fan (EF-HRV1).

.2 Supply fan (SF-HRV1).

.2 Baseboard Heaters (BB-xx) and their associated control valves (CV-BBxx).

.3 Room Temperature Sensors.

.2 Monitor the following:

.1 Supply air temperature from the HRV (T-HRV1-SA).

.2 Supply air temperature after HC-1 (T-SA).

.3 Exhaust air temperature (T-HRV1-EA).

.4 Current from HRV exhaust fan.

.5 Current from HRV supply fan.

.3 Provide a room temperature sensor for each baseboard heater. Coordinate the exact location of the sensors on site with the Architect and Departmental Representative.

.4 OCCUPIED

.1 SF-HRV1 and EF-HRV1 shall run continuously.

.2 Operate the heat recovery wheel and modulate CV-HC1 to maintain the supply air temperature set point. Initially set to 20°C [68°F]. Work with the Users to determine the lowers satisfactory temperature set point.

.3 Refer to Room Temperature Control.

.5 UNOCCUPIED

.1 SF-HRV1 and EF-HRV1 shall be OFF.

.2 Set back each temperature set point by 4°C [8°F].

.3 Refer to Room Temperature Control.

.6 Room Temperature Control

.1 Each space has a baseboard heater (BB-xx) with its associated heating control valve (CV-BBxx).

.2 OCCUPIED

.1 Modulate the control valve to maintain room temperature set point.

.3 UNOCCUPIED

.1 Set back each temperature set point by 4°C [8°F].

.2 Modulate the control valve to maintain set back room temperature set point.

3.8 ENTRANCES TEMPERATURE CONTROL

.1 The systems consists of:

.1 Forced Flow Heater (FF-xx) and associated control valve (CV-FFxx).

.2 Provide a room temperature sensor for each forced flow heater and monitor the room temperature. Coordinate the exact location of the sensors on site with the Architect and the Departmental Representative.

.3 Provide a relay in the forced flow heater.

.4 Provide a modulating heating control valve.

.5 Cycle the unit heater and modulate the control valve to maintain room temperature set point.

.6 When UNOCCUPIED set back each set point temperature by 4°C [8°F].

3.9 ELECTRICAL ROOM TEMPERATURE CONTROL (RM 06)

.1 The system consists of:

.1 Exhaust fan (EF-06) and control damper (CD-EF06).

.2 Outdoor air intake louvre and control damper (CD-EF06-OA).

.3 Electric baseboard heater - provided by Electrical Division.

.2 Provide a temperature sensor and monitor the temperature in the Electrical Room.

.3 If the temperature sensor calls for cooling then open CD-EF06-OA and cycle EF-06 to maintain set point.

.4 Hardwire the control damper CD-EF06 and CD-EF06-OA to open when the fan starts. CD-EF06 and CD-EF06-OA shall be closed when the fan is not running.

.5 Monitor the motor current for EF-06.

.6 The baseboard heater's integral temperature control shall control the operation of the baseboard heater.

3.10 MECHANICAL ROOM TEMPERATURE CONTROL (RM 12)

.1 The system consists of:

.1 Electric baseboard heater - provided by Electrical Division.

.2 The baseboard heater's integral temperature control shall control the operation of the baseboard heater.

3.11 DELIVERIES ROOM TEMPERATURE CONTROL (RM 13)

.1 The system consists of:

.1 Electric baseboard heater - provided by Electrical Division.

.2 The baseboard heater's integral temperature control shall control the operation of the baseboard heater.

3.12 BATTERY STORAGE (RM 14) AND POL STORAGE (RM 15) ROOMS TEMPERATURE CONTROL

.1 These rooms shall be installed to spark resistant construction.

.2 The system consists of:

.1 Exhaust fans (EF-14, EF-15).

.2 Baseboard heaters (BB-14, BB-15) and associated control valve (CV-BB14, CV-BB15).

.3 Provide a temperature sensors and monitor each room's temperature.

.4 Exhaust fan EF-xx shall run continuously.

.5 Monitor the motor current for EF-xx.

.6 Modulate the baseboard heater's control valve to maintain room temperature set point. Initially set to 18°C [65°F].

3.13 SHOP ROOM TEMPERATURE CONTROL (RM 16)

.1 The system consists of:

.1 Unit Heater (UH-16) and associated control valve (CV-UH16).

.2 Provide a room temperature sensor and monitor it. Coordinate the exact location of the sensors on site with the Architect and the Departmental Representative.

.3 Provide a modulating heating control valve.

.4 Cycle the unit heater and modulate the control valve to maintain room temperature set point. Initially set to 18°C [65°F].

3.14 PARTS STORAGE ROOM TEMPERATURE CONTROL (RM 17)

.1 The system consists of:

.1 Unit Heater (UH-17) and associated control valve (CV-UH17).

.2 Transfer Fan (TF-17).

.2 Provide a room temperature sensor and monitor it. Coordinate the exact location of the sensors on site with the Architect and the Departmental Representative.

.3 Provide a modulating heating control valve.

.4 Cycle the unit heater and modulate the control valve to maintain room temperature set point. Initially set to 18°C [65°F].

.5 Transfer fan TF-17 shall run continuously.

3.15 VEHICLE BAY EXHAUST SYSTEMS (RM 18)

.1 System Consists of:

.1 West System: Garage exhaust fan with associated control damper and outdoor intake louver and associated control damper.
- EF-18A/CD-EF18A,
- CD-18A-OA.

.2 East System: Garage exhaust fan with associated control damper and outdoor intake louver and associated control damper.
- EF-18B/CD-EF18B,
- CD-18B-OA.

.3 Carbon Monoxide and Combustible Gas sensors.

.4 Humidity Sensors.

.5 Manual timer control switch.

.2 Monitor the motor current for EF-18A and EF-18B.

.3 Provide a two position control damper for each exhaust fan and at each intake louver.

.1 Interlock the fan damper to open when the associated fan runs.

.2 If either fan runs then both outdoor air control dampers shall open.

.4 Provide sufficient number of carbon monoxide and combustible gas systems to cover the east and west sides of the Garage.

.1 Two independent systems. West sensor(s) shall be zoned with EF-18A; East sensor(s) shall be zoned with EF-18B.

.1 Upon low level sensor activation run the corresponding exhaust fan.

.2 Upon high level sensor activation the systems audible alarm shall sound.

.2 Confirm coverage with Manufacturer.

.3 Confirm sensor locations on site with the Architect and Departmental Representative.

.5 Provide a humidity sensor for the east and west exhaust system. If the humidity within the garage is higher than set point then run the corresponding exhaust fan. Confirm sensor locations on site with the Architect and Departmental Representative.

.6 Provide a manually operated wall mounted ON/OFF adjustable timer switch for each exhaust system. Adjustable from 15 minutes to 2 hours. The corresponding exhaust fan shall run when the timer switch is activated. Confirm timer switch locations on site with the Architect and Departmental Representative.

3.16 VEHICLE BAY HEATING SYSTEMS (RM 18)

.1 Monitor the operation (OPEN/CLOSED) of each bay door.

.2 Each Bay's space temperature set point shall initially be set to 18°C [65°F].

.3 Bay 1, 2 and 3 Temperature Control

.1 Each Bay is heated by a separate hydronic in-floor heating system.

.2 Provide two in-floor temperatures sensors per bay and monitor them. Temperatures sensors shall be installed within the floor slab within tubing and be removable for maintenance. Coordinate the proper location of the sensors with the in-floor heating supplier.

.3 Provide a 3-way modulating control valve for each in-floor heating zone connected to the zone manifold.

.4 Modulate the zone control valve to maintain floor temperature at 18°C [65°F].

.5 Provide an alarm and turn off heating if the floor temperature rises above 26°C [80°F].

.6 When unoccupied OR if one or both doors to a Bay are open for more than 20 minutes (adjustable) then set back each temperature set point by 2°C [4°F].

.4 Bay 4 and 5 Temperature Control

.1 The system consists of:

.1 Bay 4 North: Unit Heater (UH-18A) and associated control valve (CV-UH18A).

.2 Bay 4 South: Unit Heater (UH-18B) and associated control valve (CV-UH18B).

.3 Bay 5 North: Unit Heater (UH-18C) and associated control valve (CV-UH18C).

.4 Bay 5 South: Unit Heater (UH-18D) and associated control valve (CV-UH18C).

.2 Provide a room temperature sensor for each unit heater and monitor them. Coordinate the exact location of the sensors on site with the Architect and the Departmental Representative.

.3 Provide a modulating heating control valve (CV-UHxxx).

.4 Cycle the unit heater (UH-xxx) and modulate the control valve to maintain room temperature set point.

.5 When unoccupied OR if one or both doors to a Bay are open for more than 20 minutes (adjustable) then set back each temperature set point by 2°C [4°F].

3.17 COMMUNICATIONS AND SERVER ROOM TEMPERATURE CONTROL (RM XX)

.1 The system consists of:

.1 Ceiling mounted air conditioning unit (AC-xx) and associated air cooled condensing unit (CU-xx).

.2 Provide a room temperature sensor and monitor the temperature of the Room.

.3 Mount the wall-mounted controller provided with the air conditioning unit. Provide all required wiring between the wall-mounted controller, the AC unit and the condensing unit on the roof.

.4 The air conditioning unit's wall mounted controller shall control the operation of the air conditioning unit.

.5 Monitor the air conditioning system's alarm.

3.18 ALARMS

.1 Provide software high and low alarms for each space temperature sensor. Initially set at 10°C [18°F] above set point and 5°C [9°F] below set point.

.2 Provide software high and low alarms for each current sensor.

.3 Provide software high and low alarms for the difference between the Building Heating Water Supply temperature and the scheduled set point. Initially set at 10°C [18°F] above or below.

.4 Provide other software alarms as indicated in this section and the points list.

3.19 EQUIPMENT FAIL POSITIONS

.1 All heating water control valves shall fail to open (open to full heat).

.2 All outdoor air and relief air control dampers shall fail closed.

.3 The Electrical room control dampers shall fail open.

.4 VFD's shall fail to 100% speed on a loss of the EMCS control signal.

.5 The fail position is the position on a loss of power, control signal.

END OF SECTION 25 90 01

PART 1 - GENERAL

1.1 SUMMARY

.1 Section includes at minimum input/output points list for the Building Energy Monitoring and Control System (EMCS).

1.2 RELATED SECTIONS

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.3 SUBMITTALS

.1 Shop Drawings:

.1 Submit with the shop drawings the complete Input/Output points list.

.2 Submit shop drawings for all control devices.

1.4 POINTS LIST

NOTE: This Points List does not necessarily include all required points. Any additional points required to achieve the Sequence of Operation in Section 25 90 01 shall be provided.

UNIT NO. OR LOCATION	TYPE OF POINT	Input	Input	Output	Output	NOTES
		DI	AI	DO	AO	
MISCELLANEOUS SYSTEMS						
T-OA	Temp Sensor - Outdoor Air		X			
TP-x	Domestic Water Trap Priming Solenoid Valve			X		Provide number of solenoid valves as needed by the Mech Contractor
FIRE PROTECTION SYSTEMS						
FIRE ALARM	Monitor Fire Alarm Panel	X				
FIRE-TROUBLE	Monitor Fire Panel - Trouble	X				
DOMESTIC WATER SYSTEM						
DCWP-1	Pressure Sensor - Water Entering Building		X			
DCWP-2	Pressure Sensor - after the PRV		X			
DCW Meter	Water Meter		X			

NOTE: This Points List does not necessarily include all required points. Any additional points required to achieve the Sequence of Operation in Section 25 90 01 shall be provided.

UNIT NO. OR LOCATION	TYPE OF POINT	Input	Input	Output	Output	NOTES
		DI	AI	DO	AO	
DOMESTIC HOT WATER SYSTEM						
P-DHWR	Pump ON/OFF - DHW Recirc			X		
P-DHWR	Current Sensor		X			
HEATING WATER SYSTEMS						
T-HWS1	Temp Sensor - Building Heating Water Supply		X			
T-HWS2	Temp Sensor - Common Supply from Low Loss Header - to building		X			
T-HWR1	Temp Sensor - Building Heating Water Return		X			
T-HWR2	Temp Sensor - Return to Boiler		X			
VFD-P-HW1	Pump ON/OFF			X		
VFD-P-HW1	Speed Control				X	
VFD-P-HW1	Monitor Alarm	X				
P-HW1-CUR	Current Sensor		X			
VFD-P-HW2	Pump ON/OFF			X		
VFD-P-HW2	Speed Control				X	
VFD-P-HW2	Monitor Alarm	X				
P-HW2-CUR	Current Sensor		X			
DP-HW	Pressure Differential Sensor - Building Mains		X			
BOILER	Boilers ENABLE/DISABLE			X		
T-B-RESET	Boiler Supply Water Temp Reset				X	
B-1	Boiler Alarm	X				
P-B1	Current Sensor		X			
T-B1	Boiler Supply Water Temp		X			
OFFICE AREA HVAC SYSTEMS (HRV-1)						
HRV1-SF	Fan ON/OFF			X		
HRV1-SF	Current		X			
HRV1-EF	Fan ON/OFF			X		
HRV1-EF	Current		X			

NOTE: This Points List does not necessarily include all required points. Any additional points required to achieve the Sequence of Operation in Section 25 90 01 shall be provided.

UNIT NO. OR LOCATION	TYPE OF POINT	Input	Input	Output	Output	NOTES
		DI	AI	DO	AO	
T-HRV1-SA	Supply Air Temp Sensor		X			
T-HRV1-EA	Exhaust Air Temp Sensor		X			
T-xxx	Room Temp Sensor		X			Total of 11
CV-BBxx	2-Way Modulating Heating Control Valve				X	Total of 11, C_v = 1 to 1.2
FORCED FLOW HEATERS (RM XX)						
T-XX	Rm Temp Sensor		X			
FF-XX	Heater ON/OFF			X		
CV-FFXX	2-Way Modulating Control Valve - Heating Water				X	C_v = 1 to 1.2
ELECTRICAL ROOM CONTROL (RM 06)						
T-06	Rm Temp Sensor		X			
EF-06 CD-EF06 CD-EF06-OA	Fan ON/OFF, Control Damper OPEN/CLOSE			X		Damper wired to fan
BATTERY STORAGE (RM 14) AND POL STORAGE CONTROL						
T-14	Rm Temp Sensor		X			
EF-14 CD-EF14	Fan ON/OFF, Control Damper OPEN/CLOSE			X		Damper wired to fan
CV-BB14	2-Way Modulating Heating Control Valve				X	C_v = 1 to 1.2
T-15	Rm Temp Sensor		X			
EF-15 CD-EF15	Fan ON/OFF, Control Damper OPEN/CLOSE			X		Damper wired to fan
CV-BB15	2-Way Modulating Heating Control Valve				X	C_v = 1 to 1.2
SHOP ROOM CONTROL (RM 16)						
T-16	Rm Temp Sensor		X			
UH-16	Heater ON/OFF			X		
CV-UH16	2-Way Modulating Control Valve - Heating Water				X	C_v = 1 to 1.2

NOTE: This Points List does not necessarily include all required points. Any additional points required to achieve the Sequence of Operation in Section 25 90 01 shall be provided.

UNIT NO. OR LOCATION	TYPE OF POINT	Input	Input	Output	Output	NOTES
		DI	AI	DO	AO	
PARTS STORAGE ROOM CONTROL (RM 17)						
T-17	Rm Temp Sensor		X			
TF-17	Fan ON/OFF			X		
UH-17	Heater ON/OFF			X		
CV-UH17	2-Way Modulating Control Valve - Heating Water				X	C_v = 1 to 1.2
VEHICLE BAY EXHAUST SYSTEMS (RM 18)						
H-EF18A	Humidity Sensor		X			
EF-18A CD-EF18A	Fan ON/OFF, Control Damper OPEN/CLOSE			X		Damper wired to fan
EF-18A	Current Sensor		X			
H-EF18B	Humidity Sensor		X			
EF-18B CD-EF18B	Fan ON/OFF, Control Damper OPEN/CLOSE			X		Damper wired to fan
EF-18B	Current Sensor		X			
VEHICLE BAY HEATING SYSTEMS (RM 18)						
VB1-D1	Bay 1, Door 1 - OPEN/CLOSED	X				
VB1-D2	Bay 1, Door 2 - OPEN/CLOSED	X				
VB2-D1	Bay 2, Door 1 - OPEN/CLOSED	X				
VB2-D2	Bay 2, Door 2 - OPEN/CLOSED	X				
VB3-D1	Bay 3, Door 1 - OPEN/CLOSED	X				
VB3-D2	Bay 3, Door 2 - OPEN/CLOSED	X				
VB4-D1	Bay 4, Door 1 - OPEN/CLOSED	X				
VB4-D2	Bay 4, Door 2 - OPEN/CLOSED	X				
VB5-D1	Bay 5, Door 1 - OPEN/CLOSED	X				
VB5-D2	Bay 5, Door 2 - OPEN/CLOSED	X				
T-VB1-1	Bay 1 - Floor Temp Sensor - N		X			
T-VB1-2	Bay 1 - Floor Temp Sensor - S		X			
T-VB2-1	Bay 2 - Floor Temp Sensor - N		X			
T-VB2-2	Bay 2 - Floor Temp Sensor - S		X			
T-VB3-1	Bay 3 - Floor Temp Sensor - N		X			
T-VB3-2	Bay 3 - Floor Temp Sensor - S		X			

NOTE: This Points List does not necessarily include all required points. Any additional points required to achieve the Sequence of Operation in Section 25 90 01 shall be provided.

UNIT NO. OR LOCATION	TYPE OF POINT	Input	Input	Output	Output	NOTES
		DI	AI	DO	AO	
T-VB4-1	Bay 4 - Room Temp Sensor - N		X			
T-VB4-2	Bay 4 - Room Temp Sensor - S		X			
T-VB5-1	Bay 5 - Room Temp Sensor - N		X			
T-VB5-2	Bay 5 - Room Temp Sensor - S		X			
CV-VB1	3-Way Modulating Control Valve - In-floor Heating, Bay 1 - Heating Water				X	C_v = 1 to 1.2
CV-VB2	3-Way Modulating Control Valve - In-floor Heating, Bay 2 - Heating Water				X	C_v = 1 to 1.2
CV-VB3	3-Way Modulating Control Valve - In-floor Heating, Bay 3 - Heating Water				X	C_v = 1 to 1.2
UH-18A	Heater ON/OFF			X		
CV-UH18A	2-Way Modulating Control Valve - Heating Water				X	C_v = 1 to 1.2
UH-18B	Heater ON/OFF			X		
CV-UH18B	2-Way Modulating Control Valve - Heating Water				X	C_v = 1 to 1.2
UH-18C	Heater ON/OFF			X		
CV-UH18C	2-Way Modulating Control Valve - Heating Water				X	C_v = 1 to 1.2
UH-18D	Heater ON/OFF			X		
CV-UH18D	2-Way Modulating Control Valve - Heating Water				X	C_v = 1 to 1.2
WASHROOM CONTROL (RM 19)						
T-19	Rm Temp Sensor		X			
EF-19 CD-EF19	Fan ON/OFF, Control Damper OPEN/CLOSE			X		Damper wired to fan
CV-BB19	2-Way Modulating Heating Control Valve				X	C_v = 1 to 1.2
COMMUNICATIONS CLOSET (RM ??)						
T-XX	Rm Temp Sensor - Rm ??		X			

NOTE: This Points List does not necessarily include all required points. Any additional points required to achieve the Sequence of Operation in Section 25 90 01 shall be provided.						
UNIT NO. OR LOCATION	TYPE OF POINT	Input	Input	Output	Output	NOTES
		DI	AI	DO	AO	

END OF SECTION25 90 05

PART 1 - GENERAL

1.1 RELATED SECTIONS & SUMMARY

.1 The General Conditions, Supplements and Amendments shall govern this Section (read in conjunction with Instructions to Tenderers / Bidders). This section covers items common to all Electrical sections and is intended only to supplement the requirements of Division 01.

.2 Reference to “Electrical Divisions” shall mean all sections of Divisions 26, 27, 28, 33 & 34 in the Master Format or the Canadian Master Specifications.

.3 The word "Provide" shall mean "Supply and Install" the products and services specified. "As Indicated" means that the item(s) specified are shown on the drawings.

.4 Provide materials, equipment and plant, of specified design, performance and quality; and, current models with published certified ratings for which replacement parts are readily available. Provide project management and on-site supervision to undertake administration, meet schedules, ensure timely performance, ensure coordination, and establish orderly completion and the delivery of a fully commissioned installation.

.5 The most stringent requirements of this and other electrical sections shall govern.

.6 All work shall be in accordance with the PROJECT Drawings and Specifications and their intent, complete with all necessary components, including those not normally shown or specified, but required for a complete installation.

.7 Provide seismic restraints for all required fixtures, devices, equipment, pathway, and wiring systems as required by the BC Building Code.

.8 Connect to equipment specified in other Sections and to equipment supplied and installed by other Contractors or by the Owner. Uncrate equipment, move in place and install complete; start-up and test. Include all field assembly of loosely/separately packaged accessories

.9 Summary of Work:

.1 The work shall include and not limited to the following:

.1 347/600V, 200A, 3 Phase, 4W electrical underground dip service from BC Hydro overhead infrastructure on Byng Road.
.2 Telecommunications underground dip service from Telus overhead infrastructure on Byng Road.
.3 Electrical distribution.
.4 125kW, 347/600V, 3 phase, 4W standby diesel generator complete with weatherproof enclosure.
.5 Interior lighting.
.6 Exterior lighting.
.7 Connections to Mechanical specified equipment.
.8 Connections to architecturally specified overhead doors and crane.
.9 Exterior antenna support structure and raceway system.
.10 CCTV monitoring system.
.11 Access control system.
.12 Fire alarm system.
.13 Data/Voice raceway system.

1.2 CODES AND STANDARDS

.1 Comply with all laws, ordinances, rules, regulations and codes of all authorities having jurisdiction relative to this project.

.2 The project will be constructed to the current adopted edition of applicable standards, including:

.3 CSA C22.1, Canadian Electrical Code (CEC)

.4 British Columbia Building Code (BCBC)

.5 National Fire Code of Canada (NFCC)

.6 CSA 282 Emergency Electrical Power Supply for Buildings

.7 ASHRAE 90.1, Standard for Energy Efficient Design of New Buildings

.8 WorkSafe BC Regulations

.9 Applicable NFPA Regulations

1.3 REFERENCES

.1 Install in accordance with CSA C22.1 (current adopted edition) – except where specified otherwise.

.2 Refer to CSA C22.1 Appendix A “Safety Standards for Electrical Equipment” for applicable codes and the related revisions

.3 Refer to CSA C22.1 Pages xxix – xxxii for related ‘Reference Publications’

.4 Refer to NBCC Table 1.3.1.2 for applicable codes and the related revisions.

.5 Comply with Local Electrical Bulletins and by-laws relating to the Authority having Jurisdiction.

.6 Install overhead and underground systems in accordance with CSA C22.3 No.1 (current adopted edition) – except where specified otherwise.

.7 Preferred Voltage Levels for AC Systems, 0-50,000V in accordance with CAN3-C235 (current adopted edition)

1.4 PERMITS

.1 Submit to the Electrical Inspection Authority having jurisdiction the necessary number of drawings and specifications for review and approval prior to commencement of the project.

.2 Pay all associated fees and obtain all permits, licenses etc. to complete the project.

.3 Obtain a Certificated of Acceptance from the Inspection Authority having jurisdiction upon completion of the project and include in the O&M manual.

1.5 DESIGN REQUIREMENTS

.1 Operating voltages: to CAN3-C235- current edition

.2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

.3 All electrical work to be installed with common work practices and methods.

1.6 SUBMITTALS

.1 Submittals to be in accordance with Division 01.

.2 Shop Drawings:

.1 The term “shop drawing” means drawings, diagrams, illustrations, schedules, performance characteristics, brochures and other data which are to be provided by the contractor to illustrate details of a portion of the work.

.2 Prior to submitting the shop drawings to the Departmental Representative, the contractor shall review the shop drawings to determine that the equipment complies with the requirements of the specifications and drawings.

.3 Submit shop drawings, product data and samples for all electrical equipment and materials in accordance with Division 01. The submission shall be reviewed, signed and processed as described in Division 01.

.4 Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.

.5 Where applicable, include wiring, line and schematic diagrams. Include wiring drawings or diagrams showing interconnection with work of other Sections.

.6 Manufacturer of products shall conform to revised shop drawings.

.3 Content

.1 Shop drawings submitted title sheet.

.2 Data shall be specific and technical.

.3 Identify each piece of equipment including specific options selected for each type to be included in the project.

.4 Information shall include all scheduled data.

.5 Advertising literature will be rejected.

.6 The project and equipment designations shall be identified on each document.

.7 The shop drawings/product data shall include:

.1 Dimensioned construction drawings with plans and sections showing size, arrangement and necessary clearances, with all equipment weights and mounting point loads.

.2 Mounting arrangements.

.3 Control explanation and internal wiring diagrams for packaged equipment.

.4 A written description of control sequences relating to the schematic diagrams.

.5 Copies of factory tests, where applicable.

.4 Format

.1 Shop Drawings to be submitted in PDF format; larger submittals may be submitted on flash drives or uploaded to an FTP site set up the contractor.

.5 Coordination

.1 Where electrical equipment requires support or backing by other trades or mechanical connections, the shop drawings shall also be circulated through the other "services" contractor(s) prior to submission to the Departmental Representative.

.6 Keep one [1] copy of shop drawings and product data, on site, available for reference.

.7 Quality Control: in accordance with Division 01 - Quality Control

.1 Provide CSA certified equipment and material. Where CSA certified equipment and/or material is not available, submit such equipment and/or material to the authority having jurisdiction for special approval before delivery to site.

.2 Submit test results of installed electrical systems and instrumentation.

.3 Submit, upon completion of Work, the electrical “load balance” report.

.8 Permits and Fees:

.1 Submit to Electrical Inspection Department, Local Fire Authorities and Supply Authority the necessary number of drawings and specifications for examination and approval prior to commencement of work. Obtain all required permits and pay all fees.

.2 Arrange for inspection of all Work by the authorities having jurisdiction. On completion of the Work, furnish final unconditional certificates of approval by the inspecting authorities.

1.7 QUALITY ASSURANCE

.1 Quality Assurance: in accordance with Division 01 - Quality Control

.2 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license or apprentices in accordance with authorities having jurisdiction as per the conditions of Provincial and/or Territorial Act.

.1 Employees registered in provincial apprentices program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.

.2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.

.3 Site Meetings: in accordance with Division 01 - Construction Progress Schedule

.1 Site Meetings: as part of Manufacturer's Field Services: schedule site visits, to review Work, at stages listed below:

.1 At time of initial shop drawing submission to confirm any existing conditions and to coordinate with the project schedule and any cross discipline requirements.

.2 After delivery and storage of products, and when preparatory Work is complete but before installation begins.

.3 During progress of Work at key schedule points as determined.

.4 At commissioning.

.5 Upon completion of Work, after cleaning is carried out.

.4 Health and Safety Requirements: do construction occupational health and safety in accordance with Division 01 - Health and Safety Requirements.

1.8 DELIVERY, STORAGE AND HANDLING

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

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

.3 Storage and Handling Requirements:

.4 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.5 Store and protect equipment and materials from nicks, scratches, and damage. Protect from dust where applicable.

.6 Replace defective or damaged materials with new.

1.9 SYSTEM START-UP

.1 Refer to Division 01 and as follows.

.2 Instruct Departmental Representative and operating personnel in the operation, care and maintenance of equipment.

.3 Arrange and pay for services of manufacturer's factory service Engineer to supervise start-up of installation, check, adjust, balance and calibrate components, where required in these specifications.

.4 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

1.10 OPERATING INSTRUCTIONS

.1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.

.2 Operating instructions to include following:

.1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

.2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.

.3 Safety precautions.

.4 Procedures to be followed in event of equipment failure.

.5 Other items of instruction as recommended by manufacturer of each system or item of equipment.

.3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.

.4 Post instructions where directed.

.5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.

.6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

1.11 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Division 01 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Work plan.

.2 Avoid using landfill waste disposal procedures when recycling facilities are available.

.3 Place materials defined as hazardous or toxic waste in designated containers.

1.12 DRAWINGS AND MEASUREMENTS

.1 Drawings are generally diagrammatic and are intended to indicate the scope and general arrangement of work and are not detailed installation drawings. Do not scale the drawings. Obtain accurate dimensions from the Architectural and Structural drawings.

.2 Consult the architectural drawings and details for exact locations of fixtures and equipment. Obtain this information from the Departmental Representative where definite locations are not indicated.

.3 Take field measurements, where equipment and material dimensions are dependent upon building dimensions.

.4 Where imperial units have been indicated in brackets [ ] following the requirements in SI units, the conversion is approximate and provided for convenience. The SI units shall govern.

1.13 PROJECT COORDINATION

.1 Check drawings of all trades to verify space and headroom limitations for work to be installed. Coordinate work with all trades and make changes to facilitate a satisfactory installation. Make no deviations to the design intent involving extra cost to the Owner, without the Departmental Representative's written approval.

.2 The drawings indicate the general location and route to be followed by the electrical services. Where details are not shown on the drawings or only shown diagrammatically, the services shall be installed in such a way as to conserve head room and interfere as little as possible with the free use of space through which they pass. Service lines shall run parallel to building lines. All services in the ceiling shall be kept as tight as possible to beams or other limiting members at high level. All electrical services shall be coordinated in elevation to ensure that they are concealed in the ceiling or structural space provided unless detailed otherwise on drawings.

.3 Work out jointly all interference problems on the site and coordinate all work before fabricating, or installing any material or equipment. Where necessary, produce interference/coordination drawings showing exact locations of electrical systems or equipment within service areas, shafts and the ceiling space. Distribute copies of the final interference/coordination drawings to the Architect and Departmental Representative and all affected parties.

.4 Ensure that all materials and equipment fit into the allotted spaces and that all equipment can be properly serviced and replaced, if and when required. Advise the Departmental Representative of space problems before installing any material or equipment. Demonstrate to the

.5 Departmental Representative on completion of the work that all equipment installed can be properly, safely serviced and replaced, if and when required.

1.14 PROVISION FOR FUTURE EQUIPMENT AND CONSTRUCTION

.1 Leave clear spaces designated for future equipment or building expansion where indicated. Plan for the installation under this contract and ensure clear accessible, unhindered access to the space is allowed for.

.2 Were contract documents don’t clearly indicate the future expansion requirements, but known services are required, provide written “request for information” to the Departmental Representative before making assumptions as to intent.

1.15 SPRINKLER PROOF REQUIREMENTS

.1 All equipment and wiring systems shall be sprinkler proof standard where sprinkler fire protection systems are installed.

.2 In rooms where electrical equipment is installed surface mounted, electrical equipment contained in these rooms to be protected by non-combustible driphoods, shields, and gasketed doors as applicable to inhibit water ingress into electrical equipment. Exposed conduits connected to equipment to utilize watertight connectors. Top entry to be avoided where possible

.3 In particular all unit substations, transformers, switchgear, motor control and panelboard shop drawings shall be certified 'sprinkler proof' design.

1.16 EQUIPMENT RESTRAINT

.1 Related Section: 26 05 05 Seismic Restraint.

.2 It is the entire 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.

1.17 PHASED CONSTRUCTION

.1 See Architectural specifications and drawings for construction phasing. Make all allowances to phase the work in accordance with the project phasing.

.2 All trades in this Division shall make allowance for the implications of having to totally complete all work in the new addition before proceeding with work in the existing building.

1.18 WARRANTY

.1 Use of installed equipment during construction shall not shorten or alter the warranty period as specified in the Division 01.

.2 Take note of any extended warranties specified in other sections of this Division or in Division 27.

.3 Furnish a written warranty stating that all work executed under this Division will be free from defects of material and workmanship for a period of one (1) year from the date of substantial performance and include in O&M manual.

.4 Promptly investigate any electrical or control malfunction, and repair or replace all such defective work and all other damages thereby which becomes defective during the time of the warranty.

1.19 TENDER INQUIRIES

.1 All contractor queries during the tender period shall be made in writing to the Departmental Representative. Contractor queries will be collected and suitable addenda will be issued for clarification. No verbal information will be considered valid or issued by the Departmental Representative's office during tender. All tender queries may be emailed, mailed or couriered to the Departmental Representative's office. No telephone questions will be answered.

1.20 RESPONSIBILITIES

.1 Provide temporary lighting, power and systems for construction services and remove after construction is complete.

.2 Ensure that equipment does not transmit noise and/or vibration to other parts of the building, as a result of poor installation practice.

.3 Where the Contract Documents do not contain sufficient information for the proper selection of equipment for bidding, notify the Departmental Representative during the tendering period. If clarification is not obtainable, allow for the most expensive arrangement. Failure to do this shall not relieve the Contractor of responsibility to provide the intended equipment.

.4 Protect equipment and material from the weather, moisture, dust and physical damage.

.5 Cover equipment openings and open ends of conduit, piping and pullboxes as work progresses. Failure to do so will result in the Trade being required to adequately clean or replace materials and equipment at no extra cost to the Owner.

.6 Refinish damaged or marred factory finish to factory finish.

.7 The specifications and drawings form an integral part of the Contract Documents. Neither the drawings nor the specifications shall be used alone. Work omitted from the drawings but mentioned or reasonably implied in the specifications, vice versa, shall be considered as properly and sufficiently specified and shall be provided. Misinterpretation of any requirement of either plans or specifications shall not relieve this Contractor of the responsibility of properly completing his trade to the approval of the Departmental Representative.

1.21 STANDARD OF ACCEPTANCE

.1 Standard of Acceptance means that the item named and specified by manufacturer and/or catalogue number forms part of specification and sets standard regarding performance, quality of

material and workmanship and when used in conjunction with a referenced standard, shall be deemed to supplement the standard.

.2 Where a manufacturer's equipment is listed, the manufacturer's listed equipment was used in preparing the base design. Tenders may be based on the listed equipment or preapproved alternate manufacturer's equivalent products, provided that they meet every aspect of the base design and every aspect of the drawings and specifications.

.3 Where other than the listed manufacturer's equipment is selected or approved, include for the cost of any resulting work (both under this Division and other Divisions) and any necessary redesign of installation or structure. Submit redesign drawings for review with Shop Drawings. Maintain installation, access and servicing clearances. Equipment/materials shall not exceed the available space limitations. Redesign drawings shall be to scale and of a standard equal to the Project Drawings.

.4 A visible manufacturer's nameplate shall indicate manufacturer's name, model number, serial number, capacity data, electrical characteristics and approval stamps.

.5 All materials shall be new, of the quality specified and shall confirm to the standards of the Canadian Standards Association. Where equipment or materials are specified by technical description only, they shall be of the best quality for the listed application in which it is to be installed.

.6 All work shall be executed in a neat and workmanlike manner by qualified tradespersons. Electrical contractor shall keep a competent foreman and necessary assistants all satisfactory to the Departmental Representative during the progress of the work.

1.22 ADDITION OF ACCEPTABLE MANUFACTURERS

.1 Material/products considered to satisfy the specification, but of a manufacturer other than those named may be submitted to the Departmental Representative for consideration not later than five (5) working days prior to closing of tender or of bid depository subtrade tender whichever is earlier.

.2 Alternate approvals will be given by written addendum only. No other substitution will be permitted after closing of tenders.

.3 Alternate approvals granted before the closing of tenders will be limited to a manufacturer's system and/or series only. This limited approval will not preclude substitute equipment/material from complying with specific features included with equipment/material specified. Determine that the alternate product meets the specification intent before basing a tender on the product

.4 Where alternate equipment/materials are selected, allow for effects on other parts of the work of this Trade and other Trades. Where substantial changes in arrangement are required, submit shop drawings of the proposed changes with Plan and Section views and show effects on work of other Trades. Alternate equipment/materials shall not exceed the available space limitations. Maintain installation, access and servicing clearances. No extra will be allowed due to the use of alternate equipment/materials.

.5 Where two or more items of equipment and/or material, of the same type, are required, provide products of a single manufacturer.

.6 Install and test all equipment and material, in accordance with the detailed recommendations of the manufacturer.

1.23 PROGRESS CLAIM AND CHANGEORDER BREAKDOWNS

.1 In particular cases more detail may be necessary to properly assess a change order or progress claims. This additional information could include all suppliers and all sub-contractors when requested by the Departmental Representative. Provide details for each section of the electrical work listed for each separate electrical change order item.

.2 Mark-up information is required for change orders but is optional on the original tender price.

.3 Progress claims will not be certified nor payment made beyond 90% of the overall Electrical contract until commissioning and verification of the systems are complete. This procedure is to allow for any necessary deficiency holdbacks on items which do not become apparent until the systems are commissioned.

1.24 PROJECT CLOSE-OUT REQUIREMENTS

.1 Refer to detailed specifications in each section for detailed requirements. Record drawings to be submitted to Departmental Representative and all life safety systems must be operational, verified and tested and demonstrated to Departmental Representative prior to issuance of Schedule C.

1.25 SUBSTANTIAL PERFORMANCE REQUIREMENTS

.1 Before the Departmental Representative is requested to make a site review for substantial performance of the work:

.1 Commission all systems and prove out all components, interlocks and safety devices.

.2 Submit a letter certifying that all work is complete for the intended use, operational, clean and all required submissions have been completed.

.3 A complete list of incomplete or deficient items shall be provided. If, in the opinion of the Departmental Representative, this list indicates the project is excessively incomplete, a substantial completion review will not be performed.

.2 The work will not be considered to be ready for use or substantially complete until the following requirements have been met:

.1 All reported deficiencies have been corrected.

.2 Operating and Maintenance Manuals completed.

.3 "As Built" Record Drawing ready for review.

.4 Systems Commissioning has been completed and has been verified by Departmental Representative.

.5 All demonstrations to the owner have been completed.

.3 Letters of Assurance will not be issued until the following requirements have been met:

.1 All items listed in .1 above have been completed or addressed.

.2 Certificate of Penetrations through separations.

.3 Provincial or City Electrical Inspection - Certificate of inspection.

.4 Seismic Engineers letter of Assurance and final inspection report.

.5 Certificate of Substantial Performance.

.6 Signed off copy of Departmental Representative final site review report.

.7 Generator test report and certificate

.8 Fire alarm certification and verification.

.9 Connection to monitoring company for the Fire Alarm

.10 Emergency and Exit Lighting test letter.

1.26 DEFICIENCY HOLDBACKS AND DEFICIENCY INSPECTIONS

.1 Work under this Division which is still outstanding when substantial performance is certified will be considered deficient and a sum equal to at least twice the estimated cost of completing that work will be held back.

.2 It is expected that outstanding work will be completed in an expeditious manner and the entire holdback sum will be retained until the requirements for Total Performance of Division 26, 27, 28, 33 (electrical) work have been met and verified.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

.1 Provide materials and equipment in accordance with Division 01 and as follows.

.2 Material and equipment to be CSA certified. Where CSA certified material or equipment is not available, obtain special approval from authority having jurisdiction before delivery to site and submit such approval.

.3 Where equipment or materials are specified by technical description only, they are to be of the best quality available for the application for which it is to be installed.

2.2 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

.1 Provide all power and control wiring, conduit, wire, fittings, disconnect switches, motor starters, for all mechanical equipment unless otherwise specified.

.2 Bond all motors to conduit system with separate bonding conductor in flexible conduit or bonding conductor in the flexible conduit.

.3 Connections shall be made with watertight flexible conduit with watertight connectors.

.4 Control wiring and conduit standards are specified in the Electrical Divisions. Refer to Section 26 24 21 – Mechanical Equipment Controls and the Mechanical Divisions for scope of work and particular details.

2.3 WARNING SIGNS

.1 Provide warning signs, as specified or to meet the requirements of Inspection Department, Authority having Jurisdiction, and Departmental Representative.

.2 Use decal signs, minimum 175 x 250 mm [7” x 10”] size

2.4 EQUIPMENT IDENTIFICATION

.1 Identify all electrical equipment including but not limited to starters, disconnects, remote ballasts and controls with nameplates and labels as follows:

.2 Nameplates:

.1 Lamicoid 3 mm [0.125”] thick plastic engraving sheet, white face, black core, self adhesive unless specified otherwise. Provide white face, red core for all essential distribution equipment.

.2 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

.3 Wording on nameplates to be approved prior to manufacture.

.4 Allow for average of twenty-five (25) letters per nameplate.

.5 Disconnects, starters and contactors: indicate equipment being controlled and voltage and CCT.

.6 Terminal cabinets and pull boxes: indicate system and voltage and source.

.7 Transformers: indicate capacity, primary and secondary voltages, source and lead.

.3 Labels:

.1 Identify each outlet, starter, disconnect and all items of fixed equipment with the appropriate panel and circuit number origin by means of a small but good quality vinyl, self-laminating label such as T & B E-Z Code WSL, Dymo Letratag or Brother P-Touch equivalent printable markers. Embossed Dymo or any labels with edges and corners that are prone to lift will be rejected. Confirm location of labels with Departmental Representative before installing. Circuit number to agree with Record Drawings.

.4 Provide plastic covered panel directory with circuits and areas served typed in, and mounted on inside of door. Directory to conform to Record Drawings.

2.5 WIRING IDENTIFICATION

.1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour code: to CSA C22.1.

.4 Use colour coded wires in communication cables, matched throughout system.

2.6 CONDUIT, CABLE AND PULLBOX IDENTIFICATION

.1 Colour code conduits, metallic sheathed cables, pullboxes and junction boxes.

.2 Code with 25 mm plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor and at 15 m intervals.

.3 Colour coding to be as follows unless otherwise specified (note, not all systems may be present in this project):

SYSTEM	MAJOR BAND	MINOR BAND	CHARACTERS
347/600V Normal	Dark Blue	Black	
120/208V Normal	Light Blue	Black	
Ground	Dark Green		GR
Fire Alarm	Red		FA
Computer/Data	Light Green		COM
Telephone	Light Green	Black	TEL
AV/TV Systems	Light Brown		AV/TV
Security Systems	Purple		SEC
Building Alarm	Purple	White	BA
CCTV	Purple	Yellow	CCTV
Door Lock Release	Purple	Black	ED
Low Voltage Control	White	Yellow	LVC

2.7 FINISHES

.1 Shop finish metal enclosure surfaces by removal of rust and scale, cleaning, application of rust resistant primer inside and outside and at least two coats of finish enamel.

.2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original finish.

.3 Clean and prime paint exposed hangers, racks, fastenings to prevent rusting. Finish painting shall be provided by Division 09.

.4 Paint outdoor electrical equipment "equipment green" finish.

.5 Paint indoor switchgear and distribution enclosures light gray unless otherwise indicated in particular specification sections for specialised or emergency power equipment.

2.8 ACCESS PANELS (DOORS)

.1 Unless otherwise noted, access doors shall be minimum: 450mmx450mm [18"x18"] for body entry; 300mmx300mm [12”x 12”] for hand entry.

.2 Access doors in fire separations of 3/4 hour rating, and higher, and firewalls shall have a compatible fire rating and a ULC label with tamper-proof latch, self closing.

2.9 ANCHOR BOLTS AND TEMPLATES

.1 Supply anchor bolts and templates for installation by other Divisions.

2.10 FASTENING TO BUILDING STRUCTURE

.1 General:

.1 Do not use inserts in base material with a compressive strength less than 13.79 MPa [2000 psi].

.2 All inserts supporting conduit racks shall have a factor of safety of 5. All other inserts shall have a factor of safety of 4.

.2 Types:

.1 Cast-in-place type:

.1 Channel type - Burndy, Canadian Strut, Unistrut, Cantruss or Hilti Channel.

.2 Wedge type galvanized steel concrete insert, Grinnell Fig. 281 for up to 200 mm [8"] pipe size.

.3 Universal type malleable iron body insert, Grinnell Fig. 282 for up to 200 mm [8"] pipe size.

.2 Drilled, mechanical expansion type:

.1 Hilti HSL or UCAN LHL heavy duty anchor for use in concrete with compressive strength not less than 19.6 MPa [2840 psi].

.2 Hilti Kwik-Bolt or UCAN WED stud anchor for concrete. (Do not use in seismic restraint applications).

.3 Hilti HDI or UCAN IPA drop-in anchor for concrete.

.4 Hilti or UCAN Sleeve Anchor (medium and light duty) for concrete and masonry.

.5 Hilti ZBP or UCAN Zamac pin bolt (light duty) for concrete and masonry.

.3 Drilled, adhesive type:

.1 Hilti HVA or UCAN Adhesive Anchor consisting of anchor rod assembly with a capsule containing a two-component adhesive, resin and hardener.

.2 Hilti HY150 consisting of anchor rod with a 2 part adhesive system.

.3 For use in concrete housekeeping bases (in vertical downward position) where the distance to the edge of the concrete base could cause weakness if a mechanical expansion type anchor were used.

.4 Rod assemblies shall extend a minimum of 50 mm [2"] into the concrete slab below the housekeeping bases.

.3 Note:

.1 All drilling for inserts shall be performed using the appropriate tool specifically designed for the particular insert. The diameter and depth of each drilled hole shall be to the exact dimensions as specified by the insert manufacturer.

.2 Refer to manufacturer's recommendations for tightening torques to be applied to inserts.

.3 Where specifically called for, drills shall include a dust vacuum system, Hilti SAV Dust Vacuum System.

2.11 EQUIPMENT SUPPORTS

.1 Provide stands and supports for equipment and materials supplied.

.2 Lay out concrete bases and curbs required under Electrical Divisions. Coordinate with Concrete Divisions.

.3 Concrete bases shall be a minimum of 100 mm [4"] thick, or as noted and shall project at least 150 mm [6"] outside the equipment base, unless otherwise directed. Bases and curbs shall be keyed to the floor and incorporate reinforcing bars and/or steel mesh. Chamfer edges of bases at 45 degrees.

.4 Equipment with bedplates shall have metal wedges placed under the edges of the bedplates to raise them 25mm [1"] above the base after levelling. The wedges shall be left permanently in place. Fill the space between the bedplate and the base with non-shrink grout - Embeco or In-Pakt.

.5 Construct equipment supports of structural steel. Securely brace. Employ only welded construction. Bolt mounting plates to the structure.

.6 Support ceiling hung equipment with rod hangers and/or structural steel.

2.12 MISCELLANEOUS METAL

.1 Be responsible for all miscellaneous steel work relative to Electrical Divisions of the Specifications, including but not limited to:

.1 Support of equipment.

.2 Hanging, support, anchoring, guiding and relative work as it applies to wiring raceways and electrical equipment.

.3 Earthquake restraint devices - refer also to “Seismic Restraint” sections

.4 Bridle rings - secure to structure or steel supports.

.2 All steel work shall be prime and undercoat painted ready for finish under the related Division.

2.13 MAINTENANCE MATERIALS AND CABINET

.1 Provide maintenance materials in accordance with Division 01 and specified in appropriate Sections.

.2 Provide a finished painted sheet steel “spare equipment cabinet”. Cabinet to have a continuous hinge and complete with shelves and hasp to suit padlock. Minimum size 600 [24”] x 900 [36”] x 200 [8”] deep. Mount on wall in the Electrical Room. Provide a plastic covered typewritten list of spare parts and affix to the inside of the door.

2.14 OPERATION AND MAINTENANCE DATA

.1 Refer to Section 01 78 00 – Closeout Submittals for Operation and Maintenance Manual requirements.

.2 Refer to Section 26 05 03 – Operation and Maintenance Manual for detailed submittal requirements.

.3 Provide operation and maintenance data for incorporation into maintenance manual specified in Division 01 and as follows.

.4 Include in operations and maintenance data:

.1 Details of design elements, construction features, component function and maintenance requirements, to permit effective operation, maintenance, repair, modification, extension and expansion of any portion or feature of installation.

.2 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items, and parts lists. Advertising or sales literature not acceptable.

.3 Wiring and schematic diagrams.

.4 Names and addresses of local suppliers for items included in maintenance manuals.

.5 Include in the manual the following major sections:

.1 Title page (in plastic cover).

.2 Comprehensive description of the operation of the systems, including the function of each item of equipment within the system.

.3 Detailed instructions for the normal maintenance of all systems and equipment installed including procedures and frequency of operational checks and service and troubleshooting instructions.

.4 Local source of supply for each item of equipment.

.5 Wiring and control diagrams.

.6 Spare parts list.

.7 Copies of guarantees and certificates.

.8 Manufacturer's maintenance brochures and shop drawings.

2.15 PROJECT RECORD DRAWINGS

.1 Provide project record documents as specified in Division 01 as further called for in this Division.

.2 The contractor shall keep a complete set of white prints at the site office, including all addendums, change orders, site instructions, clarifications and revisions for the purpose of record drawings. As the work on site proceeds, the contractor shall clearly record in Red all as-built conditions which deviate from the original contract documents. Record drawings to include cable runs (complete with number of cables and ID number) and locations of all telecommunications equipment.

.3 Prior to substantial performance, the Contractor shall submit completed red-line record drawings to the Departmental Representative. The Contractor shall certify, in writing that the as-built record drawings are complete and that they accurately indicate all electrical services and electrical pathway, including exposed as well as concealed items.

.4 Preparation of record drawings in AutoCAD shall be performed by the Contractor after Departmental Representative reviews and accepts contractor prepared red-lines based on the red-line record drawings submitted by the Contractor.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.

3.2 NAMEPLATES AND LABELS

.1 Ensure manufacturers nameplates and CSA labels to be visible and legible after equipment is installed.

3.3 CONDUIT AND CABLE INSTALLATION

.1 Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete: schedule 40 steel pipe, sized for free passage of conduit and protruding 50 mm [2”].

.2 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.

.3 Install roof jacks where conduit and cables penetrate roofs. Apply sealant after installation. Install roof stand offs where conduit or teck is installed on roof.

.4 All cables and conduits to be installed concealed in finished areas.

3.4 LOCATION OF OUTLETS

.1 Do not install outlets back-to-back or in the same stud space in wall; allow minimum 400mm [16”] horizontal clearance between boxes.

.2 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000mm [10”- 0”] and information is given before installation.

.3 Locate light switches on latch side of doors unless otherwise indicated.

.4 Locate disconnect devices in mechanical room on latch side of door.

3.5 MOUNTING HEIGHTS

.1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.

.2 If mounting height of equipment is not indicated verify before proceeding with installation.

.3 Adjust mounting heights to accessible heights to meet the BC Building Code where applicable.

.4 Refer to detail on drawings; in the absence of a drawing detail or drawing note, use the following (note, not all devices may be present in this project):

Device	Height		Comment
Local switches	1200	[48”]	
Wall receptacles/data	460	[18”]	General
Wall receptacles/data	200	[8”]	Above top of continuous baseboard heater
Wall receptacles/data	175	[7”]	Above top of counters or counter splash backs – coordinate with Architectural detail
Wall receptacles/data	900	[36”]	In mechanical rooms
Exterior receptacles	600	[24”]	
Panelboards	2000	[80”]	Panelboards: as required by Code or as indicated.
Wall mtd telephone	1500	[60”]	

Device	Height		Comment
Card Readers/T'Stat	1200	[48"]	Confirm before installation
Fire alarm stations	1200	[48"]	ULC S524 requires not less than 1200mm or more than1400mm.
Wall Mounted Luminaires	2140	[82"]	
Fire alarm horns/audio	2300	[92"]	ULC S524 requires not less than 1800mm to centre. In any event not closer than 50mm to the ceiling
Fire alarm visual devices	2000	[80"]	ULC S524 requires not more than 2000mm to centre. In any event not closer than 150mm to the ceiling
Fire alarm Annunciator	1800 Top	[72"]	ULC S524 requires not more than 1800mm above finished floor.
End of line resistors	1800	[72"]	
Emergency Lighting (wall mounted)			300mm below ceiling or 2300mm max.
Exit Lights			300mm below ceiling or 450mm max. above door.

3.6 COORDINATION OF PROTECTIVE DEVICES

.1 Short Circuit Protective Device Coordination and Arc Flash Analysis is to be performed by the Contractor. Submit results to Departmental Representative.

.2 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to the required values and settings to provide a fully coordinated system. Adjust and modify the protective devices to the recommendations of the Analysis to minimize available incident energy in arc flash situations and maximize the coordination of the protective devices.

.3 All equipment to be labelled with appropriate PPE level requirements.

3.7 FIELD QUALITY CONTROL

.1 Load and Balance:

.1 Measure voltage and phase & neutral currents 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 and neutral currents to dry-core transformers and motor control centres, operating under normal load,

.3 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.

.2 Conduct and pay for the following tests:

.1 Power generation and distribution system including phasing, voltage, grounding and load balancing.

.2 Circuits originating from branch distribution panels.

.3 Lighting and its control to ASHRAE 90.1 – 10 requirements; this commissioning shall be conducted by the manufacture and the Departmental Representative shall receive a letter from the manufacturer detailing the commissioning and it's certification.

.4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.

.5 Systems: fire alarm system and communications.

.6 Main ground resistance (at all grounding locations).

.7 Insulation resistance testing:

.1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.

.2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.

.3 Check resistance to ground before energizing.

.3 Provide Departmental Representative with at least one week's notice prior to testing.

.4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

.5 Reports:

.1 Provide written reports in a timely manner upon completion of the testing and load balance. Indicate test hour and date.

3.8 CLEANING

.1 Do final cleaning in accordance with Division 01.

.2 At time of final cleaning, clean lighting reflectors, lenses and other lighting surfaces that have been exposed to construction dust and dirt.

.3 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

.4 Clean and prime paint exposed non-galvanised hangers, racks, fastenings to prevent rusting. Coordinate finish painting with Division 09.

.5 Clean Communication Rooms and equipment located therein with vacuum or similar compressed air/pressurized duster system.

3.9 WORKMANSHIP

.1 Workmanship shall be in accordance with well-established practice and standards accepted and recognized by the Departmental Representative and the Trade.

.2 The Departmental Representative shall have the right to reject any item of work that does not conform to the Contract Documents and accepted standards of performance, quietness of operation, finish and appearance.

.3 Employ only tradesmen holding valid Provincial Trade Qualification Certificates. Tradesmen shall perform only work that their certificate permits. Certificates shall be available for inspection by the Departmental Representative.

3.10 PROTECTION OF WORK

.1 Protect equipment and materials, stored or in place, from the weather, moisture, dust and physical damage.

.2 Mask machined surfaces. Secure covers over equipment openings and open ends of equipment and conduit, as the installation work progresses.

.3 Equipment having operating parts, bearings or machined surfaces, showing signs of rusting, pitting or physical damage will be rejected.

.4 Refinish damaged or marred factory finish.

.5 All communication rooms shall be dust free at the time of installation of cabling and equipment. Communication rooms shall remain dust free during construction.

3.11 PROTECTION OF ELECTRICAL EQUIPMENT

.1 Protect exposed live equipment during construction for personnel safety.

.2 Shield and mark live parts, e.g. "LIVE 120 VOLTS".

.3 Arrange for installation of temporary doors for rooms containing electrical distribution equipment. Keep these doors locked except when under direct supervision of electrician.

3.12 CONCEALMENT

.1 Conceal wiring and conduit in partitions, walls, crawlspaces and ceiling spaces, unless otherwise noted.

.2 Do not install wiring and conduit on outside walls or on roofs unless specifically directed.

3.13 SERVICE PENETRATIONS IN RATED FIRE SEPARATIONS

.1 All fire stopping materials shall be of one manufacturer; pre-approved manufactures are Hilti and STI.

.2 All cabling, wiring, conduits, cable trays, etc. passing through rated fire separations shall be smoke and fire stopped to a ULC or cUL tested assembly system, in accordance with CAN4-S115-95, that meets the requirements of the Building Code in effect.

.3 Firestop System installation must meet requirements of ASTM E 814 or UL 1479 tested assemblies that provide a fire rating equal to that of construction being penetrated.

.4 Install firestopping and smoke seal material and components in accordance with ULC certification and manufacturer's instructions. The Applicator shall be approved, licensed and supervised by the manufacturer in the installation of firestopping and are to follow the requirements of a rated system; installer to be FM 4991 Approved Contractor, UL Approved Contractor or Hilti Accredited Fire Stop Specialty Contractor.

.5 Contractors are expected to submit system information detailing firestopping product, backing, penetrant, penetrated assembly, Fire (F) and Temperature (T) rating, and ULC or cUL system number during shop drawing stage.

.6 Provide fire stopping material and system information in the maintenance manuals and via labels at major penetrations that are likely to be re-penetrated.

.7 All penetrations for communication cabling are to be firestopped using re-penetrable EZ Path System (Specified Technologies Inc - STI) or re-penetrable Hilti Firestop Systems designated and installed for each specific application.

.8 Allow openings for 100% capacity of raceway or 200% capacity of J-hooks (if applicable).

.9 Provide Firestopping approval certificate in including a Building Code / By-Law Schedule B & C-B signed by a BC registered Professional Engineer. Submit a letter certifying that all work is complete and in accordance with this specification.

.10 A manufacturer's direct representative (account manager, fire protection specialist, not distributor or agent) to be on-site during initial installation of firestop systems to train appropriate contractor personnel in proper selection and installation procedures. This will be done per manufacturer's written recommendations published in their literature and drawing details. Manufacturer’s fire protection specialist to work with Departmental Representative to determine frequency of site walk-throughs to be submitted to construction manager and Departmental Representative.

.11 Inspection of through-penetration firestopping by the manufacturer shall be performed in accordance with ASTM E 2174, “Standard Practice for On-Site Inspection of Installed Fire Stops” or other recognized standard and a field report shall be issued by the manufacturer to the Departmental Representative.

.12 Electrical Contractor to provide for a 10% deconstruction test by the Departmental Representative during walk-through.

3.14 SERVICE PENETRATIONS IN NON-RATED SEPARATIONS

.1 All cabling, wiring, conduits, cable trays, etc. passing through non-rated fire separations and non-rated walls and floors shall be tightly fitted and sealed on both sides of the separation with caulking or silicon sealant to prevent the passage of smoke and/or transmission of sound.

3.15 CONDUIT SLEEVES

.1 Provide conduit sleeves for all conduit and wiring passing through rated walls and floors. Sleeves to be concentric with conduit or wiring.

.2 Except as otherwise noted conduit sleeves are not required for holes formed or cored in interior concrete walls or floors.

.3 Conduit sleeves shall extend 50 mm [2"] above floors in unfinished areas and wet areas and 6 mm [1/4"] above floors in finished areas.

.4 Conduit sleeves shall extend 25 mm [1"] on each side of walls in unfinished areas and 6 mm [1/4"] in finished areas.

.5 Conduit sleeves shall extend 25mm [1"] beyond exterior face of building. Caulk with flexible caulking compound.

.6 Sleeve Size: 12 mm [1/2"] clearance all around, between sleeve and conduit or wiring.

.7 Paint exterior surfaces of ferrous sleeves with heavy application of rust inhibiting primer.

.8 Packing of Sleeves:

.1 Where sleeves pass through foundation walls and perimeter walls the space between sleeve and conduit shall be caulked with waterproof fire retardant non-hardening mastic.

.2 Pack future-use sleeves with mineral wool insulation and then seal with ULC approved fire stop sealant for rated fire separations.

3.16 ACCESSIBILITY AND ACCESS PANELS

.1 Install all equipment, controls and junction boxes so as to be readily accessible for future modification, adjustment, operation and maintenance as appropriate.

.2 Provide access panels where required in building surfaces. Do not locate access panels in panelled or special finish walls, without prior approval of the Departmental Representative.

.3 Access panels in U.L.C. fire separations and fire walls shall have a compatible fire rating and U.L.C. label. Acquire approval in writing from the local fire authority if required.

.4 Access panels shall be painted with a primer coat if applicable and then with a finish coat, colour and type to the Departmental Representative's approval.

.5 Locate equipment and junction boxes in service areas wherever possible.

3.17 EQUIPMENT INSTALLATION

.1 Provide means of access for servicing equipment.

.2 CSA identification and equipment labels to be clearly visible after installation.

3.18 CUTTING, PATCHING, DIGGING, CANNING, CORING & CONCRETE

.1 Lay out all cutting, patching, digging, canning and coring required to accommodate the electrical services. Coordinate with other Divisions. The performance of actual cutting, patching, digging, canning and coring is specified under other Divisions.

.2 The Electrical Contractor shall be responsible for all cutting, patching, digging, canning and coring required to accommodate the electrical services.

.3 The Electrical Contractor shall be responsible for correct location and sizing of all openings required under Electrical Divisions, including piped sleeves.

.4 Verify the location of existing and planned service runs and structural components within concrete floor and walls prior to core drilling and/or cutting.

.5 Openings through structural members of the building shall not be made without the approval of the Structural Consultant.

.6 Openings in Concrete:

.1 Be responsible for the layout of all openings in concrete, where openings are not left ready under previous contract.

.2 All openings shall be core drilled or diamond saw cut.

.3 Refer to structural drawings for permissible locations of openings and permissible opening sizes in concrete floors and walls.

.4 Refer to structural drawings for locations of steel reinforcing.

.5 Be responsible for repairing any damage to steel reinforcing.

.7 Openings in building surfaces other than concrete:

.1 Lay out all openings required.

.8 Poured concrete for duct encasements, pole bases, transformer pads and housekeeping pads shall be provided by other Divisions, coordinated and supervised by the Electrical Divisions.

.9 Precast concrete items such as transformer pad bases, pull boxes and light pole bases to be provided and installed by the Electrical Divisions unless otherwise specified.

.10 Excavation and backfilling will be provided by other Divisions. This Division to supervise the work and provide all layouts and parameters.

3.19 PAINTING

.1 Clean exposed bare metal surfaces supplied under the Electrical Divisions removing all dirt, dust, grease and millscale. Apply at least one coat of corrosion resistant primer paint to all supports and equipment fabricated from ferrous metal.

.2 Paint all hangers and exposed sleeves, in exposed areas, with a rust inhibiting primer, as they are installed.

.3 Repaint all marred factory finished equipment supplied under the Electrical Divisions, to match the original factory finish.

END OF SECTION 26 05 00

PART 1 - GENERAL

1.1 RELATED WORK

.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 SCOPE

.1 Electrical operations and maintenance manuals (hereinafter referred to as O&M manuals) shall be prepared by a firm specializing in this type of work.

.2 Specialty firm to be responsible for:

.1 The supply and preparation of four sets of O&M manual binders and tabs as specified in the index below.

.2 The preparation of all written system descriptions and schematics (neatly drafted) for each tab section identified as article 1.4. Format as directed by the Owner, utilizing proportional typewritten format, with schematics in appendices at the end of each section. System description shall include an overview of basic design philosophy, description of future expansion capability, general construction of components, electrical characteristics not readily deduced from the contract documents, basic system configuration and interfaces with other systems existing or new.

.3 Securing and assembling all necessary literature describing operational and maintenance procedures for all equipment into the O&M manual binders, including Preventative Maintenance data as described below. Preventative maintenance data and maintenance suggestions to be compiled in tabular format in applicable section to provide a comprehensive overview of maintenance procedures.

.4 Preparing in coordination with Electrical Divisions and equipment manufacturer's technical specialist, scheduled maintenance sheets and check lists. Scheduled maintenance sheets shall include safety in maintenance data plus detailed daily, monthly and yearly scheduled maintenance information. Format as directed by the Owner.

.5 Preparation of safety in maintenance suggestions and procedures.

.6 Summarized daily, monthly and yearly maintenance charts.

.7 Prestonia No. 2047-10 plastic sheet protectors for all drawings larger than 210 mm $\times$ 275 mm. Locate drawing title block on lower right hand corner.

.3 Division 26 shall be responsible for:

.1 Supply of four (4) copies of all information as described below:

.1 Final shop drawings.

.2 All wiring diagrams.

.3 List of all major trades, sub-trades and suppliers including names of equipment supplied and by whom, addresses, phone numbers, facsimile numbers and contact persons.

.4 Obtaining all data necessary to compile a complete comprehensive Preventative Maintenance program. Data gathered shall be neatly handwritten on forms provided by the Owner. Data to be collected for all systems described in the index below.

.5 Spare/replacement parts lists for all of the above. Copies of the electrical contractor's data collection sheets available during tendering period when requested.

.6 Test results and verification reports as outlined in other sections of this specification.

.7 Warranties as outlined in this and other sections of the Specifications.

1.3 ELECTRONIC FORMAT

.1 In addition to the specified hardcopy, provide an electronic copy in pdf format. Electronic copy to be produced on a CD-ROM in the latest version of Acrobat.

.2 CD-ROM to be reproducible by owner as required to carry out his duties.

.3 Electronic copy to consist of a single pdf file divided into chapters to allow a quick and easy access to the different sections of the manual.

.4 All log sheet, maintenance tables, preventative maintenance sheets, intended to be completed by the Owner are to be completely interactive allowing the Owner to complete all pertinent information and save, print or modify these forms as required.

.5 Provide a proposed layout to the Departmental Representative for approval prior to the construction of the O&M manuals.

.6 Electrical contractor to submit complete system description and schematics by 50% complete stage of construction. O&M manuals to be submitted to the Owner 90% complete three (3) months prior to substantial completion review.

.7 Electrical O&M manuals to be assembled in 210 mm $\times$ 275 mm capacity, expanding spine catalogue binders complete with plated piano hinges, bound in heavy fabric, hot stamped lettering on front and spine. Electrical contractor to provide sufficient quantity to allow all binders to hold system data while in full closed position (not expanded).

.8 Electrical contractor to provide sample of art work and fabric cover (before having binders constructed) to the Owner.

.9 In addition to the specified hardcopy, provide an electronic copy in pdf format. Electronic copy to be produced on a CD-ROM in the latest version of Acrobat.

.1 CD-ROM to be reproducible by owner as required to carry out his duties.

.2 Electronic copy to consist of a single .pdf file divided into chapters to allow a quick and easy access to the different sections of the manual.

.3 All log sheet, maintenance tables preventative maintenance sheets, intended to be completed by the Owner are to be completely interactive allowing the Owner to complete all pertinent information and save, print or modify these forms as required.

.4 Provide a proposed layout to the Departmental Representative for approval prior to the construction.

END OF SECTION 26 05 03

PART 1 - GENERAL

1.1 RELATED WORK

.1 This Section of the Specification is to be read, coordinated and implemented in conjunction with all other parts of the Contract Documents.

1.2 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 should be able to provide a proof of professional insurance and the related practice credentials if requested by the Electrical Consultant. The Seismic Consulting Engineer should be familiar with SMACNA, ECABC & NFPA guidelines as well as BCBC and VBBL requirements.

.3 The Contractors' Seismic Consultant shall submit original signed BC Building Code "Letters of Assurance" "Schedules B and C-B" to the Prime Consultant or Electrical Consultant.

.4 Project shall comply with the local bylaw where applicable.

.5 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.

1.3 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.

.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.

.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.

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 restraints shall be provided on suspended and shelf mounted transformers along with associated equipment and assemblies connected to them at the points of vertical support (4 points). The restraint wires shall be oriented at approximately 90 degrees to each other (in plan), and tied back to the ceiling slab or its structure at approximately 45 degrees to the slab or basic structure. The restraints shall be selected for a 1 g earthquake loading, i.e. each wire shall have a working load capacity equal to the weight of the transformer. The anchors in the structure shall be selected for a load equal to the weight of the transformers at a 45 degree pull.

.3 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.

.4 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.

.3 Riser joints shall be braced or stabilized between floors.

.4 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 [4 ft] intervals for tubing.

.5 Do not brace conduit runs against each other. Use separate support and restraint system.

.6 Support all conduits in accordance with the capability of the pipe to resist seismic load requirements indicated.

.7 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.

.8 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.

.9 Provide large enough conduit sleeves through walls or floors to allow for anticipated differential movements with firestopping where required.

.10 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 Departmental Representative 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. Design anchors and bolts for seismic force applied horizontally through the center of gravity to a seismic force of 0.5g. For equipment which may be subject to resonances, use a nominal 1.0 g seismic force.

.2 Provide flexible conduit connections between floor mounted equipment to be restrained and its adjacent associated electrical equipment.

3.4 LIGHT FIXTURES

.1 Fixtures 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 taught 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 framing above by taut cables.

.3 Fixtures which are hung independently of ceiling systems shall have minimum of one 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 26 06 06

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 This section of the specification forms part of the Contract Document and is to be read, interpreted and coordinated with all other parts.

1.2 EXCAVATION AND BACKFILL

.1 Check the drawings of other Divisions of the work for the existence of underground services, and report any serious interference before proceeding with the work. The services of Utility Authorities shall be engaged to accurately determine the location of any underground services prior to excavation.

.2 Carefully coordinate duct bank location below building with the structure.

.3 In the execution of this work, or any extra work in connection therewith, do not move any structure or services without the consent of the proper parties. In crossing or running parallel with said structures or services, secure same in place until the work is completed. Any damage to structures or services of this kind caused by neglect to attend to same shall be paid for by the Contractor.

.4 Keep excavations dry at all times by bailing, pumping, or other means as is necessary.

.5 Prove grades and the route of ductwork and conduits and the location of manholes far enough along the route in advance of forming and concrete pour so that any relocation or re-design necessitated by unforeseen obstacles may be carried out.

.6 Grade the bottom of trenches for ducts, duct banks and conduit and level with pit-run gravel and sand, graded from coarse to fine with a maximum size of 38mm [1½"]. Where excavation is carried out to a depth greater than that required for the proper elevation for the ducts, duct bank, or conduit, backfill with carefully compacted and power-tamped sand and pit-run gravel as specified to the required grade.

.7 Backfill trenches under building floor areas with sand placed in layers in an approved manner to achieve 95% modified Proctor compaction. Material from excavation shall not be used for backfilling.

.8 In locations other than under building floor areas, thoroughly tamp same around and over ducts and conduits to a height of at least 300mm [12"] above. Fill remainder of trench and consolidate on 450mm [18"] layers with approved excavated materials, free from stone and foreign materials.

.9 Except where beneath the building, supply and install polyethylene HIGH VOLTAGE marking tape over and along the full length of underground services at a depth of 300mm [12"] below grade.

.10 Backfill the top 150mm [6"] of the excavation with pit-run gravel where the excavation is situated on a paved or travelled road; crushed rock screenings where the excavation is situated on a concrete sidewalk; black loam where the excavation is on a developed grass boulevard; and sand or earth free of clay, extraneous material, or rock no larger than 38mm [1½"] in any dimensions elsewhere. All shall be thoroughly tamped. Where area was originally grassed, rake loam clear of all stones and debris and leave ready for re-sodding.

.11 Backfill as soon as possible, so that regular traffic in and around the work will not be inconvenienced.

.12 Fill depressions to restore the correct grade after a period adequate to reveal settlement has passed. Restore all surfaces (paving, sidewalk, grass) to same quality as the surroundings. Assume responsibility for making good any subsequent settlement of such fill. Pay costs involved in making good pavement, surfacing lawns, curbs and all other surfaces damaged by such settlement and subsequent restoration.

.13 Store materials excavated during the progress of the work in such locations as directed by the Departmental Representative and in such a manner as to produce a minimum of inconvenience, damage or disfigurement of existing ground.

.14 Remove and dispose of excess excavated material remaining on completion of the work and leave site clear and unencumbered.

1.3 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 Departmental Representative and as coordinated with Division 07 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.

1.4 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 Grey ASA #61 unless matching existing equipment in which case colour shall match existing.

.2 Unless otherwise directed, paint outdoor electrical equipment "equipment green" finish to EEMAC Y1-1-1955.

.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.

1.5 VIBRATION AND NOISE CONTROL

.1 Mounting

.1 Vibrating electrical equipment, such as transformers and standby diesel engine generators, shall be mounted using vibration isolators to prevent the transmission of vibration and mechanically transmitted sound to the building structure. Vibration 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.

.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.

.3 Vibration Isolators and Hangers

.1 For floor-mounted transformers, use Mason Industries bridge bearing quality neoprene "Super W" waffle pads Type SWMW, SWML, or SWM as appropriate, or approved equal, anchored to the structure through Mason hemispherical grommets.

.2 For transformers suspended from the ceiling, use hanger rod assemblies, fitted with Mason Industries Type 30N, or approved equal, vibration hangers with 30° misalignment capability.

.3 For dry type transformers 750kVA and larger, use Mason Industries SSLFH spring type vibration isolators.

.4 General

.1 In other than Mechanical or Electrical Rooms or closets, electrically held relays, contactors and starters shall be provided with vibration isolation mounts and sound enclosures.

.2 All parts of all fluorescent lighting fixtures and remote ballast boxes or racks shall be securely fastened and, if necessary, fitted with neoprene spaces to minimize ballast noise amplification.

1.6 ACOUSTICAL SPECIFICATIONS FOR TRANSFORMER

.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 50Hz and 1,000Hz based on a 300kVA transformer. Other sizes shall meet equivalent noise level with noise correction based on 10 Log kVA re: 300kVA. Use a room absorption equivalent to 1/3 of the floor area. Supply the name of a similar installation.

.2 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.

.3 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 25mm deflection spring isolators, including in-series neoprene elements with an effective deflection of 2.5mm. Use restraints meeting the National Building Code with respect to seismic requirements. (Also refer to Section 26 05 30 Seismic Restraints).

.2 Where a transformer is located on a slab on grade, use pad isolators sized for a minimum 2.5mm defection, with seismic restraints.

.3 If the transformer core is mounted on separate transverse steel supporting members independent of the transformer enclosure, size the members for a 140Hz cantilever resonant frequency under the dead load of the member (0.013mm dead load cantilever deflection) and the isolator stiffness.

.4 Where smaller transformers are supplied with core bolted into steel supports within the cabinet, supply neoprene pad isolation within cabinet with minimum 2.5mm 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 2.5mm deflection and isolate the conduit to meet the requirement.

.5 For 10 metres 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.

.6 Submit shop drawings detailing proposed isolation.

.2 Standard of Acceptance:

.1 Mason MAS or MT air mounts

.2 Mason Z-1011 seismic restraints

.3 Mason SLFH open spring isolators

.4 Mason Super W pad isolator, 50 durometer

.5 Mason HD hangers

.3 Execution

.1 Locate all mechanical equipment, electrical conduit and lighting at least 300mm below the ceiling slab, including wall-mounted equipment. Do not locate mechanical ducts over transformer cabinets.

END OF SECTION 26 05 10

PART 1 - GENERAL

1.1 RELATED WORK

.1 This section of the specification forms part of the Contract Document and is to be read, interpreted and coordinated with all other parts.

1.2 BRANCH WIRING

.1 Adhere to the circuit numbers indicated on the drawings. Provide all branch circuit wiring using materials and methods described herein and in consultation with the Departmental Representative.

.2 Calculate volt drop of all feeders and branch circuit wiring and increase wire sizes based on actual wire run to meet the minimum requirements of the Canadian Electrical Code.

.3 Install a green insulated bonding conductor in all conduits; do not rely on metallic conduit for bonding continuity. Size bonding conductor as per the Canadian Electrical Code.

.4 Phase all panelboard buses throughout the building such that the left, centre, and right hand buses represent phase A, B, and C respectively. Identify all indicating meters to this sequence.

.5 Provide all conduits and wiring including flexible connections, outlet boxes complete with wiring devices and surface raceways for all casework and millwork as shown on the drawings, unless otherwise noted. Arrange conduit so that it will be completely concealed along the entire run to the outlet.

.6 Where wiring devices are indicated on free-standing benches or tables, locate conduit so that it will be concealed along the entire run to the outlet. Location of conduit floor penetrations shall be to the approval of the Departmental Representative. Conduits will not be permitted to run in concrete floor or topping or below slab on grade.

.7 Prior to cutting of millwork for outlets/devices, prepare a "mock-up" at each location using paper cutouts to indicate the outlet/device layout. The paper cutouts shall be of the same overall size as the outlet/device that they represent and be complete with identification. The Contractor shall attach the paper cutouts to the millwork such that they are easily removable and in positions that are as generally indicated on the drawings. After each piece of millwork has all paper cutouts mounted, advise the Owner and the Departmental Representative and relocated as directed by the Departmental Representative prior to performing cutting of millwork.

.8 Wire to all electrical appliances indicated on the drawings. The word appliance is intended to include cooking equipment not of 'plug-in' nature, laundry equipment, stills, hot water tanks, and other special equipment throughout the building for which outlets are indicated on the drawings or noted in the equipment schedule. Use flexible conduit or liquid-tight flexible conduit for connection from outlets to appliances.

.9 Unless otherwise noted, appliances will be supplied and set in place in the rooms by others. Check with the trades involved and with the Owner to determine correct orientation of the appliances, the final and exact location and electrical requirements of each outlet (both control and supply) before proceeding with the installation.

.10 Prior to rough-in of outlet boxes confirm final furniture layout with the Architect.

.11 Prior to installation of switch outlets, confirm door swing on Architectural Drawings. Where switch cannot be located on latch side of door, install the outlet box a minimum of three feet from the door swing, do not install switch behind door.

.12 Wiring circuits for electronic equipment, such as computers, printers and Communications equipment shall have a separate dedicated neutral for each and every circuit.

END OF SECTION 26 05 11

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 This Section of the Specifications forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA-C22.2No.18, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.

.2 CSA C22.2No.65, Wire Connectors.

.2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)

.1 EEMAC 1Y-2, 1961 Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).

.3 National Electrical Manufacturers Association (NEMA)

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Pressure type wire connectors to: CSA C22.2No.65, with current carrying parts of copper alloy sized to fit copper conductors as required.

.2 Fixture type splicing connectors to: CSA C22.2No.65, with current carrying parts of copper alloy sized to fit copper conductors 10 AWG or less.

.3 Bushing stud connectors: to EEMAC 1Y-2/NEMA to consist of:

.1 Connector body and stud clamp for round copper conductors.

.2 Clamp for round copper conductors.

.3 Clamp for stranded aluminum conductors round aluminum bar.

.4 Stud clamp bolts.

.5 Bolts for copper conductors and bar.

.6 Bolts for aluminum conductors and bar.

.7 Sized for conductors or bars as indicated.

.4 Clamps or connectors for armoured cable, aluminum sheathed cable, flexible conduit as required to: CAN/CSA-C22.2No.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 CSA C22.2No.65.

.3 Install fixture type connectors and tighten. Replace insulating cap.

.4 Install bushing stud connectors in accordance with EEMAC 1Y-2/NEMA.

END OF SECTION 26 05 20

PART 1 - GENERAL

1.1 RELATED WORK

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

.2 Refer to Division 27 & 28 for particular Communications, Electronic Safety & Security wiring systems and types.

1.2 TERMS OF REFERENCE

.1 Typically use insulated 98% conductivity copper conductor wiring enclosed in EMT (steel) conduit for the general wiring systems unless otherwise indicated. Refer to “Site Services” Section for allowable site conduits as an alternative to steel.

.2 Teck cable may only be used where specifically indicated on the drawings or in the specifications. Where permitted, Teck wiring up to 750 system volts to be PVC jacketed armoured cable, multi-copper conductor type Teck90 1000 volt having a PVC jacket with FT-4 flame spread rating.

.3 Flexible armoured cabling (BX) shall not be used for the general wiring system other than final drops to light fixtures in ceilings.

.4 Provide all control wiring except mechanical equipment controls as specified in Section 26 24 21 Mechanical Equipment Controls and the Mechanical Divisions.

.5 Refer to Equipment Schedule(s) for detailed responsibilities.

.6 Non-metallic sheathed wiring is not to be used on this project.

1.3 PRODUCT DATA

.1 Provide product data in accordance with Division 01

PART 2 - PRODUCTS

2.1 WIRING & CABLES – GENERAL

.1 Conductors: stranded for 10 AWG and larger. Minimum size #12 AWG.

.2 Insulation to be 600 volt RW75XLPE (X link) for the general building wiring in conduit.

.3 Use RWU75XLPE for underground installations.

.4 Site services sub-circuits, including site lighting, to be minimum #10 AWG for power and #12 AWG for controls. Increase wiring size for lengthy and/or loaded circuits so that system will not exceed the maximum voltage drop as recommended by the Canadian Electrical Code CSA 22.1.

.5 Main feeders to be conduit and copper insulated wiring unless otherwise noted on drawings. Provide bond wiring for all conduits. Increase conduit size as required.

.6 Armoured (AC-90) cable may only be utilized for recessed tee bar luminaire drops from ceiling mounted outlet boxes. "Tite Bite" connectors and their counterparts of other manufacturers shall not be used. Use anti-short connectors. Cable from luminaire to luminaire is not permitted. Allow nominally 900mm [3’] extra cable looped and supported in the ceiling space to permit fixture relocations of one tile space.

.7 TBS75 #14 AWG stranded shall be used in all switchgear assemblies. Current transformer secondary wiring shall be #12 AWG stranded. Current transformer leads shall incorporate ring type tongues for termination purposes

.8 Conductors to be colour-coded. Conductors #10 AWG and smaller shall have colour impregnated into insulation at time of manufacture. Conductors size #8 AWG and larger may be colour-coded with adhesive colour coding tape, but only black insulated conductors shall be employed in this case, except for neutrals which shall be white wherever possible. Where colour-coding tape is utilized, it shall be applied for a minimum of 50 mm at terminations, junctions and pullboxes and condulet fittings. Conductors shall not be painted.

2.2 ARMOURED CABLE (AC-90) – DROPS TO LUMINAIRES IN T'BAR SUSPENDED CEILINGS ONLY.

.1 Conductors: insulated, copper, size as indicated.

.2 Type: AC90 600 V rated.

.3 Armour: interlocking type fabricated from galvanized steel.

.4 Anti-short connectors.

2.3 WIRE & BOX CONNECTORS

.1 Pressure type wire connector current carrying parts to be copper and sized to fit conductors used.

.2 Fixture type splicing connector current carrying parts to be copper sized to fit conductors 10 AWG or less.

.3 Bushing stud connectors to EEMAC 1Y-2 and suitable for stranded copper conductors

.4 Clamps or connectors for armoured cable, flexible conduit, as required.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install all cables and wiring.

.2 Conductor length for parallel feeders to be identical. Provide permanent plastic nametag indicating load fed.

.3 Group Teck, Armoured, MI & Sheathed cables on channels wherever possible.

.4 Lace or clip groups of feeder conductors at all distribution centres, pullboxes, and termination points.

.5 Wiring in walls should typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls should be avoided unless indicated.

.6 All grounding and bonding conductors and straps to be copper. All bonding conductors to have green insulation jacket.

.7 Colour coding to be strictly in accordance with Section 26 05 00 – Common Work Results.

.8 Provide sleeves where cables enter or exit cast concrete or masonry.

.9 Power wiring up to and including #6 AWG shall be spliced with nylon-insulated expandable spring-type connectors. Large conductors shall be spliced using split-bolt or other compression type connectors wrapped with cambric tape then PVC tape.

.10 Wires shall be sized for 2% maximum voltage drop to farthest outlet on a loaded circuit. Increase home run cable size to meet these requirements.

.11 All 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.

.12 Install all control cables in conduit.

.13 Provide numbered wire collars for all control wiring. Numbers to correspond to control drawing legend. Obtain wiring diagram for control wiring of other Divisions.

3.2 VOLTAGE REGULATION

.1 The drawings are diagrammatic and indicate the general routing of conduit runs and not exact routing, either horizontally or vertically.

.2 Branch circuit conductor sizes shall be #12 AWG or larger based on the Canadian Electrical Code CSA 22.1 Section 8, which allows a maximum 3% voltage drop for branch circuits.

3.3 WIRE & BOX CONNECTORS

.1 Remove insulation carefully from ends of conductors and:

.1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65

.2 Install fixture type connectors and tighten. Replace insulating cap.

.3 Install bushing stud connectors in accordance with EEMAC 1Y-2

END OF SECTION 26 05 21

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 This section of the Specification forms part of the Contract Document and is to be read, interpreted and coordinated with all other parts.

1.2 REFERENCES

.1 American National Standards Institute /Institute of Electrical and Electronics Engineers (ANSI/IEEE) – most recent version

.1 ANSI/IEEE 837, IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding.

.2 Grounding equipment to: CSA C22.2 No.41.

.3 All grounding conductors to be stranded soft annealed copper unless otherwise noted.

.4 Install complete grounding and bonding system in accordance with Canadian Electrical Code and local inspection authority requirements.

.5 ANSI/TIA 607B Generic Telecommunications Bonding and Grounding for Customer Premises.

PART 2 - PRODUCTS

2.1 EQUIPMENT

.1 Clamps for grounding of conductor: size as required to electrically conductive underground water pipe.

.2 Copper conductor: minimum 6 m long for each concrete encased electrode, bare, stranded, soft annealed, size as indicated.

.3 Rod electrodes: copper clad steel 19 mm diameter by minimum 3 m long.

.4 Plate electrodes: to CSA Standard 41.

.5 Grounding conductors: bare stranded copper, tinned, soft annealed, size as per C.E.C.

.6 Insulated grounding conductors: green, copper conductors, sized as per C.E.C.

.7 Ground bus: copper, 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 Thermit welded type conductor connectors.
.5 Bonding jumpers, straps.
.6 Pressure wire connectors.

2.2 STANDARDS OF ACCEPTANCE

.1 Acceptable manufacturers:

.1 Burndy Corp.
.2 Erico Inc.
.3 Cadweld.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for grounding equipment installation in accordance with manufacturer's written instructions.

.1 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

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

3.2 INSTALLATION GENERAL

.1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Where EMT is used, run ground wire in conduit.

.2 Install connectors in accordance with manufacturer's instructions.

.3 Protect exposed grounding conductors from mechanical injury.

.4 Make buried connections, and connections to conductive water main, electrodes, using copper welding by thermit process, permanent mechanical connectors or inspectable wrought copper compression connectors to ANSI/IEEE 837.

.5 Use mechanical connectors for grounding connections to equipment provided with lugs.

.6 Install bonding wire in EMT conduits.

.7 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.

.8 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.

.9 Install separate ground conductor to outdoor lighting standards.

.10 Connect building structural steel and metal siding to ground by welding copper to steel.

.11 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

.12 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.

.13 Ground secondary service pedestals.

.14 Provide a grounding/bonding bus in electrical room. Connect a #2/0cu bonding conductor or as shown on the drawings between grounding/bonding buses.

.15 All bonding and grounding connections to be compression type unless noted otherwise.

.16 Bond bonding bus of switchboard to the grounding grid with a #3/0 copper conductor.

.17 Ground the secondary winding of potential and current transformers.

.18 Supply and install complete grounding and bonding system as indicated and as required by Canadian Electrical Code and the local electrical inspection authorities.

.19 Provide grounding/bonding bus bars mounted on standoff insulators or as shown on the drawings.

.20 All components shall be securely and adequately bonded and where required to accomplish this, bonding jumpers, grounding studs and bushings shall be used.

.21 Ensure that all raceways, terminal panels, etc. for fire alarm, etc. are securely and adequately bonded and provide grounding conductor to main ground bus where called for or when required.

.22 All interior metallic gas piping which may become energized to be made electrically continuous and to be bonded in accordance with requirements of Canadian Electrical Code.

.23 Bond all low tension equipment with #6 AWG green insulated bonding conductor.

.24 Bond all structural steel, all concrete reinforcing steel and all metal systems with a #6 AWG copper bonding conductor. Connect to closest ground bus or bonding point.

.25 All metallic conduits longer than 1m in length, containing a single grounding or bonding conductor, shall be bonded as per the Canadian Electrical Code.

3.3 MAINTENANCE HOLES

.1 Install conveniently located grounding stud, electrode, size as indicated stranded copper conductor in each maintenance hole.

.2 Install ground rod in each maintenance hole so that top projects through bottom of maintenance hole. Provide with lug to which grounding connection can be made. Confirm ground resistance meets or exceeds Canadian Electrical Code minimum requirements.

3.4 ELECTRODES

.1 Make ground connections to continuously conductive underground water pipe on street side of water meter.

.2 Install water meter shunt.

.3 Install concrete encased electrodes in building foundation footings, with terminal connected to grounding network.

.4 Install rod electrodes and make grounding connections as indicated.

.5 Bond separate, multiple electrodes together.

.6 Copper conductors for connections to electrodes in accordance with C.E.C.

.7 Make special provision for installing electrodes that will give acceptable resistance to ground value where rock or sand terrain prevails. Ground as indicated.

3.5 EQUIPMENT BONDING

.1 Install bonding 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, UPS units, elevators and escalators, distribution panels, outdoor lighting and cable trays.

.2 Provide a bonding conductor from the secondary of every distribution transformer to the grounding system. Bond conductor to be sized and installed in accordance with Canadian Electrical Code.

3.6 GROUNDING BUS

.1 Provide a ground bus in the main electrical and communications equipment room. Ground bus shall consist of suitable length of 50mm x 6mm [2”x ¼”] copper bus mounted on a 25mm [1”] insulating standoffs. This bus shall be drilled and tapped to receive all the bonding conductors indicated and an engraved nameplate or tag installed above or below individual conductors indicating their function.

.2 Bond items of electrical equipment in electrical room and IT equipment in communication equipment room to ground bus with individual bare stranded copper connections size 2/0AWG.

3.7 MECHANICAL EQUIPMENT BONDING

.1 Provide a #2 bond conductor from the mechanical room ground bus to each MCC.

.2 Provide a #6 bond conductor from the mechanical room ground bus to each VFD

.3 Bond wires to be installed in all conduit serving motor feeder circuits and to extend to ground screws on junction and outlet boxes for bonding.

3.8 COMMUNICATION SYSTEMS

.1 Install Bonding connections for telephone, sound, fire alarm, security systems, intercommunication systems as required in ANIS/TIA 607B:

.1 Utility Provider grounding system in accordance with telephone company's requirements.

.2 Communication, sound, fire alarm, security systems, intercommunication systems as indicated.

3.9 SYSTEMS BONDING

.1 Install a home run #6 AWG insulated bonding conductor in conduit from the main ground bus to the:

.1 Main Fire Alarm panel

.2 Main Security panel.

.3 Communication systems head end.

3.10 CABLE TRAY BONDING

.1 Install 1#6 green insulated copper bond cable to each cable tray from nearest ground bus.

.2 Install 1#6 green insulated copper bond cable, for full length of tray bonded to tray at 15m [50’] intervals and to ground bus at each termination point as specified..

3.11 LABELLING

.1 Provide equipment identification labelling nameplates for grounding bus bar, bonding and grounding conductors.

.2 Apply identification and warning labels to grounding bus bar, bonding and grounding conductors.

3.12 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 08 00 – Commissioning and Demonstration.

.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 26 05 28

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 This Section of the Specifications forms part of the Contract Documents and shall be read, interpreted and coordinated with all other parts.

PART 2 - PRODUCTS

2.1 SUPPORT CHANNELS

.1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted, suspended or set in poured concrete walls and ceilings.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Secure equipment to hollow and solid masonry, tile and plaster surfaces with lead anchors or nylon shields.

.2 Secure equipment to poured concrete with expandable inserts.

.3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.

.4 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.

.5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.6 Fasten exposed conduit or cables to building construction or support system using straps.

.1 One-hole 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 dia threaded rods and spring clips.

.2 Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.

.8 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

.9 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.10 Do not use wire lashing or perforated strap to support or secure raceways or cables.

.11 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Departmental Representative.

.12 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

END OF SECTION 26 05 29

PART 1 - GENERAL

1.1 RELATED WORK

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

PART 2 - PRODUCTS

2.1 SPLITTERS

.1 Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.

.2 Main and branch lugs, connection bars to match required size and number of incoming and outgoing conductors as indicated.

.3 At least three spare terminals on each set of lugs in splitters less than 400 A.

2.2 JUNCTION AND PULL BOXES

.1 Welded steel construction with screw-on flat covers for surface mounting.

.2 Covers with 25 mm [1”] minimum extension all around, for flush-mounted pull and junction boxes.

2.3 CABINETS

.1 Type E: sheet steel, hinged door and return flange overlapping sides, handle and catch, for surface mountings.

.2 Type T: sheet steel cabinet, with full length hinged door, latch, lock, 2 keys, containing 19 mm G1S fir plywood backboard for surface or flush mounting as appropriate.

.3 Include filtered vents and/or fan-cooling when enclosed equipment is heat producing.

PART 3 - EXECUTION

3.1 SPLITTER INSTALLATION

.1 Install splitters as indicated and mount plumb, true and square to the 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 spaces.

.2 Only main junction and pull boxes are indicated. Provide pull boxes so as not to exceed 30 m of conduit run between pull boxes.

.3 Provide pull boxes and junction boxes in locations shown on the drawings and as required to suit job conditions.

.4 Locate pull boxes and junction boxes above removable ceilings, in electrical rooms, utility rooms or storage areas.

.5 Junction boxes, when used, to be installed in areas that are accessible through luminaire openings, and/or access panels.

.6 Where pull boxes are flush mounted, provide overlapping covers with flush head cover retaining screws, prime coated and painted to match wall or ceiling finish.

.7 Where cast corrosion resistant boxes are used, covers to be of matching type and gasketted.

.8 For special (not 100mm [4”] square or octagonal) pull boxes and/or junction boxes, paint identification for the system and provide lamicoid nametags to box covers with a size 2 nameplate 5mm [0.25”] lettering identifying system.

.9 Interior of all pull boxes and junction boxes for each system to be spray painted with colour as specified in Section 26 05 00

.10 All pull boxes, junction boxes and cabinets to be supported directly from building structure using one or a combination of galvanized screws, galvanized bolts, galvanized rods, and approved box clip.

.11 Support of pull boxes, junction boxes by conduit fittings or wire is not acceptable.

3.3 CABINETS INSTALLATION

.1 Mount cabinets with top not higher than 2 m [6’] above finished floor.

.2 Cabinets shall be flush mounted in finished areas where depth can be accommodated in the walls. Provide flush trim to suit.

.3 Provide fit up in Type T cabinets as indicated.

END OF SECTION 26 05 31

PART 1 - GENERAL

1.1 RELATED WORK

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

PART 2 - PRODUCTS

2.1 OUTLET AND CONDUIT BOXES IN GENERAL

.1 Size boxes in accordance with CSA C22.1.

.2 102 mm [4”] square or larger outlet boxes as required for special devices.

.3 Gang boxes where wiring devices are grouped. Do not use sectional boxes.

.4 Blank cover plates for boxes without wiring devices.

.5 347V outlet boxes for 347V switching devices.

.6 Combination boxes with barriers where outlets for more than one system are grouped shall be equal to Spyder Technology multi-gang boxes.

.7 Standard of acceptance is Thomas and Betts - Iberville.

2.2 SHEET STEEL OUTLET BOXES

.1 Electro-galvanized steel single and multi-gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm [3" x 2" x 1.5"] or as indicated. Larger 102 mm square x 54mm deep [4”x 2”] outlet boxes (No. 52151 or 52171) to be used when more than one conduit enters one side. Provide extension and plaster rings as required.

.2 For larger boxes use GSB solid type as required.

.3 Boxes for surface mounted switches, receptacles, communications, telephone to be 100mm square No. 52151 or 52171 with Taylor 8300 series covers.

.4 Lighting fixture outlets: 102 mm [4”] square outlet boxes (No 52151, 52171 or 72171) or octagonal outlet boxes (No 54151 or 54171).

.5 103 mm [4”] square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster and/or tile walls.

.6 Standard of acceptance is Thomas and Betts - Iberville.

2.3 MASONRY BOXES

.1 Electro-galvanized steel masonry single and multi-gang type MDB boxes for devices flush mounted in exposed block walls.

.2 Standard of acceptance is Thomas and Betts - Iberville.

2.4 CONCRETE BOXES

.1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

.2 Standard of acceptance is Thomas and Betts - Iberville.

2.5 SURFACE CONDUIT BOXES

.1 Cast FS or FD aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacles.

.2 Standard of acceptance is Thomas and Betts - Iberville.

2.6 FITTINGS – GENERAL

.1 Bushing and connectors with nylon insulated throats.

.2 Knock-out fillers to prevent entry of foreign materials.

.3 Conduit outlet bodies for conduit up to 35 mm [1.25”] Use pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes.

.5 Standard of acceptance is Thomas and Betts - Iberville.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Typical outlet box mounting heights are indicated in Section 26 05 00 or refer to wiring device and communication specification sections and to architectural layouts for particular mounting heights of outlet boxes where indicated.

.2 Support boxes independently of connecting conduits.

.3 Ceiling outlet boxes to be provided for each surface mounted fixture or row of fixtures installed in other than T bar ceilings with removable tiles.

.4 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm [0.25”] of opening.

.5 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers not to be used.

.6 All outlet boxes to be flush mounted in all areas, excluding mechanical rooms, electrical rooms, and above removable ceilings.

.7 Adjust position of outlets in finished masonry walls to suit masonry course lines. Coordinate cutting of masonry walls to achieve neat openings for all boxes. All cutting of masonry work for installation of electrical fittings to be done using rotary cutting equipment.

.8 No sectional or handy boxes to be installed.

.9 When installed in wood walls, plastic outlet boxes shall only be used with permission of the Departmental Representative.

.10 Provide vapour barrier wrap or boots behind outlets mounted in exterior walls. Maintain integrity of the vapour barrier and insulation to prevent condensation through boxes.

.11 Coordinate location and mounting heights of outlets above counters, benches, splash-backs and with respect to heating units and plumbing fixtures. Coordinate with architectural details.

.12 Outlets installed back to back in party stud walls to be off-set by one stud space.

.13 Back-boxes for all communications systems equipment to be provided in accordance with specific manufacturer's recommendations and as specified in the communications sections of these specifications.

.14 Separate outlets located immediately alongside one another to be mounted at exactly the same height above finished floor. Similarly, outlets mounted on a wall in the same general location at varying heights to be on the same vertical centre-line unless otherwise noted.

.15 Where outlet boxes penetrate through a fire separation, ensure that the boxes are externally tightly fitted with an approved non-combustible material to prevent passage of smoke or flame in the event of a fire.

.16 Conduit for floor mounted boxes shall terminate with a locknut and bushing in base of the fitting. Seal around conduit and the conduit itself after installation of conductors with heavy density fiberglass.

END OF SECTION 26 05 32

PART 1 - GENERAL

1.1 RELATED WORK

.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 SCOPE

.1 Drawings do not show all conduits. Those shown are in diagrammatic form only.

.2 Conceal all conduits where possible in finished areas. Conduits may be surface mounted either only where indicated or in service areas accessible only to authorized personnel.

.3 Note particular requirements for routing of conduits where detailed.

.4 Provide polypropylene pull cord in all “empty” conduits.

PART 2 - PRODUCTS

2.1 CONDUITS

.1 Rigid metal conduit: to CSA C22.2 No.45 Galvanized Steel.

.2 Electrical Metallic Tubing (EMT): to CSA C22.2 No.83.

.3 Rigid PVC conduit: to CSA C22.2 No.211.2.

.4 Flexible metal conduit: to CSA C22.2 No.56 liquid-tight flexible metal conduit.

2.2 CONDUIT FASTENINGS

.1 One hole steel straps to secure surface conduits 41mm [1.5”] and smaller. Use two hole steel straps to conduits larger than 41mm [1.5”].

.2 Beam clamps to secure conduits to exposed steel work.

.3 Channel type supports for two or more conduits.

.4 10mm [3/8”] threaded rods to support suspended channels.

2.3 CONDUIT FITTINGS

.1 Fittings manufactured for use with conduits specified. Coating same as conduit.

.2 Provide factory "ells" where 90 degree bends are required for 27mm [1”] and larger conduits.

.3 EMT couplings and connectors shall be steel, or Regal Die-cast zinc alloy. Couplings used on conduit containing fire-rated cable shall be steel. Regular die-cast alloy fittings and couplings are not acceptable. Provide plastic bushings (insulated throat) for all connectors for 27mm EMT or larger. Provide water-tight connectors in damp or wet locations and for surface equipment (e.g. Panelboards, MCC’s, etc.) in rooms that are fire sprinkler protected.

2.4 EXPANSION FITTINGS FOR RIGID CONDUIT

.1 Weatherproof expansion fittings with internal bonding assembly suitable linear expansion.

.2 Water-tight expansion fittings: with integral bonding jumper, suitable for linear expansion and 21mm [3/4”] deflection in all directions.

.3 Weatherproof expansion fittings for linear expansion at entry to panel as required.

2.5 RIGID P.V.C. CONDUIT

.1 Conduit: rigid non-metallic conduit of unplasticized polyvinyl chloride as manufactured C.G.E. "Sceptre".

.2 Fittings: threaded male or female solvent weld connectors and solvent weld couplings, as supplied by conduit manufacturer.

.3 Solvent: as recommended by conduit manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

.1 Generally use electrical metallic tubing (EMT) in the building interior and in above grade slabs except where subject to mechanical injury or where otherwise indicated.

.2 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass. Set out the work and coordinate with other services prior to installation. Maintain access to junction and pull boxes.

.3 Where practical conceal conduits.

.4 Any exposed conduit in finished areas to be free of unnecessary labels and trademarks.

.5 All conduit ends to be reamed to ensure a smooth interior finish that will not damage the insulation of the wiring.

.6 Ensure bonding continuity in all conduit systems.

.7 Surface conduits are acceptable in mechanical and electrical service rooms and in unfinished areas or where indicated.

.8 Use rigid galvanized steel (RGS) threaded conduit where the installation is subject to mechanical injury. In any event, use RGS conduit for surface installations up to 1.5m [5’] above the finished floor.

.9 Field threads on rigid conduit shall be sufficient length to draw conduits ends together.

.10 Unless otherwise noted and where practical, all conduits to be routed through the ceiling space rather than in, or below, slabs or floor structures to facilitate future changes.

.11 Conduits in walls should typically drop (or loop) vertically from above to better facilitate future renovations. Generally conduits from below and horizontal conduits in walls and concrete structures should be avoided unless indicated.

.12 All home-run branch circuit conduit and communication conduits to be minimum 27 mm [1”] diameter unless otherwise indicated.

.13 Generally use Rigid PVC conduits in or below ground level slab unless otherwise noted. Transition to RGS conduit in exposed locations: eg where conduits emerge from ground level slab.

.14 Conduits are not permitted in terrazo or concrete toppings.

.15 Cap turned up conduits to prevent the entrance of dirt of moisture during construction.

.16 Locate conduits more than 75mm [3”] parallel to steam or hot water lines with a minimum of 25mm [1”] at crossovers.

.17 Bend conduits cold, so that conduit at any point is not flattened more than 1/10th of its original diameter. Conduits bent more than this or kinked to be replaced.

.18 Provide polypropylene pull cord in empty conduits to facilitate pulling wiring in future.

.19 Where conduits become blocked, the use of corrosive agents is prohibited. Remove and replace blocked section.

.20 Damaged conduits to be repaired or replaced.

.21 Dry conduits out thoroughly before installing wiring. Swab out conduit and thoroughly clean internally before wires and cables are pulled.

.22 Conduits shall not pass through structural members except as indicated.

.23 Conduit sizes indicated on drawings are minimum only. Increase sizes as required to suit alternative wiring types, to comply with Code or for ease of conductor installation.

.24 Conduits and ducts crossing building expansion joints shall have approved conduit expansion fittings to suit the type of conduit used.

.25 Seal conduits with approved sealant where conduits are run between heated and unheated areas.

.26 Seal openings with approved sealant where conduits, cables, or cable trays pierce fire separations.

.27 Where conduits pass through walls, they shall be grouped and installed through openings. After all conduits are installed, wall openings shall be closed with material compatible with the wall construction and/or to meet any fire separation integrity.

.28 Where drawings show conduit designations, these conduits shall be identified at each point of termination with Thomas & Betts "Ty-Rap" No. TY532M labels.

.29 Use "Condulet" fittings for power and telephone type conduit terminations in lieu of standard boxes where box support is not provided.

.30 Provide necessary roof jacks or flashing where conduits pass through roof or watertight membranes. Apply approved sealant to maintain membrane integrity.

.31 Use flexible metal conduit for connection to recessed luminaires without a prewired outlet box.

.32 Use liquid tight flexible metal conduit for connection to motors sprinkler monitoring devices, and other vibrating equipment and transformers.

.33 Use explosion proof flexible connection for connection to explosion proof motors.

.34 Install conduit-sealing fittings in hazardous areas, such as Battery Charging Room and P.O.L. storage. Fill with compound.

3.2 SURFACE CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Locate conduits behind infrared or gas fired heaters with minimum 1.5m [5’] clearance.

.3 Conduits to be run in flanged portion of structural steel.

.4 Group conduits wherever possible on suspended and/or surface channels.

.5 Surface conduits will not be accepted in finished areas unless detailed.

3.3 SPARE CONDUITS

.1 Provide spare conduits as indicated.

.2 Provide 4x27 mm [1”] spare conduits up to ceiling space and 2x27 mm [1”] spare conduits down to ceiling space below from each flush panel tub. Terminate the conduits in 150x150x100 mm [6”x6”x4”] junction boxes in ceiling spaces or in case of an exposed concrete slab, terminate each conduit in a flush concrete box. Provide cover plates for all junction boxes.

3.4 CONDUITS IN CAST IN PLACE CONCRETE

.1 Locate conduits to suit reinforcing steel. Install in centre third of slab.

.2 Do not place conduit in concrete slabs in which slab thickness is less than four times conduit diameter. Place conduits larger than this size under the floor or slab. Conduits to have minimum 25 mm concrete cover. Conduits to be completely encased in concrete

.3 Organize conduit in slabs to minimize crossovers. Obtain approval and minimum concrete cover required from structural engineer prior to installing conduits in slabs.

.4 Protect conduits from damage where they stub out of concrete.

.5 Tie down conduit to prevent shifting. All joints are to be made up tight to ensure ground continuity. To prevent concrete entry, seal EMT set screw fittings with tape, pack outlet boxes and cap conduit terminations both in boxes and stub-ups. Apply Polykin #940 tape to the conduit 150 mm [6”] at the point of leaving slab.

.6 Carefully check and mark out set-backs of conduit(s) to be installed in floor slabs and to be stubbed up to equipment or motors. Verify conduit size and stub-up locations for mechanical and equipment from shop drawings or detail drawings. Brace all stub-ups. Stub-ups shall be RGS.

.7 Install sleeves in advance of concrete pour where conduits pass through slab or wall.

.8 Where conduits pass through waterproof membrane provide oversized sleeve before membrane installation. Use cold mastic between sleeve and conduit.

3.5 CONDUITS IN POURED SLABS ON GRADE

.1 Use Rigid PVC conduit in the gravel or select fill base below concrete slabs. Provide mechanical protection around exposed stub-ups through slab and extend up to 150 mm [6”] beyond concrete. Transition to RGS conduit immediately above the slab.

.2 In the event that rigid steel conduit is installed in contact with earth it shall be protected by Polykin #940 tape. Extend taping 300 mm above finished grade.

.3 Conduits 27mm and larger to be run below slab and encased in 75mm concrete envelope. Provide 50mm of sand over concrete envelope below floor slab.

3.6 EXPANSION JOINT CONDUIT FITTINGS

.1 Provide conduit expansion joint fittings at concrete expansion joint.

3.7 RIGID P.V.C. CONDUIT

.1 Use in accordance with the Canadian Electrical Code and Building Codes and as noted below:

.2 Use as raceways for following applications

.1 In poured slab on grade concrete floors and walls and for underground runs exterior to the buildings unless otherwise noted.

.2 Wiring installed in areas subject to intermittent or continuous moisture but not surface mounted.

.3 Rigid PVC conduit shall not be surface mounted or exposed within buildings.

.3 Do not use in return air plenums or for exit light circuits and emergency lighting.

.4 Provide insulated ground wire in all rigid PVC conduits in accordance with the Canadian Electrical Code.

.5 Where rigid PVC conduit is set in poured concrete, solvent joints must be completed and allowed to set as per manufacturer's instructions before pour.

.6 Bend rigid conduit in strict accordance with manufacturer's directions. Distorted bends will not be accepted.

END OF SECTION 26 05 34

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 This Section of the Specifications forms part of the Contract Documents and shall be read, interpreted and coordinated with all other parts.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSAC22.2No.26, Construction and Test of Wireways, Auxiliary Gutters and Associated Fittings.

PART 2 - PRODUCTS

2.1 WIREWAYS

.1 Wireways and fittings: to CSA C22No.26.

.2 Sheet steel with bolted cover to give uninterrupted access.

.3 Finish: baked grey enamel.

.4 Elbows, tees, couplings and hanger fittings manufactured as accessories to wireway supplied.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install wireways and auxiliary gutters.

.2 Keep number of elbows, offsets, connections to minimum.

.3 Install supports, elbows, tees, connectors, fittings.

.4 Install barriers where required.

.5 Install gutter to full length of equipment.

END OF SECTION 26 05 37

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

.1 This Section of the Specification forms part of the Contract Document and is to be read, interpreted and coordinated with all other parts.

1.2 DEFINITIONS

.1 Firestopping: Material or combination of materials used to retain integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke, and hot gases through penetrations in fire rated wall and floor assemblies

1.3 REFERENCES

.1 Test Requirements: Test Requirements: CAN/ULC-S115-11, "Standard Method of Fire Tests of Through Penetration Fire Stops".

.2 Test Requirements: CAN/ULC-S102-M, “Standard Test Method for Surface Burning Characteristics of Building Materials”.

.3 Underwriters Laboratories of Canada (ULC) of Scarborough runs CAN/ULC-S115-11 under their designation of ULC-S115-11 and publishes the results in their "FIRE RESISTANCE RATINGS DIRECTORY" that is updated annually. Underwriters Laboratories (UL) of Northbrook, IL runs ASTM E-814 under their designation of UL 1479 and publishes the results in their "FIRE RESISTANCE DIRECTORY" that is updated annually. UL tests that meet the requirements of ULC-S115-11 are given a cUL listing and are published by UL in their “Products Certified for Canada (cUL) Directory.

1. UL Fire Resistance Directory:
   - .1 Firestop Devices (XHJI7)
   - .2 Fire Resistance Ratings (BXRH7)
   - .3 Through-Penetration Firestop Systems (XHEZ7)
   - .4 Fill, Voids, or Cavity Material (XHHW7)
   - .5 Forming Materials (XHKU7)

.4 International Firestop Council Guidelines for Evaluating Firestop Systems Engineering Judgments (referred to as Firestop Custom Details in BC).

.5 Inspection Requirements: ASTM E 2174, “Standard Practice for On-site Inspection of Installed Fire Stops.”

.6 Test Requirements: ASTM E 90, “Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements”

.7 Test Requirements: ASTM E 2178, “Standard Test Method for Air Permeance of Building Materials”.

.8 Test Requirements: ASTM E 84, “Standard Test Method for Surface Burning Characteristics of Building Materials.”

.9 Test Requirements: ASTM E 2178, “Standard Test Method for Air Permeance of Building Materials”

.10 ASTM G-21, “Standard Test for Determining Resistance of Synthetic Polymeric Materials to Fungi”.

.11 British Columbia Building Code – most recent version.

.12 NFPA 101 - Life Safety Code – most recent version.

1.4 QUALITY ASSURANCE

.1 A manufacturer's direct representative (account manager, fire protection specialist, not distributor or agent) to be on-site during initial installation of firestop systems to train appropriate contractor personnel in proper selection and installation procedures. This will be done per manufacturer's written recommendations published in their literature and drawing details.

.2 Firestop System installation must meet requirements of ASTM E 814 or UL 1479 tested assemblies that provide a fire rating equal to that of construction being penetrated.

.3 Proposed firestop materials and methods shall conform to applicable governing codes having local jurisdiction.

.4 Firestop Systems do not reestablish the structural integrity of load bearing partitions/assemblies, or support live loads and traffic. Installer shall consult the structural engineer prior to penetrating any load bearing assembly.

.5 For those firestop applications that exist for which no UL tested system is available through a manufacturer, a manufacturer's firestop custom detail derived from similar UL system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Firestop custom detail drawings must follow requirements set forth by the International Firestop Council.

.6 Manufacturer’s fire protection specialist to work with consultant to determine frequency of site walk-throughs to be submitted to Departmental Representative.

1.5 SUBMITTALS

.1 Submit Product Data: Manufacturer’s specifications and technical data for each material including the composition and limitations, documentation of UL firestop systems to be used and manufacturer's installation instructions to comply with Section 01 30 00 general requirements.

.2 Submit qualified tested firestop system detail for each firestop application on the project.

.3 Manufacturer's firestop custom detail identification number and drawing details when no UL system is available for an application. Firestop custom detail must include both project name and contractor’s name who will install firestop system as described in drawing.

.4 Submit material safety data sheets provided with product delivered to job-site.

1.6 INSTALLER QUALIFICATIONS

.1 Engage an experienced Installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having been provided the necessary training to install manufacturer’s products per specified requirements. A manufacturer’s willingness to sell its firestopping products to the Contractor or to an Installer engaged by the Contractor does not in itself confer qualification on the buyer.

.2 The work is to be installed by a contractor with at least one of the following qualifications:

FM 4991 Approved Contractor

UL Approved Contractor

Hilti Accredited Fire Stop Specialty Contractor

.3 Installer shall have not less than 3 years’ experience with fire stop installation

1.7 PROJECT CONDITIONS

.1 Do not use materials that contain flammable solvents.

.2 Scheduling

.1 Schedule installation of CAST IN PLACE firestop devices after completion of floor formwork, metal form deck, or composite deck but before placement of concrete.

.2 Schedule installation of other firestopping materials after completion of penetrating item installation but prior to covering or concealing of openings.

.3 Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.

.4 Weather conditions: Do not proceed with installation of firestop materials when temperatures exceed the manufacturer's recommended limitations for installation printed on product label and product data sheet.

.5 During installation, provide masking and drop cloths to prevent firestopping materials from contaminating any adjacent surfaces.

PART 2 - PRODUCTS

2.1 FIRESTOPPING, GENERAL

.1 Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by the firestopping manufacturer based on testing and field experience.

.2 Provide components for each firestopping system that are needed to install fill material. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.

.3 Provide a round enclosed fire rated cable management device whenever cable bundles penetrate fire rated walls. The cable management device shall contain integrated intumescent firestop wrap strip materials sufficient to maintain the hourly rating of the barrier being penetrated. The cable management device shall contain a smoke seal fabric membrane or intumescent firestop plugs sufficient to achieve the L-Rating requirements of the barrier type.

.4 Provide non-curing, re-penetrable, intumescent firestop materials around communications cable trays or ladder racks penetrating through a fire rated wall. The firestop system assembly shall be able accessible and re-installed from one side of the wall. The firestop material shall allow up to 12” of unreinforced annular space.

.5 Penetrations in Fire Resistance Rated Walls: Provide firestopping with ratings determined in accordance with UL 1479 or ASTM E 814.

.1 F-Rating: Not less than the fire-resistance rating of the wall construction being penetrated.

.6 Penetrations in Horizontal Assemblies: Provide firestopping with ratings determined in accordance with UL 1479 or ASTM E 814.

.1 F-Rating: Minimum of 1-hour rating, but not less than the fire-resistance rating of the floor construction being penetrated.

.2 T-Rating: when penetrant is located outside of a wall cavity, minimum of 1-hour rating, but not less than the fire-resistance rating of the floor construction being penetrated.

.3 W-Rating: Class 1 rating in accordance with water leakage test per UL 1479.

.7 Penetrations in Smoke Barriers: Provide firestopping with ratings determined in accordance with UL 1479 or ASTM E 814.

.1 L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at both ambient and elevated temperatures.

.8 Mold Resistance: Provide penetration firestoppping with mold and mildew resistance rating of 0 as determined by ASTM G21.

2.2 ACCEPTABLE MANUFACTURERS

.1 Subject to compliance with through penetration firestop systems (XHEZ) listed in Volume II of the UL Fire Resistance Directory, provide products of the following manufacturers as identified below:

.1 Hilti (Canada) Corporation,

.2 Specified Technologies Inc. (STI)

.3 Provide products from the above acceptable manufacturers; alternatives approved via a submittal confirming products meet the tested standards listed in section 1.05.

2.3 MATERIALS

.1 Use only firestop products that have been UL 1479 or ASTM E 814 tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance.

.2 Re-penetrable, round cable management devices for use with new or existing cable bundles penetrating gypsum or masonry walls:

.1 Hilti Speed Sleeve (CP 653) or equivalent with integrated smoke seal fabric membrane.

.2 Hilti Firestop Sleeve (CFS-SL SK) or equivalent

.3 Hilti Retrofit Sleeve (CFS-SL RK) or equivalent for use with existing cable bundles.

.4 Hilti Cable Collar (CFS-CC) or equivalent surface mounted retrofit solution.

.5 Hilti Gangplate (CFS-SL GP) or equivalent for use with multiple cable management devices.

.6 Hilti Gangplate Cap (CFS-SL GP CAP) or equivalent for use at blank openings in gangplate for future penetrations.

.3 Pre-installed firestop devices for use with non-combustible and combustible pipes (closed and open systems), conduit, and/or cable bundles penetrating concrete floors and/or gypsum walls:

.1 Hilti Cast-In Place Firestop Device (CP 680-P) or equivalent for use with combustible penetrants.

.2 Hilti Cast-In Place Firestop Device (CP 680-M) or equivalent for use with non-combustible penetrants.

.3 Hilti Speed Sleeve (CP 653) or equivalent for use with cable penetrations.

.4 Hilti Firestop Drop-In Device (CFS-DID) or equivalent for use with non-combustible and combustible penetrants.

.4 Sealants, foams or caulking materials for use with non-combustible items including rigid steel conduit and electrical metallic tubing (EMT):

.1 Hilti Intumescent Firestop Sealant (FS-ONE) or equivalent

.2 Hilti Fire Foam (CP 620) or equivalent

.3 Hilti Flexible Firestop Sealant (CP 606) or equivalent

.4 Hilti Elastomeric Firestop Sealant (CFS-S SIL GG) or equivalent

.5 Intumescent sealants, caulking materials for use with combustible items (penetrants consumed by high heat and flame) including PVC jacketed, flexible cable or cable bundles, and plastic pipe:

.1 Hilti Intumescent Firestop Sealant (FS-ONE) or equivalent

.6 Foams, intumescent sealants, or caulking materials for use with flexible cable or cable bundles:

.1 Hilti Intumescent Firestop Sealant (FS-ONE) or equivalent

.2 Hilti Fire Foam (CP 620) or equivalent

.3 Hilti Flexible Firestop Sealant (CP 606) or equivalent

.4 Hilti Elastomeric Firestop Sealant (CFS-S SIL GG) or equivalent

.7 Non curing, re-penetrable intumescent putty or foam materials for use with flexible cable or cable bundles:

.1 Hilti Firestop Putty Stick (CP 618) or equivalent

.2 Hilti Firestop Plug (CFS-PL) or equivalent

.8 Wall opening protective materials for use with U.L. listed metallic and specified non-metallic outlet boxes:

.1 Hilti Firestop Putty Pad (CFS-P PA) or equivalent

.2 Hilti Firestop Box Insert or equivalent

.9 Materials used for large openings and complex penetrations made to accommodate cable trays and bundles, multiple steel and copper pipes, electrical busways in raceways:

.1 Hilti Firestop Mortar (CP 637) or equivalent

.2 Hilti Firestop Block (CFS-BL) or equivalent

.3 Hilti Fire Foam (CP 620) or equivalent

.4 Hilti Firestop Board (CP 675T) or equivalent

.10 Non curing, re-penetrable materials used for large openings and complex penetrations made to accommodate cable trays and bundles, multiple steel and copper pipes, electrical busways in raceways:

.1 Hilti Firestop Block (CFS-BL) or equivalent

.2 Hilti Firestop Board (CP 675T) or equivalent

.11 For blank openings made in fire-rated wall or floor assemblies, where future penetration of pipes, conduits, or cables is expected:

.1 Hilti Firestop Block (CFS-BL) or equivalent

.2 Hilti Firestop Plug (CFS-PL) or equivalent

.12 Provide a firestop system with a "F" Rating as determined by UL 1479 or ASTM E 814 which is equal to the time rating of construction being penetrated.

PART 3 - EXECUTION

3.1 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.

.1 Verify penetrations are properly sized and in suitable condition for application of materials.

.2 Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, rust, laitance, release agents, water repellents, and any other substances that may affect proper adhesion.

.3 Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.

.4 Comply with manufacturer's recommendations for temperature and humidity conditions before, during and after installation of firestopping.

.5 Do not proceed until unsatisfactory conditions have been corrected.

3.2 COORDINATION

.1 Coordinate location and proper selection of cast-in-place Firestop Devices with trade responsible for the work. Ensure device is installed before placement of concrete.

.2 Pre-construction firestop meeting with all stakeholders, including sub trades, code consultants, specifiers, manufacturers fire protection specialist and/or field engineer, to determine responsibility for handling such issues as FT rated partitions, firestop custom details, compatibility, complete submittals, mixed penetrations, ect.

3.3 INSTALLATION

.1 Regulatory Requirements: Install firestop materials in accordance with UL Fire Resistance Directory.

.2 Manufacturer's Instructions: Comply with manufacturer's instructions for installation of through-penetration materials.

.1 Seal all holes or voids made by penetrations to ensure an air and water resistant seal.

.2 Protect materials from damage on surfaces subjected to traffic.

3.4 FIELD QUALITY CONTROL

.1 Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas.

.2 Keep areas of work accessible until inspection by applicable code authorities.

.3 Inspection of through-penetration firestopping shall be performed in accordance with ASTM E 2174, “Standard Practice for On-Site Inspection of Installed Fire Stops” or other recognized standard.

.4 Perform under this section patching and repairing of firestopping caused by cutting or penetrating of existing firestop systems already installed by other trades.

.5 Install a warning card that is clearly visible adjacent to any openings that may be re-penetrated, have multiple penetrants, penetrate a FT rated partition, or any other critical area as deemed by the electrical consultant. This card should contain the following information:

.1 Warning that the opening has being fire stop protected

.2 Indicate the fire stop system used (ULC or cUL) or the firestop custom detail number

.3 F rating or FT rating

.4 Fire stop product(s) used

.5 Person to contact and phone number in case of modification or new penetration of fire stop system

.6 Provide Firestopping approval certificate in including a Building Code / By-Law Schedule B & C-B signed by a BC registered Professional Consultant. Submit a letter certifying that all work is complete and in accordance with this specification.

END OF SECTION 26 05 45

PART 1 - GENERAL

1.1 RELATED WORK

.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 SCOPE

.1 Provide demonstration and instruction sessions to familiarize the Owners operation and maintenance personnel with electrical systems that have been extended into the new area 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 CONSTRUCTION AND ACCEPTANCE PHASES

.1 Within 60 to 90 days of commencement of construction, the Electrical Contractor (EC) will schedule, plan and conduct a commissioning scoping meeting with the entire commissioning team in attendance. Meeting minutes will be distributed to all parties by the EC. Information gathered from this meeting will allow the EC to revise the Commissioning Plan.

.2 Other meetings will be planned and conducted by the EC as construction progresses. These meetings will cover coordination, deficiency resolution and planning issues with particular Sub trades. The EC will plan these meetings and will minimize unnecessary time being spent by Sub trades.

.1 Provide additional requested documentation to the Departmental Representative and utilize to develop start-up and functional testing procedures.

.2 Contractors shall (along with the Departmental Representative) clarify the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.

.3 Develop a full start-up and initial checkout plan using manufacturer's start-up procedures and the pre-functional checklists. Submit manufacturer's detailed start-up procedures and the full start-up plan and procedures to Departmental Representative for review.

.4 During the start-up and initial checkout process, execute and document the electrical-related portions of the pre-functional checklists for all commissioned equipment. Perform and clearly document all completed start up and system operational checkout procedures, providing a copy to the Departmental Representative.

.5 Address current deficiency list items before functional testing.

.6 Perform functional performance testing under the supervision of the Departmental Representative for specified equipment in this section.

.7 Correct deficiencies (differences between specified and observed performance) as interpreted by the EC, GC, and Departmental Representative and retest the equipment.

.8 Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.

.9 Provide training of the Owner's operating personnel as specified.

.10 Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

.11 Execute deferred functional performance testing, witnessed by the Departmental Representative, according to the specifications.

.12 Correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any testing.

1.5 SITE TOURS

.1 Provide a series of walk through Contractor guided tours of new area to allow operators to familiarize themselves with the buildings electrical systems.

.2 Coordinate timing of tours with the Departmental Representative. Allow for tours at approximately the following times.

.1 90% complete stage. Three weeks prior to Interim Acceptance of the work.

.2 At Interim Acceptance of the Work.

1.6 DEMONSTRATION AND INSTRUCTION SEMINARS

.1 Assist the Owner to present Operator Training Seminar(s) noted in this specification and including content specified by Division 01 - General Requirements.

PART 2 - PRODUCTS

2.1 NOT APPLICABLE

PART 3 - EXECUTION

3.1 REPORTING

.1 The EC will provide regular reports to the General Contractor (GC) with increasing frequency as construction and commissioning progresses.

.2 The EC will regularly communicate with all members of the commissioning team, keeping them apprised of commissioning progress and scheduling changes through memos, progress reports, etc.

.3 A final Commissioning Report is compiled which summarizes the procedures, findings, conclusions, and recommendations of the commissioning process.

3.2 SUBMITTALS

.1 The EC will provide appropriate sub-contractors with a specific request for the type of submittal documentation the EC will require to facilitate the commissioning work.

.2 The EC will review submittals related to the commissioned equipment for conformance to the Contract Documents as it relates to the commissioning process, to the functional performance of the equipment and adequacy for developing test procedures. This review is intended primarily to aid in the development of functional testing procedures.

.3 The EC may request additional design and operations narrative from the Departmental Representative and Controls Contractor.

3.3 START-UP, PREFUNCTIONAL CHECKLISTS AND INITIAL CHECKOUT

.1 The following procedures apply to all equipment to be commissioned.

.2 Pre-functional Checklists are developed and completed for all major equipment and systems being commissioned. The checklist captures equipment nameplate and characteristics data, confirming the as-built status of the equipment or system. These checklists also ensure that the systems are complete and operational, so that the functional performance testing can be scheduled.

.3 The EC shall assist the commissioning team members responsible for start-up of any equipment in developing detailed start-up plans for all equipment. The primary role of the EC in this process is to ensure that there is written documentation that each of the manufacturer-recommended procedures have been completed.

- .1 The EC creates the pre-functional checklists, based primarily on the manufacturer's start-up and initial checkout procedures. Each start-up item will have a date and initial line for completion by the contractor during start-up. The Contractor determines which Sub is responsible for executing and documenting each of the line item tasks.
- .2 The full start-up procedures and the approval form may be provided to the GC and A/E team for review.

.4 Calibration of all sensors shall be included as part of the pre-functional checklists performed by the Contractors.

.5 Execution of Pre-functional Checklists and Start-up.

- .1 Subs and vendors schedule start-up and checkout with the GC and EC.
- .2 The EC shall observe, at minimum, the procedures for each piece of primary equipment, unless there are multiple units, (in which case a sampling strategy may be used as approved by the Departmental Representative).
- .3 For lower-level components of equipment the EC shall observe a sampling of the pre-functional and start-up procedures. The sampling procedures are identified in the commissioning plan.
- .4 The Subs and vendors shall execute start-up and provide the EC with a signed and dated copy of the completed start-up and pre-functional checklists.
- .5 Only individuals that have direct knowledge and witnessed that a line item task on the pre-functional checklist was actually performed shall initial or check that item off.

.6 Deficiencies, Non-Conformance and Approval in Checklists and Start-up.

- .1 The Subs shall clearly list any outstanding items of the initial start-up and pre-functional procedures that were not completed successfully, at the bottom of the procedures form or on an attached sheet. The procedures form and any outstanding deficiencies are provided to the EC within two days of test completion.
- .2 The EC reviews the report and recommends approval to the GC. The EC shall work with the Subs and vendors to correct and retest deficiencies or uncompleted items. The EC will involve the GC and others as necessary.

3.4 FUNCTIONAL PERFORMANCE TESTING

.1 This sub-section applies to all commissioning functional performance testing for all divisions.

.2 The objective of functional performance testing is to demonstrate that each system is operating according to the documented design intent and Contract Documents. In general, each system should be operated through all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, part- and full-load) where there is a specified system response. Verifying each sequence in the sequences of operation is required. Proper responses to such modes and conditions as power failure, freeze condition, low oil pressure, no flow, equipment failure, etc. shall also be tested.

.3 Before test procedures are written, the EC shall obtain all requested documentation and a current list of change orders affecting equipment or systems, including an updated points list, program code, control sequences and parameters. The EC shall develop specific test procedures and forms to verify and document proper operation of each piece of equipment and system. Prior to execution, the EC shall provide a copy of the test procedures to the Sub(s) who shall review the tests for feasibility, safety, equipment and warranty protection. The EC may submit the tests to the Departmental Representative for review. The EC shall review owner-contracted or factory testing which the EC is not responsible to oversee and shall determine what further testing may be required to comply with the Specifications. Redundancy of testing shall be minimized.

.4 The test procedure forms developed by the EC shall include the following information:
- .1 System and equipment or component name(s).
- .2 Equipment location and ID number.
- .3 Date.
- .4 Project name.
- .5 Participating parties.
- .6 Reference to the specification section describing the test requirements.
- .7 A copy of the specific sequence of operations.
- .8 Instructions for setting up the test.
- .9 Special cautions, alarm limits, etc.
- .10 Specific step-by-step procedures to execute the test.
- .11 Acceptance criteria of proper performance with a Yes / No check box.
- .12 A section for comments.
- .13 Signatures and date block for the EC.

.5 Test Methods
- .1 Functional performance testing and verification may be achieved by manual testing (persons manipulate the equipment and observe performance) or by monitoring the performance and analyzing the results using the control system's trend log capabilities or by stand-alone data loggers. The EC will determine which method is most appropriate.
- .2 Each function and test shall be performed under conditions that simulate actual conditions as close as is practically possible. The Sub executing the test shall provide all necessary materials, system modifications, etc. to produce the necessary flows, pressures, temperatures, etc. necessary to execute the test according to the specified conditions. At completion of the test, the Sub shall return all affected building equipment and systems, due to these temporary modifications, to their pre-test condition.
- .3 Multiple identical pieces of non-life-safety or non-critical equipment may be functionally tested using a sampling strategy. The sampling strategy will be developed by the EC and approved by the GC. If, after three attempts at testing the specified sample percentage, failures are still present, then all remaining units are tested at the contractors' expense.

.6 The Subs shall provide sufficient notice to the EC regarding their completion schedule for the pre-functional checklists and start-up of all equipment and systems. The EC will schedule functional tests through the GC and affected Subs. The EC shall direct, witness and document the functional testing of all equipment and systems. The Subs shall execute the tests.

.7 The EC will have the burden of responsibility to solve, correct and retest problems is with the GC, Sub trades/contractors.

.8 Functional Performance Testing requirements:
- .1 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. Perform test prior to energizing electrical system.
- .2 Perform simulated operation tests with metering, instruments disconnected from permanent signal and other electrical sources. Verify correctness of connections,

polarities of meters, instruments, potential and current transformers, transducers, signal sources and electrical supplies. Perform tests to obtain correct calibration.

.3 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.
- .4 Power generation and distribution system including phasing, voltage, grounding and load balancing. Test and verify all torqueing settings.
- .5 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.

.4 Test and operate all miscellaneous moving and working parts in all systems including motor starters, disconnects, interlocks, breakers, GFIs, Arc Flash Breakers, H/O/A switches, buttons, contactors etc. to ensure system is operating as designed.

.5 Test each receptacle for reverse wiring, switch wiring control, occupancy or time clock control and ground fault operation (including ensuring downstream loads to do not shut off on GFCI operation).

.6 The lighting control system shall be tested and certified by the manufacturer's representative as per ASHRAE 90.1 requirements. Provide documentation of certification in maintenance manual and submit copy to the Departmental Representative.

.7 The emergency lighting system shall be tested for maintained luminance to a minimum of 1 hour. Provide written document verifying the operation of the system after the test.

.8 Generators shall be tested:

1. With 100% rated load, operate set for 23 hours, taking readings at 30 minutes intervals, and record following:
   - .1 Time of reading.
   - .2 Running time.
   - .3 Ambient temp in degrees C.
   - .4 Lube oil pressure in kPa.
   - .5 Lube oil temp in degrees C.
   - .6 Engine coolant temp in degrees C.
   - .7 Exhaust stack temp in degrees C.
   - .8 Alternator voltage: phase 1, 2, 3.
   - .9 Alternator current: phase 1, 2, 3.
   - .10 Power in kW.
   - .11 Frequency in Hz.
   - .12 Power Factor.
   - .13 Battery charger current in A.
   - .14 Battery voltage.
   - .15 Alternator cooling air outlet temp.
2. After completion of 24 hours run, demonstrate following shut down devices and alarms:
   - .1 Overcranking.
   - .2 Overspeed.
   - .3 High engine temp.

.4 Low lube oil pressure.
.5 Short circuit.
.6 Alternator over voltage.
.7 Low battery voltage, or no battery charge.
.8 Manual remote emergency stop.
.9 High alternator temperature.

3. Next install continuous strip chart recorders to record frequency and voltage variations during load switching procedures. Each load change delayed until steady state conditions exist. Switching increments to include:
   .1 No load to full load to no load.
   .2 No load to 70% load to no load.
   .3 No load to 20% load to no load.
   .4 20% load to 40% load to no load.
   .5 40% load to 60% load to no load.
   .6 60% load to 80% load to no load.
4. Demonstrate:
   .1 Automatic starting of set and automatic transfer of load on failure of normal power.
   .2 Operation of manual bypass switch.
   .3 Automatic shutdown of engine on resumption of normal power.
   .4 That battery charger reverts to high rate charge after cranking.
5. Demonstrate low oil pressure and high engine temperature shutdown devices operation without subjecting engine to these excesses.

.9 For Automatic Transfer Switches:
   .1 Operate equipment both mechanically and electrically to ensure proper performance.
   .2 Check selector switch, in modes of operation - Test, Auto, Manual, Engine Start and record results.
   .3 Check voltage sensing and time delay relay settings.
   .4 Check:
      .1 Automatic starting and transfer of load on failure of normal power.
      .2 Retransfer of load when normal power supply resumed.
      .3 Automatic shutdown.
      .4 In-phase monitor operation.

.10 Communication Systems testing:
   .1 Refer to Section 27 10 05 for testing results.

.11 Access control, CCTV and intrusion systems shall have each device verified for address, functionality and intercommunication with other systems. The manufacturer shall assist the electrical contractor and Departmental Representative with the entire system verification and provide documentation detailing each device tests with pass/fail for each device.

.12 The Fire Alarm system shall be tested by the electrical to ensure that all opens, troubles, shorts and grounds are clear on the system before verification begins.
   .1 Performance Verification:
      .1 The Manufacturer’s technician will direct the Performance Verification of Fire Alarm System in accordance with CAN/ULC-S537-13, Standard for Verification of Fire Alarm System Installations.
      .2 Electrical subcontractor and fire alarm system manufacturer’s representative shall be present at all times during the verification procedure and shall ensure the verification is complete as follows:
         .1 Provide all required testing equipment and tools.
         .2 Disassemble and re-assemble system components.
         .3 Disconnect and reconnect wiring.
         .4 Perform required field adjustments.

.5 Replace defective components.
.6 Perform all other work on the system required by the verification procedure.

.2 The Fire Alarm manufacturer shall supply a fire alarm verification certificate and test report to the electrical contractor for inclusion in the O&M manuals; a copy of both must be sent to the Departmental Representative.

3.5 DOCUMENTATION, NON-CONFORMANCE AND APPROVAL OF TESTS

.1 The EC shall witness and document the results of all functional performance tests using forms developed for that purpose. Prior to testing, these forms are provided to the Departmental Representative for review and approval.

.2 The EC will record the results of the functional test on the procedure or test form. All deficiencies or non-conformance issues shall be noted and reported to the Departmental Representative on a standard form.

.3 Corrections of minor deficiencies identified may be made during the tests at the discretion of the EC. In such cases the deficiency and resolution will be documented on the procedure form.

.4 Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. However, the EC will not be pressured into overlooking deficient work or loosening acceptance criteria to satisfy scheduling or cost issues, unless there is an overriding reason to do so at the request of the GC.

.5 As tests progress and a deficiency is identified:

.1 When there is no dispute on the deficiency and the responsibility to correct it:
.1 The EC documents the deficiency and the Sub's response and intentions the testing continues. The Sub corrects the deficiency and notifies the EC that the equipment is ready to be retested.
.2 The EC reschedules the test and the test is repeated.

.2 If there is a dispute about a deficiency or who is responsible:
.1 The deficiency shall be documented on the non-compliance form and a copy given to the Departmental Representative.
.2 Resolutions are made at the lowest management level possible. Other parties are brought into the discussions as needed. Final interpretive authority is with the Departmental Representative.
.3 The EC documents the resolution process.
.4 Once the interpretation and resolution have been decided, the appropriate party corrects the deficiency and notifies the EC that the equipment is ready to be retested. The EC reschedules the test and the test is repeated until satisfactory performance is achieved.

.6 Cost of Retesting.

.1 The cost for the Sub to retest a pre-functional or functional test, if they are responsible for the deficiency, shall be theirs. If they are not responsible, any cost recovery for retesting costs shall be negotiated with the GC.

.2 The time for the Departmental Representative to direct any retesting required because a specific pre-functional checklist or start-up test item, reported to have been successfully completed, but determined during functional testing to be faulty, will be back charged to the GC, who may choose to recover costs from the party responsible for executing the faulty pre-functional test.

.7 The EC notes each satisfactorily demonstrated function on the test form. Formal approval of the functional test is made later after review by the EC. The EC recommends acceptance of each test to the Departmental Representative. The Departmental Representative gives final approval on each test, providing a signed copy to the EC and the GC.

3.6 OPERATION AND MAINTENANCE MANUALS

.1 Prior to substantial completion, the EC shall review the O&M manuals, documentation and redline as-builts for systems that were commissioned to verify compliance with the Specifications. The EC will communicate deficiencies in the manuals to the Departmental Representative. This work does not supersede the A/E team's review of the O&M manuals according to the A/E contract.

.2 The EC is responsible to compile, organize and index all commissioning data by equipment into labelled, indexed and tabbed, three-ring binders and deliver it to the GC. Three copies of the manuals will be provided. The manuals shall include the Commissioning Plan, Final Commissioning Report, System Type, Design Intent narrative, Start-up and Pre-functional checklists, Functional performance tests, trending and analysis, approvals and corrections, training plan, records, and approvals.

3.7 SYSTEM 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.

.2 The GC shall be responsible for training coordination and scheduling and for ensuring that training is completed.

.3 Some systems may require two independent seminars, one for the maintenance staff and on seminar for the user groups. Accommodate split seminars as required.

.4 The EC shall be responsible for overseeing and approving the content and adequacy of the training of Owner personnel for commissioned equipment.

.1 Each Sub and vendor responsible for training will submit a written training plan to the EC for review and approval prior to training. The plan will cover the following elements:

.1 Equipment (included in training)
.2 Intended audience
.3 Location of training
.4 Objectives
.5 Subjects covered (description, duration of discussion, special methods, etc.)
.6 Duration of training on each subject
.7 Instructor for each subject
.8 Methods (classroom lecture, video, site walk-through, actual operational demonstrations, written handouts, etc.)
.9 Instructor and qualifications

.5 Power Distribution Equipment:

.1 Distribution Switchgear:

.1 Torqueing procedures and values.
.2 Circuit breaker or disconnect switch operation.
.3 Protective features on breakers.
.4 Metering - calibration and operation.
.5 Safety procedures.
.6 Troubleshooting procedures.
.7 Visual maintenance inspections.
.8 Maintenance procedures.
.9 Testing requirements and procedures.
.10 Spare parts.

.2 Dry Type Transformers:

.1 Tap adjustment procedures.
.2 Drying and cleaning requirements.

.3 Safety procedures.
.4 Visual maintenance inspections.
.5 Maintenance procedures.
.6 Testing requirements and procedures.

.3 Panelboards:
.1 Types and sizes of breakers.
.2 Spare capacity.
.3 Visual maintenance inspections.
.4 Maintenance procedures.
.5 Testing requirements and procedures
.6 Spare parts.

.4 Branch Circuits:
.1 Power receptacle system
.2 Miscellaneous wiring devices
.3 Miscellaneous equipment
.4 Heat tracing and electric heat

.5 Grounding and Bonding System
.1 System Overview
.2 Location and routing
.3 System tests and labelling
.4 Special grounding/bonding testing results

.6 Generator Set

.1 System Overview.
.2 Circuit breaker operation.
.3 Automatic Transfer Switch operation and controls
.4 Bypass features
.2 Alarms and monitoring - calibration and operation.
.5 Metering - calibration and operation.
.6 Interconnection with other systems
.7 Safety procedures.
.8 Troubleshooting procedures.
.9 Visual maintenance inspections.
.10 Maintenance procedures.
.11 Testing requirements and procedures.
.12 Spare parts.

.7 Lighting:

.1 Interior/Exterior Lighting:
.1 Description of each luminaire with respect to lamp and ballast or any other special features:
.1 Troubleshooting procedures
.2 Maintenance procedures
.3 Re-lamp schedules.
.4 Spare parts.
.2 Emergency Lighting Battery Units and Exit Lights:
.1 Troubleshooting procedures
.2 Maintenance procedures
.3 Spare parts.
.3 Lighting Controls:
.1 Line voltage switching:
.1 Dimming

.2 Occupancy Sensor operation and adjustments.
.3 Daylight Sensors operation and adjustments,

.2 Low voltage switching:
.1 Relay replacement.
.2 Master control unit programming.
.3 Programming Adjustments.
.4 Sensor operation and calibration

.3 Photo-cell/time clock operation
.4 Occupancy Sensor operation and adjustments.
.5 Daylight Sensors operation and adjustments,
.6 Troubleshooting procedures
.7 Maintenance procedures
.8 Spare parts

.8 Communication and Security Systems:

.1 Communications Systems
.1 System Overview
.2 Cable types, routing and communication room locations.
.3 Wireless access points and mapping
.4 Grounding and Bonding system
.5 Warranty
.6 Interface with other systems
.7 Troubleshooting procedures
.8 Maintenance procedures

.9 Fire Alarm System:

.1 Alarm silence
.2 Trouble conditions, alarm and silence
.3 Annunciator and control panel operation.
.4 Mechanical systems control.
.5 Control panel module replacement.
.6 Alarm lamp replacement
.7 Power supply.
.8 Sequence of operation under alarm conditions:
.1 Central station tie-in
.2 Sprinkler system interface
.3 Fan shutdown
.4 Troubleshooting procedures
.5 Maintenance requirements and procedures
.6 Spare parts.

.10 Access Control System:

.1 System Overview
.2 Programming of individual devices, access privileges, schedules, zones and groups.
.3 Addition and deletion of staff/cards onto the system.
.4 Interface with other systems.
.5 Sequence of operations
.6 Interface with door hardware
.7 Maintenance Procedures

.11 Closed Circuit Television (CCTV)

.1 System Overview
.2 Monitoring/display controls.
.3 Recording and playback features.
.4 Interface with other systems.
.5 Maintenance Procedures

.12 Intrusion Detection System

.1 System Overview
.2 Programming of schedules, zones and groups.
.3 Addition and deletion of devices onto the system.
.4 Interface with other systems.
.5 Interface with door hardware
.6 Maintenance Procedures

END OF SECTION 26 08 00

PART 1- GENERAL

1.1 RELATED REQUIREMENTS

.1 This section of the Specifications forms part of the contract documents and shall be read, interpreted and coordinated with all other parts.

1.2 REFERENCES

.1 International Electrotechnical Commission (IEC) – most recent version

.1 IEC 62053-22 - Electricity metering equipment (a.c.) Particular requirements Part 22: Static meters for active energy (classes 0,2 S and 0,5 S).

.2 IEC 61010-1 - Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements

.2 International Standards; Institute of Electrical and Electronics Engineers (IEEE), Underwriters Laboratories (UL), European Committee for Standardization (CEN), National Electrical Manufacturers Association (NEMA) – most recent versions

.1 IEEE C.37-90.1 - Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus

.2 UL 61010-1 UL Standard for Safety Electrical Equipment For Measurement, Control, and Laboratory Use; Part 1: General Requirements

.3 CEN - EN61000-6-2 - Electromagnetic compatibility (EMC) -- Part 6-2: Generic standards

.4 NEMA C12.20 - Electricity Meters 0.2 and 0.5 Accuracy Classes

.3 Canadian Standards Association (CSA) – most recent version

.1 CAN/CSA-C22.2 No. 61010-1-12 - Safety requirements for electrical equipment for measurement, control, and laboratory use — Part 1: General requirements

PART 2 - PRODUCTS

2.1 UTILITY METER

.1 Combination energy and demand meter: IEC 62053-22 .1%.

.2 To Utility's requirements and standards. It is the electrical contractors responsibility to coordinate and follow the Utility's' standards.

.3 Register: instrument transformer operated, pulse contacts for transmitting signal.

.4 Allow for remote sensing.

.5 Meter Socket: Weatherproof (where required) meter socket[s] to suit meter[s] with automatic current transformer shorting devices when meter removed.

.6 Meter Cabinet: Sheet steel CSA enclosure 1 with meter backplate, to accommodate meters, test terminal block and associated equipment, factory installed and wired.

.7 Metering Instrumentation Cabinet: Sheet steel CSA enclosure 1 to accommodate potential and current transformers.

2.2 DIGITAL INSTRUMENTATION

.1 Digital indicating instruments: IEC 62053-22 .1% accuracy, switchboard mounting, equal to ION 7550 by Powerlogic (Square D) or approved alternate.

.1 Ammeter: average, instant and peak range.

.2 Voltmeter: average, instant and peak range.

.3 Wattmeter: average, instant and peak range.

.4 Varmeter: average, instant and peak range.

.5 Frequency meter: average, instant and peak range.

.6 Power factor meter: average, instant and peak range.

PART 3 - EXECUTION

3.1 METERING INSTALLATION

.1 Where meters and instruments are not factory installed, install meters and instruments in location free from vibration and shock.

.2 Make connections in accordance with diagrams.

.3 If applicable, ensure power factor corrective equipment connected on load side of meter.

.4 Connect meter and instrument transformer cabinets to ground.

.5 Locate meters within 9 m of instrument transformers.

.1 Use 32mm conduit for interconnections.

.2 Use separate conduit for each set of current transformer connections, exclusive for metering.

3.2 FIELD QUALITY CONTROL

.1 Conduct tests in accordance with Section 26 05 00 - Common Work Results for Electrical and in accordance with manufacturer's recommendations.

.2 Perform simulated operation tests with metering, instruments disconnected from permanent signal and other electrical sources.

.3 Verify correctness of connections, polarities of meters, instruments, potential and current transformers, transducers, signal sources and electrical supplies.

.4 Perform tests to obtain correct calibration.

.5 Do not dismantle meters and instruments.

3.3 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by metering and switchboard instrument installation.

END OF SECTION 26 09 23.01

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 This Section of the Specifications forms part of the Contract Documents and shall be read, interpreted and coordinated with all other parts.

1.2 REFERENCES

.1 ASHRAE 90.1 American Society of Heating, Refrigeration and Air Conditioning Engineers. – most recent version.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Control system: by one manufacturer and assembled from compatible components.

.2 Line voltage dual technology occupancy wall mounted sensors shall be equal to Sensor Switch WSD-PDT-SA (set to manual on); color to match switches.

.3 Line voltage dual technology occupancy two pole wall mounted sensors shall be equal to Sensor Switch WSD-PDT-2P and be set to manual on for both loads; color to match switches.

.4 Line voltage dual technology occupancy wall mounted sensors installed in larger rooms shall be equal to Sensor Switch LWS-PDT (set to manual on); color to match switches.

.5 Line voltage dual technology occupancy ceiling mounted sensors shall be equal to Sensor Switch CMR-PDT-9 color white.

.6 Line voltage dual technology occupancy ceiling mounted sensors for larger rooms shall be equal to Sensor Switch CMR-PDT-10 color white.

.7 Line voltage dual technology occupancy ceiling mounted two pole sensors shall be equal to Sensor Switch CMR-PDT-9-2P color white.

.8 Line voltage dual technology occupancy and daylight sensing ceiling mounted sensors shall be equal to Sensor Switch CMR-PC-ADT color white.

.9 Line voltage dual technology occupancy ceiling mounted wide view sensors shall be equal to Sensor Switch WVR-PDT color white.

.10 Line voltage dual technology occupancy ceiling mounted hallway sensors shall be equal to Sensor Switch HWR-13 color white.

.11 Photocell equal to Sensor Switch SBOR series.

.12 Line voltage dimmers shall be equal to Leviton TPI10-1LW series.

.13 Line voltage switches as per Section 26 27 26.

.14 Exterior Lighting Timeclock: Digital, 30A 347 DPST, Exterior photocell.

.15 The lighting control system shall be tested and certified by the manufacturer's representative as per ASHRAE 90.1-10 requirements. Provide documentation of certification in maintenance manual and submit copy to the Departmental Representative.

.16 Acceptable manufactures: Lutron, Leviton and Hubbell.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install system and components in accordance with manufacturer's recommendations and as shown on the drawings to provide a fully functional system as shown on the drawings and contained herein. Not all system components for a fully functional system may be detailed in this specification; provide all necessary components for a fully functional system.

.2 Install cabling and connect to each component in accordance with the manufacturer's recommendations.

.3 Adjust each component in the system to function as shown on the drawings and in conjunction with the Owners' directions.

.4 Connect to other systems such as DDC and Security as shown on the drawings; verify operation of lighting system of connections to the other systems.

.5 Measure and adjust all occupancy sensors, vacancy sensors, daylight sensors and photocells. Unless otherwise noted, wall mounted occupancy sensors shall be set to manual on and auto off.

.6 Where daylighting controls are installed, the lighting levels during full day light and at night shall be measured and light levels adjusted to provide even illumination in both scenarios. Retest after adjustments and re-adjust as necessary.

.7 Ensure all switching and controls requirements of ASHRAE 90.1 have been met; bring any variances to the Departmental Representative.

3.2 FIELD QUALITY CONTROL

.1 On completion of installation the manufacturer representative shall carry out site inspection and verification. Verification to comply with the ASHRAE 90.1 requirements, the design as shown on the drawings in addition to the Manufacturer's own requirements. Provide copy of verification report to the Departmental Representative. Corrections are to be implemented to comply with manufacturer's report.

END OF SECTION 26 09 25

PART 1- GENERAL

1.1 SECTION INCLUDES

.1 This Section specifies the materials and components for dry type transformers up to 600 V primary, equipment identification and transformer installation.

1.2 REFERENCES

.1 Use transformers of one manufacturer throughout the project.

.2 Canadian Standards Association (CSA International)

.1 CAN/CSA-C22.2 No.47, Air-Cooled Transformers (Dry Type).

.2 CSA C9, Dry-Type Transformers.

1.3 PRODUCT DATA

.1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.

PART 2- PRODUCTS

2.1 STANDARD TRANSFORMERS

.1 Type: ANN, 600 volts, 3 phase delta primary.

.2 Primary taps: 2 x 2 ½% full capacity taps above and 2 x 2 ½% taps below the nominal voltage.

.3 Secondary: 3 phase, 60 Hz 120V/208V 4 wire (see drawings for kVA rating).

.4 Class H, 220°C insulation with temperature rise not exceeding 115°C maximum in 40°C ambient.

.5 K rating: minimum K-13.

.6 Efficiency: Energy Star rating & NEMA Premium.

.7 Basic Impulse Level (BIL): standard.

.8 Hipot: standard.

.9 Windings: High grade copper windings, VPE or VPI type.

.10 Impedance: per ANSI recommendations but must not be less than 4%.

.11 Average Sound Level: Noise emission shall not exceed requirements per ST20 standard.

.12 Impedance at 170 degrees C: standard.

.13 Enclosure: air ventilated EEMAC 1, removable metal front panel “sprinkler-proof” design. Provide angled louvres for ventilation slots to prevent entrance of water from the sprinkler fire protection system. Air cooled type, natural circulation in ventilated enclosure.

.14 Mounting: provide external vibration isolator kit. Provide neoprene isolation pads.

.15 Finish: in accordance with Section 26 05 00 – Common Work Results - Electrical.

.16 Scott-T connected transformers not acceptable.

PART 3- EXECUTION

3.1 MOUNTING

.1 Mount dry type transformers on floor unless otherwise noted on drawings.

.2 Provide 100 mm concrete house-keeping base pad unless otherwise detailed.

.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 Provide wonderboard or approved alternate if installed closer than 300mm from any combustible surface.

3.2 CONNECTIONS

.1 Make primary and secondary connections in accordance with the manufacturers diagram.

.2 Check all factory connections for correct tightness before energization.

.3 Torque the building system wiring transformer connections using a torque wrench set to the manufacturers recommended settings. Note the torque setting on the equipment identification label for future maintenance reference.

.4 All external wiring connections to transformer casing shall be enclosed in flexible conduit. Typically minimum 900mm flex to minimize vibration transmission to building structure.

.5 Conduit to only enter transformers within the bottom third of the transformer casing, to minimize heat transfer to conduit.

.6 Energize transformers immediately after installation is completed, where practicable.

3.3 EQUIPMENT IDENTIFICATION

.1 Size 7 label in accordance with Section 26 05 00 – Common Work Results – Electrical.

.2 Include the transformer identification (as indicated on the project drawings), primary power source equipment designation, equipment served and torque setting of connections. E.g. Transformer T1, served from CDPH-1, serving CDPL-1, Cable Connection Torque x Nm.

3.4 GROUNDING

.1 Provide a ground conductor with all feeder runs to dry type transformer installations. The ground shall be either green insulated or identified and connected a s a ground to the ground pad tin the transformer enclosure and then to the secondary neutral of the transformer. From the transformer ground pad make cable connection to non-current carrying ground of the distribution centre or panel supplied from transformer.

END OF SECTION 26 12 16.01

PART 1 - GENERAL

1.1 RELATED WORK

.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 PLANT ASSEMBLY

.1 Install circuit breakers in panelboards before shipment from plant.

.2 Install and prewire low voltage relays assemblies where indicated.

.3 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.

.4 All panelboards to be of a common manufacturer.

1.3 FINISH

.1 Apply finishes in accordance with Section 26 05 00.

.2 Panel finish in electrical and equipment rooms and closets to be standard ASA Grey baked enamel for normal power service and confirm with Departmental Representative prior to shop finishing panels.

.3 Panels in finished and/or public areas to be either as clause .2 above or prepared to accept painting to closely match surroundings as directed by the Architect. In the later instance, the final paint coat to be done by Division 09 but coordinated by the Electrical Division in particular for protection and masking of locks and sensitive parts. Confirm with Departmental Representative prior to paint finishing panels.

PART 2 - PRODUCTS

2.1 PANELBOARDS, DOORS AND TRIMS

.1 Bus and breakers rated for 22 KA symmetrical, minimum, interrupting capacity for 600V and 10kA symmetrical, minimum interrupting capacity for 208V or as indicated.

.2 Copper bus with full size neutral.

.3 Minimum 20% spare capacity.

.4 Mains, number of circuits and number and size of branch circuit breakers as indicated.

.5 Provide all necessary connectors and mounting hardware in every space to facilitate installation of future breakers. Provide blank fillers for all spaces.

.6 Concealed hinges and concealed trim mounting screws, hinged locking door with flush catch.

.7 Panelboards to have flush doors. (Gasketted where required).

.8 Provide two keys for each panelboard and key similar voltage panelboards alike.

.9 Panel tubs to be typically 600mm [20”] wide.

.10 Provide "sprinkler-proof" design in areas where sprinkler fire protection is installed. In any event, all surface mounted enclosures to be complete with sprinkler drip cover.

.11 Provide door within door trims where indicated to facilitate ease of service maintenance Each tub trim cover to be hinged and self-supporting and to swing out to expose breaker cable terminations and wireways. Hinged trim shall be secured with cover screws on opening side by concealed machine screws. Hinged breaker cover shall be recessed into the hinged overall tub cover.

Breaker cover shall have latch type closures. Submit details on shop drawings prior to manufacturing.

.12 Feed through lugs as indicated.

.13 Integral Surge Protection Devices as indicated; refer to section 26 24 17.

2.2 BREAKERS

.1 All breakers to be bolt on type, moulded case, non-adjustable and non-interchangeable trip, single, two and three pole, 120/208(240)V or 347/600V and with trip free position separate from "On" or "Off" positions.

.2 Two and three pole breakers to have common simultaneous trip and able to be located in any circuit position within the panelboard. Minimum interrupting rating of breakers to be as follows:

.1 347/600V panelboards - 22,000 Amps at 347 volts.

.2 120/208V panelboards - 10,000 Amps at 250 volts.

.3 Main breaker to be separately mounted at top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.

.4 Provide circuit breakers with indicated trip ratings as shown in the panelboard schedules.

.5 Provide at least 10% spare 15 Amp single pole breakers whether indicated or not.

.6 Provide GFI type breakers as indicated.

.7 Provide Lock-on devices as indicated and in any event for Fire Alarm circuits, Security equipment circuits, EXIT sign circuits and Emergency Battery equipment circuits.

2.3 PANELBOARD IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00.

.2 Nameplate for each panelboard size 5 (2 line) engraved as indicated and include panel designation and voltage/phase.

.3 Complete circuit directory with typewritten card(s) located in slide-in plastic pocket(s) fixed to the back of the related door. Directory card to indicate the panel designation, mains size, voltage/phase and the location and load controlled of each circuit. Include a “letter sized” paper copy of each directory in the project maintenance manual.

.4 Provide a plasticized typewritten information card fixed to the back of the each panel door. Information card to indicate the panel designation and location, feeder type and size and locations of any controlling contactors and feeder pullboxes. Include a “letter sized” paper copy of each information card in the project maintenance manual.

PART 3 -EXECUTION

3.1 INSTALLATION

.1 Locate panelboards as indicated and mount securely, plumb true and square, to adjoining surfaces.

.2 Panelboards located in service rooms, mechanical rooms, and electrical rooms to be mounted on unistrut supports.

.3 Connect loads to circuits as indicated.

.4 Connect neutral conductors to common neutral bus with respective neutral identified.

.5 Install 4x27mm [1”] empty conduits (or equivalent) from each flush mounted panelboard single tub to ceiling space above and 2x27mm [1”] empty conduits (or equivalent) from each flush mounted panelboard single tub down to ceiling or space below where space exists.

END OF SECTION 26 24 16

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 This Section of the Specification forms part of the Contract Document and is to be read, interpreted and coordinated with all other parts.

PART 2 - PRODUCTS

2.1 SURFACE RACEWAY FOR WIRING DEVICES

.1 Two piece assembly manufactured for mounting wiring devices and associated wiring.

.2 Plastic Raceway with base channel and snap on cover plate.

.3 Finish: grey enamel, as indicated.

.4 Internal barrier for raceway having power and communication.

.5 Height 127mm Depth 45mm

2.2 WIRING DEVICES

.1 Wiring devices: as indicated.

.2 Communication devices: as indicated.

.3 Cover plate: to match raceway manufacturer's standard snap-on cover.

2.3 PREWIRED RECEPTACLE HARNESS

.1 Receptacle harness factory assembled with single receptacles and duplex as indicated.

2.4 VINYL PLASTIC STRIP

.1 Extruded rigid vinyl plastic with 2- No. 12 AWG 3 mm^2 copper wires and continuous ground strip.

.2 Unfused "U" ground lock-in receptacle for each 1.5 m of strip.

2.5 FITTINGS

.1 Elbows, tees, supports, connectors, couplings and fittings to make a complete installation.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install multi-outlet assemblies and raceway system in accordance with manufacturer's instructions.

.2 Install supports, elbows, tees, connectors, fittings.

.3 Keep number of elbows, offsets and connections to minimum.

.4 Install barriers where required.

.5 Install surface raceway continuous around corners. Provide corner and vertical sections as required.

3.2 WIRING

.1 Install wiring after installation of raceway system is complete.

.2 Install receptacle harness as indicated.

.3 Fasten wiring with wire clips inside raceway.

.4 Install ground wire as required.

3.3 WIRING DEVICES

.1 Install wiring devices and cover plates as indicated

.2 Install vinyl strip receptacles as indicated.

.3 Install identification labels for all electrical outlets.

END OF SECTION 26 27 19

PART 1 - GENERAL

1.1 RELATED WORK

.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 REFERENCES

.1 Canadian Standards Association (CSA International) – most recent version

.1 CSA-C22.2 No.42, General Use Receptacles, Attachment Plugs and Similar Devices.

.2 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, twelfth edition).

PART 2 - PRODUCTS

2.1 SWITCHES

.1 20 A, 120 V or 347 V, single pole, double pole, three-way, four-way switches as indicated, ivory specification grade.

.2 Switches of one manufacturer throughout project.

.3 Provide 3 way switches/dimmers as required and as shown.

2.2 RECEPTACLES – GENERAL

.1 Duplex receptacles, CSA type 5-15R, 125 V, 15 A, U ground, ivory specification grade.

.2 T-Slot duplex receptacles, CSA type 5-20R, 125 V, 20 A, U ground**,** ivory specification grade.

.3 Use tamper resistant receptacles where required by Code and as indicated.

.4 Receptacles of one manufacturer throughout project.

2.3 RECEPTACLES – PARTICULAR APPLICATION

.1 Ground Fault Interrupter type to be 15 Amp, 125 volt duplex receptacles to be 2 pole, 3 wire, U ground, impact resistant nylon face, complete with breaker and reset button. Ivory specification grade.

.2 Ground Fault Interrupter located outside shall come with wet location cover plates.

.3 Use tamper resistant receptacles where required by Code and as indicated.

.4 Receptacles of one manufacture throughout project.

.5 Surge Protective type to be T slot 5-20R, 125 volt duplex receptacles to be 2 pole, 3 wire hospital grade, blue face, parallel blade, U ground, impact resistant nylon face audible and LED indicator.

.6 All other single outlet and special purpose receptacles to be similar to the grade and series indicated above. Confirm ampacity, voltage and pin configuration prior to installation.

2.4 COVER PLATES

.1 Cover plates for devices shall be stainless steel. In service rooms, shops and other like applications, provide stamped steel cover plates.

.2 Wall plates to be flush mounting with "positive bow" feature to ensure that all edges of plate are flush with wall or surface box when installed.

.3 All plates to be bevelled type with smooth rolled outer edge and smooth face. Exposed sharp edges are not acceptable.

.4 Cover plates for all wiring devices to be from one manufacturer throughout project.

PART 3 - EXECUTION

3.1 INSTALLATION GENERAL

.1 Mount wiring devices to height specified in Section 26 05 00 or as indicated.

.2 Upper edge of plates located on separate outlets immediately alongside one another to be at exactly the same height above finished floor.

.3 All plates to be installed parallel or perpendicular to building lines.

3.2 INSTALLATION PARTICULAR

.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 Install on latch side of door; coordinate with Architectural drawings prior to install.

.2 Receptacles:

.1 Install all receptacles in the vertical plane unless otherwise noted.

.2 Generally install the 5-15/20R U ground pin down unless otherwise noted. Neutral up when receptacle in mounted horizontal.

.3 Install receptacles vertically in gang type outlet box when more than one receptacle is required in one location.

.4 Install receptacles near mechanical equipment mounted on the roof as per the CEC. Provide wet location rated cover plates.

.5 Ground fault interrupter duplex receptacles to be used whenever within 1.5 meters of all sinks or water sources.

.6 Utilize tamper resistant receptacles in public areas and in all areas dedicated for children.

.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 Provide wet location cover plates which provide a seal whether or not a plug is inserted into the receptacle.

.4 Provide labels on all receptacle cover plates indicating circuit number.

.4 In-Floor Devices:

.1 Conduit for floor mounted boxes shall terminate with a locknut and bushing in base of the fitting. Seal around conduit and the conduit itself after installation of conductors with heavy density fiberglass.

END OF SECTION 26 27 26

PART 1 - GENERAL

1.1 RELATED WORK

.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 REFERENCES

.1 Canadian Standards Association (CSA International):

.1 CAN/CSA C22.2 No.4, Enclosed Switches.

.2 CSA C22.2 No.39, Fuseholder Assemblies.

PART 2 - PRODUCTS

2.1 DISCONNECT EQUIPMENT

.1 "Heavy Duty" class, enclosed manual air break switches in non-hazardous locations: to CSA C22.2 No.4

.2 Fuseholder assemblies to CSA C22.2 No.39.

.3 Fusible and non-fusible disconnect switch in CSA enclosure.

.4 Provision for padlocking in off switch position.

.5 Fuses as indicated. Allow for Class J or L for general circuits, Class RK5 for transformer, motor or other high inrush current circuits

.6 Fuseholders in each switch suitable without adaptors, for type of fuse as indicated.

.7 Quick-make, quick-break action.

.8 ON-OFF switch position indication on switch enclosure cover.

.9 Weatherproof as required.

.10 NEMA-3 rated disconnect for roof top.

2.2 EQUIPMENT IDENTIFICATION

.1 Indicate name of load controlled on size 4 name plate to Section 26 05 00.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Provide and locate safety disconnect switches to isolate individual items of equipment in accordance with Canadian Electrical Code CSA 22.1 whether indicated on not on the contract drawings.

.2 Install disconnect switches complete with fuses where indicated or required.

.3 All disconnect switches for elevator machine rooms shall be fused in accordance with the equipment supplier's requirements.

.4 Provide and locate safety disconnect switches to isolate individual items of equipment in accordance with Canadian Electrical Code CSA 22.1 whether indicated on not on the contract drawings.

3.2 MOTOR PLUG/RECEPTACLE AND QUICK DISCONNECTS

.1 Motor quick disconnects do not negate the requirement for a switched safety disconnect as specified in this Division. A separate disconnect is still required unless the Departmental Representative has given a special pre-approved circumstance.

END OF SECTION 26 28 23

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 This Section of the Specifications forms part of the Contract Documents and shall be read, interpreted and coordinated with all other parts.

1.2 REFERENCES

.1 International Electrotechnical Commission (IEC)

.1 IEC 947-4-1, Part 4: Contactors and motor-starters.

1.3 EXTRA MATERIALS

.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Starters: to IEC 947-4 with AC4 utilization category.

2.2 MANUAL MOTOR STARTERS

.1 Single and Three phase manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:

.1 Switching mechanism, quick make and break.

.2 One or Three overload heater[s], manual reset, trip indicating handle.

.2 Accessories:

.1 Pushbutton: heavy duty labelled as indicated.

.2 Indicating light: heavy duty type and colour as indicated.

.3 Locking tab to permit padlocking in "ON" or "OFF" position.

2.3 FULL VOLTAGE MAGNETIC STARTERS

.1 Combination magnetic starters of size, type, rating and enclosure type as indicated with components as follows:

.1 Contactor solenoid operated, rapid action type.

.2 Motor overload protective device in each phase, manually reset from outside enclosure.

.3 Wiring and schematic diagram inside starter enclosure in visible location.

.4 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.

.2 Combination type starters to include circuit breaker with operating lever on outside of enclosure to control circuit breaker, and provision for:

.1 Locking in "OFF" position with up to 3 padlocks.

.2 Independent locking of enclosure door.

.3 Provision for preventing switching to "ON" position while enclosure door open.

.3 Accessories:

.1 Selector switches: heavy duty labelled as indicated.

.2 Indicating lights: heavy duty type and color as indicated.

.3 1-N/O and 1-N/C spare auxiliary contacts unless otherwise indicated.

2.4 FULL VOLTAGE REVERSING MAGNETIC STARTERS

.1 Full voltage reversing magnetic starters of size, type, rating and enclosure type as indicated with components as follows:

.1 Two - 3 pole magnetic contactors mounted on common base.

.2 Mechanical and electrical interlocks to prevent both contactors from operating at same time.

.3 Three overload relays with heater elements, automatic reset.

.2 Accessories:

.1 Selector switches: heavy duty labelled as indicated.

.2 Indicating lights: heavy duty type and color as indicated.

.3 Auxiliary control devices as indicated.

2.5 MULTI-SPEED STARTERS

.1 2 speed starters of size, type, rating and enclosure type as indicated. Starter suitable for variable torque type motor and with components as follows:

.1 One-3 pole contactor for each winding for separate winding motors.

.2 One-3 pole and one-5 pole contactor for each reconnectable winding for consequent pole type motors.

.3 Three overload relays with 3 heater elements and manual reset for each speed.

.2 Accessories:

.1 Selector switches: heavy duty labelled as indicated.

.2 Indicating lights: heavy duty, type and color as indicated.

.3 Auxiliary control devices as indicated.

2.6 CONTROL TRANSFORMER

.1 Single phase, dry type, control transformer with primary voltage as indicated and 120 V secondary, complete with secondary fuse, installed in with starter as indicated.

.2 Size control transformer for control circuit load plus 20% spare capacity.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install starters, connect power and control as indicated.

.2 Ensure correct fuses and overload devices elements installed.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 08 00 – Commissioning and Demonstrations and manufacturer's instructions.

.2 Operate switches, contactors to verify correct functioning.

.3 Perform starting and stopping sequences of contactors and relays.

.4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

END OF SECTION 26 29 10

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 Materials and installation for liquid cooled electric diesel generating unit.

1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 74 19 - Construction/Demolition Waste Management and Disposal.

.3 Section 01 45 00 - Quality Control.

.4 Section 01 78 00 - Closeout Submittals.

1.3 REFERENCES

.1 Canadian Standards Association, (CSA International)

.1 CAN3-Z299.3-85(R1997) (R2002), Quality Assurance Program - Category 3.
.2 CAN/CSA-B139-15 (2015 version) Installation Code for Oil Burning Equipment;

.2 International Organization for Standardization (ISO)

.1 ISO 3046-1-2002, Reciprocating internal combustion engines - Performance - Part I: Declarations of power, fuel and lubricating oil consumptions, and test methods - Additional requirements for engines for general use.
.2 ISO 3046-4-1997, Reciprocating internal combustion engines - Performance – Part 4: Speed governing.

.3 National Electrical Manufacturers Association (NEMA)

.1 NEMA MG 1-1998, Motors and Generators.

.4 The Master Painters Institute (MPI)

.1 Architectural Painting Specification Manual - March 1998.

.5 National Research Council - Canada

.1 2015 National Fire Code of Canada (NFC);

1.4 SYSTEM DESCRIPTION

.1 Provide automatic, unattended, standby power supply system consisting of:

.1 Liquid cooled low voltage diesel electric generating units with remote operated generator breakers and consolidated generator and transfer controls.
.2 Self contained, sub-base double wall fuel tank.
.3 Accessories and equipment specified in this specification.

.2 Provide design, fabrication, testing, transportation, demonstration and equipment warranty.

1.5 DESIGN REQUIREMENTS

.1 Design equipment to meet following requirements:

.1 Total load: 125 kW, 0.8pf.
.2 Voltage: 347/600 V.
.3 Frequency: 60 Hz.
.4 Phase/Wire: 3 phase, 4 wire.
.5 Power factor: 0.8.
.6 Load harmonic content: 20% THD.
.7 Maximum rotational speed: 1800 rpm.
.8 Duty rating: full load continuous plus 10% overload for 1h in every 12h period.
.9 Performance: automatic.
.10 Elevation above sea level: 10 m.
.11 Ambient temperature: 40 ^{o}C.
.12 Relative humidity: 60 %.

.2 Design unit capable of starting, settling to specified steady state bands, within 10 seconds for any temperature between -15^{o}C to 40 ^{o}C.

.3 Use engine manufacturer's standard, published continuous (prime) horsepower rating in assessing engine capacity and derate this rating for specified conditions and engine driven accessories in accordance with ISO 3046-1.

.4 Description of generating set operation:

.1 Automatic starting, stopping shall be handled by the transfer switch.
.2 Adjustable time delay relay to allow engine to run unloaded to cool down and subsequently to shut down, ready for next cycle.
.3 Equip engine with key switch with following positions: auto-off-crank-start, key removable in auto position only.
.4 Automatic shut down on:
.1 Overcranking.
.2 Overspeed.
.3 High Engine Temperature.
.4 Low lubricating oil pressure.
.5 Over and under frequency.

.5 Provide remote annunciator as indicated on the drawings.

1.6 SUBMITTALS

.1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

.1 Dimensions and data in metric units and symbols followed by in bracket imperial units and symbols wherever applicable.

.2 Include following:

.1 Engine: make, model, rating and performance curves.
.2 Starter motor, make model.
.3 Generator: make, model and rating complete with generator saturation curves, heat damage curves, reactive capability and special data.
.4 Voltage regulator: make, model, type.
.5 Governor: type, model.
.6 Battery: make, type, voltage, capacity.
.7 Charger: make, model, input and output rating.
.8 Submit general outline drawing of complete assembly showing engine, radiator and generator mounting, exhaust, recirculating and intake air louvre arrangement, exhaust gas silencer and pipe arrangement, locations of fuel and lubricating oil filters, fuel supply and return line connections, lubricating oil drain valve, radiator and coolant drain valves, air cleaner, engine

instrument panel, starting motor, power and control junction boxes, engine and generator mounting feet. Indicate on drawings:

.1 Horizontal and vertical dimensions.
.2 Minimum door opening required for moving unit.
.3 Head room required for removal of piston and connecting rod.
.4 Weight of engine, generator, baseplate, and radiator and exhaust silencer.

.9 Baseplate construction details and materials.
.10 Transfer and bypass system: make, model, type.
.11 Outline and layout of panels.
.12 Schematic and wiring diagrams of engine, generator, control panel, and power panels complete with interconnecting wiring diagrams.
.13 Single line diagram showing all breakers, switches, metering and protective relays.
.14 Field wiring diagrams.
.15 Complete bill of materials, including manufacturer's name, catalogue numbers and capacity.

.3 Lubricating oil system: where oil pump not provided, submit certification to ensuring oil pump is not required and will not detract from service life of engine.

1.7 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for diesel generating units for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

.2 As built drawings of the fuel tanks shall be signed and sealed by a Professional Engineer prior to filling the tanks on site.

.3 Provide following in English for incorporation into instruction manuals:

.1 Complete set of reviewed shop drawings.
.2 Factory test data of engine, generator, exciter, control logic, metering and other pertinent test data.
.3 Maintenance and operation bulletins for:
.1 Engine and Accessories.
.2 Generator.
.3 Voltage Regulator and Accessories.
.4 Exciter.
.5 Permanent magnet generator.
.6 Battery charger.
.7 Speed Governor.
.8 Starting Motor.
.9 Batteries.
.10 Ventilating Equipment.
.11 Timers, Relays, Meters.
.12 Power Circuit Breakers.
.13 Controller, Contactors.
.14 Other Accessories.
.4 Submit original brochures; photocopies are not acceptable. Include technically relevant data.
.5 Complete sequence of system operation.
.6 Complete bill of materials including nameplate data of equipment and accessories.

1.8 QUALITY ASSURANCE

.1 Do work in accordance with CAN3-Z299.3.

1.9 DELIVERY, STORAGE AND HANDLING

.1 Prepare, crate and protect equipment against shipping and storage damage.

.2 Provide minimum 12.5 mm plywood outer covering single vapour barrier inside.

.3 Provide minimum 20 mm plywood outer covering with one side finished and double vapour barrier and sufficient desiccant for one year's storage.

.4 Mount unit and panel on shipping skids with plank floor.

.5 Each package to have shipping weight, address, dimensions and brief description of contents stencilled on at least two sides.

.1 Staple on outside packing list contained in waterproof envelope.
.2 Place copy of packing list inside.

1.10 WASTE MANAGEMENT AND DISPOSAL

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

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

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

.4 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Departmental Representative.

.5 Dispose of unused paint material at official hazardous material collections site approved by

.6 Departmental Representative.

.7 Do not dispose of unused paint material into sewer system, into streams, lakes, onto ground or other location where it will pose health or environmental hazard.

.8 Dispose of unused lubricating oil and fuel material at official hazardous material collections site approved by Departmental Representative.

.9 Dispose of unused batteries material at official hazardous material collections site approved by the Departmental Representative.

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

1.11 MAINTENANCE - EXTRA MATERIALS

.1 For panels provide following:

.1 One spare control circuit breaker per rating.
.2 Twelve spare indicating light bulbs per rating.
.3 One spare control relay and socket per rating and contact arrangement.
.4 One spare contactor operating coil.

.2 Provide generator unit with standard set of engine manufacturer's spare parts for normal operation of 1,000 operating hours. Spares to include:

.1 Twelve fuel filter elements for each type of fuel filter/water separator.
.2 Twelve lubricating oil filter elements.
.3 Six air cleaner elements.

.3 Provide conclusive evidence that Canadian distributor has been established and will stock in Canada spare parts likely to be required during normal life of engine.

1.12 MAINTENANCE - TOOLS

.1 Supply suitable engine barring device and battery manufacturer's standard set of tools for battery service.

.1 Battery service tools to include hydrometer, one plastic bottle for topping up purposes and one insulated battery terminal wrench.

PART 2 - PRODUCTS

2.1 ASSEMBLY

.1 Provide following items plus such other items as necessary to make unit complete:

.1 Diesel Engine.
.2 Diesel Engine Accessories.
.3 Baseplate and Drip Pan.
.4 Vibration isolators.
.5 Governor.
.6 Engine Exhaust System.
.7 Engine Cooling System.
.8 Engine Ventilating System.
.9 Starting Motors.
.10 Batteries and Rack.
.11 Battery Charger.
.12 Generator and Exciter.
.13 Voltage Regulator and Accessories.
.14 Fuel Tank.
.15 Spares and Accessories.

2.2 MOUNTING

.1 Connect engine flywheel housing rigidly to generator stator housing with SAE adapter.

.1 Mount unit on common, heavy duty fabricated steel baseplate.
.2 Obtain approval for design and materials of baseplate from engine manufacturer and Departmental Representative.

.2 Baseplate: rigid material to maintain alignment of engine-generator shafts and frames under shipping, installation and service conditions.

.3 Install machine engine-generator feet and baseplate sole plates parallel and true.

.1 Shims: steel type, installed under generator feet.

.4 Support baseplate on spring type isolating fixtures from welded side brackets located to support bottom of baseplate 25 mm above supporting floor.

.1 Isolators: cast iron housings, complete with levelling bolts, adjustable oil proof snubbers and minimum 6 mm sound pads.
.2 Isolation efficiency 95% minimum.

.5 Determine quantity and location of isolators. Locate each isolator to carry equal proportion of weight and that pressure exerted on floor by each isolator does not exceed 345 kPa.

.6 Ship isolators loose for installation at project site.

2.3 DIESEL ENGINE

.1 Full diesel, heavy duty, cold start, liquid cooled, vertical in-line or vee, and current manufacture of a type and size that has been service as a prime mover for electric power generation for not less than two years.

.1 Turbo supercharged engine acceptable providing brake mean effective pressure (BMEP) at rated output does not exceed 1800 kPa (225 psi).
.2 Mechanically driven superchargers not acceptable.
.3 Tier 4 EPA Emissions performance certification.

.2 Engine: minimum of four (4) cylinders.

.3 Engine with auxiliary starting aids (e.g., glow plug assist start) not acceptable.

.4 Equip engine air intakes with dry type heavy duty air cleaners located close to inlet manifold.

.1 Cleaner element: directly replaceable with elements of Canadian manufacture.

.5 Provide engine wiring in liquid-tight conduit and fittings with insulated bushings.

.1 Use stranded, minimum No.14 AWG, TEW 105°C and coloured coded wires.
.2 Terminate wiring with coded, insulated terminals flanged fork type. Terminal blocks heavy duty, screw type.
.3 Wire markers of slip on oil proof type.
.4 Junction boxes on unit of liquid-tight type.
.5 Maximum of two wires per terminal block.

.6 Provide high quality lubricating oil pressure gauge, lubricating oil temperature gauge, tachometer, coolant temperature gauge, exhaust pyrometer and other standard gauges and instruments.

.1 Calibrate and scale gauges and instrument in both metric and imperial units and symbols.
.2 Mount oil temperature sensors on engine full flow pressure line.
.3 Hoses or tubing for gauges: high pressure reinforced type.

.7 Mount unit accessories, including gauges, instruments, and protective sensors, to isolate or dampen vibrations.

.8 Dynamically balance complete engine-flywheel generator arrangement after assembly.

.1 Torsional or other vibration tolerance within 10% above or below rated speed of unit, when operating unloaded or connected to any load within its rating.
.2 Cyclic irregularity: 1/250 maximum.

.9 Provide engine flywheel with graduated marking around its periphery to facilitate fuel injection and valve timing.

.10 Provide removable wet type cylinder liners.

.1 Furnish cylinder head with removable valve seat insert and guides.

.11 Provide personnel safety guards for exposed moving parts and exhaust manifolds.

.1 Provide platform for servicing upper part of engine where applicable.

.12 Engine control panel complete with:

.1 Lubricating oil pressure gauge.
.2 Lubricating oil temperature gauge.
.3 Coolant temperature gauge.
.4 Low coolant level gauge.
.5 Engine switch auto-off-crank-start selector switch and crank pushbutton.
.6 D.C. main power supply circuit breaker.
.7 Terminal blocks for connection to D.C. power supply, engine monitoring and shutdown device.
.8 Provide low oil pressure, high coolant temperature, and low coolant level and overspeed protection to shut down engine on manual operation.

2.4 COOLING AND VENTILATING SYSTEM

.1 Provide complete cooling and ventilating system for unit as indicated.

.2 Thermostatically control system and maintain coolant, ethylene glycol, within engine manufacturer's tolerance, with unit operating at rated load under specified conditions. Cooling system engine mounted radiator type.

.1 Design and supply complete ventilating system as indicated where engine mounted radiator is required. Radiator cooling fan to be pusher type, minimum two belt drive with belt adjuster. Fan, pulley and belt with removable protective cage.

.3 Provide drain valves for draining coolant from engine block and radiator.

.1 Drain coolant conveniently into large container through flexible extensions.
.2 Dripping valves or leaking connections will not be permitted.

2.5 LUBRICATION SYSTEM

.1 Provide full pressure lubricating system complete with duplex filters and oil cooler.

.2 Oil pump: engine driven gear type complete with strainer.

.3 Equip filters with automatic by-pass valve and full flow filter elements conveniently located for servicing and directly replaceable with elements of Canadian manufacture.

.1 Cooler to have sufficient capacity to maintain oil temperature within engine manufacturer's tolerances with unit operating at rated load under conditions specified.

.4 Equip engine oil sump with oil drain pipe, gate valve and pipe cap.

.1 Permit complete drainage in a convenient manner.

.5 Ensure unit is able to start and assume full rated load within the specified time period when, operational requirements are such that unit may lay idle for periods up to one month.

.1 Provide electrical motor driven, integrally mounted, gear type oil priming pump with interval timer and breaker type combination starter.
.2 Lubrication oil pressure switch to stop priming pump when engine is running.

.6 Metallic oil hoses: steel reinforced rubber type with crimped or swaged end fittings.

2.6 FUEL SYSTEM

.1 Provide complete fuel system including fuel lift pump and duplex filters.

.1 Filter elements to be directly replaceable with elements of Canadian manufacture.

.2 Bring fuel supply and return lines to extreme forward part of baseplate with drop ear elbows. Connect other end of each elbow with 1 m of flexible neoprene hose.

.3 Non-metallic fuel hoses: steel reinforced rubber type with crimped or swaged end fittings.

2.7 EXHAUST SYSTEM

.1 Provide complete exhaust system including heavy duty critical type silencer with condensate drain, plug and flanged couplings; stainless steel, corrugated expansion joints, length to suit, to absorb both vertical and horizontal expansion; flanges, bolts, gaskets, adjustable hangers and pipe and pipe-thimble to permit projection of pipe 1.0 m beyond wall.

.1 Exhaust tail pipe to terminate in bird screen. Insulate all interior exhaust piping, turbo and silencer.
.2 Exhaust system discharge shall be oriented to the south of the site.

.2 Arrange exhaust system to suit openings.

.1 Where schedule of dimensions does not indicate location of opening, arrange exhaust run best suited to engine.

.3 Provide exhaust pyrometers located on common exhaust manifold or two pyrometers on separate manifolds.

.1 Pyrometer range to include temperature at 110% load.

2.8 JACKET COOLANT HEATER

.1 Provide engine jacket coolant heater(s) complete with 20°C to 60°C adjustable immersion type thermostat. Size heater(s) to maintain coolant at 40°C in an ambient temperature of 0°C.

.2 Obtain circulation of heated coolant on thermosiphon principle.

.1 However, if this does not provide sufficient circulation to avoid hot spots in system, provide electrical motor driven circulating pump to operate automatically when heater is energized.
.2 Motor: 120V single phase splash-proof type complete with breaker type combination starter.
.3 Starter mounted in control panel.

2.9 SPEED GOVERNOR

.1 Provide full electronic governor with speed changer and dry type actuator.

.1 Governing system: in accordance with ISO 3046-4.
.2 Isochronous control for single units with synchronizing control for parallel units as controlled by synchronizing relays and generator speed controllers.

.2 Governor with following features:

.1 Ten turn locking type manual speed adjustment.
.2 Speed regulation, steady state, no-load to full load and vice versa: +/-0.25%.
.3 Transient peak, no-load to full-load and vice versa +/-10%.
.4 Recovery time to steady state condition on application of full load from no load not to exceed 3 seconds.
.5 Frequency: externally adjustable from zero to 5% while engine is running.
.6 Class A accuracy.

2.10 STARTING SYSTEM

.1 Provide complete starting system including cranking starting motor, batteries, heavy-duty battery cables and battery charger.

.2 Provide positive engaging type cranking motor. Cranking motor and flywheel ring gear arrangements which may permit tooth to tooth abutment are not acceptable.

.3 Provide lead acid battery with sufficient capacity in ambient room temperature of 0°C to crank unit at engine manufacturer's recommended cranking starting speed for period of 3 minutes.

.1 Voltage measured at starting motor terminals at end of 3 minutes cranking, with cranking current flowing, not less than 1.75 V per cell.
.2 Size battery to suit engine and battery manufacturer's published data.
.3 Batteries: dry charged, specific gravity of electrolyte 1.220 when fully charged at 27°C.
.4 Battery termination: bolt-on or study type.
.5 Protect terminals and exposed electrical connections from accidental short circuit by falling conductive objects on battery.

.4 Provide battery charger with 120 volt AC input and output equal to 1.20 of ampere-hour capacity of battery based on 8h rate.

.1 Output voltage ripple: 3% or less.
.2 Provide AC input circuit breaker and 24h terminating equalizer timer with approximately 4 m of connecting cord and permanent connectors for connecting to battery terminals.
.3 Provide 5 spare fuses inside charger panel.
.4 Charger: CSA approved.

.5 Provide necessary heavy duty, maintenance-free battery cables and connectors.

.1 Select cable wire size on the basis of allowing not more than 5% voltage drop at time of peak load.
.2 Cable length sufficient to allow battery location on either side of engine.

.6 Fit turbocharged engines with one spring actuated, two stage accumulator per turbocharger to automatically provide pre-start and post run lubrication to turbocharger(s).

2.11 GENERATOR

.1 Provide generator, drip proof, single bearing and close coupled to engine with SAE housing to NEMA MG 1.

.1 Generator: full amortisseur winding, direct connected brushless exciter with easily removable bolt-on diodes with surge protection.

.2 Maximum deviation of open circuit terminal voltage waveform not to exceed 5%.

.3 Provide permanent magnet generator (PMG) for generator short circuit sustaining capability not less than 3 times rated current for a minimum of 10 seconds.

.4 Generator winding insulation: Class F; winding temperature rise not to exceed 80^{o}C as measured by resistance in ambient temperature of 40^{o}C.

.5 Identify generator windings with metal tags.

.1 Bring windings to insulated terminals in metal junction box mounted on side or top of generator.
.2 Size junction box to permit mounting of engine and generator low voltage controls and wiring terminals blocks.
.3 Provide barrier in junction box to separate low and high voltage wiring.

.6 Provide voltage regulation system complete with auto/manual control module.

.1 Voltage regulator: capable of withstanding continuous vibration, 15 shock and temperature up to 50^{o}C while maintaining accuracy to plus/minus 1%.

.7 Steady-state voltage regulation not to exceed 1%.

.1 Transient voltage regulation, when full load is applied or removed, not to exceed 10% when measured by oscilloscope or high speed strip chart recorder with recovery time to steady-state less than 3 seconds.

.8 Design equipment to minimize radio frequency interference (RFI) under operating conditions.

.1 Balanced telephone influence factor (TIF) to: NEMA MG 1.

2.12 PANEL - GENERAL

.1 Panel: indoor, dead front, metal-enclosed steel construction complete with lifting eye bolts.

.1 Doors: formed edges, reinforced by stiffeners and complete with lockable handles.

.2 Design and construct panel to withstand strains, jars, vibrations and other conditions incident to shipping, storage, installation and service.

.3 Panel CSA certified. Mount a nameplate bearing CSA monogram in a prominent position on panel.

.4 Identify instruments and controls with lamacoid or metal engraved nameplates fastened by rivets or screws for permanent identification.

.1 Identify door mounted items with nameplates.
.2 Attach nameplates to removable items such as relays and wireway covers.

.5 Provide panel with bolted rear covers.

.6 Factory wire panel completely. Use stranded, minimum No.14AWG, TEW 105°C and coloured for control wiring. Use No.10AWG for CT secondary connections:

.1 Blue - DC control.
.2 Red - AC control.
.3 Black - PT secondary connections.
.4 Orange - CT secondary connections.
.5 Green - non-current carrying ground.
.6 White - current carrying ground.
.7 Yellow - interlocks.
.8 Brown - generator excitation system.

.7 Code wiring at each wire end with permanent, non-aging slip on markers. Support and run wiring neatly. Protect wiring from mechanical damage by grommets and shields.

.8 Code terminal blocks, clamp type, serrated for positive grip and of tough, non-brittle, unbreakable nylon, size 3,453/0 or equivalent.

.1 For current transformer secondary circuits, provide terminals blocks of dual connector type.
.2 Provide test block for current transformer secondary connections.

.9 Provide door detent mechanism to maintain hinged door at open position.

.10 Supply loose 2 sets of wiring markers for each external wiring connection. Place markers in plastic bag and secured inside panel.

.11 Use wiring duct for interconnection within panel.

.12 Direct inter-panel connection not permitted, use terminal blocks.

2.13 CIRCUIT BREAKERS

.1 Generator shall come factory equipped with integrated circuit breakers mounted to generator assembly, size and quantity as noted in drawings.

.2 Circuit breakers shall be moulded case, with interrupting capacity as required per generator performance.

2.14 CONTROL PANEL

.1 Provide control panel for controlling engine generator unit.

.2 Provide hinged front door and internal sub-panel.

.3 Panel dimensions and layout.

.4 Mount terminal blocks on common mounting strips for interconnection wiring between the following:

.1 Sub-panel and panel door.
.2 Sub-panel and external wiring from diesel generator unit circuits.
.3 Sub-panel and external indicating circuits.
.4 Sub-panel and secondary circuits of power sub-cubicle.

.5 Sub-panel and external wiring from transfer control panel.

.5 Terminal blocks: CSA approved, clamp type, serrated for positive grip and of tough, non-brittle unbreakable nylon material; maximum two wires per terminal block.

.1 Use factory made terminal block jumpers wherever necessary.

.6 Provide circuit breakers for equipment protection: use fuses where breakers are not applicable.

.7 Provide top and bottom entry for power and control cables. Provide removable bottom plate.

2.15 SUBBASE

.1 The engine-generator set shall be mounted on a heavy duty steel base to maintain alignment between components. The base shall incorporate a battery tray with hold-down clamps within the rails.

.2 The generator set shall be equipped with factory installed vibration isolators mounted between the set and fabricated steel base to prevent distortion of alignment between generator and engine when installed.

2.16 GENERATOR SUBBASE TANK

.1 Provide an in-skid sub-base diesel fuel tank, in size suitable for 72 hours operation of the engine at 100% loading for the generator set. The fuel tank shall be a standard product of the manufacturer of the engine-generator set. The tank shall be ULC listed, made of aluminized steel, with welded construction, and pressure tested to 5 psi.

.2 The tank is to be dual wall complete with interstitial alarm connected to generator control panel.

.3 The fuel tank shall be provided with a fuel level sensing at 1/8, 1/4, and 1/3 levels.

.4 Refer to Section 1.7 for earthquake restraint.

.5 All tank sensors shall be installed such that there is a service loop in the wiring to allow for removal of the sensor from the tank with wiring intact confirming correct operation of the sensor.

.6 Contractor is to provide all fuel required for testing, commissioning and demonstration purposes and is to leave the tanks in a 100% full state at substantial completion.

.7 Tank fill pipe openings shall be located outside of the equipment enclosures and shall be equipped with tight fill connections, with weathertight covers, designed to prevent tampering.

.8 Visual tank level gauges shall be provided at the tank fill points.

.9 Tanks shall be provided with audible/visual overfill protection devices conforming to CAN/ULC-S661, set to operate at 90% of tank capacity, located at the fill points.

.10 Tank fill pipes shall be provided with positive shut off overfill protection devices conforming to CAN/ULC-S661, set to operate at 95% of tank capacity.

.11 Tank normal and emergency vent pipes shall terminate outdoors and at heights specified in NFC.

.12 Each tank shall be provided with suction and return pipe connections to facilitate "fuel polishing" - location and arrangement to be approved prior to tank manufacture.

2.17 SPILL RESPONSE KIT

.1 Supply a mobile spill response kit with a sorbent capacity of 350 litres.

.2 Spill response kit shall be contained in a weatherproof, UV resistant enclosure and permanently mounted in a readily accessible location at the fuel transfer area.

2.18 GENERATOR ENCLOSURE

.1 The sound attenuated generator housing shall be a minimum 12 gauge, marine-grade (copper free, 5000 series) Aluminum, rigid, free-standing, vandal-resistant cabinet, fabricated to EEMAC 3 standards with sufficient bracing to form a structure capable of withstanding wind, snow and ice loading. The roof shall have a minimum 25 mm overhang and provide rain gutters over all doors and openings. All hinges shall be internally mounted and concealed, with grease fittings as required. External hinges will not be accepted. Note that stainless steel enclosures will be considered.

.2 All enclosure sheet metal shall be primed for corrosion protection and finish painted with a powder coat finish. The finish paint and color shall be polyester RAL color code RAL 7004 or approved equal. Note that RAL Code is subject to final approval by Departmental Representative during final shop drawing review.

.3 Access to all regularly serviced items within the enclosure shall be provided by at least two hinged lockable doors on each side. All handles shall be recessed or flush when in the locked state.

.4 The enclosure must be vandal resistant. Externally accessible fasteners shall preferably be blind head (e.g. stove bolts) although Allen head will be permissible. Air inlet and outlet openings shall be designed such that objects of any size directed at the enclosure from vertically downward to horizontally flat cannot enter and shall be sized such that inlet air velocity is below the level at which water penetration will occur. No other enclosure openings will be allowed.

2.19 GENERATOR NOISE

.1 The engine exhaust system shall incorporate a seamless, stainless steel flex-connector and critical silencing type muffler, all mounted within the genset enclosure. Discharge shall be into the air outlet hood, downstream of the radiator. Sound attenuated air inlet and discharge hoods with opening bird screens shall be rectangular in shape and match the profile of the enclosure.

.2 Genset overall full load operating noise level shall be less than **68 dbA** when measured at a distance of ***7*** meters from any side of the enclosure and 1 meter above ground. This shall be demonstrated and will be verified on site. Manufacturer will be required to ensure that noise levels meet the requirements as stated herein at the time of installation/commissioning.

.3 Ducting and sound attenuation components shall be designed and supplied by an approved manufacturer specializing in this type of work.

2.20 SIGNS

.1 Provide at front top of each panel and on each generator junction box, lamacoid or metal engraved identification nameplate.

.1 Provide nameplates with letter and number identification designation to be given at time of acceptance tests.

.2 Provide and attach to unit in prominent location, bilingual warning sign.

.3 Where metric tools are required to service engine-generator unit, provide bilingual warning sign.

.4 Provide signage in accordance with NFC 2015 4.3.1.7 "A storage tank and its filling and emptying connections shall be identified in conformance with CFA 1990, "Using the Canadian Fuels Colour-Symbol System to Mark Equipment and Vehicles for Product Identification."

.5 Supply and install signage outlining the site specific fill procedure sign to be posted at each tank fill port. Details to be provided by the Departmental Representative.

.6 Supply and install signage outlining the site specific emergency response procedures.

.7 Details to be provided by the Departmental Representative.

.8 Supply and install a weather proof cabinet for storage of the site specific emergency response plan documentation.

.9 Final details for all signage to be approved during shop drawing submittal and review.

2.21 FINISHES

.1 Clean, finish and paint equipment with smooth and durable finish.

.1 Use grey gloss paint; inside of panel white glossin accordance with The Master Painters Institute (MPI) schedule of paint colours.

.2 Provide one half pint can of grey gloss paint for touch up.

2.22 WORKMANSHIP

.1 Manufacture and construct equipment free from blemishes, defects, burrs and sharp edges; accuracy of dimensions and marking of parts and assemblies; thoroughness of welding, brazing, painting and wiring, alignment of parts and tightness of assembly screws and bolts.

2.23 QUALITY CONTROL

.1 General: before acceptance, assemble and set up the unit, complete with specified equipment, for tests on site.

.1 Ensure tests are witnessed by Departmental Representative on mutually agreed date.
.2 Provide suitable test area with adjustable loading facilities.
.3 Ensure that engine has run in sufficiently prior to load test, test forms completed, system debugged and recorders connected.

.2 Product examination: complete mechanical and electrical examination to determine compliance with specification and drawings with respect to materials, workmanship, dimensions and marking.

.3 Non-operational tests and checks: perform following test and checks before starting the unit:

.1 Shaft alignment, end float, angular and parallel.
.2 Cold resistance of generator windings.
.3 Belt tensioning.
.4 E quipment grounds.
.5 Electrical wiring.
.6 All grease lubricating points.
.7 Personnel safety guards.
.8 Air cleaner.
.9 Coolant.
.10 Lubricating oil type and level.
.11 Type of fuel.
.12 Vibration isolator adjustment.
.13 Temperature and pressure sensors.
.14 Engine exhaust system.
.15 Tools.
.16 Spares.

.4 Operation test and check: on completion of non-operational tests and checks, start unit cold.

.1 Provide multi-channel recorder and record following:
.1 Time for unit to start and reach settled voltage and frequency.
.2 Time from initiation of start to full load application, with voltage and frequency settled.
.3 Voltage and frequency transient and steady state limits for full load to no load, 3/4 load to no load, 1/2 load to no load, 1/4 load to no load and vice versa. Measure machine vibration levels under the same load conditions.
.4 Record battery voltage drop during cranking.

.5 Protection and control demonstration: on completion of operation test and check, demonstrate following:

- .1 Overheat protection.
- .2 Low oil pressure protection.
- .3 Cranking cut out.
- .4 Overcrank protection (3 tries).
- .5 Overspeed protection.
- .6 Under and over frequency.
- .7 Under and over voltage.
- .8 Electrical fault protection:
  - .1 Failure to close breaker.
  - .2 Failure to build up voltage.
  - .3 Generator short circuit and overcurrent.
- .9 All control functions.

.6 Load tests: load test the unit for 4h at full rated load in ambient temperature in excess of 20oC. Take following data at start of load test and every one hour interval thereafter:

- .1 Frequency.
- .2 Voltage.
- .3 Current.
- .4 Kilowatts.
- .5 Generator winding temperature.
- .6 Generator frame temperature.
- .7 Engine coolant temperature.
- .8 Oil temperature and pressure.
- .9 Manifold pressure.
- .10 Ambient room temperature.
- .11 Generator cooling air outlet temperature.
- .12 Exciter field current and voltage.
- .13 Vibration displacement.
- .14 Ambient air temperature inside panel with all doors closed.

.7 Miscellaneous: provide accurate means for determining fuel and lubricating oil consumption.

- .1 Provide strip chart recorders for monitoring frequency, voltage and load.
- .2 Provide recorder with ability to select speeds to allow accurate measurement of voltage, frequency and time during tests.
- .3 Calibrate recorder by the recorder manufacturer (or designated representative) within three months of factory testing.

.8 Interpretation of ambient room temperature: consider ambient room temperature as that temperature, which is lowest temperature registered out of a group of three thermometers when placed in engine room as follows:

- .1 One thermometer located on each side of engine block, approximately two-thirds of length of block back from front (radiator) end of block, 900 mm out from block and at height equal to height of block
- .2 Locate third thermometer over end of exciter on unit centre line, approximately 150 mm above top of exciter.
- .3 Take thermometer showing lowest temperature to give true ambient air temperature.
- .4 Adjust temperature to maintain this thermometer at 40^{o}C during heat test.

.9 Voltage and frequency regulation tests: on completion of load tests take hot resistance reading of generator windings.

.1 Subject the unit to hot voltage and frequency regulation tests for full load to no load, 3/4 load to no load, 1/2 load to no load, 1/4 load to no load and vice versa.

.10 Panel performance and functions: check sequence of operation under service conditions.

.1 Make provision for supplying and connecting required levels of voltage for primary circuits.
.2 Test overcurrent relays by impressing current in secondary circuits.

.11 Hi-pot tests: perform over potential tests on primary and secondary wiring in accordance with NEMA, NETA.

.12 Additional tests: perform tests, consistent with contract, which Departmental Representative may require to satisfy adequacy and satisfactory operation of the unit.

.1 Complete forms with requisite information pertaining to make, model and serial numbers prior to test.

.13 Record test data on appendix forms, recording charts and manufacturers' test forms and be complete with diagrams and description of test results, deficiencies and corrective action.

.1 Ensure test data sheets signed by supplier and Departmental Representative.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION 26 32 14

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 This Section of the Specifications forms part of the Contract Documents and shall be read, interpreted and coordinated with all other parts.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN3-C13, Instrument Transformers.

.2 CSA C22.2No.5, Moulded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, tenth edition, and the second edition of NMX-J-266-ANCE).

.3 CSA C22.2No.178, Automatic Transfer Switches.

.4 CSA 282 Emergency Power Supply for Buildings.

.2 American National Standards Institute (ANSI)/National Electrical Manufacturers Association (NEMA)

.1 ANSI/NEMA ICS 2, Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.

1.3 SYSTEM DESCRIPTION

.1 Automatic load transfer equipment to:

.1 Monitor voltage on phases of normal power supply.

.2 Initiate cranking of Generator unit on normal power failure or abnormal voltage on any one phase below pre-set adjustable limits for adjustable period of time.

.3 Transfer load from normal supply to Generator unit when Generator unit reaches rated frequency and voltage pre-set adjustable limits.

.4 Transfer load from Generator unit to normal power supply when normal power restored, confirmed by sensing of voltage on phases above adjustable pre-set limit for adjustable time period.

.5 Shut down Generator unit after running unloaded to cool down using adjustable time delay relay.

.6 Automatic Transfer Switch to transfer load from Utility to Back-up in less than 15 seconds of loss of Utility Power.

.7 Automatic Transfer Switches to be double by-pass.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Instrument transformers: to CAN3-C13.

.2 Contactors: to ANSI/NEMA ICS2.

2.2 CONTACTOR TYPE TRANSFER EQUIPMENT

.1 Contact Type Transfer Equipment: to CSA C22.2No.178.

.2 All transfer switches shall be approved by the Utility Provider.

.3 Two - 3 phase contactors mounted on common frame, in double throw arrangement, mechanically and electrically interlocked, solenoid operated, open type with CSA enclosure.

.4 Rated: 347/600 V, 60Hz, 200 A. 4 wire, solid neutral.

.5 Main contacts: silver surfaced, protected by arc disruption means.

.6 Switch and relay contacts, coils, spring and control elements accessible for inspection and maintenance from front of panel without removal of switch panel or disconnection of drive linkages and power conductors.

.7 Auxiliary contact: silver plated, to initiate emergency generator start-up on failure of normal power.

.8 Fault withstand rating: Standard.

.9 Lever to operate switch manually when switch is isolated.

.10 Overlapping neutral contacts on contactor type transfer equipment.

.11 Switchable neutral pole on circuit breaker type equipment.

.12 Equal to ASCO 7000 Series.

2.3 CONTROLS

.1 Selector switch - four position "Test", "Auto", "Manual", "Engine start".

.1 Test position - Normal power failure simulated. Engine starts and transfer takes place. Return switch to "Auto" to stop engine.

.2 Auto position - Normal operation of transfer switch on failure of normal power; retransfers on return of normal voltage and shuts down engine.

.3 Manual position - Transfer switch may be operated by manual handle but transfer switch will not operate automatically and engine will not start.

.4 Engine start position - Engine starts but unit will not transfer unless normal power supply fails. Switch must be returned to "Auto" to stop engine.

.2 Control transformers: dry type with 120V secondary to isolate control circuits from:

.1 Normal power supply.

.2 Back-up power supply.

.3 Relays: continuous duty, industrial control type, with wiping action contacts rated 10 A minimum:

.1 Voltage sensing: 3 phase for normal power and on one phase only for emergency, solid state type, adjustable drop out and pick up, close differential, 2V minimum undervoltage and over voltage protection.

.2 Time delay: normal power to Generator, adjustable solid state, 0 to 60s.

.3 Time delay on engine starting to override momentary power outages or dips, adjustable solid state, 0 to 60s delay.

.4 Time delay on retransfer from Generator to normal power, adjustable 0 to 60s.

.5 Time delay for engine cool-off to permit Generator set to run unloaded after retransfer to normal power, adjustable solid state, 0 to 60s.

.6 Time delay during transfer to stop transfer action in neutral position to prevent fast transfer, adjustable, 5s intervals to 180s.

.7 Frequency sensing, to prevent transfer from normal power supply until frequency of Generator unit reaches pre-set adjustable values.

.4 Solid state electronic in-phase monitor.

2.4 ACCESSORIES

.1 LED pilot lights to indicate power availability normal and Generator, switch position, green for normal, red for Generator, mounted remote.

.2 Plant exerciser: 168h timer to start Generator unit once each week for selected interval transfers load to emergency supply and retransfers to normal supply on Generator unit shutdown. Timer adjustable 0-168h in 15 min intervals.

.3 Auxiliary relay to provide 2 N.O. and 2 N.C. contacts for remote alarms.

.4 Digital Instruments:

.1 Digital true rms, indicating type 2% accuracy, flush panel mounting:

.1 Voltmeter: ac, scale standard.

.2 Ammeter: ac, scale standard.

.3 Frequency meter: scale 55 to 65 Hz.

.5 Voltmeter selector switch: digital, maintained contacts, panel mounting type, round notched handle, four positions, labelled "OFF-Phase A-Phase B-Phase C".

.6 Potential transformers - dry type for indoor use:

.1 Ratio: 600 to 120.

.2 Rating: 600 V, 60Hz.

.3 Accuracy rating: 5%.

.7 Ammeter selector switch: digital, maintained contacts, panel mounting type, designed to prevent opening of current circuits, round notched handle, four position labelled "OFF - Phase A - Phase B - Phase C".

.8 Current transformers - dry type for indoor use:

.1 Ratio: 200 to 5.

.2 Rating: 600 V, 60Hz.

.3 Accuracy rating: 5%.

.4 Positive action automatic short- circuiting device in secondary terminals.

2.5 SOURCE QUALITY CONTROL

.1 Complete equipment, including transfer mechanism, controls, relays and accessories factory assembled and tested in presence of Departmental Representative.

.2 Notify Departmental Representative 10 days in advance of date of factory test.

.3 Tests:

.1 Operate equipment both mechanically and electrically to ensure proper performance.

.2 Check selector switch, in modes of operation Test, Auto, Manual, Engine Start and record results.

.3 Check voltage sensing and time delay relay settings.

.4 Check:

.1 Automatic starting and transfer of load on failure of normal power.

.2 Retransfer of load when normal power supply resumed.

.3 Automatic shutdown.

.4 In-phase monitor operation.

PART 3- EXECUTION

3.1 INSTALLATION

.1 Locate, install and connect transfer equipment.

.2 Check solid state monitors and adjust as required.

.3 Install and connect battery and remote alarms.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 08 00 – Commissioning and Demonstrations.

.2 Energize transfer equipment from Utility power supply.

.3 Set selector switch in "Test" position to ensure proper Generator start, running, transfer, retransfer. Return selector switch to "Auto" position to ensure Generator shuts down.

.4 Set selector switch in "Manual" position and check to ensure proper performance.

.5 Set selector switch in "Engine start" position and check to ensure proper performance. Return switch to "Auto" to stop engine.

.6 Set selector switch in "Auto" position and open Utility power supply disconnect. Generator should start, come up to rated voltage and frequency, and then load should transfer to Generator. Allow to operate for 10 min, then close main power supply disconnect. Load should transfer back to Utility power supply and Generator should shutdown.

.7 Repeat, at 1h intervals, 3 times, complete test with selector switch in each position, for each test.

END OF SECTION 26 36 23

PART 1 - GENERAL

1.1 RELATED WORK

.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 REFERENCES

.1 CAN/CSA C22.1, Canadian Electrical Code, Part I - most recent version

.2 CAN/CSA C22.2 No.9.0, General Requirements for Luminaires.

.3 IESNA Illuminating Engineering Society of North America - Lighting Handbook – most recent version

.4 ASHRAE 90.1 – American Society of Heating, Refrigerating and Air-Conditioning Engineers – most recent version.

.5 IES RP-1 – Lighting for Offices – most recent version**.**

.6 IES RP-33 Lighting for the Exterior Environment – most recent version**.**

1.3 INTENT

.1 Provide lighting fixtures and accessories for all outlets as listed in the Fixture Schedule and as shown on drawings.

.2 Lighting fixtures shall be structurally well designed and constructed, using new parts and materials of the highest commercial grade available.

.3 Bond all lighting equipment to grounding system.

.4 Verify all ceiling types and finishes before ordering fixtures and provide fixtures suitable for mounting in or on ceilings being installed in each area, as specified. Where fixture types specified are not suitable for ceiling being installed, obtain written instructions from the Departmental Representative before ordering fixtures.

.5 Fixtures of the same or similar type shall be supplied by the same manufacturer.

.6 Electrical contractor shall supply and install all luminaries complete with lamps, mounting brackets, lenses, ballasts (dimming or otherwise), drivers and all necessary accessories in accordance with luminaire types shown on drawings and listed in luminaries schedule unless otherwise noted.

.7 Supply and install complete and proper support and hangers for all luminaires in ceiling space where required for proper support of outlet boxes and luminaire hanger assemblies.

PART 2 - PRODUCTS

2.1 BALLASTS

.1 All ballasts shall be supplied with a rated voltage matching the supply voltage indicated on the drawings. Ballast output current and voltage shall match the current and voltage ratings of the lamp or lamps they are designed to operate. All ballasts to be built to CSA Standard C22.2 No.74.

.2 Ballasts shall comply with FCC and NEMA limits covering EMI and RFI and shall not interfere with operation of other normal electrical equipment.

.3 Fluorescent electronic ballasts shall be suitable for use with 120V operation with power factor of not less than .90 and a max 10% THD. Provide the minimum number of ballasts per luminaire as possible unless noted otherwise. Ballasts shall be dimmable where required.

.4 Fluorescent ballasts for T8 lamps shall be equal to Philips programmed rapid start Optanium low wattage ballast. Lamp and ballasts combination shall provide an average of 40,000 hours of lamp life. Osram and GE are acceptable alternates.

.5 Fluorescent ballasts for T5 lamps shall be equal to Philips programmed rapid start Centium low wattage ballast with a ballast factor of .95. Osram and GE are acceptable alternates.

.6 Fluorescent ballasts for T5HO lamps shall be equal to Philips programmed rapid start Optanium low wattage ballast. Osram and GE are acceptable alternates.

.7 Lamps and ballasts shall be of the same manufacturer to provide a minimum 1 year warranty. All ballasts shall be compatible with the dimming and control system selected.

2.2 LED DRIVERS

.1 LED drivers shall be fully dimmable, Energy Star compliant, maximum THD of 20%, power factor to be greater than .95, have high voltage regulation and have internal surge protection.

.2 LED lit luminaires shall meet the LM-79 and LM-80 test protocols (70% output at 50,000 hours), a minimum efficacy of 90 watts per lumen and shall meet or exceed ENERGY STAR SSL standards to ensure lumen and color consistency between luminaires.

2.3 LAMPS

.1 Provide and install lamps in all fixtures in the project. All fluorescent lamps shall be by one manufacturer.

.2 All fixtures shall be provided with proper, new, and operable lamps. Provide lamps indicated on the Fixture Schedule, or, if not indicated, as recommended by the fixture manufacturer. Lamps shall be compatible with the respective fixture in all cases.

.3 All luminaires to be supplied complete with lamps. Incandescent lamps shall not be used.

.1 32 w T8 fluorescent lamps shall be equal to Philips ALTO 11 extra-long life 3500K unless noted otherwise.

.2 28 w T5 fluorescent lamps shall be equal to Philips Silhouette long life lamps.

.3 54 w T5HO fluorescent lamps shall be equal to Philips Silhouette long life lamps.

.4 Install fluorescent lamps with the same Watt rating as called for on the electrical drawings. Install lamps as called for in a fixture schedule. Refer to schedule for lamp colour and colour rendering index.

.5 Store the lamps in a safe place and install them in accordance with the requirements of this specification leaving fixtures completely lamped and in operating condition.

.6 Acceptable Lamp Manufacturers:

.1 Philips

.2 Sylvania / Osram

2.4 WIRE GUARDS

.1 All fixtures in storage rooms and service rooms shall have wire guards.

2.5 FIXTURES

.1 Provide fixtures as indicated on the fixture schedule.

.2 All fixtures shall comply with CSA Standard C22.2 No.9. Accessories and components shall comply with relevant CSA Standards applicable to accessory or components.

.3 Recessed down light luminaires shall be of the approved pre-wired type with junction box forming an integral part of luminaires assembly with access facility to the satisfaction of the electrical

inspection authority. Supply and install all necessary plaster rings, supports, etc. required for complete and proper installation.

.4 Except where otherwise noted in the Fixture Schedule, depth of recessed fluorescent fixtures shall not exceed 150 mm, including mounting yokes, or bridges and the distance from the back face of the diffuser or lens to the centre of the lamp shall be not less than 75 mm. Design of reflector and lamp position shall be to provide high efficiency, even brightness and lack of lamp lines.

.5 Fluorescent fixtures shall be constructed of not less than code gauge steel. All metal parts shall be thoroughly cleaned and finished in high reflectance baked white enamel over corrosion-resistant primer. Reflecting surfaces and exposed surface shall have not less than two coats of baked white enamel with reflectance of not less than 85%.

.6 All fixture diffusers, lens panels, lens frames, etc., shall be securely and adequately supported and shall be removable without the use of tools for cleaning.

.7 Where recessed fluorescent and LED luminaires are to be mounted in drywall ceilings or type of ceilings requiring frames, supply drywall frames for the recessed luminaires and turn frames over to the general contractor for installation.

PART 3 - EXECUTION

3.1 VERIFICATION OF CONDITIONS

.1 Confirm all ceiling depths against the final architectural ceiling plans and sections to ensure that recessed fixtures can be installed in all ceiling conditions and advise the Departmental Representative immediately of any discrepancies prior to ordering of the fixtures or proceeding with the work.

3.2 INSTALLATION - GENERAL

.1 Lighting fixtures shall be installed as indicated on architectural reflected ceiling plans, Electrical Drawings, and per approved shop drawings.

.2 Verify locations and spacing of lighting fixtures with reflected ceiling plans and notify Departmental Representative of any variance or conflict between the plans and field conditions. Do not proceed until conflict has been resolved.

.3 Work shall be coordinated with other trades. Lighting fixture locations shall have priority over locations of ducts, diffusers, sprinklers, smoke detectors, and other non-structural obstructions.

.4 All fixtures shall be supported directly from the building structural members or from bridging attached to the structural members by rod hangers and inserts. Provide all necessary hardware and blocking to ensure that fixtures hang true.

.5 Lighting fixtures shall be adequately supported and braced to satisfy seismic codes. Refer to Section 26 05 05 Seismic Restraints.

.6 Mount wall fixtures at elevations specified or as shown on Architectural or Electrical Drawings. Where no elevation is shown, confirm mounting height with the Departmental Representative prior to rough-in.

3.3 INSTALLATION AND SUPPORTS

.1 Provide complete and proper support for all fixtures, fixture hangers, etc., including headers in ceiling space, where required, for proper support of outlet boxes and fixture hanger assemblies.

.2 Support fixtures as shown on the drawings, level, plumb and true with the structure and other equipment in a horizontal or vertical position as intended. Wall or side bracket mounted fixture housings shall be rigidly installed and adjusted to give a neat flush fit to the surface on which it is mounted.

.3 All hangers, supports, fastenings or accessory fittings shall be protected against corrosion. Care shall be taken during the installation to assure that insulation and corrosion protection is not damaged.

.4 Self-aligning seismically rated ball joint hangers shall be used for rod suspended fixtures. Ceiling canopies or hood assemblies intended to cover the suspension attachments shall be installed to fit tightly to the ceiling without restricting the alignment of the hanger. Support fixtures by hangers and mounting arrangements which will not cause the fixture frame, housing, sides or lens frame to be distorted; or prevent complete alignment of several fixtures in a row.

.5 The suspension length of all ceiling mounted suspended types of lighting fixtures as listed in the Fixture Schedule shall be the overall length from the ceiling to the lowest point of the fixture body, reflector or glassware in its hanging position.

.6 Metal inserts, expansion bolts or toggle bolts in concrete slabs for stems which do not carry wiring must be accurately located in relation to the outlet boxes, to allow perfect alignment and spacing of suspension stems.

.7 Where fixtures are surface mounted on the underside of an inverted tee bar ceiling, the fixture shall be supported either directly from the building structure by means of rod hangers and inserts or by means of metal angle headers, supported from the tee bar framing structure above the tile. Fixtures shall be supported from the quarter points.

.8 Wiring from outlet boxes to fluorescent fixtures and wiring through fluorescent fixture channels shall be rated for 90 degrees C.

.9 All recessed fixtures to be installed so that they are removable from below to gain access to outlet box or prewired fixture box. Connect all recessed fixtures to boxes with flexible conduit and approved fixture wire. Provide approved drywall enclosures in insulated ceilings. Volume of enclosure to comply with Electrical Code.

.10 Install fixture lenses as late as possible to protect from dirt and dust. Remove and clean or replace lenses to the satisfaction of the Departmental Representative.

.11 Provide and install all conduit, boxes, wire and make emergency power connection to all units and to unit controllers. Refer to architectural reflected ceiling plans for locations prior to conduit installation. Obtain all specialty backboxes, switches, controllers, etc. from contractor and coordinate installation as required.

.12 Where ballasts are to be remotely located, they shall be racked together and labelled with size 3 lamicoid. Label shall bear the ballast number which has a corresponding location on an adjacent floor plan reference drawing. Labels and floor plans shall be provided by electrical contractor. Floor plans shall measure 280mm x 430mm (11"x17") and shall be framed and laminated.

END OF SECTION 26 50 00

PART 1 - GENERAL

1.1 RELATED WORK

.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 GUARANTEE

.1 Provide a written guarantee, stating that the battery for emergency lighting is guaranteed against defects in material and workmanship for a period of ten years, with a no-charge replacement during the first five years and a pro-rate charge on the second five years, from the date of the Final Certificate of Completion.

PART 2 - PRODUCTS

2.1 BATTERY UNIT EQUIPMENT

.1 Unit equipment for emergency lighting: to CSA C22.2 No.141.

.2 Battery pack units shall be 12V DC complete with 2 LED emergency light heads. Units shall be sized as per Drawings.

.3 Battery packs located in electrical rooms shall be sized for 2 hours, have self-diagnostic circuitry and a surge protection device on the supply side.

2.2 REMOTE LAMP HEADS

.1 LED Remote Dual Head devices shall be 12V 6W. Do not provide single lamp devices.

2.3 WIRING FOR REMOTE EQUIPMENT

.1 Wiring 12V battery standby circuits to all remote heads and exit signs.

.2 Low voltage wiring to be installed so that the maximum volt drop does not exceed 5%. The following wiring/load sizes shall not be exceeded for the 12-volt system:

.1 #8 AWG not to exceed 6500 watt feet per run.

.2 #10 AWG not to exceed 4000 watt feet per run (minimum size).

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Provide and install a fully functional emergency lighting system as detailed on the Drawings. Paint all junction boxes green for the emergency lighting system.

.2 The emergency lighting system shall be tested for maintained luminance to a minimum of 2 hours. Provide written document verifying the operation of the system after the test.

.3 The contractor shall ensure conductor size is suitable for the emergency lighting system to maintain a minimum of 3% volt drop to remote heads.

.4 Install unit equipment for emergency lighting in accordance with CSA C22.1, Section 46.

.5 Install unit equipment and remote mounted fixtures as indicated.

.6 Direct heads as indicated.

.7 Provide a junction box adjacent to the battery pack for the purpose of splicing the separate wiring runs together.

.8 Provide a 15 Amp, 125 volt receptacle adjacent to each battery unit and connect circuit to lighting circuit in the area service by the batter pack.

END OF SECTION 26 52 00

PART 1 - GENERAL

1.1 RELATED WORK

.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 REFERENCES

.1 Canadian Standards Association:

.1 CSA C22.2 No.141, Unit Equipment for Emergency Lighting.

.2 CSA C860, Performance of Internally-Lighted Exit Signs.

.3 Canadian Electrical Code, Section 46.

.2 BC Building Code, Part 3, Section 3.4.5

PART 2 - PRODUCTS

2.1 SCHEDULE

.1 Refer to drawings for location and types. Install in direction as indicated.

2.2 EXIT SIGNS GENERAL

.1 Green and white coloured pictogram.

.2 Wall, end, or ceiling mounted as shown on drawings.

.3 Exit signs must meet CSA C860, 22.2 No. 141-10 and ISO 7010 standards.

.4 Exit sign wiring to be installed in separate conduit and conductors to be #12 AWG with RW90 X-link insulation. Exit signs to be complete with LED lamps.

.5 Single or double-faced as indicated

.6 Faceplate and housing to have no visible unused knockouts.

.7 Provide weatherproof exit signs for all exterior installations.

.8 CSA 860-01 approved.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install Exit Signs as indicated.

.2 Connect Exit Signs to dedicated circuits and breakers as required by the Canadian Electrical Code. Provide circuit breaker locks for Exit Sign circuits.

.3 Power to exit signs to be sourced from emergency power where available.

.4 Provide at least one Exit Sign circuit for each floor level except as noted.

.5 All Exit Sign wiring to be installed in separate conduit and boxes.

.6 All conductors to be minimum #12 AWG with RW90 X-link insulation.

.7 Provide Exit Sign 12VDC standby lighting and separate connection points where standby emergency lighting battery packs are used for the emergency lighting.

.8 Support Exit Signs from ceiling tile in tee bar installation locations so as to provide a flush/neat installation and minimize tile lift.

.9 Provide approved support hardware to the tee bar rail assembly to minimize tile stress and provide independent seismic cable(s) restraint from building structure.

.10 Wall mounted exit signs to be mounted 2290mm 7’ 6” to underside or as detailed.

.11 Ceiling mounted exit signs in all service spaces to be suspended to 2290mm 7’ 6” to the underside.

3.2 FINAL ACCEPTANCE

.1 Position exit signs to optimize viewing angles and to avoid line of site obstructions.

.2 Attend the building occupancy review with the Authority Having Jurisdiction and adjust any locations as required.

END OF SECTION 26 53 00

PART 1 - GENERAL

1.1 RELATED WORK

.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 REFERENCES

.1 Canadian Electrical Code (CEC)

.2 BICSI Telecommunications Distribution Methods Manual (TDMM), latest edition

.3 ANSI/TIA-568-C.0 Generic Telecommunications Cabling for Customer Premises

.4 ANSI/TIA-568-C.1 Commercial Building Telecommunications Cabling Standard

.5 ANSI/TIA -568-C.2 Balanced Twisted Pair Telecommunications Cabling & Components Standard

.6 ANSI/TIA-568-C.3 Optical Fibre Cabling Components Standard

.7 ANSI/TIA-569-D Telecommunications Pathways and Spaces Standard

.8 ANSI/TIA -606-B Administration Standard for Commercial Telecommunications Infrastructure.

.9 ANSI/TIA-607-B Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

1.3 PRODUCT DATA

.1 Submit product data in accordance with Section 26 05 00.

1.4 LABOUR

.1 The communications contractor must comply with all job-site requirements for the duration of the project.

.2 The communications contractor agrees to use only trade person who are fully trained, qualified and experienced on the installation, termination and testing of the structured cabling solution. The communications contractor must be an approved installer of the specific structured cabling solution.

PART 2 - PRODUCTS

2.1 UNIFORMITY OF MANUFACTURE

.1 Unless otherwise specifically called for in the specifications, uniformity of manufacture shall be maintained for similar products throughout the work.

PART 3 - EXECUTION

3.1 COORDINATION WITH OTHER DIVISIONS

.1 Examine the specifications and drawings of all divisions and become fully familiar with their work. Coordinate work with all trades and make changes to facilitate a satisfactory installation.

.2 Lay out the work and equipment with due regard to architectural, structural, mechanical, electrical and A/V features. Architectural and structural drawings take precedence over the

telecommunications drawings regarding locations of walls, doors, equipment and the location and heights of outlets.

.3 Coordinate with all Divisions installing and services, and ensure that there are no conflicts.

.4 Install anchors, bolts, pipe sleeves, hanger inserts, etc. in ample time to prevent delays.

3.2 LOCATION OF OUTLETS

.1 Telecommunications drawings are, unless otherwise indicated, drawn to scale and approximate distances and dimensions may be obtained by scaling. Figured dimensions shall govern over scaled dimensions. Where exact dimensions and details are required, refer to Architectural and Structural drawings.

.2 Unless otherwise specified or shown, install products in accordance with recommendations and ratings of manufacturers.

3.3 SEPARATION OF SERVICES

.1 Maintain separation between electrical wiring system and building piping, ductwork, etc. so that wiring system is isolated (except at approved connections to such systems) to prevent galvanic corrosion.

.2 In particular, contact between dissimilar metals, such as copper and aluminum, in damp or wet locations is not permitted.

.3 Do not support wiring from pipes, ductwork, etc. Hangers for suspended ceilings may be used for the support of wiring only when approval is obtained from the Owner and the ceiling installer, and approved clips or hangers are used.

3.4 EQUIPMENT IDENTIFICATION

.1 Colour code exposed conduits (including conduits above t-bar ceilings), junction and pull boxes and metallic sheathed cables with paint or plastic tape (27mm wide band) at 15 metre intervals. Refer to Section 26 05 00.

3.5 MOUNTING HEIGHTS

.1 Refer to section 26 05 00 Common Work Results for general mounting heights specification.

3.6 SERVICE PENETRATIONS IN RATED FIRE SEPARATIONS

.1 All cabling, wiring, conduits, cable trays, etc. passing through rated fire separations shall be smoke and fire stopped to a ULC or cUL tested assembly system; refer to Section 26 05 45.

.2 All penetrations are to be firestopped using re-penetrable EZ Path System (Specified Technologies Inc - STI) or re-penetrable Hilti Firestop Systems designated and installed for each specific application.

.3 Allow openings for 100% capacity of raceway or 200% capacity of J-hooks.

.4 Provide split systems where existing cables are involved.

3.7 SERVICE PENETRATIONS IN NON-RATED SEPARATIONS

.1 All cabling, wiring, conduits, cable trays, etc. passing through non-rated fire separations and non-rated walls and floors shall be tightly fitted and sealed on both sides of the separation with caulking or silicon sealant to prevent the passage of smoke and/or transmission of sound.

3.8 CONDUIT SLEEVES

.1 Vertical floor penetration sleeves shall extend 102mm above finished floor level.

.2 The space between the sleeve and the conduit shall be filled with approved permanently resilient, non-flammable and weatherproof silicone base compound and ensure that the seal is compatible with the floor and ceiling finishes.

.3 Located and position sleeves exactly prior to construction of walls and floors.

.4 Failure to comply with the above requirements shall be remedied at this Division's expense.

END OF SECTION 27 05 00

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 This Section of the Specifications forms part of the Contract Documents and shall be read, interpreted and coordinated with all other parts.

1.2 REFERENCES

.1 ANSI/TIA 607-B Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.

.2 ANSI/TIA-606-B Administration Standard for the Commercial Telecommunications Infrastructure.

1.3 SYSTEM DESCRIPTION

.1 The facility shall be equipped with a Telecommunications Bonding Backbone (TBB). This backbone shall be used to ground all telecommunications cable shields, equipment, raceways, and other associated hardware that has the potential for acting as a current carrying conductor. The TBB shall be installed independent of the buildings electrical and building ground and shall be designed in accordance with the recommendations contained in the ANSI/TIA-607-B Telecommunications Bonding and Grounding Standard.

.2 Provides ground reference for telecommunications systems within building and bonding to it of telecommunications rooms.

.3 Metallic pathways, cable shields, conductors, and hardware within telecommunications spaces are bonded to telecommunications grounding and bonding system.

PART 2 - PRODUCTS

2.1 TELECOMMUNICATIONS MAIN GROUNDING BUSBAR (TMGB)

.1 Predrilled copper bus-bar, listed by NRTL, electro-tin plated with holes 8 mm diameter for use with standard-sized lugs to: ANSI/TIA 607-B.

.2 Dimensions 6mm thick, 100 mm wide, 300 mm long to: ANSI/TIA 607-B.

2.2 TELECOMMUNICATIONS GROUNDING BUSBAR (TGB)

.1 Predrilled copper bus-bar, listed by NRTL, electro-tin plated with holes 8 mm diameter for use with standard-sized lugs to: ANSI/TIA 607-B.

.2 Dimensions 6 mm thick, 50 mm wide, 300 mm long to: ANSI/TIA 607-B.

2.3 BONDING CONDUCTOR FOR TELECOMMUNICATIONS

.1 3/0 AWG copper conductor, green insulated to: ANSI/TIA 607-B.

2.4 TELECOMMUNICATIONS BONDING BACKBONE (TBB)

.1 3/0 AWG copper conductor, green insulated to: ANSI/TIA 607-B.

2.5 GROUNDING EQUALIZER (GE)

.1 3/0 AWG copper conductor, green insulated to: ANSI 607-B.

2.6 WARNING LABELS

.1 Non-metallic warning labels in English and French to: ANSI/TIA 607-B. Identify labels with wording "If this connector is loose or must be removed, please call the building telecommunications manager".

PART 3 - EXECUTION

3.1 TELECOMMUNICATIONS MAIN GROUNDING BUSBAR (TMGB)

.1 Install TMGB in entrance room on insulated supports 50 mm high at location close to electrical power panel if one is installed in same room as indicated.

.2 Install #6 AWG copper bonding conductor from TMGB to alternating current equipment ground (ACEG) enclosure of serving electrical power panel (panelboard).

3.2 TELECOMMUNICATIONS GROUNDING BUSBAR (TGB)

.1 Install TGB in main terminal/equipment room and each telecommunications room.

.2 Install #6 AWG copper bonding conductor from TGB to alternating current equipment ground (ACEG) enclosure of serving electrical power panel (panelboard).

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 grounding bushing 6 AWG copper conductor.

.2 Where metallic panels attached to the rack to not have sufficient metal to metal contact to provide an adequate path to ground, they shall be bonded to the rack using a minimum #14 AWG copper conductor. The copper conductor size shall be upgraded based on the largest power conductor feeding any rack mount equipment. The conductor shall be continuous; attaching all isolated components in a daisy chain fashion from top to bottom and bonded to the rack using an appropriate compression connector.

3.4 BONDING CONDUCTOR FOR TELECOMMUNICATIONS

.1 Install bonding conductor for telecommunications from TMGB to service equipment (power) ground.

.2 Use exothermic welding, approved 2 hole compression lugs lugs for connection to TMGB.

3.5 TELECOMMUNICATIONS BONDING BACKBONE (TBB)

.1 Install TBB[s] from TMGB to each TGB as indicated.

.2 Use exothermic welding, approved 2 hole compression lugs for connection to TMGB and TGBs.

3.6 GROUNDING EQUALIZER (GE)

.1 Install GE between TBBs in multi-storey building by bonding TGBs with GE on top floor and every third floor in between top and bottom floors.

3.7 BONDING TO TMGB

.1 Bond metallic raceways in telecommunications entrance room to TMGB using #6 AWG green insulated copper conductor.

.2 For cables within telecommunications entrance room having shield or metallic member, bond shield or metallic member to TMGB using #14 AWG green insulated copper conductor.

.3 Bond equipment racks and cabinets located in telecommunications entrance room to TMGB using #6 AWG green insulated copper conductor.

3.8 BONDING TO TGB

.1 All racks, metallic backboards, cable sheaths, metallic strength members, splice cases, cable trays, etc. entering or residing in the Communication rooms shall be grounded to the respective TGB using a minimum #6 AWG stranded copper bonding conductor and compression connectors.

.2 Bond metallic raceways in telecommunications rooms and telecommunications equipment rooms to TGB using #6 AWG green insulated copper conductor.

.3 For cables within telecommunications room having shield or metallic member, bond shield or metallic member to TGB using #14 AWG green insulated copper conductor.

.4 Bond equipment racks and cabinets located in telecommunications rooms and equipment room to TGB using #6 AWG green insulated copper conductor.

3.9 LABELLING

.1 All wires used for telecommunications grounding purposes shall be identified with a green insulation. Non-insulated wires shall be identified at each termination point with a wrap of green tape. All cables and bus bars shall be identified and labelled in accordance with the System Documentation Section of this specification.

.2 Apply additional administrative labels to: ANSI/TIA-606B.

END OF SECTION 27 05 26

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 This Section of the Specifications forms part of the Contract Documents and shall be read, interpreted and coordinated with all other parts.

1.2 SYSTEM DESCRIPTION

.1 Empty telecommunications raceways system consists of outlet boxes, cover plates, distribution cabinets, conduits, cabletroughs, pull boxes, sleeves and caps, fish wires, service poles, service fittings, concrete encased ducts.

PART 2 - PRODUCTS

2.1 MATERIAL

.1 Conduits: in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings. Minimum conduit size shall be 19mm from wall outlet to ceiling above suspended ceiling..

.2 Underground cable ducts: in accordance with Section 33 65 76 - Direct Buried Underground Cable Ducts.

.3 Junction boxes, cabinets: in accordance with Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets.

.4 Outlet boxes 4x4 deep, conduit boxes, and fittings: in accordance with Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets.

.5 Cable Tray: in accordance with Section 26 05 36 Cable Tray.

.6 Fish wire: polypropylene type.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install empty raceway system, including distribution system, fish wire, terminal cabinets, outlet boxes, floor boxes, pull boxes, cover plates, conduit, sleeves and caps, cabletroughs, service poles, miscellaneous and positioning material to constitute complete system.

END OF SECTION 27 05 28

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 This section specifies the components for a complete card access control system, including door locking, and control/release to form a complete and operating door release system.

.2 Door release panel and controllers.

.3 Request to exit sensors.

.4 Door contacts

.5 Magnetic Door locks

.6 Pushbuttons and keyed unlocking switches.

.7 Power supplies.

.8 Electrical supervision circuits.

.9 Wiring.

.10 Card readers.

.11 Fobs, cards and programming peripheral.

.12 Computer/PC, operating system and complete access control management software.

.13 Accessory software upgrades and re-programming.

1.2 REFERENCE STANDARDS

.1 Underwriters' Laboratories (UL)

.1 UL 294, Standard for Safety for Access Control System Units.

.2 UL 1981-1994, Standard for Central-Station Automation Systems.

1.3 DEFINITIONS

.1 Electronic Access Control (EAC): The control of people through entrances and exits of a controlled area. An aspect of security that utilizes hardware systems and specialized procedures to control and monitor movements into, out of, or within a controlled area. Access to various areas may be a function of authorized level or time or a combination or both.

.2 DRS:.Door Release System.

1.4 DESIGN PERFORMANCE REQUIREMENTS

.1 Design access control and security access systems using only ULC/UL Listed products.

.2 Design security access system using company specializing in security access systems.

.3 Design security access system as a ULC/UL Certified Alarm System alarm system

.4 Central System: Design operation of electrical protection circuits and devices for signaled automatically to, recorded in, maintained and supervised from central station with arming and disarming supervised by central station.

.1 Remote monitoring:

.1 Monitoring location: Auto dialer.

.2 System with no investigator response.

.3 Primary signal transmission method.

.4 Standard line security employed.

.5 Monitor for fault or alarm.

.6 Identify fault location.
.7 Monitor all power.

.5 Design access control systems to meet safety requirements specified in accordance with UL 294.

.6 Design system to provide door manual and automatic control functions from locations indicated to central monitoring system.

.7 Each activation unit must have door panel control function/equipment item located as indicated.

.8 Door activation units

.1 Fully complement and function and match door manufacturer's magnetic controls and hardware.

.2 Fully function with OEM supplied door controls and hardware to activate system in routine and emergency conditions.

.3 Fully function within supplied electrical supervision circuits as specified.

.9 Control Panel

.1 Fully compatible, compliment and operate door magnets provided by door manufacturer of system or OEM supplied door-operating hardware.

.2 Complete with card reader to release and secure each door, as indicated.

.3 Permanently label (paper labels are not acceptable) or electronically identified each door location on panel or associated display unit

.4 Fully function within supplied electrical supervision circuits as specified.

1.5 SUBMITTALS

.1 Product Data: Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures.

.1 Submit two copies of WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit manufacture's literature for each system component.

.3 Submit:
.1 Functional description of equipment.
.2 Technical data for all devices.
.3 Device location plans and cable lists.
.4 Devices mounting location detail drawings.
.5 Typical devices connection detail drawings.

.2 Shop Drawings: Submit in accordance with Section 01 33 00 – Submittal Procedures.

.1 Submit shop drawings to indicate project layout, including details as follows:
.1 Indicate mounting heights and locations.
.2 Zone layout drawing indicating number and location of zones and areas covered.
.3 Wiring diagrams.
.4 Complete equipment list.

.3 Quality Assurance Submittals: Submit the following in accordance with Section 01 33 00 - Submittal Procedures.

.1 Test Reports: Submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

.2 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .1 Submit 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".

.3 Instructions: Submit manufacturer's installation instructions.

.4 Manufacturer's Field Services: Submit copies of manufacturer's field reports.

.4 Maintenance Data: Submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

.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.

PART 2- PRODUCTS

2.1 MATERIALS

.1 Door controls Items and panels

.1 Provide standard "off the shelf" equipment items to form a complete and operating DRS system.

.2 Provide as required: Equipment cabinets, equipment panels, AC power strips, power line conditioner, uninterrupted power supplies, system power supply, junction box, door control panels, door activation units, electronic supervising master panel, electronic supervising remote panels, system connectors, and system cables.

.2 Provide system cables including multi-conductor control cable, fibre optic, RS-485, and AC power cable required.

.3 Power supplies: to CAN/ULC-S318 or UL 603.

.4 Connectors and switches: to ORD-C634.

.5 Basic System Criteria

.1 Card Readers:
- .1 Type: Weigand proximity.
- .2 Quantity of card readers required: as indicated on plans.
- .3 Proximity technology.
- .4 Fitted with LED indicator light.
- .5 Reading distance 50 - 200 mm.
- .6 Compatible with access card or fob.

.2 Electromagnetic Locks:
- .1 Flat plate armature style.
- .2 Hold force: 1500 lb.
- .3 UL1034 and BHMA Grade 1 Certified.
- .4 LED indication of magnetic bond.
- .5 Adjustable time delay.
- .6 Automatic dual voltage 12/24 Volt DC.

.7 UL 1034, UL 10C and ANSI/BHMA156.3 Certified.
.8 Temperature range: 0° – 49°C.
.9 120VAC power supply, suitable for wall mounting in nearby accessible ceiling space or service room.
.10 Magnetic locks configured for 'fail safe' (lock releases upon loss of power).

.3 Door Contacts:
.1 Recessed/concealed style.
.2 Suitable for door type being installed (steel); pressure or lever type for overhead doors
.3 Three wire with supervision resistors in place.
.4 All wiring fully concealed.

.6 System Accessories:

.1 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.

.2 Proximity Cards – Fobs
.1 Provide 50 cards fully compatible with the readers provided.
.2 Provide 25 fobs fully compatible with the readers provided.
.3 Provide lanyards for all cards and fobs.

.7 System Software:

.1 System software shall be complete with all required administration, programming and configuration applications required for ongoing operations and maintenance without reliance upon an outside vendor or proprietary interface.

.2 System shall be complete with licensing requirements suitable for the number of control points in this design, plus five (5) additional doors.

.3 Setup scheduled backups of databases and access logs.

.4 System shall be connected to the ATB infrastructure

.8 Control Panels

.1 Provide integral battery backup for all access control equipment, including power supplies to allow for 2 minutes of runtime under normal operations. Provided power circuits will have standby power available.

.2 Door control panels shall be as single, dual or multidoor assemblies best suited for the installation noted.

.3 Control panels shall be fitted with tamper switches on the covers.

PART 3- PRODUCTS

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install 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.

3.3 PROGRAMMING AND INTEGRATION

.1 Provide programming and configuration of up to 50 cards or fobs, including scheduled access to doors as required. A schedule of requirements for the cards will be provided to the technician during final commissioning.

.2 Demonstration and training shall include a complete familiarization with all aspects of setting up the system for access and programming cards/fobs.

3.4 FIELD QUALITY CONTROL

.1 Manufacturer's Services:

.1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its products and submit written reports, in acceptable format, to verify compliance of Work with Contract.

.2 Manufacturer's Field Services: Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.5 VERIFICATION

.1 Perform verification inspections and test in the presence of Departmental Representative.

.1 Provide all necessary tools, ladders and equipment.

.2 Ensure appropriate subcontractors, manufacturer's representatives are present for verification.

.2 Pretesting Procedure

.1 Verify that System is fully operational and meets all System performance requirements of this specification.

.2 Measure and record, control carrier levels of every System channel at each of following points in the system:

.1 Door located actuating devices.
.2 Door control panel functions.
.3 Electronic supervisory control units inputs and outputs.
.4 Distribution system input and output.

.3 Provide and submit to Departmental Representative two copies of recorded system pre-test measurements, along with pre-test certification.

.3 Performance Testing

.1 Test Procedure: perform test on a "go-no-go" basis.

.1 Make only operator adjustments required to show proof of performance.
.2 Test to demonstrate and verify that installed System complies with installation and technical requirements of this specification under operating conditions.
.3 Test results to be evaluated by Departmental Representative as either acceptable or unacceptable using following procedures.

.2 Documentation Review

.1 This review will determine if information provided is sufficient to meet requirements of this specification.
.2 Provide for review all System manuals, as installed drawings, pre- test forms, equipment cabinet pictorials, video and audio equipment details.

.3 Mechanical Inspection
- .1 Departmental Representative and Contractor to tour all areas to insure that all Systems and Subsystems are installed in place for proof of performance testing.
- .2 Take system inventory at this time. Verify following items before beginning proof of performance tests:
  - .1 All electrical power circuits designated for system equipment are properly labelled, wired, phased, protected and grounded.
  - .2 Conductor ends are protected by heat shrink wrap; audio spade lugs, barrier strips and punch blocks are used.
  - .3 Dust, debris, solder splatter, etc. are cleaned and removed from site.
  - .4 All equipment is properly labelled.
  - .5 All equipment identified in System's equipment list[s] are in place and properly installed.
  - .6 Each system ground is installed in accordance with manufacturer's instructions and this specification.

.4 Subsystem Functional Test
- .1 Conduct operational testing after review of documentation and mechanical inspection completed. Proceed as follows.
  - .1 Perform operational test of each Subsystem to verify that all equipment is properly connected, interfaced and is functionally operational to meet requirements of this specification.
- .2 Control Units
  - .1 Take S/N readings from control unit's input and output in manual and/or automatic mode. Check output of DC/Data converter for S/N. Evaluate entire signal quality at baseband connector output of control unit and remote equipment.
- .3 Distribution (or Interface) System
  - .1 Check each door utilizing a volt/ohm or signal level meter to confirm each function and to insure that System meets all performance requirements.
  - .2 Test each interconnection point (i.e: Door unit, junction box "cross connection", control unit, etc.) to ensure compliance with this specification.
- .4 Total System Test
  - .1 Proceed with testing when System and Subsystems are functionally tested and accepted. Total System tests to verify that requirements have been met for DC and/or audio, sub carrier, and control signals in accordance with this specification.
- .5 Safety
  - .1 Demonstrate with documentation that access control system meets safety requirements specified in UL 294.

.5 Visual Verification: Objective is to assess quality of installation and assembly and overall appearance to ensure compliance with Contract Documents. Visual inspection to include:
- .1 Sturdiness of equipment fastening.
- .2 Non-existence of installation related damages.
- .3 Compliance of device locations with reviewed shop drawings.
- .4 Compatibility of equipment installation with physical environment.
- .5 Inclusion of all accessories.
- .6 Device and cabling identification.
- .7 Application and location of ULC approval decals.

.6 Technical Verification: Purpose to ensure that all systems and devices are properly installed and free of defects and damage. Technical verification includes:
- .1 Validate sensitivity of readers and applicability and application of cards.

.2 Connecting joints and equipment fastening.
.3 Compliance with manufacturer's specification, product literature and installation instructions.

.7 Operational Verification: Purpose to ensure that devices and systems' performance meet or exceed established functional requirements. Operational verification includes:
.1 Operation of each device individually and within its environment.
.2 Operation of each device in relation with programmable schedule and or/specific functions.

3.6 CLEANING

.1 Remove protective coverings from accessories and components.

.2 Adjust all components for correct function.

.3 Clean housings and system components, free from marks, packing tape, and finger prints, in accordance with manufacturer's written cleaning recommendations.

.4 Clean all components free from dirt and fingerprints.

END OF SECTION 28 13 00

PART 1 - GENERAL

1.1 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for building entrance control systems and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.1 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for convectors and include product characteristics, performance criteria, physical size, finish and limitations.

1.2 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for[building entrance control systems for incorporation into manual.

.3 Include description of system operation.

.4 Include parts list, using component identification numbers standard to electronics industry.

1.3 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 indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect from nicks, scratches, and blemishes.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

.1 Building entrance control system:

.1 Caller pushes button on building entrance panel to sound tone signal in room indicated on drawings.

.2 Building staff may operate talk-listen switch to converse with caller.

.3 Building staff may operate button to release building entrance door via the access control system.

2.2 BUILDING ENTRANCE PANELS

.1 Control and communication panel at building entrance location as indicated.

.1 Enclosed, flush mounting.
.2 1 pushbutton, engraved nameplates .
.3 Buzzer.
.4 Adjustable volume control.
.5 Solid state controls.
.6 Power supply: input 120V.
.7 Amplifier.
.8 Integral microphone/speaker.
.9 Panel finish: Stainless Steel.

.2 Control and communication panel[s] at building entrance location[s] as indicated.

.1 Enclosed, flush mounting.
.2 1 pushbutton, engraved nameplates.
.3 Buzzer.
.4 Adjustable volume control.
.5 Solid state controls.
.6 Power supply: input 120V.
.7 Amplifier.
.8 Integral microphone/speaker.
.9 Panel finish: Stainless Steel.

2.3 DOOR OPENER

.1 Interface with door control system

2.4 COMMUNICATION CONDUCTORS

.1 Type in accordance with Section 26 05 00 - Common Work Results for Electrical.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for building entrance control system installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative.
.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
.3 Proceed with installation only after unacceptable conditions have been remedied [and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

.1 Install system in accordance with manufacturer's instructions.

.2 Connect system to door access control system..

3.3 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Perform intelligibility tests.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

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

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by building entrance control system installation.

END OF SECTION 28 31 00

PART 1- GENERAL

1.1 SECTION INCLUDES

.1 This Section specifies the intrusion detection system consisting of a control panel, detection accessories, communications and environmental monitoring.

.2 This section also provides specifications on the panic alarm system to provide for silent response to staff interfacing with public.

1.2 REFERENCE DOCUMENTS

.1 National Fire Protection Association (NFPA)

.1 NFPA 70, Article 517, National Electric Code.

.2 NFPA 101, Life Safety Code.

.2 Electronic Industries Association (EIA)

.1 REC 12749, Power Supplies.

.2 RS 16051, Sound Systems.

1.3 REFERENCE STANDARDS

.1 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S303-latest edition, Local Burglar Alarm Units and Systems.

.2 CAN/ULC-S304-latest edition, Intrusion Detection.

.3 CAN/ULC-S306-latest edition, Intrusion Detection Units.

.4 ULC-S318-latest edition, Power Supplies for Burglar Alarm Systems.

.5 ORD-C634-latest edition, Connectors and Switches for Use with Burglar Alarm Systems.

1.4 DEFINITIONS

.1 EAC: Electronic Access Control System.

.2 PIR: Passive Infrared Detectors.

1.5 DESIGN PERFORMANCE REQUIREMENTS

.1 Design intrusion detection system using only ULC/UL Listed products.

.2 Design intrusion detection system using ULC/UL Listed Alarm Service Company, company specializing in intrusion detection systems.

.3 Design intrusion detection system as a ULC/UL Certified Alarm System.

.4 Design system as a modular access control, alarm monitoring system expandable, and easily modified for inputs, outputs and remote control stations.

.1 Design components in accordance with CAN/ULC-S306 and be capable of:

.1 Annunciating undesirable, abnormal or dangerous condition.

.2 Prioritizing alarms by alarm type, and to include panic/duress alarm, intrusion alarm and tamper alarm.

.3 Determining zone where alarm occurred.

.4 Annunciating power failure and power restoration

.5 Annunciating low battery condition.

.6 Operate continuously for minimum period of 4 hours in the event of a power failure.

.5 Equip control panels with continuous tamper detection on door and wall.

.1 Tamper detection to trigger alarm.

.6 Design system with:

.1 Alarm masking.

.2 Remote maintenance or diagnostics with password activation.

.3 Unique identifier for each authorized person.

.4 Arming and disarming capabilities: manual and automatic by time of day, day of week, or by operator command.

.5 Support both manual and automatic responses to alarms entering system.

.6 Each alarm capable of initiating different functions of camera, homing, and activation of remote devices, audio switching, door control and card or pin validation.

.7 Zone or alarm location annunciated at monitoring station.

.7 Communications link: security level as appropriate for type of facility as described in CAN/ULC-S304.

.8 Signal link: Security level as appropriate for type of facility as described in CAN/ULC-S304.

.9 Alarm condition: Design system to provide maximum time for an alarm to be communicated of 60 seconds from alarm initiation to annunciation at remote monitoring location.

.10 Junction boxes: tamper proof.

.11 Design system power supplies rated to provide cumulative load of all systems components plus safety factor of 50% or greater.

1.6 PRODUCT DATA

.1 Product Data: Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures.

.1 Submit two copies of WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit manufacture's literature for each control panel, detection accessory device.

.3 Submit:

.1 Functional description of equipment.

.2 Technical data for all devices.

.3 Device location plans and cable lists.

.4 Devices mounting location detail drawings.

.5 Typical devices connection detail drawings

.2 Shop Drawings: Submit in accordance with Section 01 33 00 - Submittal Procedures.

.1 Submit shop drawings to indicate project layout, mounting heights and locations, wiring diagrams, detection device coverage patterns, contact operating gaps.

.2 Submit zone layout drawing indicating number and location of zones and areas covered.

.3 Quality Assurance Submittals: Submit the following in accordance with Section 01 33 00 - Submittal Procedures.

.1 Test Reports: Submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

.2 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.1 Submit UL Product Safety Certificates.

.2 Submit verification Certificate that service company is ULC/UL List alarm service company.

.3 Submit verification Certificate that intrusion alarm system is Certified Alarm

.3 Instructions: Submit manufacturer's installation instructions.

.4 Manufacturer's Field Services: Submit copies of manufacturer's field reports.

.4 Maintenance Data: Submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

.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.

1.7 WARRANTY

.1 Extended warranty period must include warranty against meeting specified performance requirements, for specified time period.

.2 Manufacturer's Warranty: Submit, for Departmental Representative's acceptance, manufacturer's standard warranty document executed by authorized company official.

1.8 SUPPORT SERVICES

.1 Provide manufacturer/dealer advice, information and support services for 1 years.

PART 2- GENERAL

2.1 MATERIALS

.1 Control Panel: ULC approved, expandable [and designed for multiplexed expansion].

.1 Zones (protection inputs): 16.

.2 Fixed Zones: 16.

.3 Expandable: 32 to 64 zones.

.4 Number of user codes required: 16.

.5 Number of Areas/Partitions required: as note on drawings.

.6 Keypads: LED (lights), alphanumeric LCD display.

.7 Alarm: Monitored.

.8 System: Wired.

.9 Integrated with sub systems: access control.

.10 Number of programmable outputs required: 8.

.11 System supervision: telephone.

.12 Siren output.

.13 Number of devices per zone: Refer to drawings.

.2 Detection Accessories:

.1 Passive Infrared Detectors PIR's: ULC approved.

.1 Coverage pattern: Variable with extents noted in drawings. Adjustable shutters.

.2 Tamper switch.

.3 Mounting: wall or ceiling as required.

.2 Contacts: ULC approved.

.1 Mounting: concealed.

.2 Mounting locations: swing, slide and overhead doors.

.3 Security level: high security.

.4 Type: magnetic; roller/pressure.

.3 Notification Devices:

.1 Siren: 30 watt.

.2 Speaker complete with driver.

.3 110 dBA at 3 meters.

.3 Connectors and switches: to ORD-C634.

.1 Panic switches: ULC approved.

.1 Mounting: concealed.

.2 Mounting locations: under millwork, in millwork or on walls.

.3 Security level: high security.

.4 Type: mechanical, latching.

.2 Power supplies: to ULC-S318 or UL 603.

.3 Ethernet based contact signalling device:

.1 Uses standard Ethernet based TCP/IP protocols to transmit contact status to remote location to be decoded by complimentary device for use with panic alarm system.

.2 Multiple contact inputs/outputs, quantity as noted on drawings.

.3 CSA/ULC approved.

PART 3- GENERAL

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.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 panels, intrusion detection system and components secure to walls, ceilings or other substrates.

.3 Install required boxes in inconspicuous accessible locations.

.4 Conceal all conduit and wiring.

.5 Connect Ethernet contact device to network. Extend contacts to monitoring devices and initiating devices.

.6 Connect panic alarm to radio signalling device using output contacts. Radio signalling device to be provided by Departmental Representative.

3.3 FIELD QUALITY CONTROL

.1 Manufacturer's Services:

.1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, and protection and cleaning, of its product[s] and submit written reports, in acceptable format, to verify compliance of Work with Contract.

.2 Manufacturer's Field Services: Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review Work, at stages listed:

.1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.

.2 Twice during progress of Work at 25% and 60% complete.

.3 Upon completion of the Work, after cleaning is carried out.

.4 Obtain reports, within 3 days of review, and submit, immediately, to Departmental

3.4 VERIFICATION

.1 Perform verification inspections and test in the presence of Departmental Representative.

.1 Provide all necessary tools, ladders and equipment.

.2 Ensure appropriate subcontractors and manufacturer's representatives are present for verification.

.2 Visual verification: Objective is to assess quality of installation and assembly and overall appearance to ensure compliance with Contract Documents. Visual inspection to include:

.1 Sturdiness of equipment fastening.

.2 Non-existence of installation related damages.

.3 Compliance of device locations with reviewed shop drawings.

.4 Compatibility of equipment installation with physical environment.

.5 Inclusion of all accessories.

.6 Device and cabling identification.

.7 Application and location of ULC approval decals.

.3 Technical verification: Purpose to ensure that all systems and devices are properly install and free of defects and damage. Technical verification includes:

.1 Measurements of coverage patterns

.2 Connecting joints and equipment fastening.

.3 Compliance with manufacturer's specification, product literature and installation instructions.

.4 Operational verification: Purpose to ensure that devices and systems' performance meet or exceed established functional requirements. Operational verification includes:

.1 Operation of each device individually and within its environment.

.2 Operation of each device in relation with programmable schedule and or/specific functions.

3.5 CLEANING AND ADJUSTING

.1 Remove protective coverings from control panels, detection accessories and components.

.2 Adjust all components for correct function.

.3 Clean housings and system components, free from marks, packing tape, and finger prints, in accordance with manufacturer's written cleaning recommendations.

END OF SECTION 28 16 00

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 This section specifies video components configured as a system, which performs functions related to image acquisition, video display and recording images.

1.2 REFERENCE STANDARDS

.1 Canadian Standards Association (CSA International)

.1 CSA C22.1- latest edition, Canadian Electrical Code, Part 1 Safety Standard for Electrical Installations.

.2 Underwriters Laboratories of Canada (ULC)

.1 ULC-S317-1996, Installation and Classification of Closed Circuit Video Equipment (CCVC) Systems for Institutional and Commercial Security Systems.

1.3 SCOPE OF WORK

.1 Supply and installation of complete and operational video surveillance systems in the Temp new Maintenance Building. Installations include all required components, cabling, devices, power supplies, cameras and network video recorders as well as all integration and programming for a complete and operational system.

PART 2- GENERAL

2.1 CONDUIT

.1 Conduits: to Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

.2 Pullboxes at terminus of conduits shall be 103mm square flush mounted pullbox complete with blank coverplate.

.3 Provide blank covers for all junction boxes and future camera locations.

.4 All conduits are minimum 27mm (1") unless noted otherwise.

2.2 CABLING

.1 Cabling shall be UTP Cat 6 installed in conduit.

2.3 JUNCTION BOX

.1 Metal, sized to handle all system conduit interconnections with appropriate expansion.

.2 Boxes intended to support cameras shall be adequately sized to contain terminated Ethernet outlet and patch cord.

2.4 SYSTEM DESIGN PERFORMANCE REQUIREMENTS

.1 All cameras indicated on drawings shall be configured for continuous recording and storage of this data for 30 days in the server/processor/storage system.

.2 All cameras shall be switchable via software/workstation interface to allow and combination of cameras to be viewed and controlled.

.3 System shall support multiple streams of camera image to multiple workstations.

.4 Video analytics shall be configured into the system based on close coordination with the Departmental Representative. Examples of expected functionality shall include (but not limited to): Motion triggering of alarms, scheduled recording on motion detection, etc.

.5 Switching:

.1 Provision to switch any camera in system to any monitor in system manually or automatically.

.2 Provision to view any recording, time, sequence or video stream and capture for export to external devices.

.6 Control: Provision for any camera equipped with pan, tilt, and/or motorized zoom lens:

.1 Manually control pan, tilt and lens functions.

.2 Set pan and tilt home position.

.3 Set and clear movement limits of pan and tilt mechanism.

.4 Adjust motorized zoom lens.

.7 Overall control of CCTV provided through software control, which provides complete integration of security components.

.8 Environment: Design video components and systems to operate with all specified requirements under following ambient temperatures:

.1 Indoor installations:

.1 Temperature: 0qC to 30qC.

.2 Humidity: 10 to 90%.

.2 Outdoor installations:

.1 Temperature: -40qC to 60qC.

.2 Humidity: 10 to 100%

2.5 ETHERNET BASED SURVEILLANCE CAMERA

.1 CCTV cameras utilising Ethernet based communication protocols for storing and accessing video. Cameras shall be managed via this Ethernet connection.

.2 Cameras shall be powered using standard Power Over Ethernet (POE), with an optional direct power connection available.

.3 Video Camera Characteristics:

.1 Colour.

.2 Sensitivity: Suitable for day, low light usage.

.3 Resolution: Lines of horizontal resolution:

.1 Color HD 1080 resolution, 30/25 frames per second. H.264.

.4 Progressive scan CMOS 1/3”

.5 Environment: Outdoor.

.6 Mounting: fixed dome, weatherproof where noted. Remote Pan/Tilt where noted.

.7 Lens functions: electronic iris.

.8 Addition features: Backlight compensation.

.4 Lenses

.1 5.1-55mm focal lens; Manual focus, auto day/night.

.2 Motorized Zoom Lens.

.5 Camera Housings

.1 Dome style with tamper resistant, tinted dome.

.2 Enclosure will mount on standard device box, effectively concealing all cabling and connections.

.3 Outdoor: Equipped with heater; weatherproof.

2.6 NETWORK VIDEO RECORDER

.1 Supports up to 32 channels of individual Ethernet based video data streams with all channels pre-licensed.

.2 Front swappable SATA-II hard drives providing 8 TB (4, 2 TB drives) of gross storage capacity.

.3 System utilises a 'Storage Server' 64 bit operating system.

.4 Single processor; 4GB of 1333MHZ DDR3 RAM. On board graphics processor, DVI port and USB ports to allow for direct access to NVR. Complete with rack shelf for mounting in data rack.

.5 Client viewing software for fixed, standalone workstations and for remote based client viewing of video images. All required licenses for software shall be provided.

2.7 SOFTWARE AND INTEGRATION

.1 Software and NVR configurations shall be complete and thorough, meeting the requirements of the site and with scheduling, recording, backup and alarming as required and identified during commissioning.

.2 Install and configure software on up to four (4) computers supplied within in this contract or by the Departmental Representative.

.3 Coordinate setup of all network based security, port forwarding and subnets as necessary for a secure system sharing a physical layer with other ATB infrastructure communications schemes.

PART 3- GENERAL

3.1 GENERAL

.1 Install conduits, cables and pullboxes in accordance with instructions in drawings.

.2 All conduits shall be installed from indicated points to Communications Room complete with pullbox at field end of run. Conduits in Communications rooms shall be terminated with connecters and bushings.

.3 Provide labelling on all conduits.

.4 Install pullstrings in all conduits that are left empty.

3.2 MANUFACTURER'S INSTRUCTIONS

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

3.3 INSTALLATION

.1 Install video surveillance equipment and components in accordance with ULC-S317.

.2 Install cable, boxes, mounting hardware, brackets, video cameras and system components in accordance with manufacturer's written installation instructions.

.3 Install components secure, properly aligned and in locations shown on reviewed shop drawings.

.4 Connect cameras to cabling in accordance with installation instructions.

.5 Install ULC labels where required.

3.4 FIELD QUALITY CONTROL

.1 Manufacturer's Services:

.1 Have manufacturer of products, supplied under this Section, review Work involved

.2 in the handling, installation/application, and protection and cleaning, of its products and submit written reports, in acceptable format, to verify compliance of Work with Contract.

.3 Manufacturer's Field Services: Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.4 Obtain reports, within 3 days of review, and submit, immediately, to Departmental Representative.

3.5 VERIFICATION

.1 Perform verification inspections and test in the presence of Departmental Representative.

.1 Provide all necessary tools, ladders and equipment.

.2 Ensure appropriate subcontractors and manufacturer's representatives are present for verification.

.2 Visual verification: Objective is to assess quality of installation and assembly and overall appearance to ensure compliance with Contract Documents. Visual inspection to include:

.1 Sturdiness of equipment fastening.

.2 Non-existence of installation related damages.

.3 Compliance of device locations with reviewed shop drawings.

.4 Compatibility of equipment installation with physical environment.

.5 Inclusion of all accessories.

.6 Device and cabling identification.

.7 Application and location of ULC approval decals.

.3 Technical verification: Purpose to ensure that all systems and devices are properly installed and free of defects and damage. Technical verification includes:

.1 Measurements of tension and power.

.2 Connecting joints and equipment fastening.

.3 Measurements of signals (dB, lux, baud rate, etc).

.4 Compliance with manufacturer's specification, product literature and installation
Operational verification: Purpose to ensure that devices and systems' performance meet or exceed established functional requirements. Operational verification includes:

.1 Operation of each device individually and within its environment.

.2 Operation of each device in relation with programmable schedule and or/specific functions.

.3 Operation control of camera lens, pan, tilt and zoom.

.4 Switching of camera to any monitor.

.5 Switching of system video recorder to selective monitor.

.6 Set dwell times.

.7 Demonstrate:

.1 Sequence viewing of cameras on each monitor.

.2 Bypass capability.

.3 Display of stored image to backup hardware.

3.6 CLEANING AND ADJUSTING

.1 Remove protective coverings from cameras and components.

.2 Adjust cameras for correct function.

.3 Clean camera housings, system components and lens, free from marks, packing tape, and finger prints, in accordance with manufacturer's written cleaning recommendations.

END OF SECTION 28 23 00

PART 1- GENERAL

1.1 REFERENCES

.1 NBC-latest edition, National Building Code of Canada.

.2 Government of Canada

.1 TB OSH Chapter 3-03, latest edition, Treasury Board of Canada, Occupational Safety and Health, Chapter 3-03, Standard for Fire Protection Electronic Data Processing Equipment.

.2 TB OSH Chapter 3-04, latest edition, Treasury Board of Canada, Occupational Safety and Health, Chapter 3-04, Standard for Fire Alarm Systems.

.3 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S524-latest edition, Installation of Fire Alarm Systems.

.2 ULC-S525- latest edition, Audible Signal Appliances.

.3 CAN/ULC-S526- latest edition, Visual Signal Appliances, Fire Alarm.

.4 CAN/ULC-S527- latest edition, Control Units.

.5 CAN/ULC-S528- latest edition, Manual Pull Stations.

.6 CAN/ULC-S529- latest edition, Smoke Detectors.

.7 CAN/ULC-S530- latest edition, Heat Actuated Fire Detectors.

.8 CAN/ULC-S531- latest edition, Smoke Alarms.

.9 CAN/ULC-S536- latest edition, Inspection and Testing of Fire Alarm Systems.

.10 CAN/ULC-S537- latest edition, Verification of Fire Alarm Systems..

1.2 DESCRIPTION OF SYSTEM

.1 Install new fire alarm system as indicated.

.2 System shall be fully supervised, microprocessor-based, fire alarm system, utilizing digital techniques for data control and digital and multiplexing techniques for data transmission.

.3 System to carry out fire alarm and protection functions; including receiving alarm signals; initiating general alarm; supervising components and wiring; actuating annunciators and auxiliary functions; initiating trouble signals and signalling to fire department.

.4 The system shall be fully addressable, zoned, non-coded single stage.

.5 System to be modular in design to allow for future expansion with a minimum of 6 spare zones and associated hardware in the panel.

.6 Operation of system shall not require personnel with special computer skills.

.7 System to include:

.1 Central Control Unit in separate enclosure with power supply, stand-by batteries, central processor with microprocessor and logic interface, main system memory, input-output interfaces for alarm receiving, annunciation/display, and program control/signalling.

.2 Power supplies.

.3 Initiating/input circuits.

.4 Output circuits.

.5 Auxiliary circuits.

.6 Wiring.

.7 Manual and automatic initiating devices.

.8 Audible and visual signalling devices.

.9 End-of-line resistors.

.10 Local and Remote annunciators and displays.

1.3 REQUIREMENTS OF REGULATORY AGENCIES

.1 System:

.1 To TB OSH Chapter 3-04.

.2 Subject to Fire Commissioner of Canada (FC) approval.

.3 Subject to FC inspection for final acceptance.

.4 To Canadian Forces Fire Marshal approval.

1.4 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

.2 Include:

.1 Layout of equipment.

.2 Zoning.

.3 Complete wiring diagram, including schematics of modules.

1.5 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for Fire Alarm System for incorporation into manual.

.2 Include:

.1 Operation and maintenance instructions for complete fire alarm system to permit effective operation and maintenance.

.2 Copy of sound pressure levels for each space.

.3 Technical data - illustrated parts lists with parts catalogue numbers.

.4 Copy of approved shop drawings.

.5 List of recommended spare parts for system.

1.6 EXTRA MATERIALS

.1 Provide maintenance materials as recommended by the system manufacturer. Submit recommended spare parts list to Departmental Representative for review in accordance with Section 01 33 00 - Submittal Procedures.

.2 Include four (4) spare glass rods for manual pull box stations if applicable.

.3 Include for six (6) additional spare audible devices, wired and installed within 30m of the nearest audible device. Devices will be utilised where sound level readings during verification are below Building Code requirements. Unused devices are to be turned over to the Departmental Representative or credited to the contract.

1.7 MAINTENANCE

.1 Provide one year's free maintenance with two inspections by manufacturer during warranty period. Inspection tests to conform to CAN/ULC-S536. Submit inspection report to Departmental Representative.

PART 2- GENERAL

2.1 MATERIALS

.1 Equipment and devices: ULC listed and labelled and supplied by single manufacturer.

.2 In accordance with applicable CAN/ULC standards.

2.2 SYSTEM OPERATION

.1 Single stage operation. Operation of any alarm initiating device to:

.1 Cause audible signal devices to sound throughout building.

.2 Transmit signal to fire department via fire alarm transmitter.

.3 Cause zone of alarm device to be indicated on control panel and remote annunciator.

.4 Cause air conditioning and ventilating fans to shut down or to function so as to provide required control of smoke movement.

.5 Cause fire doors and smoke control doors if normally held open, to close automatically.

.2 Capability to program smoke detector status change confirmation on any or all zones in accordance with CAN/ULC-S527, Appendix C.

2.3 CONTROL PANEL

.1 Single stage operation.

.2 Zoned.

.3 Non-coded.

.4 Enclosure: CSA Enclosure 1, c/w lockable concealed hinged door, full viewing window, flush lock and 2 keys.

.5 Provide 120 volt circuit and ceramic heater for all exterior mounted annunciator panels, whether indicated or not.

.6 Supervised, modular design with plug-in modules:

.1 Alarm receiver with trouble and alarm indications provision for remote supervised annunciation, for class A and B initiating circuits.

.2 Spare zones: compatible with smoke detectors and open circuit devices.

.3 Space for future modules in addition to spare zones provided.

.4 Latching type supervisory receiver circuits. Discrete indication for both off-normal and trouble.

.7 Components:

.1 Coded alarm receiver panel with trouble and alarm indications for class A and B initiating circuits.

.2 Single stage alarm pulse rate panels:

.1 Single stroke control type for output to signal control panel continuously.

.3 Common control and power units:

.1 Control panel containing following indications and controls:

.1 "Power on" LED (green) to monitor primary source of power to system.

.2 "Power trouble" indication.

.3 "Ground trouble" indication.

.4 "Remote annunciator trouble" indication.

.5 "System trouble" indication.

.6 "System trouble" buzzer and silence switch c/w trouble resound feature.

.7 System reset switch.

.8 "LED test" switch if applicable.

.9 "Alarm silence" switch to silence signals manually. If new alarm occurs after signals have been silenced, signals to resound.

.10 "Signals silenced" indication.

.2 Master power supply panel to provide 24Vdc to system from 120Vac, 60Hz input.

.3 Fire department connections:

.1 Plug-in module for shunt type municipal box.

.2 Fire department bypass switch c/w indicator for trouble at panel.

.4 Auxiliary relays: plug-in type, dust cover, supervised against unauthorized removal by common trouble circuit.

.1 Contacts: 2.0A, 120Vac, for functions such as release of door holders or initiation of fan shut down.

.2 Contact terminal size: capable of accepting 22-12AWG wire.

2.4 POWER SUPPLY

.1 120V, ac, 60Hz input, 24Vdc output from rectifier to operate alarm and signal circuits, with standby power of gel cell batteries minimum expected life of 4 years, sized in accordance with BC Building Code.

2.5 MANUAL ALARM STATIONS

.1 Manual alarm pull stations: Dual language (French and English)addressable, pull lever, wall mounted surface type, non-coded single pole normally open contact for single stage English signage.

.2 Manufacturer - Addressable manual pull station.

.3 Provide steel protective guards for pull stations installed where required by Departmental Representative.

2.6 AUTOMATIC ALARM INITIATING DEVICES

.1 Heat detectors, fixed temperature, non-restorable, rated 57°C.

.2 Thermal detectors, addressable, fixed temperature: 57qC.

.3 Smoke detector: addressable ionization type.

.1 Dual chamber, ionization, twistlock, plug-in type with fixed wire-in base assembly with integral red alarm LED. Detector to be addressable type c/w electronics o communicate detector’s status and field adjustable address setting.

.4 Remote LED alarm indicator for concealed thermal and smoke detectors.

2.7 AUDIBLE SIGNAL DEVICES

.1 Signal chimes: heavy duty, single stroke, 24Vdc, with solid striking plunger and resonating chamber, 95dB.

.2 Bells: vibrating type, gongs of special alloy steel, 24Vdc, 150mm, 95dB.

.3 Horns: 95dB, weatherproof mounting, 24Vdc.

.4 Mini-horns: 95dB, surface mounting, red colour, 24Vdc.

.5 All audible devices must be programmed to a temporal pattern 3, as required by the BC Building Code.

2.8 END-OF-LINE DEVICES

.1 End-of-line devices to control supervisory current in alarm circuits and signalling circuits, sized to ensure correct supervisory current for each circuit. Open, short or ground fault in any circuit will alter supervisory current in that circuit, producing audible and visible alarm at main control panel and remotely as indicated.

2.9 REMOTE ANNUNCIATOR PANELS

.1 LED type with designation cards to indicate zone.

.2 LED's to annunciate alarm and trouble.

.3 Wired in multiple with main control panel.

.4 Supervised, including trouble signal for open circuit.

.5 LED test button.

2.10 VISUAL ALARM SIGNAL DEVICES

.1 Strobe type: flashing blue, 24Vdc.

.2 Designed for surface mounting on ceiling or walls as indicated.

2.11 SPRINKLER SYSTEM CONNECTION

.1 Provide waterflow/tamper modules for connection to sprinkler system for monitoring of flow switches and valves.

.2 Provide input modules for connection of pressure switches for monitoring.

.3 Provide alarm/trouble indication of heat tracing system at the control panel and remote annunciator panel.

2.12 ISOLATION MODULES

.1 Addressable zone isolation modules.

2.13 MAGNETIC DOOR HOLD OPEN DEVICES

.1 Magnetic two-piece device. One piece flush mounted on wall and the other piece on door, 120V AC.

.2 Wire through Low Voltage Relay, to de-energize door holder, upon signal from fire alarm system.

2.14 ANCILLARY DEVICES

.1 Remote relay unit to initiate fan shutdown.

.2 Provide relay interlocks to fire alarm control panel to shut down fans as indicated on mechanical equipment schedule.

.3 Provide relay interlocks and control switches in main control panel and annunciator panels to enable smoke removal fans operation as described in the Mechanical Specifications.

.4 Provide relay contact to DDC system to signal the status of the fire alarm system.

2.15 WIRE AND CABLE

.1 Conductor Insulation: Minimum rating 300 volts. Single conductor RW90XLPE (X-link).

.2 Multi-conductor cables 105°C with outer PVC jacket, colour coded, FAS rated armoured cable where required.

.3 Conductor sizes as follows:

.1 To initiating circuits: #18 AWG minimum, and in accordance with manufacturer's requirements.

.2 To signal circuits: #16 AWG minimum, and in accordance with manufacturer's requirements.

.3 To control circuits: #12 AWG minimum, and in accordance with manufacturer's requirements.

.4 Size all fire alarm wiring for maximum 3% voltage drop at maximum load at last device in run.

.4 All wiring to be copper.

.5 All wiring to be tag identified at the points of connection.

.6 Provide a ground conductor with all system wiring and bond all metal parts including device boxes.

.7 All fire alarm system wiring to be in conduit except short drops from ceiling junction box to detectors mounted in T-Bar ceiling may be rated fire alarm system cable.

.8 Where noted, provide a 2 hour rated wiring method as recognized by CSA and Authority having jurisdiction.

PART 3- GENERAL

3.1 INSTALLATION

.1 Install systems in accordance with CAN/ULC-S524 and TB OSH Chapter 3-04.

.2 Install main control panel and connect to ac power supply.

.3 Locate and install manual alarm stations and connect to alarm circuit wiring.

.4 Locate and install detectors and connect to alarm circuit wiring. Do not mount detectors within 1 m of air outlets. Maintain at least 600 mm radius clear space on ceiling, below and around detectors. Locate duct type detectors in straight portions of ducts.

.5 Connect alarm circuits to main control panel.

.6 Locate and install signal devices, bells, chimes, horns and visual signal devices and connect to signalling circuits.

.7 Connect signalling circuits to main control panel.

.8 Install end-of-line devices at end of alarm and signalling circuits.

.9 Install remote annunciator panels and connect to annunciator circuit wiring.

.10 Locate and install door releasing devices.

.11 Locate and install remote relay units to control fan shut down.

.12 Sprinkler system: wire alarm and supervisory switches and connect to control panel.

.13 Provide quantity of six (6) spare gongs and allow for installation to within 10m radius of nearest gong shown on plans to suit final fit-up sound level requirements.

.14 Provide quantity of two (2) spare manual pull stations and allow for installation within 10m radius of fire alarm system devices.

.15 Provide quantity of two (2) spare heat detectors and allow for installation within 10m radius of fire alarm system devices.

.16 Provide quantity of two (2) spare smoke detectors and allow for installation within 10m radius of fire alarm system devices.

3.2 FIRE ALARM ZONES

.1 Provide zoning for fire alarm detection devices as noted in drawings.

.2 Provide all required connections to all mechanical sprinkler system alarm and supervisory devices. Coordinate with Mechanical drawings and specifications.

.3 Provide and install minimum two bell circuits per floor. Confirm exact locations.

3.3 FIELD QUALITY CONTROL

.1 Perform tests as described herein and in accordance CAN/ULC-S537.

.2 Fire alarm system:

.1 Test each device and alarm circuit to ensure manual stations, thermal and smoke detectors, and sprinkler system transmit alarm to control panel and actuate general alarm ancillary devices.

.2 Check annunciator panels to ensure zones are shown correctly.

.3 Simulate grounds and breaks on alarm and signalling circuits to ensure proper operation of system.

.4 Manufacturer's technician to verify all new devices and reconnected existing fire alarm system equipment and components in accordance with ULC Standard S537.

.5 Provide a Certification of Verification.

.6 After verification, demonstrate and spot test system as required by Departmental Representative and Fire Commissioner.

.7 Provide Departmental Representative with written verification report for review and include copies in maintenance manuals

.8 Class A circuits.

.1 Test each conductor on all circuits for capability of providing alarm signal on each side of single open-circuit fault condition imposed near midmost point of circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.

.2 Test each conductor on all circuits for capability of providing alarm signal during ground-fault condition imposed near midmost point of circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.

.9 Class B circuits.

.1 Test each conductor on all circuits for capability of providing alarm signal on line side of single open-circuit fault condition imposed at electrically most remote device on circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.

.2 Test each conductor on all circuits for capability of providing alarm signal during ground-fault condition imposed at electrically most remote device on

circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.

3.4 TRAINING

.1 Arrange and pay for on-site lectures and demonstrations by fire alarm equipment manufacturer to train operational personnel in use and maintenance of fire alarm system.

END OF SECTION 28 31 00

Part 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 02 41 99 Demolition for Civil Works

.2 Section 31 22 13 Rough Grading

.3 Section 31 23 33.01 Excavating, Trenching and Backfilling

.4 Section 32 11 23 Aggregate Base Courses

.5 Section 32 12 16.01 Asphalt Paving – Short Form

.6 Section 32 16 15 Concrete Walks, Curbs and Gutters

.7 Section 33 05 13 Manholes and Catchbasin Structures

.8 Section 33 11 16 Site Water Utility Distribution Piping

.9 Section 33 31 13 Public Sanitary Utility Sewerage Piping

.10 Section 33 41 00 Storm Utility Drainage Piping

.11 Section 33 46 16 Subgrade Drainage Network

1.2 SUBMITTALS

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

.1 Submit name of professional engineer retained by the Contractor for geotechnical testing for review and approval by Departmental Representative.

.2 Submit name of testing laboratory retained by Contractor for materials testing for review and approval by Departmental Representative.

.3 Inform Departmental Representative at least 4 weeks prior to beginning Work, of proposed source of fill materials and provide access for sampling.

.4 Submit geotechnical quality assurance information and test results within 1 week of undertaking.

1.3 GEOTECHNICAL QUALITY ASSURANCE

.1 Retain and pay for the services of a qualified independent geotechnical testing agency under the supervision of a registered professional engineer, and pay the cost of testing services for quality control including, but not limited to, the following:

.1 Sieve analysis of sands and aggregates to be supplied

.2 Standard proctor density curves for backfill materials

.3 Standard proctor density curves for approved borrow materials

.4 Compaction control tests for backfill and embankment material including the following:

.1 Trench bedding (service) - once per road crossing

.2 Trench backfill (service) - once per road crossing

.3 Trench bedding (mainline) - once per every 75m of trench at 1.0m vertical lifts with min. one between manholes.

.4 Trench backfill (mainline) - once per every 75m of trench at 1.0m vertical lifts with min. one between manholes.

.5 Granular base (sidewalks) - once per 50 lineal metres

.5 Concrete mix design and testing

.6 Concrete strength tests (minimum three specimen cylinders in accordance with CSA a23.1) for the following:

.1 Sidewalk - once per 150 lineal metres (minimum one per day during concrete placing)

.7 Asphalt mix design and testing

.8 Asphalt tests for the following:

.1 Aggregate gradation tests - one per each 300 tonnes of production (minimum once per day during asphalt placement)

.2 Marshall test - three briquettes for every 300 tonnes of production (minimum once per day during asphalt placement)

.3 Compaction - one core for each 500m².

.2 Site excavated material is not suitable for use as backfill.

1.4 SURVEY

.1 The Contractor is to retain a qualified surveyor to complete:

.1 A pre-construction survey of any site features not already surveyed

.2 All site layout, both vertical and horizontal, for pipes, manholes, underground features, curbs, sidewalks, roads, ditches, and surface features.

.3 All as-constructed locations of utilities and surface features.

.2 A copy of the as-constructed survey and drawing markups are to be compiled and provided to the Departmental Representative within 10 days of construction completion.

Part 2 - PRODUCTS

2.1 NOT USED

.1 Not used.

Part 3 - EXECUTION

3.1 NOT USED

.1 Not used.

END OF SECTION 31 05 00

Part 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 02 41 99 Demolition for Civil Works

.2 Section 31 05 00 Common Works Results – Earthworks, Exterior Improvements, and Utilities

.3 Section 31 23 33.01 Excavating, Trenching and Backfilling

1.2 REFERENCES

.1 ASTM International

.1 ASTM D698, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (600 kN-m/m3).

.2 Master Municipal Contract Documents (MMCD), Platinum Edition Volume II - 2009, British Columbia. Contractor to maintain a copy on-site at all times.

1.3 EXISTING CONDITIONS

.1 Examine Geotechnical Assessment prepared by WSP Canada Inc., dated November 2016.

.2 Known underground and surface utility lines and buried objects are as indicated on site plan.

.3 Refer to dewatering in Section 31 23 33.01 - Excavating, Trenching and Backfilling.

Part 2 - PRODUCTS

2.1 MATERIALS

.1 Fill material: Granular base to MMCD (Master Municipal Contract Documents 2009, British Columbia), Section 31 05 17.

Part 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for rough grading installation in accordance with manufacturer's written instructions.

.1 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.2 Proceed with installation only after unacceptable conditions have been remedied.

3.2 STRIPPING OF TOPSOIL

.1 Do not handle topsoil while in wet or frozen condition or in any manner in which soil structure is adversely affected as determined by Departmental Representative.

.2 Commence topsoil stripping of areas as indicated after area has been cleared of surface features and removed from site.

.3 Strip topsoil to depths as directed by Departmental Representative. mixing topsoil with subsoil.

.4 Stockpile in locations as directed by Departmental Representative. Stockpile height not to exceed 2 m.

.5 Dispose of unused topsoil to location as directed by Departmental Representative.

3.3 GRADING

.1 Complete granular roadbed re-shaping to MMCD 31 22 16 – Reshaping Granular Roadbeds.

.2 Complete re-shaping of existing subgrade to MMCD 31 22 16 – Reshaping Existing Subgrade.

.3 Rough grade to levels, profiles, and contours allowing for surface treatment as indicated.

.4 Rough grade to depths below finish grades as shown in Contract Drawings

.5 Slope rough grade away from building at minimum 2%.

.6 Grade ditches to depth as indicated in Contract Drawings.

.7 Prior to placing fill over existing ground, scarify surface to depth of 150 mm minimum before placing fill over existing ground. Maintain fill and existing surface at approximately same moisture content to facilitate bonding.

.8 Compact filled and disturbed areas to modified maximum dry density to ASTM D698, as follows:

.1 85% under landscaped areas.

.2 95% under paved and walk areas.

.9 Do not disturb soil within branch spread of trees or shrubs to remain.

3.4 TESTING

.1 Refer to Section 01 45 00 – Quality Control and Section 31 05 00 Common Works Results – Earthworks, Exterior Improvements, and Utilities for geotechnical testing requirements.

3.5 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

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

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

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

3.6 PROTECTION

.1 Protect existing site features including fencing, trees, landscaping, natural features, bench marks, buildings, pavement, surface or underground utility lines which are to remain. If damaged, restore to original or better condition unless directed otherwise.

.2 Maintain access roads to prevent accumulation of construction related debris on roads.

END OF SECTION 31 22 13

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 02 41 99 Demolition for Civil Works.

.2 Section 31 05 00 Common Works Results – Earthworks, Exterior Improvements, and Utilities

.3 Section 32 11 23 Aggregate Base Courses.

1.2 REFERENCES

.1 Master Municipal Contract Documents (MMCD), Platinum Edition Volume II - 2009, British Columbia. Contractor to maintain a copy on-site at all times.

.2 Geotechnical Assessment prepared by WSP Canada Inc., dated November 2016.

.3 American Society for Testing and Materials International (ASTM)

.1 ASTM C117, Standard Test Method for Material Finer than 0.075 mm (No.200) Sieve in Mineral Aggregates by Washing.

.2 ASTM C136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

.3 ASTM D422-632002, Standard Test Method for Particle-Size Analysis of Soils.

.4 ASTM D698-00ae1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft ³) (600 kN- m/m ³).

.5 ASTM D1557-02e1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft ³) (2,700 kN- m/m ³).

.6 ASTM D4318, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

.4 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.

.5 Canadian Standards Association (CSA International)

.1 CAN/CSA-A3000, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

.1 CSA-A3001-03, Cementitious Materials for Use in Concrete.

.2 CSA-A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

.6 BC Ministry of Transportation and Highways Specification I-11, Fracture Count for Coarse Aggregate

.7 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.

1.3 DEFINITIONS

.1 Excavation classes: two classes of excavation will be recognized; common excavation and rock excavation.

.1 Rock: solid material in excess of 1.00m^3, and which cannot be removed by means of heavy duty mechanical excavating equipment available on site. 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 Unclassified excavation: excavation of deposits of whatever character encountered in Work.

.3 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 larger than 25 millimeters in any dimension.

.4 Waste material: excavated material unsuitable for use in Work or surplus to requirements.

.5 Borrow material: material obtained from locations outside area to be graded, and required for construction of fill areas or for other portions of Work.

.6 Recycled fill material: material, considered inert, obtained from alternate sources and engineered to meet requirements of fill areas.

.7 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 D4318, and gradation within limits specified when tested to ASTM D422 and ASTM C136: Sieve sizes to CAN/CGSB-8.1 CAN/CGSB-8.2.

.2 Coarse grained soils containing more than 20 % by mass passing 0.075 mm sieve.

.8 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 EXCAVATION AND DISPOSAL

.1 Contractor to submit to Departmental Representative for review and approval, location of proposed disposal facility prior to disposal of any material.

1.5 SUBMITTALS

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

.2 Quality Control: in accordance with Section 01 45 00 - Quality Control:

.1 Submit name of professional engineer retained by the Contractor for design and review of temporary works related to underpinning and bracing of existing structure and excavations for review and approval by Departmental Representative.

.2 Submit to Departmental Representative testing inspection results report as described in PART 3 of this Section.

.3 Inform Departmental Representative at least 3 weeks prior to beginning Work, of proposed source of fill materials and provide access for sampling.

1.6 QUALITY ASSURANCE

.1 Qualification Statement: submit proof of insurance coverage for professional liability for professionals retained by Contractor.

.2 Submit design and supporting data for excavations at least 2 weeks prior to beginning Work. Design and supporting data submitted to bear stamp and signature of qualified professional engineer registered or licensed in Province of British Columbia, Canada.

.3 Keep design and supporting data on site.

.4 Do not use soil material until written report of soil test results are reviewed and approved by Departmental Representative.

.5 Health and Safety Requirements:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.7 WASTE MANAGEMENT AND DISPOSAL

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

.2 Divert materials from landfill to local facility for reuse.

1.8 EXISTING CONDITIONS

.1 Carefully examine existing mapping of site utilities prior to excavation.

.2 Buried services:

.1 Before commencing work verify location of buried services on and adjacent to site by either soil hydrovactor excavation or hand-digging methods.

.2 Remove obsolete buried services within 2 m of foundations: cap cut-offs.

.3 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.

.4 Prior to beginning excavation Work, notify applicable Departmental Representative establish location and state of use of buried utilities and structures. Clearly mark such locations to prevent disturbance during Work.

.5 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered.

.6 Where utility lines or structures exist in area of excavation, obtain direction of Departmental Representative before removing or re-routing.

.7 Record location of maintained, re-routed and abandoned underground lines.

.8 Confirm locations of recent excavations adjacent to area of excavation.

.3 Existing buildings and surface features:

.1 Conduct, with Departmental Representative, condition survey of existing buildings, trees and other plants, lawns, fencing, service poles, wires, 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.

PART 2- PRODUCTS

2.1 MATERIALS

.1 Gravel to be composed of inert, durable material, reasonably uniform in quality and free from soft or disintegrated particles. In absence of satisfactory performance records over a five year period for particular source of material, soundness to be tested according to ASTM C88 or latest issue. Maximum weight average losses for course and fine aggregates to be 30% when magnesium sulphate is used after five cycles.

.2 All crushed gravel when tested according to ASTM C136 and ASTM C117 to have a generally uniform gradation and conform to MMCD gradation limits and 60% of the material passing each sieve must have one or more fractured faces. Determination of amount of fractured material shall be in accordance with BC Ministry of Transportation and Highways Specification I-11, Fracture

Count for Coarse Aggregate, Method 'A', which determines fractured faces by count. The Plasticity Index for crushed gravel to not exceed 6.0.

.3 Granular base and sub-base to MMCD (Master Municipal Contract Documents 2009, British Columbia), Section 31 05 17 – Aggregates and Granular Materials.

.4 Granular pipe bedding to MMCD (Master Municipal Contract Documents 2009, British Columbia), Section 31 05 17 – Aggregates and Granular Materials.

.5 Drain rock to MMCD (Master Municipal Contract Documents 2009, British Columbia), Section 31 05 17 – Aggregates and Granular Materials.

.6 Structural fill to be approved by a Departmental Representative and be in conformance with the WSP Geotechnical Site Assessment. Structural fill should consist of well-graded material with a maximum particle size of 75mm and less than 5% passing the 0.075mm sieve size.

PART 3 - EXECUTION

3.1 SURVEY

.1 Refer to Section 31 05 00 - Common Works Results – Earthworks, Exterior Improvements, and Utilities for survey requirements.

3.2 **TEMPORARY EROSION AND SEDIMENTATION CONTROL**

.1 Refer to Section 01 35 43 – Environmental Procedures for additional information.

.2 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 drawings, specific to site, that complies with EPA 832/R-92-005 or requirements of authorities having jurisdiction, whichever is more stringent.

.3 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

.4 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 **SITE PREPARATION**

.1 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.

.2 Cut pavement or sidewalk neatly along limits of proposed excavation in order that surface may break evenly and cleanly.

3.4 **PREPARATION/PROTECTION**

.1 Protect existing features in accordance with applicable local regulations.

.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 the approval of the Departmental Representative.

.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.

3.5 STRIPPING OF TOPSOIL

.1 Begin topsoil stripping of areas as indicated after area has been cleared of brush, weeds, grasses and removed from site.

.2 Strip topsoil to depths as indicated.

.1 Do not mix topsoil with subsoil.

.3 Stockpile in locations as directed by Departmental Representative.

.1 Stockpile height not to exceed 3m and should be protected from erosion.

.4 Dispose of unused topsoil as directed by Departmental Representative.

3.6 STOCKPILING

.1 Stockpile fill materials in areas designated by Departmental Representative.

.1 Maximum stockpile height: 2m.

.2 Stockpile granular materials in manner to prevent segregation.

.3 Implement sufficient erosion and sediment control measures to prevent sediment release off construction boundaries and into water bodies.

3.7 SHORING, BRACING AND UNDERPINNING

.1 Contractor is responsible for the protection and temporary support of all project excavations.

.2 Contractor to retain and pay for services of professional geotechnical engineer registered in the Province of British Columbia for design and review of temporary works related to underpinning and bracing of existing structure and excavations.

.3 Maintain sides and slopes of excavations in safe condition by appropriate methods and in accordance with Section 01 35 29.06 - Health and Safety Requirements and WorkSafe BC.

.1 Where conditions are unstable, Contractor to retain and pay costs for geotechnical engineer to review condition, provide recommendations, and certify the excavation.

.4 Construct temporary Works to depths, heights and locations as indicated by Contractor's geotechnical engineer.

.5 During backfill operation:

.1 Unless otherwise indicated or directed by Departmental Representative, remove sheeting and shoring from excavations.

.2 Do not remove bracing until backfilling has reached respective levels of such bracing.

.3 Pull sheeting in increments that will ensure compacted backfill is maintained at elevation at least 500 mm above toe of sheeting.

.6 When sheeting is required to remain in place, cut off tops at elevations as indicated.

.7 Upon completion of substructure construction:

.1 Remove cofferdams, shoring and bracing.

3.8 DEWATERING AND HEAVE PREVENTION

.1 Keep excavations free of water while Work is in progress.

.2 Provide for Departmental Representative review details of proposed dewatering or heave prevention methods, including dikes, well points, and sheet pile cut- offs.

.3 Avoid excavation below groundwater table if quick condition or heave is likely to occur.

.1 Prevent piping or bottom heave of excavations by groundwater lowering, sheet pile cut-offs, or other means.

.4 Protect open excavations against flooding and damage due to surface run-off.

.5 Dispose of water in accordance with Section 01 35 43 - Environmental Procedures to approved runoff areas or containment facilities and in 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.

3.9 EXCAVATION

.1 All or any existing underground utilities are not necessarily shown on the Contract Drawings. Existing Underground utilities shall be located and all utility companies contacted, prior to installing any new underground services.

.2 Test holes may be required to be excavated to determine exact depths of existing utilities. Any discrepancy in elevation or location shall be referred to the Departmental Representative prior to construction.

.3 Advise Departmental Representative at least 7 days in advance of excavation operations. Excavate to lines, grades, elevations and dimensions as indicated.

.4 All trenches to conform to WorkSafeBC Guidelines and Regulations and MMCD standard drawing G4.

.1 Any costs associated with trench certification and shoring are to be paid by the Contractor.

.5 Remove concrete, masonry, paving, walks, demolished foundations and rubble and other obstructions encountered during excavation offsite.

.6 Excavation must not interfere with bearing capacity of adjacent foundations and slabs. Contractor to notify Departmental Representative immediately where undermining of slabs of foundations occurs. Contractor responsible for devising and executing a remediation plan for filling all voids associated with undermining of slabs and foundations.

.7 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, as directed by the project Arborist.

.2 Provide 24 hours' notice to Departmental Representative of need for Arborist on site.

.8 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. No more than 5 m of trench may be exposed at end of day's operation and must be securely covered. Road plates are to be used to cover exposed excavations in areas of vehicular travel.

.9 Keep excavated and stockpiled materials safe distance away from edge of trench as directed by Departmental Representative.

.10 Restrict vehicle operations directly adjacent to open trenches.

.11 Do not obstruct flow of surface drainage or natural watercourses.

.12 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.

.1 Subgrade for paved areas to be reviewed and approved by the Contractor's geotechnical engineer prior to placement of fill materials.

.2 Any soft/loose areas identified should be excavated and replaced with structural fill placed and compacted in 300mm lifts to 95% Modified Proctor Maximum Dry Density, or as directed by Geotechnical Engineer.

.13 Correct unauthorized over-excavation as follows:

.1 Fill with MMCD granular base material to not less than 95% Modified Proctor Density.

.14 Maintain subgrade surface in condition conforming to this section until succeeding material is applied or until subgrade is accepted by the Departmental Representative, including any dewatering required.

.15 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.

3.9 ROADWAY EXCAVATION, EMBANKMENT AND COMPACTION

.1 Complete all roadway excavation in conformance in conformance to the following MMCD sections:

.1 Section 31 24 13 – Roadway Excavation, Embankment and Compaction,

.2 Section 31 22 16 – Reshaping Granular Roadbeds,

.3 Section 31 22 16.1 – Reshaping Existing Subgrade

3.10 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.

3.11 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.

.2 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.

.3 Do not use backfill material which is frozen or contains ice, snow or debris.

.4 Backfill materials:

.1 Boulevards and easements: for areas not subject to vehicle or building loading and outside ditch lines, backfill with approved native material except as shown otherwise on Contract Drawings. Compact to 90% modified proctor density.

.2 Roads, foundations, buildings, driveways, concrete walks: backfill with imported granular material. Place backfill material in uniform layers not exceeding 150 mm compacted to 95% Modified Proctor Maximum Dry Density thickness up to grades indicated. Compact each layer before placing succeeding layer.

.5 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 150mm.

.3 Where temporary unbalanced earth pressures are liable to develop on walls or other structures:

.1 Permit concrete to cure for minimum 14 days or until it has sufficient strength to withstand earth and compaction pressure and approval obtained from Departmental Representative.

.6 All structural fill should extend beyond footing and hard surfaced areas so that compact/dense native soils, or approved structural fill are present within an area extending one metre laterally from the edge of the foundation and then at a 1H:1V (Horizontal:Vertical) downward projection.

.7 Place unshrinkable fill in areas as indicated.

.8 Consolidate and level unshrinkable fill with internal vibrators.

.9 Install drainage system in backfill as indicated.

3.12 TESTING

.1 Refer to Section 01 45 00 – Quality Control for geotechnical testing requirements and Section 31 05 00 - Common Works Results – Earthworks, Exterior Improvements, and Utilities.

3.13 RESTORATION

.1 Existing underground utilities may need to be lowered or rose to suit the final design grades in accordance with minimum and maximum cover requirements for each utility.

.2 Upon completion of Work, remove waste materials and debris in accordance to Section 01 74 21 - Construction/Demolition Waste Management and Disposal, trim slopes, and correct defects as directed by Departmental Representative.

.3 Replace topsoil as indicated.

.4 Reinstate lawns to elevation which existed before excavation.

.5 Reinstate pavements and sidewalks disturbed by excavation to thickness, structure and elevation which existed before excavation.

.6 Restore surface to match existing and to MMCD G5.

.1 Minimum topsoil depth: 100mm

.2 Minimum asphalt thickness: 75mm

.7 Clean and reinstate areas affected by Work as directed by Departmental Representative.

.8 Use temporary plating to support traffic loads over unshrinkable fill for initial 24 hours.

.9 Protect newly graded areas from traffic and erosion and maintain free of trash or debris.

END OF SECTION 31 23 33.01

PART 1 -GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 31 23 33.01 Excavating, Trenching and Backfilling.

1.2 REFERENCES

.1 ASTM International

.1 ASTM A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

.2 ASTM D4491-99a, Standard Test Methods for Water Permeability of Geotextiles by Permittivity.

.3 ASTM D4595, Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method.

.4 ASTM D4716, Standard Test Method for Determining the (In-Plane) Flow Rate Per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head.

.5 ASTM D4751, Standard Test Method for Determining Apparent Opening Size of a Geotextile.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-4.2 No. 11.2, Textile Test Methods - Bursting Strength - Ball Burst Test (Extension of September 1989).

.2 CAN/CGSB-148.1, Methods of Testing Geotextiles and Complete Geomembranes.

.1 No.2-M85, Methods of Testing Geosynthetics - Mass per Unit Area.

.2 No.3-M85, Methods of Testing Geosynthetics - Thickness of Geotextiles.

.3 No.6.1-93, Methods of Testing Geotextiles and Geomembranes - Bursting Strength of Geotextiles Under No Compressive Load.

.4 No.7.3-92, Methods of Testing Geotextiles and Geomembranes - Grab Tensile Test for Geotextiles.

.5 No. 10-94, Methods of Testing Geosynthetics - Geotextiles - Filtration Opening Size.

.3 CSA International

.1 CSA G40.20/G40.21-04(R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for geotextiles and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 DELIVERY, STORAGE AND HANDLING

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

.2 Storage and Handling Requirements:

.1 Store materials in clean, dry, well-ventilated area.

.2 Store and protect geotextiles from direct sunlight and UV rays.

.3 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

2.1 MATERIAL

.1 Geotextile: non-woven synthetic fibre fabric, supplied in rolls.

.1 Width: 4.6m minimum.

.2 Length: 91m minimum.

.3 Composed with inhibitors added to resist deterioration by ultra-violet and heat exposure for 500 hours at minimum 70% by mass.

.4 Physical properties:

.1 Grab tensile strength: minimum 0.8 kN, wet condition.

.2 Mullen burst strength: 2410 kPa, wet condition.

.3 Puncture: 0.465 kN

.4 Trapezoidal tear: 0.330 kN

.5 Hydraulic properties:

.1 Apparent opening size (AOS): 0.150 mm

.2 Permittivity: 1.5 1/sec

.3 Flow rate: 4470 l/min/m2

.2 Geotextile: woven synthetic sediment fence, supplied in rolls.

.1 Composed with inhibitors added to resist deterioration by ultra-violet and heat exposure for 500 hours at minimum 90% by mass.

.2 Physical properties:

.1 Grab tensile strength: minimum 0.45 kN, wet condition.

.2 Mullen burst strength: 1826 kPa, wet condition.

.3 Puncture: 0.26 kN

.4 Trapezoidal tear: 50 lbs.

.3 Hydraulic properties:

.1 Apparent opening size (AOS): 0.850 mm

.2 Permittivity: 0.20 1/sec

.3 Flow rate: 611 l/min/m2

.3 Securing pins and washers: to CSA G40.21, Grade 300W, hot-dipped galvanized with minimum zinc coating of 600 g/m2to ASTM A123/A123M.

.4 Factory seams: sewn in accordance with manufacturer's recommendations.

.5 Thread for sewn seams: equal or better resistance to chemical and biological degradation than geotextile.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for geotextile material installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

.1 Place geotextile material by unrolling onto graded surface in orientation, manner and locations indicated and retain in position with suitable anchors.

.2 Place geotextile material smooth and free of tension stress, folds, wrinkles and creases.

.3 Place geotextile material on sloping surfaces in one continuous length from toe of slope to upper extent of geotextile.

.4 Overlap each successive strip of geotextile 600 mm over previously laid strip.

.5 Protect installed geotextile material from displacement, damage or deterioration before, during and after placement of material layers.

.6 After installation, cover with overlying layer within 4 hours of placement.

.7 Replace damaged or deteriorated geotextile to approval of Departmental Representative.

.8 Place and compact soil layers in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

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

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

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

3.4 PROTECTION

.1 Vehicular traffic not permitted directly on geotextile.

END OF SECTION 31 32 19.01

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 03 30 00 Cast-In-Place Concrete

.2 Section 31 05 00 Common Works Results – Earthworks, Exterior Improvements, and Utilities

.3 Section 31 23 33.01 Excavating, Trenching and Backfilling

.4 Section 32 12 16.01 Asphalt Paving – Short Form

1.2 REFERENCES

.1 ASTM International

.1 ASTM C117, Standard Test Methods for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.

.2 ASTM C131, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

.3 ASTM C136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

.4 ASTM D698-07e1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft³) (600kN- m/m³).

.5 ASTM D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000ft-lbf/ft³) (2,700kN-m/m³).

.6 ASTM D1883-07e2, Standard Test Method for CBR (California Bearing Ratio) of Laboratory Compacted Soils.

.7 ASTM D4318, 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-M88, Sieves, Testing, Woven Wire, Metric.

.3 U.S. Environmental Protection Agency (EPA) / Office of Water

.1 EPA 832/R-92-005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

.4 Master Municipal Contract Documents (MMCD), Platinum Edition Volume II - 2009, British Columbia. Contractor to maintain a copy on-site at all times.

1.3 DELIVERY, STORAGE AND HANDLING

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

1.4 ACTION AND INFORMATION SUBMITTALS

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

.2 Product Data:

.1 Submit proposed source and sieve analysis of all aggregate materials 2 weeks prior to commencing work.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Granular base and sub-base to MMCD (Master Municipal Contract Documents 2009, British Columbia), Section 31 05 17.

PART 3 – EXECUTION

3.1 PREPARATION

.1 Temporary Erosion and Sedimentation Control:

.1 Refer to Section 01 35 43 – Environmental Procedures for additional information.

.2 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction, sediment and erosion control plan, specific to site, that complies with EPA 832/R-92-005 or requirements of authorities having jurisdiction, whichever is more stringent.

.3 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

.4 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.2 PLACEMENT AND INSTALLATION

.1 Place granular base after sub-base and subgrade surface is inspected and approved in writing 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 Place material to full width in uniform layers not exceeding 150 mm compacted thickness.

.1 Departmental Representative may authorize thicker lifts (layers) if specified compaction can be achieved.

.7 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.

.8 Remove and replace that portion of layer in which material becomes segregated during spreading.

.3 Compaction Equipment:

.1 Ensure compaction equipment is capable of obtaining required material densities.

.2 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 in writing by Departmental Representative.

.5 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

.4 Proof rolling:

.1 For proof rolling use standard roller of 45,400 kg gross mass with four pneumatic tires each carrying 11,350 kg and inflated to 620 kPa. Four tires arranged abreast with centre to centre spacing of 730 mm.

.2 Obtain written approval from Departmental Representative to use non-standard proof rolling equipment.

.3 Make sufficient passes with proof roller to subject every point on surface to three separate passes of loaded tire.

.4 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 common material and compact.

.3 Replace sub-base material and compact.

.4 Replace base material and compact in accordance with this Section.

.5 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 this section at no extra cost.

.6 At the discretion of the Departmental Representative, nuclear densometer testing may be utilized for compaction testing rather than proof rolling. Location and frequency of densometer tests to be approved by the Departmental Representative.

3.3 TESTING

.1 Refer to Section 01 45 00 – Quality Control and Section 31 05 00 - Common Works Results – Earthworks, Exterior Improvements, and Utilities for geotechnical testing requirements.

.2 Contractor shall notify Departmental Representative in advance of planned testing.

.3 Contractor to pay costs for uncovering and making good work that is covered before required inspection or testing is completed and approved by Departmental Representative.

.4 Provide Departmental Representative with 2 copies of testing and commissioning reports as soon as they are available.

3.4 SITE TOLERANCES

.1 Finished base surface to be within plus or minus 10 mm of established grade and cross section but not uniformly high or low.

3.5 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 32 11 23

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 31 05 00 Common Works Results – Earthworks, Exterior Improvements, and Utilities

.2 Section 32 11 23 Aggregate Base Courses

1.2 REFERENCES

.1 American Society for Testing and Materials International, (ASTM).

.1 ASTM D1557-12e1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lb/ft^3 (2,700 kN-m/m^3)).

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.5 – M91, Low Flash Petroleum Spirits Thinner.

.2 CAN/CSGB-1.74, Alkyd Traffic Paint.

.3 Master Municipal Contract Documents (MMCD), Platinum Edition Volume II - 2009, British Columbia. Contractor to maintain a copy on-site at all times.

1.3 SAMPLES AND SUBMITTALS

.1 Submit samples in accordance with Section 01 33 00 – Submittal Procedures.

.2 Submit asphalt mix design to Departmental Representative for review at least 1 week proir to commencing work.

1.4 WASTE MANAGEMENT AND DISPOSAL

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

.2 Place materials defined as hazardous or toxic in designated containers.

.3 Divert unused aggregate materials from landfill to facility for reuse as approved by Department Representative.

.4 Dispose of unused paint and paint thinner materials at official hazardous material collections site as approved by Department Representative.

.5 Do not dispose of unused paint thinner material into sewer system, into streams, lakes, onto ground or in other location where it will pose health environmental hazard.

.6 Divert unused asphalt from landfill to facility capable of recycling materials.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Prime coat: N/A

.2 Tack coat: CAN/CGCB – 16.2, Grade SS-1

.3 Asphalt cement: CGSB – 16.3-M 90, Grade 80-100

.4 Asphalt concrete: MMCD Upper Course #1 and 2

.5 Traffic paint: yellow and white to CAN/CGSB-1.74.

.6 Paint thinner: to CAN/CGSB-1.5.

PART 3 - EXECUTION

3.1 FOUNDATIONS

.1 Roadway foundations to be constructed in conformance to MMCD Section 31 24 13 – Roadway Excavation, Embankment and Compaction.

.2 Foundations for roadways and parking lots comprise:

.1 compacted granular subbase, thickness as shown in Contract Drawings.

.2 compacted granular base, thickness as shown in Contract Drawings.

.3 Compaction: compact each lift of granular material to 95% Modified Proctor density. Maximum lift thickness: 150 mm.

3.2 PAVEMENT THICKNESS

.1 Pavement thickness for roadways and parking lots is to be as specified in the Contract Drawings with the following gradation:

.1 Air side and ground side asphalt adjacent to maintenance building: MMCD Upper Course #1 in one lift.

.2 Road patches for trench crossings: MMCD Upper Course #2 in one lift.

3.3 PAVEMENT CONSTRUCTION

.1 Construction of asphalt concrete to MMCD 32 12 16 – Hot-Mix Asphalt Concrete Paving.

.2 Surface preparation to MMCD 32 12 16 – Hot-Mix Asphalt Concrete Paving

.3 Cold milling to MMCD 32 01 16.7 – Cold Milling

3.4 TESTING

.1 Refer to Section 01 45 00 – Quality Control and Section 31 05 00 - Common Works Results – Earthworks, Exterior Improvements, and Utilities for geotechnical testing requirements.

END OF SECTION 32 12 16.01

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 03 20 00 Concrete Reinforcing

.2 Section 03 30 00 Cast-In-Place Concrete

.3 Section 31 05 00 Common Works Results – Earthworks, Exterior Improvements, and Utilities

.4 Section 31 23 33.01 Excavating, Trenching and Backfilling.

.5 Section 32 11 23 Aggregate Base Courses.

1.2 REFERENCES

.1 American Society for Testing and Materials International (ASTM)

.1 ASTM C117, Standard Test Method for Materials Finer than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.

.2 ASTM C136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

.3 ASTM D260-86, Standard Specification for Boiled Linseed Oil.

.4 ASTM D1557-12e1, Modified Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3(2,700 kN- m/m^3)).

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-3.3-99, Kerosene, Amend. No. 1, National Standard of Canada.

.2 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.

.3 CAN/CGSB-19.24-M90, Multicomponent, Chemical-Curing Sealing Compound

.3 Canadian Standards Association (CSA International)

.1 CSA-A23.1-04/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

.2 CSA-G30.5-M1983 (R1998), Welded Steel Wire Fabric for Concrete Reinforcement

.4 Master Municipal Contract Documents (MMCD), Platinum Edition Volume II - 2009, British Columbia. Contractor to maintain a copy on-site at all times.

1.3 SUBMITTALS

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

.1 Submit concrete mix designs 2 weeks prior to construction.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal:

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

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Concrete mixes and materials: in accordance with Section 03 30 00 - Cast-in- Place Concrete and:

.1 Hand-formed and hand-placed concrete:

- Slump: 80mm
- Air entrainment: 5-8%
- Max. aggregate size: 20mm

- Min. cement content: 335 kg/m^3
- Min. 28 day strength: 32 MPa

.2 Extruded concrete:

- Slump: 0-25mm
- Air entrainment: 6-9%
- Max. aggregate size: 10mm
- Fineness modulus: 2.1 to 2.4
- Min. cement content: 335 kg/m^3
- Min. 28 day strength: 32 MPa

.2 Reinforcing steel: in accordance with Section 03 20 00 - Concrete Reinforcing.

.1 Welded steel wire fabric to CSA CSA-G30.5-M1983 (R1998)

.3 Joint filler and Curing Compound: in accordance with Section 03 30 00 - Cast- in-Place Concrete.

.4 Joint sealer to CAN/CGSB-19.24-M90, Type 1, Class B

.5 Granular base: material to following requirements:

.1 Granular base to MMCD (Master Municipal Contract Documents 2009, British Columbia), Section 31 05 17.

.6 Non-staining mineral type form release agent: chemically active release agents containing compounds that react with free lime to provide water-soluble soap.

.7 Fill material:

.1 Granular material as specified on contract drawings

.8 Curing compound: to be spray applied, liquid type conforming to ASTM C309 containing a fugitive dye, applied in accordance with manufacturer's recommendations, or other during methods such as sheet material and burlap mats, subject to Departmental Representative approval.

PART 3 - EXECUTION

3.1 GRADE PREPARATION

.1 Do grade preparation work in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

.2 Construct embankments using excavated material free from organic matter or other objectionable materials.

.1 Dispose of surplus and unsuitable excavated material in approved location off site.

.3 Place fill in maximum 300 mm layers and compact to at least 95% Modified Proctor Density in compliance with ASTM D1557.

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 300 mm layers to at least 95% Modified Proctor Density in compliance with ASTM D1557.

3.3 FORMWORK

.1 Use flexible forms for all curves less than 60m radius

.2 Set forms to line and grade as shown on Contract Drawings free from waves or irregularities in line or grade

.3 Adequately brace forms to maintain specified tolerances after concrete is placed.

.4 Treat forms lightly with approved form release agent and remove surplus agent.

3.4 CONCRETE

.1 Obtain Departmental Representative approval of granular base prior to placing concrete.

.2 Do not place concrete when air temperature appears likely to fall below 5 degrees Celsius within 24 hours unless specified precautions are taken and approved.

.3 Do concrete work in accordance with Section 03 30 00 - Cast-in-Place Concrete.

.4 Immediately after floating, give sidewalk surface uniform broom finish to produce regular corrugations not exceeding 2 mm deep, by drawing broom in direction normal to center line.

.5 Provide edging as indicated with 10 mm radius edging tool.

3.5 TOLERANCES

.1 Finish surfaces to within 3 mm in 3 m as measured with 3 m straightedge placed on surface.

3.6 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 of 9 m.

.3 When sidewalk is adjacent to curb, make joints of curb, gutters and sidewalk coincide.

3.7 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 Use 13mm pre-molded hardboard joint material to form isolation joints joint filler in isolation joints.

.3 Seal isolation joints with sealant noted on drawings.

3.8 CURING

.1 Cure concrete by adding moisture continuously in accordance with CSA- A23.1/A23.2 to exposed finished surfaces for at least 1 day after placing, or sealing moisture in by curing compound as directed by Departmental Representative.

.2 Where burlap is used for moist curing, place two pre-wetted layers on concrete surface and keep continuously wet during curing period of at least 7 days.

.3 Apply curing compound evenly to form continuous film, in accordance with manufacturer's requirements.

3.9 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 indicated.

3.10 TESTING

.1 Refer to Section 01 45 00 – Quality Control for geotechnical testing requirements and Section 31 05 00 - Common Works Results – Earthworks, Exterior Improvements, and Utilities.

3.11 CLEANING

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

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION 32 16 15

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 01 33 00 – Submittal Procedures

.2 Section 01 35 43 – Environmental Procedures

.3 Section 01 35 29.06 – Health and Safety Requirements

.4 Section 01 61 00 – Common Product Requirements

1.2 REFERENCES

.1 CAN/CGSB-1.5-M91, Low Flash Petroleum Spirits Thinner.

.2 CGSB1-GP-12c-68, Standard Paint Colours.

.3 CGSB1-GP-71-83, Method, of Testing Paints and Pigments.

.4 CGSB1-GP-74M-79, Paint, Traffic, Alkyd.

.5 Environment Canada (EC)

.1 Volatile Organic Compound (VOC) Concentration Limits for Architectural Coatings Regulations, SOR/2009-264.

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

.1 Material Safety Data Sheets (MSDS).

1.3 ACTION AND INFORMATION SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's printed product literature and data sheets for pavement markings and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit 2 copies of WHMIS MSDS in accordance with Section 01 35 43- Environmental Procedures and 01 35 29.06- Health and Safety Requirements.

1.4 MEASUREMENT AND PAYMENT

.1 Pavement marking will be measured by lump sum.

1.5 DELIVERY, STORAGE AND HANDLING

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

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

PART 2- PRODUCTS

2.1 MATERIALS

.1 Paint:

.1 To CGSB1-GP-74M, alkyd traffic paint.

.2 Colour: to CGSB1-GP-12C.

.1 Fire lane markings to be yellow 505-308;

.2 Parking stall details to be white 513-301.

.3 Upon request, Department Representative will supply a qualified product list of paints applicable to work. Qualified paints may be used but Department Representative reserves right to perform further tests.

.2 Thinner: to CAN/CGSB-1.5.

.3 Glass beads:

.1 Overlay type: to CGSB1-GP-74M.

PART 3 - EXECUTION

3.1 EQUIPMENT REQUIREMENTS

.1 Paint applicator to be an approved pressure type mobile distributor capable of applying paint in single, double and dashed lines. Applicator to be capable of applying marking components uniformly, at rates specified, and to dimensions as indicated, and to have positive shut-off.

.2 Distributor to be capable of applying reflective glass beads as an overlay on freshly applied paint.

3.2 CONDITION SURFACES

.1 Pavement surface to be dry, free from ponded water, frost, ice, dust, oil, grease and other foreign materials.

3.3 APPLICATION

.1 Lay out pavement markings

.2 Unless otherwise approved by Department Representative, apply paint only when air temperature is above 10°C, wind speed is less than 60km/h and no rain is forecast within next 4h.

.3 Apply traffic paint evenly at rate of 3 m^2/L.

.4 Do not thin paint unless approved by Department Representative.

.5 Symbols and letters to conform to dimensions indicated.

.6 Paint lines to be of uniform colour and density with sharp edges.

.7 Thoroughly clean distributor tank before refilling with paint of different colour.

.8 Apply glass beads at rate of 200g/$m^2$of painted area immediately after application of paint.

3.4 SITE TOLERANCES

.1 Paint markings to be within plus or minus 12mm of dimensions indicated.

3.5 PROTECTION

.1 Protect pavement markings until dry.

END OF SECTION 32 17 23

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 03 30 00 Cast-In-Place Concrete.

1.2 REFERENCES

.1 ASTM International

.1 ASTM A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

.2 ASTM A90/A90M, Standard Test Method for Weight Mass of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.

.3 ASTM A121-07, Standard Specification for Zinc-Coated (Galvanized) Steel Barbed Wire.

.4 A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.5 ASTM C618-08a, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.

.6 ASTM F1664-08, Standard Specification for Poly(Vinyl Chloride) (PVC)- Coated Steel Tension Wire Used with Chain-Link Fence.

.7 ASTM A123/A123M, Standard Specification for Zinc (Hot Dip Galvanized) coatings on Iron and Steel Products.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-138.1, Fabric for Chain Link Fence.

.2 CAN/CGSB-138.2, Steel Framework for Chain Link Fence.

.3 CAN/CGSB-138.3, Installation of Chain Link Fence.

.4 CAN/CGSB-138.4, Gates for Chain Link Fence.

.5 CAN/CGSB-1.181, Ready-Mixed Organic Zinc-Rich Coating.

.6 CAN/CSA-G164-M92, Hot Dip Galvanizing of Irregularly Shaped Articles

.7 CAN/CSA-G40.20-13/G40.21-13, General requirements for rolled or welded structural quality steel / Structural quality steel

.8 CAN/CSA-W59 - Welded steel construction (metal arc welding)

.3 CSA International

.1 CSA A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.

.2 CAN/CSA-A3000, Cementitious Materials Compendium.

.4 Master Painters Institute (MPI)

.1 Architectural Painting Specification Manual - current edition.

.5 U.S. Environmental Protection Agency (EPA) / Office of Water

.1 EPA 832/R-92-005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

.6 Appendix K – EGD 2015 North Security Fence Project Documents.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for concrete mixes, fences, posts and gates and include product characteristics, performance criteria, physical size, finish and limitations.

.2 For powered gates:

.1 Indicate electric power requirements, installation details, wiring diagrams.

.2 Submit manufacturer's written installation instructions.

.3 Drive unit shall bear a label indicating that the gate controller/operator mechanism has been tested certified to UL 325 and CSA C22.2 No. 247 standards for all electrical components.

.4 Provide operation and maintenance data for gate for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

.5 Provide concrete foundation designs sealed by an Engineer registered to practice in BC.

.3 Layout drawings for the powered gates at the south end of the new Terminal Building:

.1 The Contractor will provide a detailed drawing showing the proposed layout of the powered bi-fold gate and dual telescopic gates, including the following:

.1 Clearance to existing and proposed site features such as the scale, building, fencing, access control, bollards, etc.

.2 Connection and termination details between gates/fences/buildings

.3 Gate clear openings and line of gate swing.

.4 Proposed access control pedestal details.

.5 Electrical conduit routing and panel placement.

1.4 QUALITY ASSURANCE

.1 Manufacturer: A company specializing in the manufacture of automated gate systems.

.2 Installer: A minimum of three years' experience installing similar equipment and approved by manufacturer.

1.5 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.

.2 Store and protect fence and gate materials from damage.

.3 Replace defective or damaged materials with new.

.3 Packaging Waste Management: remove for reuse of pallets, crates, padding, packaging materials as specified in Waste Reduction Workplan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Concrete mixes and materials: in accordance with CSA A23.1 and Section 03 30 00 - Cast-in-Place Concrete.

.1 Nominal coarse aggregate size: 20-5.

.2 Compressive strength: 20 MPa minimum at 28 days.

.3 Additives: fly ash to CSA A3000 ASTM C618.

.2 Chain-link fence fabric: to CAN/CGSB-138.1.

.1 Type 1, Class A, medium style, Grade 2.

.2 Height of fabric: as indicated.

.3 Posts, braces and rails: to CAN/CGSB-138.2, galvanized steel pipe. Dimensions as indicated.

.4 Top, bottom tension wire: to CAN/CGSB-138.2, single strand, galvanized steel wire.

.5 Tie wire fasteners: aluminum wire.

.6 Tension bar: to ASTM A653/A653M, 5 x 20 mm minimum galvanized steel.

.7 Gates: to CAN/CGSB-138.4.

.8 Gate frames: to ASTM A53/A53M, galvanized steel pipe, standard weight 45 mm outside diameter pipe for outside frame, 35 mm outside diameter pipe for interior bracing.

.1 Fabricate gates as indicated with electrically welded joints, and hot-dip galvanized after welding.

.2 Fasten fence fabric to gate with twisted selvage at top.

.3 Furnish gates with galvanized malleable iron hinges, latch and latch catch with provision for padlock which can be attached and operated from either side of installed gate.

.4 Furnish pilots access gates with galvanized malleable iron hinges and knob with five button access code on the ground side of the gate. Knob hardware to allow free exit from the air side and protected from operation through the gate/fence. Gates to be fitted with automatic closing hardware. Refer to architectural specifications for further details.

.5 Furnish double gates with chain hook to hold gates open and centre rest with drop bolt for closed position.

.6 Refer to electrical specifications for gate power and control details.

.9 Fittings and hardware: to CAN/CGSB-138.2, galvanized steel.

.1 Tension bar bands: 3 x 20 mm minimum galvanized steel or 5 x 20 mm minimum aluminum.

.2 Post caps to provide waterproof fit, to fasten securely over posts and to carry top rail.

.3 Overhang tops to provide waterproof fit, to hold top rails and an outward inward projection to hold barbed wire overhang.

.4 Include projection with clips or recesses to hold 3 strands of barbed wire spaced 100 mm apart.

.5 Projection of approximately 300 mm long to project from fence at 45 degrees above horizontal.

.6 Turnbuckles to be drop forged.

.7 Organic zinc rich coating: to CAN/CGSB-1.181 MPI #18.

.10 Barbed wire: to ASTM A121 2 mm diameter galvanized steel wire aluminum coated steel wire 4 point barbs 125 mm spacing.

.11 Barbed wire: to CAN/CGSB-138.2, 2.5 mm diameter.

.12 Grounding rod per Canadian Electrical Code.

.13 For powered gates:

.1 Steel sheet: hot dipped galvanized to ASTM A653/A653M, A36 pre galvanized steel.

.2 Steel sections: to CAN/CSA-G40.21

.3 Welding materials: to CSA W59.

.4 Electrical components: Complete gate system to be CSA C22.2 No.247 and complying with local requirements.

.5 Power Supply: 115VAC/230VAC – 20 Amp single phase 60 hertz power supply

.6 Panels to be capable of fully opening within 10 seconds

.7 Panels: 6 gauge welded wire infill with 3 strands of barbed wire on top

.8 Through beam photoelectric transmitter and receiver: Equip each column with 2 built-in photocells at 20" and 60 inches above the base plate. To be mounted within the columns.

.9 Fence Mounting Devices: Provide mounting brackets for mounting adjoining fence material to columns.

.10 Bi-folding gate to be 2.4m high and have a minimum clear opening of 4.5m

.11 Dual telescoping gates to be 2.4m high and provide a combined clear opening of 5.5m

.12 Drive unit:

.1 Provide 24VDC drive with printed circuit board - integrated motor control circuitry for controlling electro-mechanical drive system. Drive system to incorporate current sensing resistors and adaptive monitoring software as inherent entrapment protection.

.2 All electrical drive components to be enclosed in weather-resistant housing.

.3 Integrated battery back up

.4 Emergency override: Provide point for manual opening and closing in case of power failure/malfunction.

2.2 FINISHES

.1 Galvanizing:

.1 For chain link fabric: to CAN/CGSB-138.1 Grade 2.

.2 For pipe: 550 g/m²minimum to ASTM A90.

.3 For barbed wire: to CAN/CGSB-138.2 ASTM A121, Class 2.

.4 For other fittings: to ASTM A123/A123M.

.5 For powered gates: Hot dip galvanized finish 0.5 kg/m2 zinc coating to CAN/CSA-G164.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrate previously installed under other Sections or Contracts are acceptable for fence and gate installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

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

3.2 PREPARATION

.1 Temporary Erosion and Sedimentation Control:

.1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction sediment and erosion control drawings sediment and erosion control plan, specific to site, that complies with EPA 832/R-92-005 or requirements of authorities having jurisdiction, whichever is more stringent.

.2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

.3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

.2 Grading:

.1 Remove debris and correct ground undulations along fence line to obtain smooth uniform gradient between posts.

.1 Provide clearance between bottom of fence and ground surface of 30 mm to 50 mm.

.3 Layout

.1 Contractor to provide full layout of the fences, gates, powered gates and adjacent features and report any potential conflicts to the Departmental Representative prior to construction.

3.3 RESTORATION OF FENCE

.1 Restore and damaged or temporarily removed sections of fence as shown in the Contract Drawings in accordance with this specification and to match existing.

3.4 ERECTION OF FENCE

.1 Erect fence along lines as directed by Departmental Representative and to CAN/CGSB-138.3.

.2 Excavate post holes to dimensions indicated 600 mm depth x 300 mm diameter as directed by Departmental Representative.

.3 Space line posts 3 m apart, measured parallel to ground surface.

.4 Space straining posts at equal intervals not to exceed 150 m if distance between end or corner posts on straight continuous lengths of fence over reasonably smooth grade, is greater than 150 m.

.5 Install additional straining posts at sharp changes in grade and where directed by Departmental Representative.

.6 Install corner post where change in alignment exceeds 10 degrees.

.7 Install end posts at end of fence and at buildings.

.1 Install gate posts on both sides of gate openings.

.8 Place concrete in post holes then embed posts into concrete to minimum 450 mm depth.

.1 Extend concrete 50 mm above ground level and slope to drain away from posts.

.2 Brace to hold posts in plumb position and true to alignment and elevation until concrete has set.

.9 Install fence fabric after concrete has cured, minimum of 5 days.

.10 Install brace between end and gate posts and nearest line post, placed in centre of panel and parallel to ground surface.

.1 Install braces on both sides of corner and straining posts in similar manner.

.11 Install overhang tops and caps.

.12 Install top rail between posts and fasten securely to posts and secure waterproof caps and overhang tops.

.13 Install bottom tension wire, stretch tightly and fasten securely to end, corner, gate and straining posts with turnbuckles and tension bar bands.

.14 Lay out fence fabric. Stretch tightly to tension recommended by manufacturer and fasten to end, corner, gate and straining posts with tension bar secured to post with tension bar bands spaced at 300 mm intervals.

.1 Knuckled selvedge at bottom.

.2 Twisted selvedge at top.

.15 Secure fabric to top rails, line posts and bottom tension wire with tie wires at 450 mm intervals.

.1 Give tie wires minimum two twists.

.16 Install barbed wire strands and clip securely to lugs of each projection.

.17 Install grounding rods as required.

3.5 INSTALLATION OF GATES

.1 Install gates in locations as indicated.

.2 Install powered gates to manufacturer's written instructions.

.3 Level ground between gate posts and set gate bottom approximately 40 mm above ground surface.

.4 Determine position of centre gate rest for double gate.

.1 Cast gate rest in concrete as directed.

.2 Dome concrete above ground level to shed water.

.5 Install gate stops where indicated.

3.6 TOUCH UP

.1 Clean damaged surfaces with wire brush removing loose and cracked coatings. Apply two coats of organic zinc-rich paint to damaged areas as indicated.

.1 Pre-treat damaged surfaces according to manufacturers' instructions for zinc-rich paint.

3.7 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 .Leave Work area clean at end of each day.

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

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

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

END OF SECTION 32 31 13

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 03 20 00 Concrete Reinforcing

.2 Section 03 30 00 Cast-In-Place Concrete

.3 Section 31 05 00 Common Works Results – Earthworks, Exterior Improvements, and Utilities

.4 Section 31 23 33.01 Excavating Trenching and Backfilling

1.2 REFERENCES

.1 American Society for Testing and Materials International (ASTM)

.1 ASTM A48/A48M, Standard Specification for Gray Iron Castings.

.2 ASTM C117, Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing.

.3 ASTM C136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

.4 ASTM C139, Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes.

.5 ASTM C478M, Standard Specification for Precast Reinforced Concrete Manhole Sections Metric.

.6 ASTM D1557-12e1, Modified Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³(2,700 kN- m/m³)).

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.

.2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.

.3 Canadian Standards Association (CSA International)

.1 CAN/CSA-A23.1-04/A23.2-04, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

.2 CAN/CSA-A3000-03(R2005), 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-04, CSA Standards on Concrete Masonry Units (Consists of A165.1, A165.2 and A165.3).

.4 CAN/CSA-G30.18-M92, Billet Steel Bars for Concrete Reinforcement.

.5 CAN/CSA-G164-M92, Hot Dip Galvanizing of Irregularly Shaped Articles.

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

.1 Material Safety Data Sheets (MSDS).

.5 Master Municipal Contract Documents (MMCD), Platinum Edition Volume II - 2009, British Columbia. Contractor to maintain a copy on-site at all times.

1.3 SUBMITTALS

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

.2 Product Data:

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

1.4 DELIVERY, STORAGE AND HANDLING

.1 Packing, shipping, handling and unloading:

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

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

.2 Waste Management and Disposal:

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

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Cast-in-place concrete:

.1 In accordance with Section 03 30 00 - Cast-in-Place Concrete.

.2 Cement: to CAN/CSA-A3001, Type GU.

.3 Concrete mix design to produce minimum 27.6 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, class C-3 exposure.

.4 Supplementary cementing materials: with minimum 20% Type F fly ash replacement, by mass of total cementitious materials to CAN/CSA A3001.

.5 Concrete reinforcement: in accordance with Section 03 20 00 - Concrete Reinforcing.

.2 Precast manhole units: to ASTM C478M, circular.

.1 Top sections eccentric cone or flat slab top type with opening offset for vertical ladder installation.

.2 Monolithic bases to be approved by Departmental Representative.

.3 Precast catch basin sections: to ASTM C139 and ASTM C478M.

.4 Joints: made watertight using rubber rings, bituminous compound, epoxy resin cement.

.5 Mortar:

.1 Masonry Cement: to CAN/CSA-A3002.

.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 C478M.

.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 Gray iron castings: to ASTM A48/A48M, strength class 30B.

.3 Castings: coated with two applications of asphalt.

.4 Manhole frames and covers: cover cast with perforations and complete with two 25 mm square lifting holes.

.5 Catch basin frames and covers: ASTM A48 and to withstand H20 loading.

.13 Lawnbasins as shown on MMCD standard drawing S12.

.14 Granular bedding and backfill: in accordance with Section 31 23 33.01 Excavating Trenching and Backfilling.

.15 Unshrinkable fill: in accordance with Section 31 23 33.01 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 33.01 - Excavating Trenching and Backfilling and as indicated.

3.3 CONCRETE WORK

.1 Do concrete work in accordance with Section 03 30 00 - Cast-in-Place Concrete.

.2 Place concrete reinforcement in accordance with Section 03 20 00 - Concrete Reinforcing.

.3 Position metal inserts in accordance with dimensions and details as indicated.

3.4 INSTALLATION

.1 Construct units in accordance with details indicated, plumb and true to alignment and grade.

.2 Complete units as pipe laying progresses.

.1 Maximum of three units behind point of pipe laying will be allowed.

.3 Dewater excavation to approval of Departmental Representative and remove soft and foreign material before placing concrete base.

.4 Cast bottom slabs directly on undisturbed ground.

.5 Set precast concrete base on 150 mm minimum of granular bedding compacted to 95% Modified Proctor Density to ASTM D1557.

.6 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 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.

.7 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 full diameter of sewer.

.2 Slope adjacent floor at 1 in 20.

.3 Curve channels smoothly.

.4 Slope invert to establish sewer grade.

.8 Compact granular backfill to 95% Modified Proctor Density to ASTM D1557.

.9 Place unshrinkable backfill in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

.10 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.

.11 Set frame and cover to required elevation on no more than three courses of concrete rings.

.1 Make brick joints and join brick to frame with cement mortar.

.2 Parge and make smooth and watertight.

.12 Place frame and cover on top section to elevation as indicated.

.1 If adjustment required use concrete ring.

.13 Clean units of debris and foreign materials.

.1 Remove fins and sharp projections.

.2 Prevent debris from entering system.

3.5 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 600 mm use standard manhole 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.

.1 Re-use existing gratings, frames.

.2 Re-set gratings and frames to required elevation on not more than 3 courses of brick.

.1 Make brick joints and join brick to frame with cement mortar, parge and trowel smooth.

.2 Re-set gratings and frames to required elevation on full bed of cement mortar, parge and trowel smooth.

3.6 SEALING OVER EXISTING UNITS

.1 Cut galvanized iron sheet to extend 50 mm beyond opening of existing manhole or catch basin grating.

.1 Center iron sheet over existing grating and spot or stitch weld to grating.

.2 Fill with cast-in-place concrete.

3.7 FIELD QUALITY CONTROL

.1 In accordance with Section 01 45 00 – Quality Control and Section 31 05 00 Common Works Results – Earthworks, Exterior Improvements, and Utilities.

3.8 CLEANING

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

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION 33 05 13

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 31 05 00 Common Works Results – Earthworks, Exterior Improvements, and Utilities

.2 Section 32 11 23 Aggregate Base Courses.

.3 Section 31 23 33.01 Excavating, Trenching and Backfilling.

1.2 REFERENCES

.1 American National Standards Institute/American Water Works Association (ANSI/AWWA)

.1 ANSI/AWWA B300, Standard for Hypochlorites.

.2 ANSI/AWWA B303, Standard for Sodium Chlorite.

.3 ANSI/AWWA C207, Standard for Steel Pipe Flanges for Waterworks Service, 4 Inch through 144 Inch (100 mm through 3,600 mm).

.4 ANSI/AWWA C208, Standard for Dimensions for Fabricated Steel Water Pipe Fittings.

.5 ANSI/AWWA C500, Standard for Metal-Seated Gate Valves for Water Supply Service.

.6 ANSI/AWWA C651, Standard for Disinfecting Water Mains.

.7 ANSI/AWWA C800, Standard for Underground Service Line Valves and Fittings.

.8 ANSI/AWWA C900, Standard for Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 Inch through 12 Inch (100 mm - 300 mm), for Water Transmission and Distribution.

.9 AWWA C901, Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In. (13 mm) through 3 In. (76 mm), for Water Service

.2 Master Municipal Contract Documents (MMCD), Platinum Edition Volume II - 2009, British Columbia. Contractor to maintain a copy on-site at all times.

.3 ASTM International

.1 ASTM A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

.2 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.

.3 ASTM B88M(2011), Standard Specification for Seamless Copper Water Tube Metric.

.4 ASTM C117, Standard Test Methods for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.

.5 ASTM C136, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.

.6 ASTM D698, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).

.4 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.

.5 CSA International

.1 CAN/CSA-B137 Series-09, Thermoplastic Pressure Piping Compendium. (Consists of B137.0, B137.1, B137.2, B137.3, B137.4, B137.4.1, B137.5, B137.6, B137.8, B137.9, B137.10, B137.11 and B137.12).

.1 CAN/CSA-B137.1, Polyethylene Pipe, Tubing, and Fittings for Cold-Water Pressure Services.

.2 CAN/CSA-B137.3, Rigid Polyvinyl Chloride (PVC) Pipe for Pressure Applications.

.2 CSA G30.18-09, Carbon and Steel Bars for Concrete Reinforcement.

.6 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S520, Standard for Fire Hydrants.

.2 CAN/ULC-S543, Standard for Internal-Lug, Quick Connect Couplings for Fire Hose.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Pipe certification to be on pipe.

.3 Submit plan for cutting, handling, and disposing of asbestos cement pipe prior to construction. Identify disposal site. All work to be in accordance with WorkSafeBC and

1.4 DELIVERY, STORAGE AND HANDLING

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

.2 Storage and Handling Requirements:

.1 Store materials off ground and in accordance with manufacturer's recommendations.

.2 Store and protect water distribution piping from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

1.5 SCHEDULING OF WORK

.1 Schedule Work to minimize interruptions to existing services.

.2 Submit schedule of expected interruptions for approval and adhere to interruption schedule as approved by Departmental Representative.

.3 Notify Departmental Representative and occupants minimum of 24 hours in advance of interruption in service.

.4 Notify fire department of planned or accidental interruption of water supply to hydrants.

.5 Provide and post "Out of Service" sign on hydrant not in use.

.6 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 AWWA C900, DR 18 (pressure class 235 psi), gasket bell end, cast iron outside diameter.

.1 Joints: push-on integrally thickened bell and spigot type to ASTM D3139 with single elastomeric gasket to ASTM F477.

.2 PVC injection-moulded fittings shall be DR18, conforming to AWWA C907 and certified to CSA B137.2. PVC compound is 12454B according to ASTM D1784.

.3 Bolts to be carbon steel, Grade B to ASTM A307, heavy hex style, zinc plated to ASTM B633. Bolt sizes to AWWA C110

.4 Nuts and washers: to be carbon steel, Grade A, to ASTM A563. Washers to be flat hardened steel to ASTM F436. Nuts and washers to be zinc plated to ASTM B633.

.5 Tie rods to be continuous threaded, quenched and tempered alloyed steel to ASTM A354, Grade BC. To be zinc plated to ASTM B633. Tie rods to be minimum 19mm diameter or greater.

.6 Couplings:

.1 Minimum pressure class: 225 psi

.2 To AWWA C219, with compression gaskets.

.3 Epoxy coated to AWWA C213

.4 Stainless steel bolts and nuts to ASTM F593.

2.2 VALVES AND VALVE BOXES

.1 Valves to open counter clockwise.

.2 Gate valves: to AWWA C500 with working pressure of 250 psi, standard iron body, bronze mounted wedge valves with non-rising stems, stem seal to be O-ring type, joints as shown in the Contract Drawings.

.3 Cast iron valve boxes:

.1 Base to be large round type.

.2 Top of box to be marked "WATER".

2.3 SERVICE CONNECTIONS

.1 Underground services line valves and fittings 19 to 50mm to AWWA C800 suitable for 1035 kPa working pressure

.2 HDPE pressure pipe: to CSA-B137.1 and AWWA C901, minimum pressure rating 200 psi.

.3 Corporation stops to be bronze to ASTM B62, AWWA thread inlet, compression type outlet

.4 Curb stops to be bronze to ASTM B62, compression type, inverted key, ball or cylinder type construction utilizing rubber O-ring seals.

.1 All fitting and valve connections on polyethylene to have solid fluted stiffening liners manufactured from stainless steel to ANSI T304 designed for the appropriate type and ID of pipe.

.5 Service valve boxes:

.1 Curb stop valve boxes on 25mm diameter and smaller services to be telescoping assembly comprised of threaded cast iron top with bronze pentagon centre plug, 25 NPS iron pipe, cast iron base allowing threaded insertion of 25 NPS pipe and accommodation for curb stop valve and 14mm diameter steel operating rod attached to curb stop valve with bronze cotter pin.

.6 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.

.7 Tee connections: for services above 100mm. 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.

2.4 PIPE BEDDING AND SURROUND MATERIAL

.1 Granular material to: Section 31 23 33.01 – Excavating, Trenching and Backfilling

.2 Concrete mixes and materials required for bedding cradles, encasement, supports, thrust blocks: to Section 03 30 00 - Cast-in-Place Concrete.

2.5 BACKFILL MATERIAL

.1 As per Section 31 23 33.01 - Excavating, Trenching and Backfilling.

2.6 PIPE DISINFECTION

.1 Sodium hypochlorite, Calcium hypochlorite to AWWA B300 to disinfect water mains.

.2 Disinfect water mains in accordance with AWWA C651.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for distribution piping installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate and inform Departmental Representative of unacceptable conditions immediately upon discovery.

.2 Proceed with installation only after unacceptable conditions have been remedied.

3.2 PREPARATION

.1 Clean pipes, fittings, valves, hydrants, and appurtenances of accumulated debris and water before installation.

.1 Inspect materials for defects.

.2 Remove defective materials from site.

3.3 TRENCHING

.1 Do trenching work in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

.2 Ensure trench depth allows coverage over pipe of 0.9 m minimum from finished grade.

3.4 GRANULAR BEDDING

.1 Place granular bedding material in uniform layers not exceeding 150 mm compacted thickness to depth as indicated 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 95% minimum of corrected maximum dry density.

.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 with compacted bedding material.

3.5 PIPE INSTALLATION

.1 Terminate and cap building water service 1m outside building wall opposite point of connection to main with allowances made for testing and disinfection.

.1 Install coupling necessary for connection to building plumbing.

.2 If plumbing is already installed, make connection; otherwise cap or seal end of pipe and place temporary marker to locate pipe end.

.2 Lay pipes to AWWA C600 manufacturer's standard instructions and specifications.

.1 Do not use blocks except as specified.

.3 Join pipes in accordance with manufacturer's recommendations.

.4 Bevel or taper ends of PVC pipe to match fittings.

.5 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.

.6 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.

.7 Face socket ends of pipe in direction of laying. For mains on grade of 2% or greater, face socket ends up-grade.

.8 Do not exceed permissible deflection at joints as recommended by pipe manufacturer.

.9 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.

.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.

.1 Cut, handle, and dispose of AC pipe in accordance with all applicable WorkSafeBC, environmental, provincial and federal regulations/guides.

.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 When stoppage of work occurs, block pipes in an approved manner to prevent creep during down time.

.18 Recheck plastic pipe joints assembled above ground after placing in trench to ensure that no movement of joint has taken place.

.19 Do not lay pipe on frozen bedding.

.20 Do hydrostatic and leakage test and have results approved by Departmental Representative before completing surface works.

.21 Backfill remainder of trench.

3.6 VALVE INSTALLATION

.1 Install valves to manufacturer's recommendations at locations as indicated.

.2 Support valves located in valve boxes or valve chambers by means of bedding same as adjacent pipe. Valves not to be supported by pipe.

3.7 SERVICE CONNECTIONS

.1 Terminate building water service 1m outside building wall.

.1 Install coupling necessary for connection to building plumbing.

.2 If plumbing is already installed, make connection, otherwise 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, leakage tests, and disinfection of water main.

.3 Employ only competent workmen equipped with suitable tools to carry out tapping of mains, cutting and flaring of pipes.

.4 Place temporary location marker at ends of plugged or capped unconnected water lines.

.1 Each marker to consist of a stake extending from pipe end at pipe level to 60 mm above grade.

.2 Paint exposed portion of stake blue with designation "WATER SERVICE LINE".

3.8 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 Departmental Representative.

.3 Keep joints and couplings free of concrete.

.4 Do not backfill over concrete within 48 hours after placing.

.5 For restrained joints: use restrained joints as shown in Contract Documents.

3.9 HYDROSTATIC AND LEAKAGE TESTING

.1 Do tests in accordance with AWWA C600.

.2 Provide labour, equipment and materials required to perform hydrostatic and leakage tests hereinafter described.

.3 Notify Departmental Representative at least 48 hours in advance of proposed tests.

.1 Perform tests in presence of Departmental Representative.

.4 Where section of system is provided with concrete thrust blocks, conduct tests at least 5 days after placing concrete.

.5 When testing is done during freezing weather, protect hydrants, valves, joints and fittings from freezing.

.6 Strut and brace caps, bends, tees, and valves, to prevent movement when test pressure is applied.

.7 Open valves.

.8 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.

.9 Fill asbestos cement pipe and concrete pipe at least 24 hours before testing to allow water absorption by pipe material.

.10 Apply leakage test pressure of 1380 kPa minimum after complete backfilling of trench, based on elevation of lowest point in main and corrected to elevation of gauge, for period of 2 hours.

.11 Define leakage as amount of water supplied in order to maintain test pressure for 2 hours.

.12 Do not exceed allowable leakage, including lateral connections.

.13 Locate and repair defects if leakage is greater than amount specified.

.14 Repeat test until leakage is within specified allowance for full length of water main.

3.10 PIPE SURROUND AND BACKFILL

.1 Upon completion of pipe laying and after Departmental Representative has inspected Work in place, surround, cover, and backfill pipes as per Section 31 23 33.01 – Excavating, Trenching, and Backfilling

3.11 FLUSHING AND DISINFECTING

.1 Complete all flushing and disinfection to AWWA C651

.2 Flushing and disinfecting operations: witnessed by Departmental Representative.

.1 Notify Departmental Representative at least 5 days in advance of proposed date when disinfecting operations will begin.

.2 Complete disinfection works concurrent with pressure test.

.3 Flush water mains through available outlets with a sufficient flow of potable water to produce velocity of 0.9 m/s, within pipe until foreign materials have been removed and flushed water is clear and a minimum of one pipe volume has been flushed.

.4 Provide connections and pumps for flushing as required with approved and certified backflow prevention device.

.5 Open and close valves, hydrants and service connections to ensure thorough flushing.

.6 When flushing has been completed introduce strong solution of chlorine of minimum 25 mg/L free chlorine into water main and ensure that it is distributed throughout entire system.

.7 Rate of chlorine application to be proportional to rate of water entering pipe.

.8 Chlorine application to be close to point of filling water main and to occur at same time.

.9 Operate valves, hydrants and appurtenances while main contains chlorine solution.

.10 Flush line to remove chlorine solution after 24 hours.

.1 Provide de-chlorination per AWWA standards for all discharge to the environment using ascorbic acid in a manner approved by the Departmental Representative

.11 Measure chlorine residuals at extreme end of pipe-line being tested.

.1 After 24 hours, take further samples to ensure that there is still not less than 10 ppm of chlorine residual remaining throughout system.

.12 Perform bacteriological tests on water main, after chlorine solution has been flushed out.

.1 Take samples in accordance with AWWA C651.

.2 Should contamination remain or recur during this period, repeat disinfecting procedure.

.3 Contractor to coordinate, deliver and pay for all testing

.13 Take water samples at service connections, in suitable sequence, to test for chlorine residual.

3.12 TIE-INS

.1 Provide a shutdown and tie-in plan to the Departmental Representative for review 5 days prior to any planned shutdowns.

.2 All water service tie-ins to be completed after-hours. Timing to be confirmed with Departmental Representative

.3 Provide a temporary sump and pump for trench de-watering, including any water discharged from watermains. Dirty water shall not enter watermains or services during the tie-in.

.4 Provide clean, square cuts on any watermains or services free of burrs.

.5 Clean, swab and disinfect any materials used for the tie-in per AWWA C651.

.6 Install all couplers, valves, and fittings per manufacturer's recommendation.

.7 When tie-in is complete, slowly fill the watermain and purge air. Flush the line until water runs clear and is free of additional disinfectant. Visually observe all exposed joints for leaks and rectify in a timely manner.

3.13 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

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

.3 Waste Management: separate waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END OF SECTION 33 11 16

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 31 05 00 Common Works Results – Earthworks, Exterior Improvements, and Utilities

.2 Section 32 11 23 – Aggregate Base Courses.

.3 Section 31 23 33.01 - Excavating, Trenching and Backfilling.

1.2 REFERENCES

.1 ASTM International

.1 ASTM C117, Standard Test Method for Material Finer Than 75 MU m (No. 200) Sieve in Mineral Aggregates by Washing.

.2 ASTM C136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

.3 ASTM D698-07e1, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft4-lbf/ft3 (600 kN-m/m3)).

.4 ASTM D2680-01, Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping.

.5 ASTM D3034, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

.2 Master Municipal Contract Documents (MMCD), Platinum Edition Volume II - 2009, British Columbia. Contractor to maintain a copy on-site at all times.

.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 CSA International

.1 CSA A3000-08, Cementitious Materials Compendium.

.2 CSA A257 Series-09, Standards for Concrete Pipe and Manhole Sections.

.3 CSA B1800-11, Thermoplastic Non-pressure Pipe Compendium.

.1 CSA B182.1, Plastic Drain and Sewer Pipe and Pipe Fittings.

.2 CSA B182.2, PSM Type Polyvinylchloride PVC Sewer Pipe and Fittings.

.3 CSA B182.11, Standard Practice for the Installation of Thermoplastic Drain, Storm, and Sewer Pipe and Fittings.

.5 U.S. Environmental Protection Agency (EPA) / Office of Water

.1 EPA 832/R-92-005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Pipe certification to be on pipe.

1.4 DELIVERY, STORAGE AND HANDLING

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

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

.3 Storage and Handling Requirements:

.1 Store materials in accordance with manufacturer's recommendations.

.2 Store and protect pipes from damage.

.3 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

2.1 PLASTIC PIPE

.1 Type PSM Polyvinyl Chloride (PVC): to CSA B182.2.

.1 Standard Dimensional Ratio (SDR), 150mm diameter and less: SDR28, greater than 150mm: SDR 35.

.2 Gasket and integral bell system.

.3 Nominal lengths: 4 m.

2.2 SERVICE CONNECTIONS

.1 Plastic pipe: PVC DR 28 to CSA B182.1, with push-on joints.

2.3 PIPE BEDDING AND SURROUND MATERIALS

.1 As indicated on drawings and in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling

.2 Concrete mixes and materials for bedding, cradles, encasement, supports: in accordance with Section 03 30 00 - Cast-in-Place Concrete.

2.4 BACKFILL MATERIAL

.1 As indicated on drawings and in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

.2 Unshrinkable fill: in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

PART 3 - EXECUTION

3.1 PREPARATION

.1 Temporary Erosion and Sedimentation Control as per Section 31 23 33.01 – Excavating, Trenching, and Backfilling

.2 Clean pipes and fittings of debris and water before installation, and remove defective materials from site.

.3 Clean and dry pipes and fittings before installation.

3.2 TRENCHING

.1 Do trenching Work in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

.2 Protect trench from contents of sewer or sewer connection.

3.3 GRANULAR BEDDING

.1 Place bedding in unfrozen condition.

.2 Place granular bedding material in uniform layers not exceeding 300 mm compacted thickness to depth as indicated.

.3 Shape bed true to grade and to provide continuous, uniform bearing surface for pipe.

.1 Do not use blocks when bedding pipes.

.4 Shape transverse depressions as required to suit joints.

.5 Compact each layer full width of bed to at least 95 % Modified Proctor Density to ASTM D155.

.6 Fill excavation below bottom of specified bedding adjacent to manholes or catch basins with lean mix concrete compacted bedding material.

3.4 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 Joint deflection permitted within limits recommended by pipe manufacturer.

.6 Water to flow through pipes during construction only as 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 CAN/CSA-B1800.

.9 When any stoppage of Work occurs, restrain pipes as directed by Departmental Representative, to prevent "creep" during down time.

.10 Plug lifting holes with Departmental Representative approved prefabricated plugs, set in shrinkage compensating grout.

.11 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.

.12 Make watertight connections to manholes.

.1 Use shrinkage compensating grout when suitable gaskets are not available.

.13 Use prefabricated saddles or approved field connections for connecting pipes to existing sewer pipes.

.1 Joint to be structurally sound and watertight.

.14 Temporarily plug open upstream ends of pipes with removable watertight concrete, steel or plastic bulkheads.

3.5 PIPE SURROUND

.1 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.

.2 Hand place surround material in uniform layers not exceeding 300 mm compacted thickness as indicated.

.1 Do not dump material within 3 m of pipe.

.3 Place layers uniformly and simultaneously on each side of pipe.

.4 Compact each layer full width of bed to at least 95 % Modified Proctor Density to ASTM D155.

.5 When field test results are acceptable to Departmental Representative, place surround material at pipe joints.

3.6 BACKFILL

.1 Place backfill material in unfrozen condition.

.2 Place backfill material, above pipe surround, in uniform layers not exceeding 300 mm compacted thickness up to grades as indicated.

.3 Compact each layer full width of bed to at least 95 % Modified Proctor Density to ASTM D155.

.4 Place unshrinkable backfill in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

3.7 SERVICE CONNECTIONS

.1 Install pipe to CSA B182.1 and to manufacturer's instructions and specifications.

.2 Maintain grade for 100mm diameter sewers at 2% unless directed otherwise by Departmental Representative.

.3 Service connections to main sewer: standard Wye fitting or 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 4 pipe diameters.

.1 Use long sweep bends where applicable.

.6 Plug service laterals with water tight caps or plugs.

.7 Place location marker at ends of plugged or capped unconnected sewer lines.

.1 Each marker: stake extending from pipe end at pipe level to 0.6 m above grade.

.2 Paint exposed portion of stake red.

3.8 FIELD TESTING AND INSPECTIONS

.1 Provide means of access to permit Departmental Representative to do inspections.

.2 Repair or replace pipe, pipe joint or bedding found defective.

.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 closed circuit television camera, photographic camera or by other related means. Contractor will pay for costs of tests. Work to be completed to MMCD 33 01 30.1 – CCTV Inspection of Pipelines and 33 01 30.2 – Cleaning of Sewers.

.2 Submit reports to Departmental Representative within 10 working days of completion of the field work on a continuous basis as the inspection area or pipeline types are finalized.

.3 Submit inspection report, digital video on DVD-R and corresponding digital report on CD-R to Departmental Representative for review.

3.9 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

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

END OF SECTION 33 31 13

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 31 05 00 Common Works Results – Earthworks, Exterior Improvements, and Utilities

.2 Section 32 11 23 – Aggregate Base Courses.

.3 Section 31 23 33.01 Excavating, Trenching and Backfilling.

1.2 REFERENCES

.1 Master Municipal Contract Documents (MMCD), Platinum Edition Volume II - 2009, British Columbia. Contractor to maintain a copy on-site at all times.

.2 ASTM International

.1 ASTM C117, Standard Test Method for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.

.2 ASTM C136, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.

.3 ASTM C443M, Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric).

.4 ASTM D698-12e2, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³(600 kN- m/m³)).

.5 ASTM D1557-12e1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lb/ft^3 (2,700 kN-m/m^3)).

.6 ASTM D1056, Standard Specification for Flexible Cellular Materials- Sponge or Expanded Rubber.

.7 ASTM D2680-01, Standard Specification for Acrylonitrile- Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping.

.8 ASTM D3034, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

.9 ASTM F405, Standard Specification for Corrugated Polyethylene (PE) Tubing and Fittings.

.10 ASTM F794-03, Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.

.11 ASTM A760, Standard Specification for Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains

.3 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-8.1-M89, Sieves, Testing, Woven Wire, Inch Series.

.2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.

.3 CAN/CGSB-34.9, Asbestos-Cement Sewer Pipe.

.4 CSA International

.1 CAN/CSA-A3000, Cementitious Materials Compendium.

.2 CAN/CSA-B1800, Thermoplastic Non-pressure Pipe Compendium - B1800 Series.

.3 CSA G401, Corrugated Steel Pipe Products.

.5 U.S. Environmental Protection Agency (EPA) / Office of Water

.1 EPA 832/R-92, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

1.3 SCHEDULING

.1 Schedule Work to minimize interruptions to existing services and to maintain existing flow during construction.

.2 Submit schedule of expected interruptions for approval and adhere to approved schedule.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's recent test data and certification that materials to be incorporated in to the works are representative and meet the requirements for this section. Include manufacture's drawings where pertinent

.3 Certification to be marked on pipe.

1.5 DELIVERY, STORAGE AND HANDLING

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

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

.3 Storage and Handling Requirements:

.1 Store materials in accordance with manufacturer's recommendations.

.2 Store and protect pipes from damage.

.3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan Waste Reduction Work plan related to Work of this Section.

.1 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan Waste Reduction Work plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal Section.

PART 2 - PRODUCTS

2.1 OIL WATER SEPARATORS

.1 Oil water separators are to have the following minimum standards:

.1 Minimum 595 litre capacity

.2 AASHTO HS20 live loading

.3 12 gauge galvanized baffles

.4 PVC SDR28 tees on the inlet and outlet

.5 Minimum concrete strength: 35 MPa

.6 Concrete lid with 635mm diameter opening and round cast iron casting

.7 Additionally, for the vehicle wash oil water separator:

.1 Coalescing plates, 8mm spacing

.2 Influent oil = 100mg/l

.3 Effluent oil <=15 mg/l

.4 Max. flow rate 5.3 l/s

2.2 PLASTIC PIPE

.1 Type PSM Poly Vinyl Chloride (PVC): to ASTM D3034 CAN/CSA-B182.2.

.1 Standard Dimensional Ratio (SDR), 150mm diameter and less: SDR28, greater than 150mm: SDR 35.

.2 Locked-in Separate gasket and integral bell system.

.2 Corrugated polyethylene pipe: high density to ASTM F667 ASTM F405 BNQ- 3624-115.

2.3 CORRUGATED STEEL PIPE

.1 Pipe to CSA G401, except external helical corrugation pattern to be 19mm x 19mm x 190mm as described in AASHTO M36 or ASTM A760.

.2 Pipe material: galvanized Type II

.3 Pipe wall thickness: in accordance with manufacturer's recommendations given minimum and maximum cover limits and condition.

.4 Couplers: hugger band type complete with O-ring gasket. Coupler to be 500mm wide.

.5 Maximum installed vertical deflection not to exceed 5% of base inside diameter. Maximum installed horizontal deflection not to exceed 3% of base inside diameter.

2.4 PIPE BEDDING AND SURROUND MATERIAL

.1 As indicated on drawings and in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling

.2 Concrete mixes and materials for bedding, cradles, encasement, supports: in accordance with Section 03 30 00 - Cast-in-Place Concrete.

2.5 BACKFILL MATERIAL

.1 As indicated on drawings and in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

.2 Unshrinkable fill: in accordance with Section 31 23 33.01 - 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.

3.2 TRENCHING

.1 Do trenching Work in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

.2 Protect trench from contents of sewer.

3.3 GRANULAR BEDDING

.1 Place bedding in unfrozen condition.

.2 Place granular bedding material in uniform layers not exceeding 300 mm compacted thickness to depth as indicated.

.3 Shape bed true to grade and to provide continuous, uniform bearing surface for pipe.

.4 .1 Do not use blocks when bedding pipes.

.5 Shape transverse depressions as required to suit joints.

.6 Compact each layer full width of bed to at least 95 % Modified Proctor Density to ASTM D155.

.7 Fill excavation below bottom of specified bedding adjacent to manholes or catch basins with lean mix concrete compacted bedding material.

3.4 INSTALLATION

.1 Install culverts in accordance with MMCD 33 42 13 – Pipe Culverts

.2 Lay and join pipe in accordance with manufacturer's recommendations and to approval of Departmental Representative.

.3 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.

.4 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.

.5 Begin laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.

.6 Joint deflection permitted within limits recommended by pipe manufacturer.

.7 Water to flow through pipes during construction only as 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 CAN/CSA-B1800.

.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.

3.5 PIPE SURROUND

.1 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.

.2 Hand place surround material in uniform layers not exceeding 300 mm compacted thickness as indicated.

.1 .Do not dump material within 3 m of pipe.

.3 Place layers uniformly and simultaneously on each side of pipe.

.4 Compact each layer full width of bed to at least 95 % Modified Proctor Density to ASTM D155.

.5 When field test results are acceptable to Departmental Representative, place surround material at pipe joints.

3.6 BACKFILL

.1 Place backfill material in unfrozen condition.

.2 Place backfill material, above pipe surround, in uniform layers not exceeding 300 mm compacted thickness up to grades as indicated.

.3 Compact each layer full width of bed to at least 95 % Modified Proctor Density to ASTM D155.

.4 Place unshrinkable backfill in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

3.7 SERVICE CONNECTIONS

.1 Install pipe to CSA B182.1 and to manufacturer's instructions and specifications.

.2 Maintain grade for 100mm diameter sewers at 2% unless directed otherwise by Departmental Representative.

.3 Service connections to main sewer: standard Wye fitting or 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 4 pipe diameters.

.1 Use long sweep bends where applicable.

.6 Plug service laterals with water tight caps or plugs.

.7 Place location marker at ends of plugged or capped unconnected sewer lines.

.1 Each marker: stake extending from pipe end at pipe level to 0.6 m above grade.

.2 Paint exposed portion of stake green.

3.8 FIELD TESTS AND INSPECTIONS

.1 Provide means of access to permit Departmental Representative to do inspections.

.2 Repair or replace pipe, pipe joint or bedding found defective.

.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 closed circuit television camera, photographic camera or by other related means. Contractor will pay for costs of tests. Work to be completed to MMCD 33 01 30.1 – CCTV Inspection of Pipelines and 33 01 30.2 – Cleaning of Sewers.

.2 Submit reports to Departmental Representative within 10 working days of completion of the field work on a continuous basis as the inspection area or pipeline types are finalized.

.3 Submit inspection report, digital video on DVD-R and corresponding digital report on CD-R to Departmental Representative for review.

3.9 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

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

END OF SECTION 33 41 00

PART 1- GENERAL

1.1 RELATED SECTIONS

.1 This Section of the Specifications forms part of the Contract Documents and shall be read, interpreted and coordinated with all other parts.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.2 No. 211.1, Rigid Types EBI and DB2/ES2 PVC Conduit.

.2 CSA C22.2 No. 211.3, Reinforced Thermosetting Resin Conduit (RTRC) and Fittings (Bi-national standard, with UL 1684).

PART 2 - PRODUCTS

2.1 PVC DUCTS AND FITTINGS

.1 Rigid PVC duct: to CSA C22.2 No. 211.1, Type DB2/ES2, with fabricated fittings, for direct burial, Trade size 5 or 6. Nominal length: 3 m plus or minus 12 mm.

.2 Rigid PVC split ducts.

.3 Rigid PVC bends, couplings, reducers, bell end fittings, plugs, caps, adaptors same product material as duct, to make complete installation.

.4 Rigid PVC 90 degrees and 45 degrees bends.

.5 Rigid PVC 5 degrees angle couplings.

.6 Expansion joints as required.

2.2 SOLVENT WELD COMPOUND

.1 Solvent cement for PVC duct joints.

2.3 FIBREGLASS DUCTS

.1 Fibreglass reinforced thermoset duct: to CSA C22.2 No. 211.3, Trade size 5 or 6, watertight type.

.2 Couplings, reducers, plugs, caps, adaptors, and supports to make complete installation.

.3 Expansion joints as required.

2.4 PLASTIC POLYETHYLENE PIPE

.1 Rigid plastic polyethylene pipe with approved couplings and fittings required to make complete installation.

2.5 CABLE PULLING EQUIPMENT

.1 6 mm stranded nylon pull rope tensile strength 5 kN.

2.6 MARKERS

.1 Concrete type cable markers: as indicated, with words: "Cable", "Joint" or "Conduit" impressed in top surface, with arrows to indicate change in direction of duct runs.

.2 Cedar post type markers: 89 x 89mm square, 1.5 m long, pressure treated with clear, copper napthenate or 5% pentachlorophenol solution, water repellent preservative, with nameplate fastened near post top, on side facing duct.

.1 Nameplate: aluminum anodized 89 x 125 mm, 1.5mm thick mounted on cedar post with mylar label 0.125 mm thick with words "Cable" "Joint" or "Conduit" with arrows to indicate change in direction.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install duct in accordance with manufacturer's instructions.

.2 Clean inside of ducts before laying.

.3 Ensure full, even support every 1.5 m throughout duct length.

.4 Slope ducts with 1 to 400 minimum slope.

.5 During construction, cap ends of ducts to prevent entrance of foreign materials.

.6 Pull through each duct steel mandrel not less than 300 mm long and of diameter 6 mm less than internal diameter of duct, followed by stiff bristle brush to remove sand, earth and other foreign matter.

.7 Pull stiff bristle brush through each duct immediately before pulling-in cables.

.8 In each duct install pull rope continuous throughout each duct run with 3m spare rope at each end.

.9 Install markers as required.

END OF SECTION 33 65 76

PORT HARDY AIRPORT MAINTENANCE BUILDING

GEOTECHNICAL ASSESSMENT

WSP Canada Inc.

Project No: 161-14582-00
Date: March 2017

WSP Canada Inc.
760 Enterprise Crescent
Victoria, BC V8Z 6R4

Phone: 250-475-1000
Fax: 250-475-2211
www.wspgroup.com

TABLE OF CONTENTS

FIGURES

APPENDICES

1 INTRODUCTION

WSP Canada Inc. (WSP) has completed a geotechnical engineering assessment in support of the design for a proposed maintenance building at the Port Hardy Airport in Port Hardy, BC. We understand that the maintenance building is to be constructed in the current location of a fenced parking compound with its main purpose being to provide an enclosed area to store large airport maintenance equipment. In addition to the building, an asphalt road and parking area will be built in the area immediately surrounding the new building.

Outlined in this report are the findings of a subsurface exploration and laboratory testing program. Discussion is provided with respect to overall geotechnical suitability along with recommendations for site preparation, earthworks and foundations, and road/parking lot design considerations. Attached to this report are figures indicating the location of the site, the location of the exploratory test holes and with appendices containing test pit logs, laboratory test results, and site photographs.

This report supersedes our November 2016 document for the project.

2 SITE DESCRIPTION

The Port Hardy Airport is located at the eastern terminus of Byng Road to the southeast of Port Hardy (Figure 1). The proposed maintenance building is located approximately 44.5 m to the northwest of an existing maintenance building, as shown in Figure 2. The majority of the proposed maintenance building footprint falls within an existing gravel parking lot that is enclosed by a chain link fence. WSP understands that the area of the proposed building was once used as an asphalt plant.

The southeastern most portion of the proposed building footprint was located within the gravel shoulder of an asphalt surfaced yard area behind the existing maintenance building. An approximately 20 m long gravel access road from Byng Road lead to the fenced parking lot. The site was relatively flat lying, with a gradual increase in elevation from northwest to southeast of about 0.5 m. Surficial geology maps of the area generally indicate that the near surface soils consist of a mixture of fluvial deposits and organic soils.

3 FIELD AND LABORATORY ASSESSMENT

On 13 October 2016, WSP visited the site to observe the excavation of six test pits in the vicinity of the proposed maintenance building. Prior to the site visit, test pit locations were chosen to provide a general understanding of the soils in the area, but not disturb the soils beneath the proposed building footprint. At the time of the field investigation, two test pits (TP16-02 and TP16-03) were relocated slightly at the request of the airport manager to avoid disturbing the ground within the area enclosed by the fence. Prior to excavation, the test pit locations were marked out and a private utility locates contractor checked and cleared the immediate vicinity of any known underground utilities. -

In general, the conditions encountered in the test pits consisted of:

- Between 0.5 m and 1.2 m of loose to compact, silty sand and gravel fill that contained organics and wood debris, overlying;
- Between 0.3 m and 1.0 m of compact to dense, sand or sand and gravel containing cobbles; overlying;
- Hard, till-like silt and sand containing gravel and cobbles.

Groundwater was encountered within the fill or sand and gravel in all six test pits. Flow volumes varied from minor to relatively heavy. Water was also noted to be sitting on the ground surface during the investigation.

In addition to the six test pits, a penetration test was completed using a Wildcat Dynamic Cone Penetrometer (Wildcat) immediately adjacent to TP16-06. The Wildcat uses a 15.9 kg (35 lb) hammer raised to a height of 381 mm (15 inches) to drive standard sized cone tips and steel rods into the ground. Blow counts are logged every 10 cm and correlations are made to equivalent Standard Penetration Test (SPT) N values. The Wildcat provides trends in soil consistency and relative density of the soil. The Wildcat was advanced to a depth of 1.1 m below surface where it encountered effective penetration refusal.

Detailed test pit logs are shown in Appendix I with the Wildcat results shown on the log from TP16-06. Soil samples collected during the test pit excavations were returned to WSP's laboratory in Nanaimo where visual classification and index testing were completed. An aggregate gradation analyses of a sample of the natural sand and gravel from TP16-06 is attached. All test pits were backfilled with excavated material which was packed with the excavator bucket.

4 DISCUSSION AND RECOMMENDATIONS

4.1 GENERAL

Based on the results of this assessment, the proposed maintenance building site is considered to be geotechnically suitable for the proposed development, provided that the recommendations in this report are followed.

There was no evidence of asphalt materials within the test pits. However, the intent of this report is geotechnical in nature and is not intended for environmental purposes.

The soils encountered in the test pits contained variable amounts of fines (silt sized particles) that would be susceptible to erosion and sediment generation, especially during the wet winter months. Materials with fine grained particles are also more difficult to compact when wet. As such, construction of the project is better suited for the drier summer months. In any case, an effective erosion and sediment control (ESC) plan should be in place and implemented prior to, and during, construction.

4.2 SITE PREPARATION

In general, site preparation will include removal of surface gravels, vegetation, and up to 1.2 m of poor quality fill materials to expose natural, compact sand and gravel and/or hard glacial till. WSP should review and approve the suitability of the exposed natural soil subgrades prior to placement of fill or building elements. Where loosened, the natural granular soils should be recompacted to a minimum of 95% Modified Proctor Maximum Dry Density (MPMDD) prior to placement of fill or foundations.

The test pits that were excavated for this assessment were backfilled in a manner that may not be considered suitable for structural support. The test pits should be identified during construction and where necessary, re-excavated, backfilled, and compacted with suitable materials in a manner that would be appropriate for the intended use.

Groundwater was present at the interface between the glacial till and the sand and gravel soils in the test pits. It is expected that groundwater seepage can be managed by conventional sumps and pumps provided that sediment within the water is suitably managed according to an approved ESC plan.

4.3 MATERIALS

Depending on proposed site grades, engineered (structural) fill may be required to support foundation elements and pavement structures. In general, the existing site fills and natural soils are not considered suitable for use as engineered fill due to their variability, the presence of organics in the fill, and the amount of fines in the natural soils.

In general, engineered fill that may be required to raise subgrade elevations for foundations and pavement structures should be well-graded, granular material with a maximum particle size of 75 mm and less than 5% passing the 0.075 mm (#200) sieve size. Engineered fill should be placed in uniform horizontal lifts with a maximum thickness of 300 mm and compacted to 95% MPMDD. In-place density testing with a nuclear densometer should be carried out to verify compaction densities.

Material recommended for use in pavement structures for parking and site access areas is presented in Table 1. Design thicknesses are presented in Section 4.6.

Table 1. Recommended Gradation of Aggregate for Pavement Structures

Sieve Size (mm)	Percent Passing	
	Sub- Base	Base Course
75	100	100
25	100	100
19	80 – 100	15 – 100
9.5	50 – 85	0 – 100
4.75	35 – 70	
2.36	25 – 50	
1.18	15 – 35	
0.600		0 – 100
0.300	5 – 20	0 – 15
0.075	0 – 5	0 – 5

Pavement structure materials should be placed in uniform horizontal lifts and compacted to 95% MPMDD. In-place density testing should be carried out to verify compaction densities.

4.4 SEISMIC SITE CLASS

The site would be considered as “Site Class C” according to Table 4.1.8.4.A in the National Building Code of Canada 2015.

4.5 FOUNDATIONS AND PERIMETER DRAINAGE

Building foundations can be supported on compact natural sand and gravel, hard till, or engineered fill placed over these natural materials. Recommended factored ultimate and serviceability limit states bearing resistance for strip and spread footings founded on these materials is provided in Table 2.

Table 2. Recommended Bearing Pressures for Building

Bearing Conditions	Factored Ultimate Limit States Bearing Pressure (kPa)	Serviceability Limit States Bearing Pressure (kPa)
Compact natural sand and gravel	225	150
Dense natural glacial till	300	200
Engineered fill over compact or natural dense material	225	150

Footings designed based upon the above materials are expected to have maximum total and differential settlements of 25 mm and 19 mm, respectively.

Footings should be buried a minimum depth of 600 mm for protection against frost action.

The natural till soils are considered to be poor draining and perimeter drains should be installed as per building code requirements.

4.6 PAVEMENT STRUCTURE

It is understood that a pavement structure will be required for parking and to access the site. For the purpose of preliminary design of the pavement structure for the vehicle access and parking areas, we have assumed the following conditions:

- Subgrade will consist of natural sand and gravel and/or glacial till;
- These areas will be considered as a ‘low’ to ‘medium’ volume road with a maximum ESAL of 100,000; and
- The road will be used occasionally by heavy commercial vehicles.

Based upon the above assumptions, a pavement structure is provided in Table 3.

Table 3. Preliminary Pavement Structure

Sub-Base Thickness (mm)	Base Thickness (mm)	Asphalt Pavement (mm)
300	225	75

5 FUTURE GEOTECHNICAL WORK

Future geotechnical related work for this project is expected to consist of the following:

- Preparing Building Code Schedules for the geotechnical discipline;
- Carrying out field reviews and testing during construction; and
- Engineering consultation, as required.

6 CLOSURE

This report has been prepared exclusively for Kasian Architecture Interior Design and Planning Ltd. for application to the proposed new Port Hardy Airport Maintenance building and in accordance with the appended Terms of Reference for Geotechnical Reports. Public Works Government Services Canada is considered to be an approved user of the report subject to the terms and conditions under which it was prepared.

We trust that this report meets your current needs and we look forward to providing further input as the project progresses. Please do not hesitate to contact the undersigned if you required any further information.

Yours truly,

WSP Canada Inc.

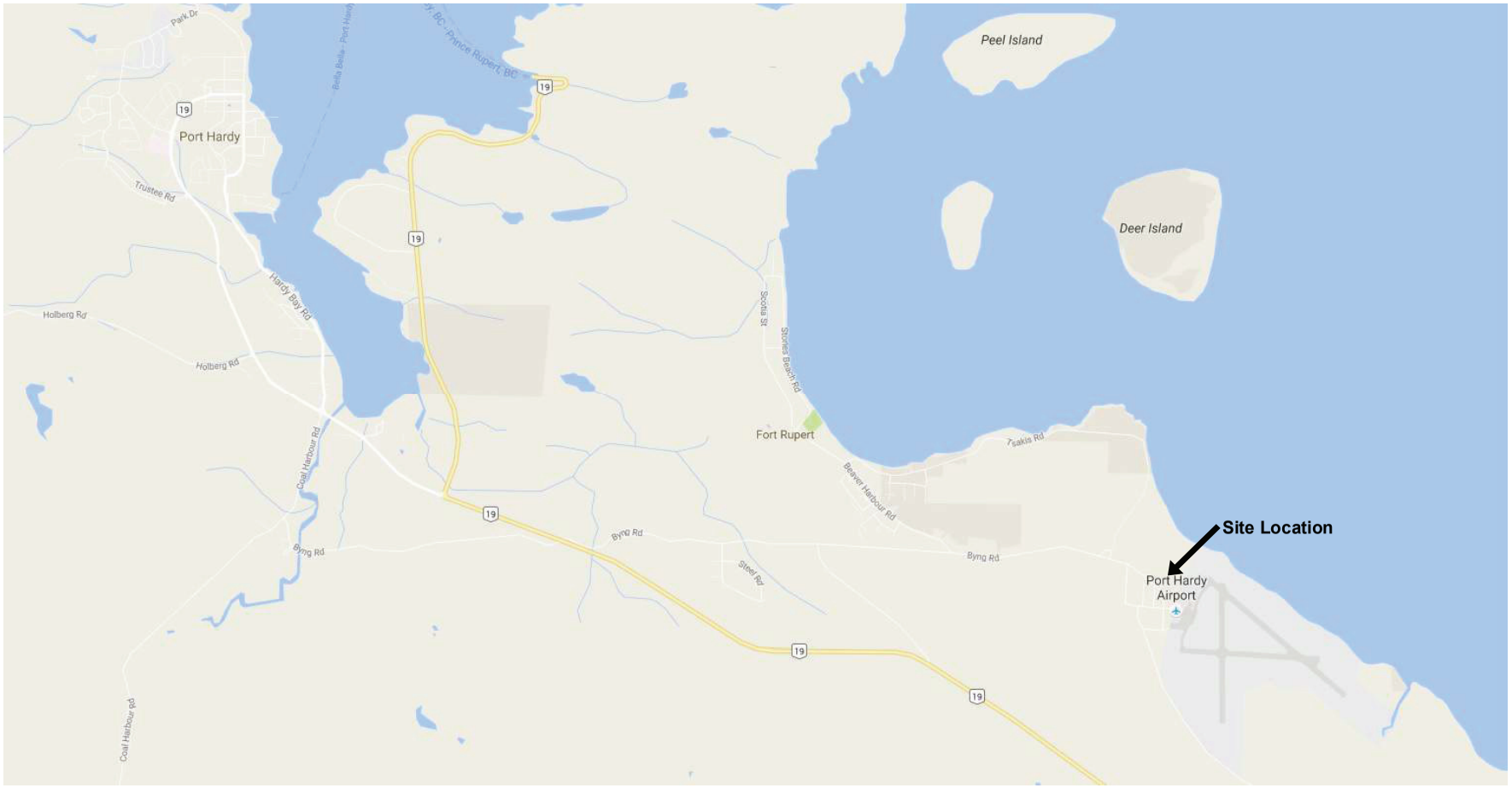
Per: Don Kaluza, P.Eng.
Senior Geotechnical Engineer

Reviewed by:

Tom Oxland, P.Eng
Senior Geotechnical Engineer

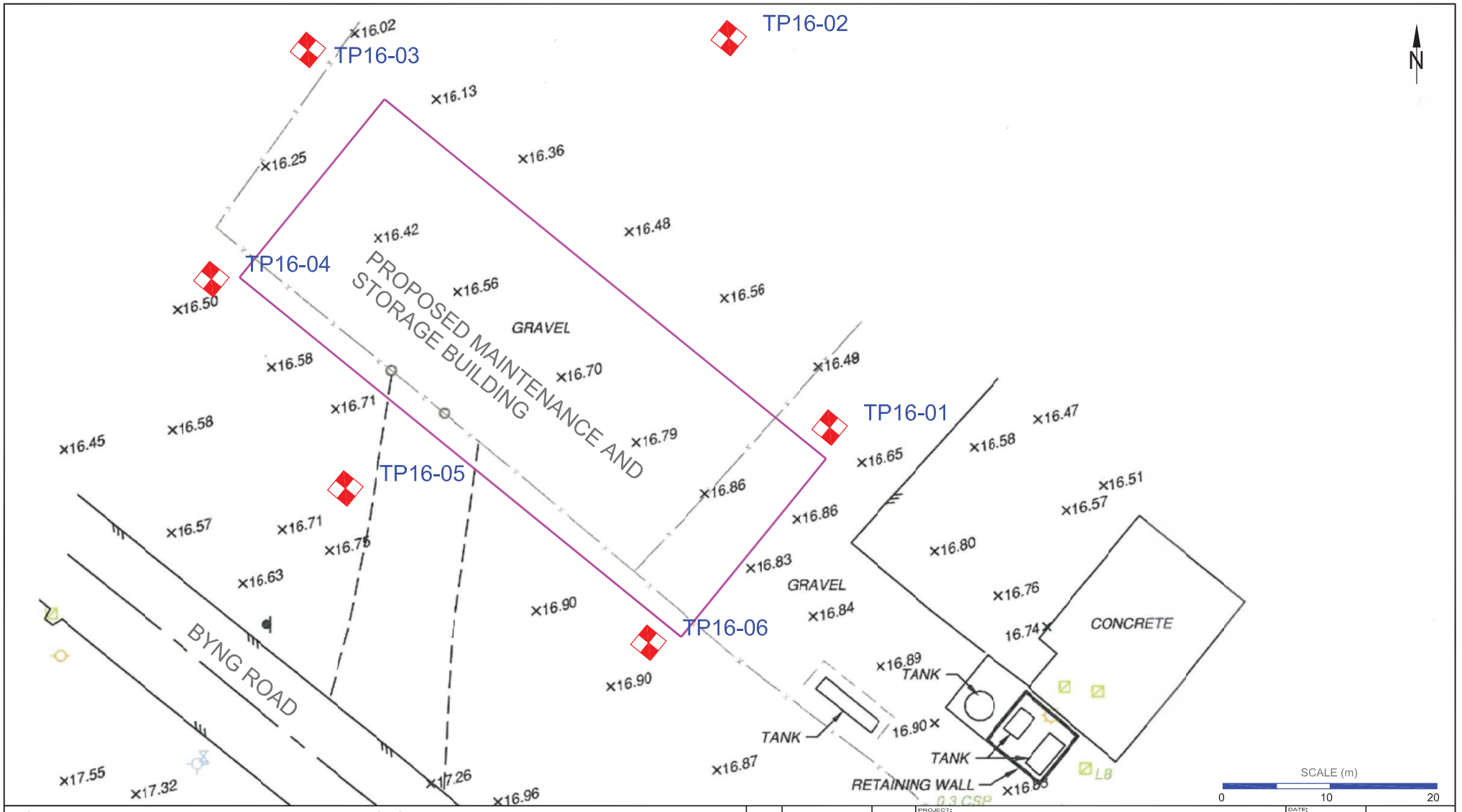
Attachments:

	Figure 1.	Site Location Plan
	Figure 2.	Site Plan
	Appendix I	Test Pit Logs and Laboratory Test Results
	Appendix II	Site Photos
	Appendix III	Terms of Reference for Geotechnical Reports



WSP	PROJECT: Port Hardy Airport Maintenance Building – Geotechnical Assessment			
	TITLE: Site Location Plan			
	CLIENT: Kasian Architecture Interior Design and Planning Ltd.			
FIGURE NO.: 1	DATE: March 2017	FILE NO.: 161-14582-00	SCALE: NTS	DRAWN BY: LM

WSP Canada Inc., 760 Enterprise Crescent, Victoria, B.C., V8Z 6R4 Phone: 250-475-1000 Fax: 250-475-2211



LEGEND:

TEST PIT (APPROX. LOCATIONS)

NOTES:

BASE PLAN PROVIDED BY WSP CANADA INC.

REV. :	DESCRIPTION:	DATE : (M/D/YR)

PROJECT: Port Hardy Maintenance Building - Geotechnical Assessment

CLIENT: Kaslan Architecture Interior Design and Planning Ltd.

TITLE: Site and Test Pit Location Plan

DATE:	March 2017
DESIGN BY:	DEK
DRAWN BY:	DEK
CHECKED BY:	TWO
SCALE:	As Shown
PROJECT No.:	161-14582-00
FIGURE NO.:	2

APPENDIX I

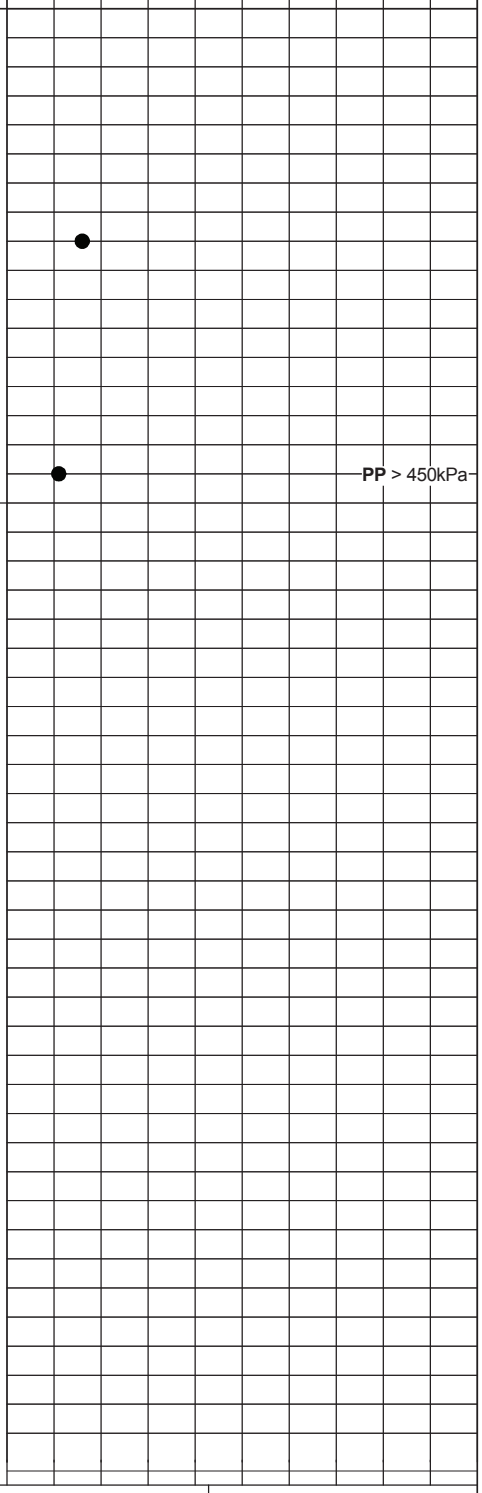
TEST PIT LOGS AND LABORATORY TEST RESULTS

WSP Canada Inc.
760 Enterprise Crescent
Victoria, B.C. V8Z 6R4
Tel: +1 250-475-1000
Fax: +1 250-475-2211
www.wspgroup.com

Port Hardy Airport Maintanance Building
Geotechnical Assessment

TP16-01
Pg 1 of 1
Project No: 161-14582

Depth (m)	Depth (ft)	Description	C	N	Type/ Sample #	Water Level
		loose to compact, brown/grey, silty, SAND and GRAVEL (FILL), poorly graded, maximum particle size = 40 mm, moist, organics, wood debris.				
	2	dense SAND AND GRAVEL			G1	
1	4					
		hard, grey, SILT and SAND (TILL LIKE), some gravel, non plastic, moist, cobbles.			G2	
	6	End of hole at 1.7 m. Minor sloughing within fill. Minor seepage above till. Hole backfilled with bucket packed excavated material.				
2	8					
	10					
3	12					
4	14					
	16					



C: Condition of Sample
Good
Disturbed
No Recovery

Type: Type of Sampler
SPT : 2 in. standard
ST : Shelby
G : Grab
CORE

N: Number of Blows
WH : Weight of Hammer
WR : Weight of Rod
Standard Penetration Test : ASTM D1586
Hammer Type:
DCPT Blow/300 mm

Plastic Limit (%) — Liquid Limit (%)
Moisture Content (%)
Ground Water Level
Shear strength in kPa (Torvane)
PP Pocket Penetrometer (compressive strength in kPa)
Shear strength in kPa (Unconfined)
Shear strength in kPa (Field vane)
Remolded strength in kPa
Percent Passing # 200 sieve

Drill Method: Excavator
Date Drilled: 13/10/2016
Logged by: LM
Checked by: DK

SOIL CLASSIFICATION IN ACCORDANCE WITH THE CANADIAN FOUNDATION ENGINEERING MANUAL 4TH EDITION 2006.

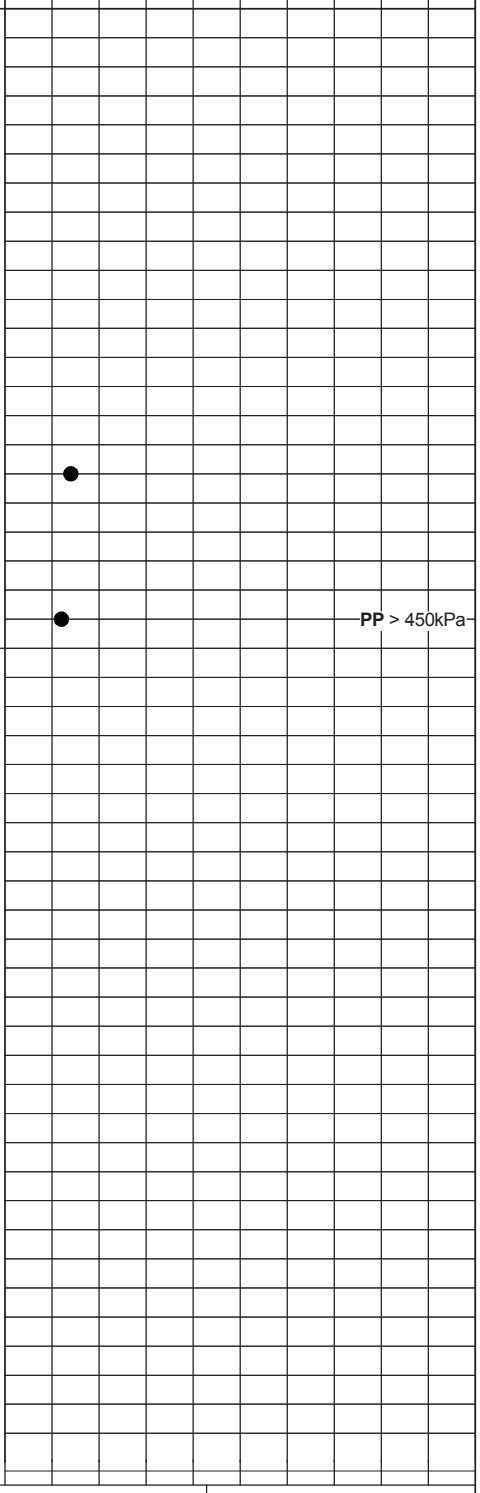
1 LOG PER PAGE 14/3/17

WSP Canada Inc.
760 Enterprise Crescent
Victoria, B.C. V8Z 6R4
Tel: +1 250-475-1000
Fax: +1 250-475-2211
www.wspgroup.com

Port Hardy Airport Maintanance Building
Geotechnical Assessment

TP16-02
Pg 1 of 1
Project No: 161-14582

Depth (m)	Depth (ft)	Description	C	N	Type/ Sample #	Water Level
		loose to compact, brown/grey, silty, SAND and GRAVEL (FILL), poorly graded, maximum particle size = 60 mm, moist, organics, wood debris.				
1	2					
	4	dense, grey, SAND, some gravel, trace fines, poorly graded, maximum size = 30 mm, moist to wet, cobbles.			G1	
	6					
2		- gourndwater seepage at 1.9 m				
		hard, grey, SILT and SAND (TILL LIKE), some gravel, non plastic, moist, cobbles.			G2	
		End of hole at 2.2 m. Minor sloughing within fill. Seepage at 1.9 m. Hole backfilled with bucket packed excavated material.				
	8					
3	10					
	12					
4						
	14					
	16					



C: Condition of Sample
Good
Disturbed
No Recovery

Type: Type of Sampler
SPT : 2 in. standard
ST : Shelby
G : Grab
CORE

N: Number of Blows
WH : Weight of Hammer
WR : Weight of Rod
Standard Penetration Test : ASTM D1586
Hammer Type:
DCPT Blow/300 mm

Plastic Limit (%) — Moisture Content (%) — Liquid Limit (%)
Ground Water Level
Shear strength in kPa (Torvane)
PP Pocket Penetrometer (compressive strength in kPa)
Shear strength in kPa (Unconfined)
Shear strength in kPa (Field vane)
Remolded strength in kPa
Percent Passing # 200 sieve

Drill Method: Excavator
Date Drilled: 13/10/2016
Logged by: LM
Checked by: DK

SOIL CLASSIFICATION IN ACCORDANCE WITH THE CANADIAN FOUNDATION ENGINEERING MANUAL 4TH EDITION 2006.

1 LOG PER PAGE 14/3/17

WSP Canada Inc.
760 Enterprise Crescent
Victoria, B.C. V8Z 6R4
Tel: +1 250-475-1000
Fax: +1 250-475-2211
www.wspgroup.com

Port Hardy Airport Maintanance Building
Geotechnical Assessment

TP16-03
Pg 1 of 1
Project No: 161-14582

Depth (m)	Depth (ft)	Description	C	N	Type/ Sample #	Water Level
		loose to compact, brown/grey, silty, SAND and GRAVEL (FILL), poorly graded, maximum particle size = 60 mm, moist, organics, wood debris.				
1	4	very dense, grey, silty, SAND, some gravel, poorly graded, maximum particle size = 100 mm, moist, cobbles.			G1	
		hard, grey, SILT and SAND (TILL LIKE), some gravel, non plastic, moist, cobbles.			G2	
2	6	End of hole at 1.8 m. Minor sloughing within fill. Minor seepage above till. Hole backfilled with bucket packed excavated material.				
3	10					
4	14					
	16					

10 20 30 40 50 60 70 80 90

PP > 450kPa

C: Condition of Sample
Good
Disturbed
No Recovery

Type: Type of Sampler
SPT : 2 in. standard
ST : Shelby
G : Grab
CORE

N: Number of Blows
WH : Weight of Hammer
WR : Weight of Rod
Standard Penetration Test : ASTM D1586
Hammer Type:
DCPT Blow/300 mm

Plastic Limit (%) — Moisture Content (%) — Liquid Limit (%)
Ground Water Level
Shear strength in kPa (Torvane)
PP Pocket Penetrometer (compressive strength in kPa)
Shear strength in kPa (Unconfined)
Shear strength in kPa (Field vane)
Remolded strength in kPa
Percent Passing # 200 sieve

Drill Method: Excavator
Date Drilled: 13/10/2016
Logged by: LM
Checked by: DK

SOIL CLASSIFICATION IN ACCORDANCE WITH THE CANADIAN FOUNDATION ENGINEERING MANUAL 4TH EDITION 2006.

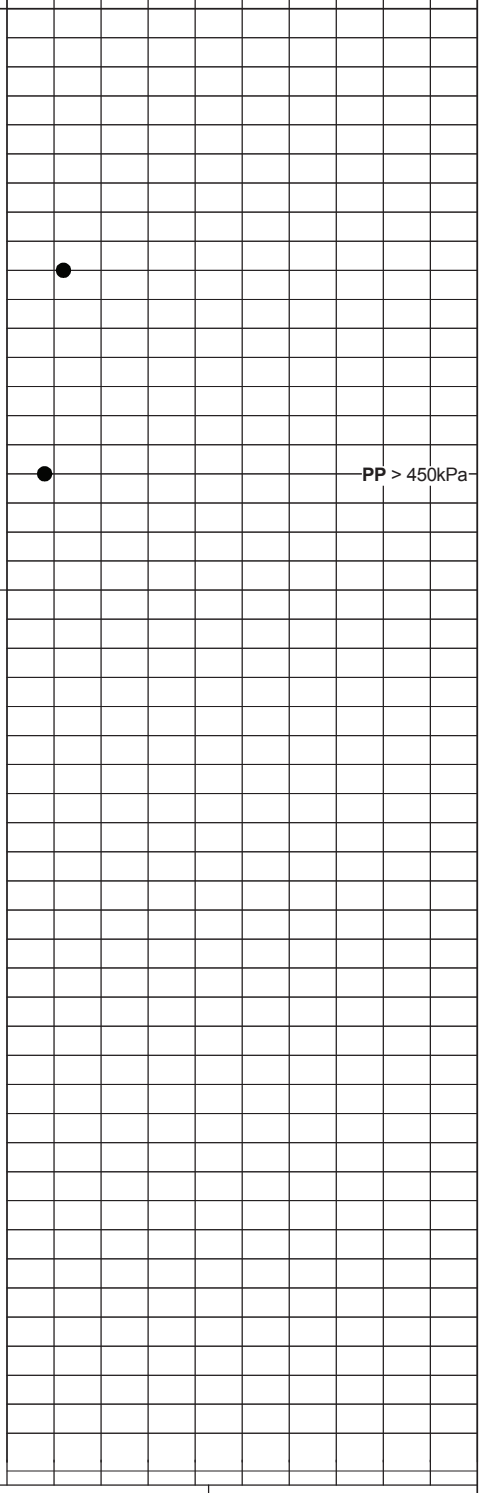
1 LOG PER PAGE 14/3/17

WSP Canada Inc.
760 Enterprise Crescent
Victoria, B.C. V8Z 6R4
Tel: +1 250-475-1000
Fax: +1 250-475-2211
www.wspgroup.com

Port Hardy Airport Maintanance Building
Geotechnical Assessment

TP16-04
Pg 1 of 1
Project No: 161-14582

Depth (m)	Depth (ft)	Description	C	N	Type/ Sample #	Water Level
		loose to compact, brown/grey, silty, SAND and GRAVEL (FILL), poorly graded, maximum particle size = 40 mm, moist, organics, wood debris.				
1	2	very dense, brown, SAND and GRAVEL, trace to some fines, poorly graded, maximum particle size = 100 mm, wet, cobbles. - groundwater seepage at 0.8 m			G1	
	4					
		hard, grey, SILT and SAND (TILL LIKE), some gravel, non plastic, moist, cobbles.			G2	
2	6					
		End of hole at 2.0 m. Hole sloughing above till. Seepage at 0.8 m. Hole backfilled with bucket packed excavated material.				
	8					
3	10					
	12					
4						
	14					
	16					



C: Condition of Sample
Good
Disturbed
No Recovery

Type: Type of Sampler
SPT : 2 in. standard
ST : Shelby
G : Grab
CORE

N: Number of Blows
WH : Weight of Hammer
WR : Weight of Rod
Standard Penetration Test : ASTM D1586
Hammer Type:
DCPT Blow/300 mm

Plastic Limit (%) — Liquid Limit (%)
Moisture Content (%)
Ground Water Level
Shear strength in kPa (Torvane)
PP Pocket Penetrometer (compressive strength in kPa)
Shear strength in kPa (Unconfined)
Shear strength in kPa (Field vane)
Remolded strength in kPa
Percent Passing # 200 sieve

Drill Method: Excavator
Date Drilled: 13/10/2016
Logged by: LM
Checked by: DK

SOIL CLASSIFICATION IN ACCORDANCE WITH THE CANADIAN FOUNDATION ENGINEERING MANUAL 4TH EDITION 2006.

1 LOG PER PAGE 14/3/17

WSP Canada Inc.
760 Enterprise Crescent
Victoria, B.C. V8Z 6R4
Tel: +1 250-475-1000
Fax: +1 250-475-2211
www.wspgroup.com

Port Hardy Airport Maintanance Building
Geotechnical Assessment

TP16-05
Pg 1 of 1
Project No: 161-14582

Depth (m)	Depth (ft)	Description	C	N	Type/ Sample #	Water Level
		loose to compact, brown/grey, silty, SAND and GRAVEL (FILL), poorly graded, maximum particle size = 40 mm, moist, organics, wood debris.				
1	2					
	4	very dense, brown, SAND and GRAVEL, trace to some fines, poorly graded, maximum particle size = 300 mm, moist cobbles.			G1	
		hard, grey, SILT and SAND (TILL LIKE), some gravel, non plastic, moist, cobbles.			G2	
	6	End of hole at 1.8 m. Minor sloughing within fill. Minor seepage above till. Hole backfilled with bucket packed excavated material.				
2	8					
3	10					
	12					
4	14					
	16					

10 20 30 40 50 60 70 80 90

PP > 450kPa

C: Condition of Sample
Good
Disturbed
No Recovery

Type: Type of Sampler
SPT : 2 in. standard
ST : Shelby
G : Grab
CORE

N: Number of Blows
WH : Weight of Hammer
WR : Weight of Rod
Standard Penetration Test : ASTM D1586
Hammer Type:
DCPT Blow/300 mm

Plastic Limit (%) ▶ ● ◀ Liquid Limit (%)
Moisture Content (%)

- Ground Water Level
- Shear strength in kPa (Torvane)
- **PP** Pocket Penetrometer (compressive strength in kPa)
- Shear strength in kPa (Unconfined)
- Shear strength in kPa (Field vane)
- Remolded strength in kPa
- Percent Passing # 200 sieve

Drill Method: Excavator
Date Drilled: 13/10/2016
Logged by: LM
Checked by: DK

SOIL CLASSIFICATION IN ACCORDANCE WITH THE CANADIAN FOUNDATION ENGINEERING MANUAL 4TH EDITION 2006.

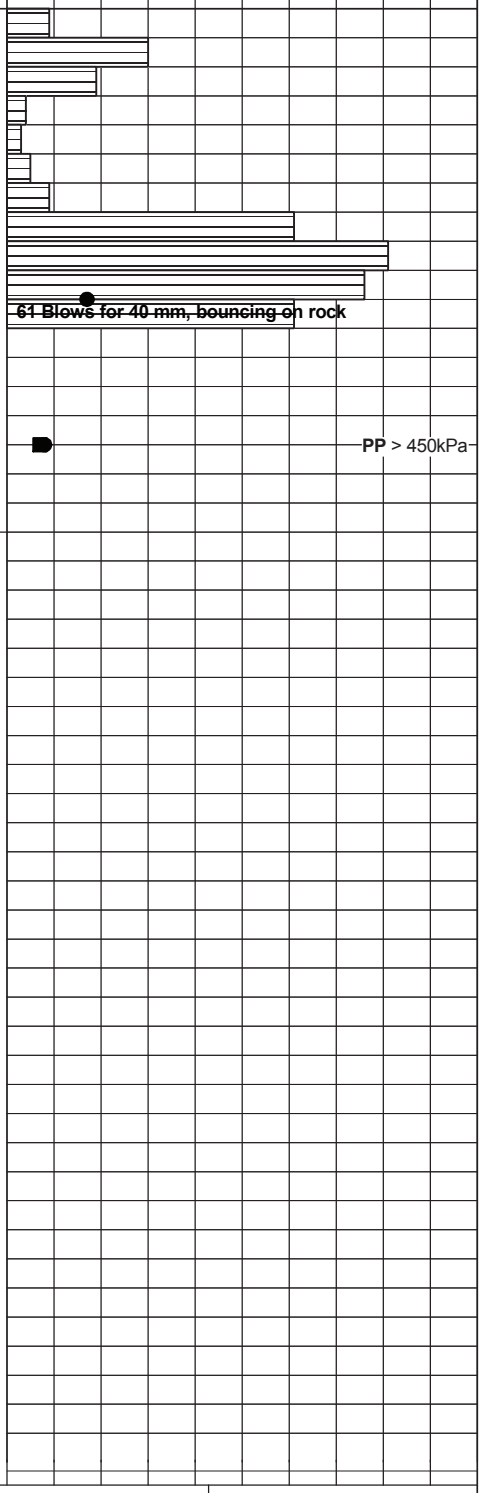
1 LOG PER PAGE 14/3/17

WSP Canada Inc.
760 Enterprise Crescent
Victoria, B.C. V8Z 6R4
Tel: +1 250-475-1000
Fax: +1 250-475-2211
www.wspgroup.com

Port Hardy Airport Maintanance Building
Geotechnical Assessment

TP16-06
Pg 1 of 1
Project No: 161-14582

Depth (m)	Depth (ft)	Description	C	N	Type/ Sample #	Water Level
		loose to compact, brown/grey, silty, SAND and GRAVEL (FILL), poorly graded, maximum particle size encountered = 60 mm, moist, organics, wood debris.				
1	2	very dense, brown, SAND and GRAVEL, trace fines, poorly graded, maximum particle size encountered = 100 mm, moist cobbles. - groundwater seepage at 0.9 m			G1	
	4	hard, grey, SILT and SAND (TILL LIKE), some gravel, non plastic, moist, cobbles.			G2	
	6	End of hole at 1.8 m. Hole sloughing above till. Seepage at 0.9 m. Hole backfilled with bucket packed excavated material.				
2	8					
3	10					
	12					
4	14					
	16					



C: Condition of Sample
Good
Disturbed
No Recovery

Type: Type of Sampler
SPT : 2 in. standard
ST : Shelby
G : Grab
CORE

N: Number of Blows
WH : Weight of Hammer
WR : Weight of Rod
Standard Penetration Test : ASTM D1586
Hammer Type:
DCPT Blow/300 mm

Plastic Limit (%) ▶ ● ◀ Liquid Limit (%)
Moisture Content (%)
Ground Water Level
Shear strength in kPa (Torvane)
PP Pocket Penetrometer (compressive strength in kPa)
Shear strength in kPa (Unconfined)
Shear strength in kPa (Field vane)
Remolded strength in kPa
Percent Passing # 200 sieve

Drill Method: Excavator
Date Drilled: 13/10/2016
Logged by: LM
Checked by: DK

SOIL CLASSIFICATION IN ACCORDANCE WITH THE CANADIAN FOUNDATION ENGINEERING MANUAL 4TH EDITION 2006.

1 LOG PER PAGE 14/3/17

WSP Canada Inc.

1935 Bollinger Road
Nanaimo, BC
Canada V9S 5W9
Tel.: 250-753-1077
Fax.: 250-753-1203
E-mail: nanaimo@wspgroup.com

AGGREGATE GRADATION ANALYSIS

IDENTIFICATION:

Client: WSP Canada Inc.
Project: Port Hardy Airport Maintenance Building
Sample Location: TP16-06 G1 @ 1.0m

File No.: 161-14582-00
Report No.: 4473
Date: 20-Oct-16

SAMPLING INFORMATION:

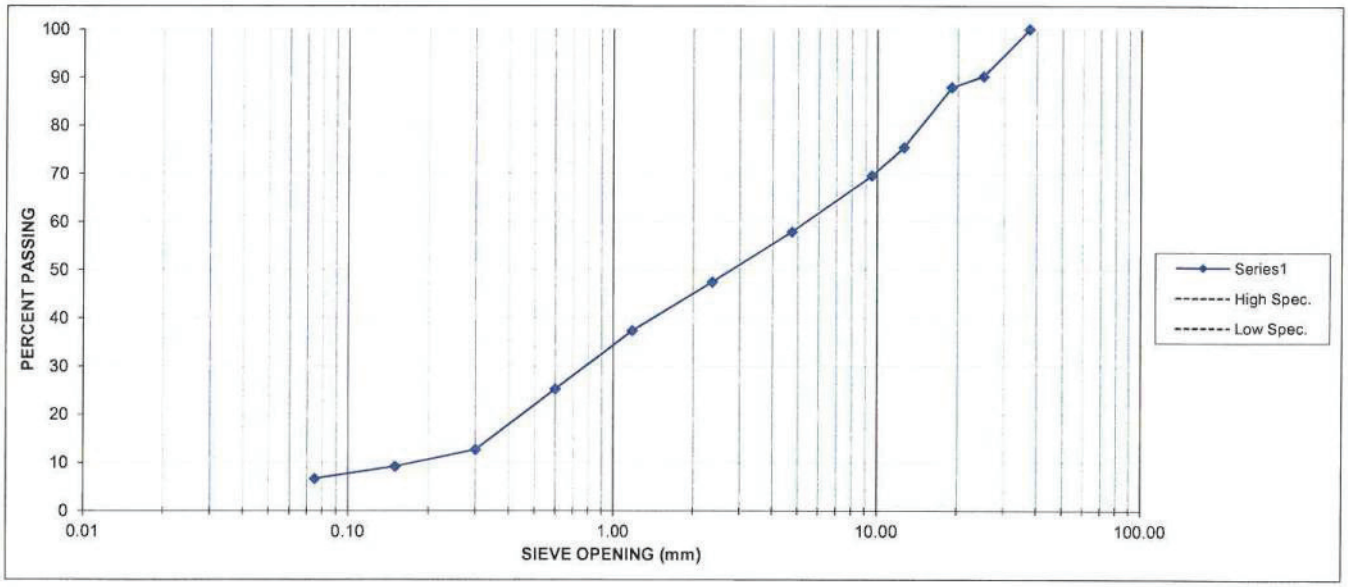
Material: Sand with gravel, some silt
Specification:

Date Sampled	13-Oct-16
Date Tested	20-Oct-16
Sample No:	4473
Fracture by Count:	n/a
Supplier:	In-Situ
Sampled by:	LM
Tested by:	EL

Material Specification		
Sieve	High Spec.	Low Spec.

Sieve Analysis	
Sieve	% Passing
100	100.0
75	100.0
50	100.0
37.5	100.0
25	90.3
19	88.0
12.5	75.5
9.5	69.6
4.75	57.9
2.36	47.5
1.18	37.4
0.600	25.2
0.300	12.7
0.150	9.2
0.075	6.7

AGGREGATE GRADATION:



REMARKS: Tested in accordance with ASTM C- 136 and C-117

REPORTS TO:

WSP CANADA INC.

per:

APPENDIX II

SITE PHOTOS

Photo 1: Looking north at the proposed location of the new maintenance building prior to starting the test pitting.

Photo 2: Looking into TP16-01, note fill near surface and the minor water seepage pooling at the bottom.

Photo 3: Looking into TP16-02, note grey sand layer below the fill and above the fill.

WSP	PROJECT: Port Hardy Airport Maintenance Building – Geotechnical Assessment			
	TITLE: Site Photos			
	CLIENT: Kasian Architecture Interior Design and Planning Ltd.			
PHOTO PAGE NO.: 1	DATE: March 2017	FILE NO.: 161-14582-00	SCALE: NTS	DRAWN BY: LM

WSP Canada Inc., 760 Enterprise Crescent, Victoria, B.C., V8Z 6R4 Phone: 250-475-1000 Fax: 250-475-2211

Photo 4: Looking into TP16-03, note the large amount of wood debris within the fill layer on the right side.

Photo 5: Looking into TP16-04, note water seepage from below the fill in the sand and gravel soil unit.

Photo 6: Looking at the spoil pile excavated from TP16-05, note large cobbles.

Photo 7: Looking into TP16-06, note large amount of pooling water.

WSP	PROJECT: Port Hardy Airport Maintenance Building – Geotechnical Assessment			
	TITLE: Site Photos			
	CLIENT: Kasian Architecture Interior Design and Planning Ltd.			
PHOTO PAGE NO.: 2	DATE: March 2017	FILE NO.: 161-14582-00	SCALE: NTS	DRAWN BY: LM

WSP Canada Inc., 760 Enterprise Crescent, Victoria, B.C., V8Z 6R4 Phone: 250-475-1000 Fax: 250-475-2211

APPENDIX III

TERMS OF REFERENCE FOR GEOTECHNICAL REPORTS

TERMS OF REFERENCE FOR GEOTECHNICAL REPORTS ISSUED BY WSP CANADA INC.

1. STANDARD OF CARE

WSP Canada Inc. ("WSP") prepared and issued this geotechnical report (the "Report") for its client (the "Client") in accordance with generally-accepted engineering consulting practices for the geotechnical discipline. No other warranty, expressed or implied, is made. Unless specifically stated in the Report, the Report does not address environmental issues.

The terms of reference for geotechnical reports issued by WSP (the "Terms of Reference") contained in the present document provide additional information and caution related to standard of care and the use of the Report. The Client should read and familiarize itself with these Terms of Reference.

2. COMPLETENESS OF THE REPORT

All documents, records, drawings, correspondence, data, files and deliverables, whether hard copy, electronic or otherwise, generated as part of the services for the Client are inherent components of the Report and, collectively, form the instruments of professional services (the "Instruments of Professional Services"). The Report is of a summary nature and is not intended to stand alone without reference to the instructions given to WSP by the Client, the communications between WSP and the Client, and to any other reports, writings, proposals or documents prepared by WSP for the Client relative to the specific site described in the Report, all of which constitute the Report.

TO PROPERLY UNDERSTAND THE INFORMATION, OBSERVATIONS, FINDINGS, SUGGESTIONS, RECOMMENDATIONS AND OPINIONS CONTAINED IN THE REPORT, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. WSP CANNOT BE RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT AND ITS VARIOUS COMPONENTS.

3. BASIS OF THE REPORT

WSP prepared the Report for the Client for the specific site, development, building, design or building assessment objectives and purpose that the Client described to WSP. The applicability and reliability of any of the information, observations, findings, suggestions, recommendations and opinions contained in the Report are only valid to the extent that there was no material alteration to or variation from any of the said descriptions provided by the Client to WSP unless the Client specifically requested WSP to review and revise the Report in light of such alteration or variation.

4. USE OF THE REPORT

The information, observations, findings, suggestions, recommendations and opinions contained in the Report, or any component forming the Report, are for the sole use and benefit of the Client and the team of consultants selected by the Client for the specific project that the Report was provided. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION OR COMPONENT WITHOUT THE WRITTEN CONSENT OF WSP. WSP will consent to any reasonable request by the Client to approve the use of this Report by other parties designated by the Client as the "Approved Users". As a condition for the consent of WSP to approve the use of the Report by an Approved User, the Client must provide a copy of these Terms of Reference to that Approved User and the Client must obtain written confirmation from that Approved User that the Approved User will comply with these Terms of Reference, such written confirmation to be provided separately by each Approved User prior to beginning use of the Report. The Client will provide WSP with a copy of the written confirmation from an Approved User when it becomes available to the Client, and in any case, within two weeks of the Client receiving such written confirmation.

The Report and all its components remain the copyright property of WSP and WSP authorises only the Client and the Approved Users to make copies of the Report, but only in such quantities as are reasonably necessary for the use of the Report by the Client and the Approved Users. The Client and the Approved Users may not give, lend, sell or otherwise disseminate or make the Report, or any portion thereof, available to any party without the written permission of WSP. Any use which a third party makes of the Report, or any portion of the Report, is the sole responsibility of such third parties. WSP accepts no responsibility for damages suffered by any third party resulting from the use of the Report. The Client and the Approved Users acknowledge and agree to indemnify and hold harmless WSP, its officers, directors, employees, agents, representatives or sub-consultants, or any or all of them, against any claim of any nature whatsoever brought against WSP by any third parties, whether in contract or in tort, arising or related to the use of contents of the Report.

TERMS OF REFERENCE FOR GEOTECHNICAL REPORTS ISSUED BY WSP CANADA INC. (continued)

5. INTERPRETATION OF THE REPORT

a. **Nature and Exactness of Descriptions**: The classification and identification of soils, rocks and geological units, as well as engineering assessments and estimates have been based on investigations performed in accordance with the standards set out in Paragraph 1 above. The classification and identification of these items are judgmental in nature and even comprehensive sampling and testing programs, implemented with the appropriate equipment by experienced personnel, may fail to locate some conditions. All investigations or assessments utilizing the standards of Paragraph 1 involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and all persons making use of such documents or records should be aware of, and accept, this risk. Some conditions are subject to changes over time and the parties making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. Where special concerns exist, or when the Client has special considerations or requirements, the Client must disclose them to WSP so that additional or special investigations may be undertaken, which would not otherwise be within the scope of investigations made by WSP or the purposes of the Report.

b. **Reliance on information**: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site investigation and field review and on the basis of information provided to WSP. WSP has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, WSP cannot accept responsibility for any deficiency, misstatement or inaccuracy contained in the report as a result of misstatements, omissions, misrepresentations or fraudulent acts of persons providing information.

c. **Additional Involvement by WSP**: To avoid misunderstandings, WSP should be retained to assist other professionals to explain relevant engineering findings and to review the geotechnical aspects of the plans, drawings and specifications of other professionals relative to the engineering issues pertaining to the geotechnical consulting services provided by WSP. To ensure compliance and consistency with the applicable building codes, legislation, regulations, guidelines and generally-accepted practices, WSP should also be retained to provide field review services during the performance of any related work. Where applicable, it is understood that such field review services must meet or exceed the minimum necessary requirements to ascertain that the work being carried out is in general conformity with the recommendations made by WSP. Any reduction from the level of services recommended by WSP will result in WSP providing qualified opinions regarding adequacy of the work.

6. ALTERNATE REPORT FORMAT

When WSP submits both electronic and hard copy versions of the Instruments of Professional Services, the Client agrees that only the signed and sealed hard copy versions shall be considered final and legally binding upon WSP. The hard copy versions submitted by WSP shall be the original documents for record and working purposes, and, in the event of a dispute or discrepancy, the hard copy versions shall govern over the electronic versions; furthermore, the Client agrees and waives all future right of dispute that the original hard copy signed and sealed versions of the Instruments of Professional Services maintained or retained, or both, by WSP shall be deemed to be the overall originals for the Project.

The Client agrees that the electronic file and hard copy versions of Instruments of Professional Services shall not, under any circumstances, no matter who owns or uses them, be altered by any party except WSP. The Client warrants that the Instruments of Professional Services will be used only and exactly as submitted by WSP.

The Client recognizes and agrees that WSP prepared and submitted electronic files using specific software or hardware systems, or both. WSP makes no representation about the compatibility of these files with the current or future software and hardware systems of the Client, the Approved Users or any other party. The Client further agrees that WSP is under no obligation, unless otherwise expressly specified, to provide the Client, the Approved Users and any other party, or any or all of them, with specific software and hardware systems that are compatible with any electronic submitted by WSP. The Client further agrees that should the Client, an Approved User or a third party require WSP to provide specific software or hardware systems, or both, compatible with the electronic files prepared and submitted by WSP, for any reason whatsoever included but not restricted to an order from a court, then the Client will pay WSP for all reasonable costs related to the provision of the specific software or hardware systems, or both. The Client further agrees to indemnify and hold harmless WSP, its officers, directors, employees, agents, representative or sub-consultant, or any or all of them, against any claim or any nature whatsoever brought against WSP, whether in contract or in tort, arising or related to the provision or use or any specific software or hardware provided by WSP.