

SPECIFICATION

for

New & Renovated Labs

**Centre for Aquaculture and Environmental Research
4160 Marine Drive, West Vancouver, B.C.**

Project No. **2017575**

prepared for: **Fisheries and Oceans, Real Property**

prepared by: **Number Ten Architectural Group**

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SPECIFICATION

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Part 1 General

1.1 WORK COVERED BY CONTRACT DOCUMENTS

- .1 Work of this Contract comprises the general construction of 1 freestanding lab building of modular construction, and the renovation of 2 labs inside the existing building. The labs are to be constructed at the Centre for Aquaculture and Environmental Research, 4160 Marine Drive, West Vancouver, B.C.

- .2 New freestanding lab:

The Owner will supply the aluminum structural frame, and all of the fasteners required for the erection of this frame, insulated roof, floor and wall panels, associated flashings and all of the fasteners for the attachment of these panels. Shop drawings and construction details will be provided for these components.

The contractor will be responsible for erecting the pre fab aluminum structural frame and insulated panels.

The contractor will also supply and install the steel floor deck, all windows and doors, exterior stairs and ramps. All interior construction and electrical and mechanical components to be supplied and installed by the contractor under this contract. Interior finishes including but not limited to flooring, interior wall framing, finishes and painting, millwork and fixtures are to be supplied and installed by the contractor. Refer to individual specification sections and drawings.

- .3 Lab renovations:

Lab renovations to include but not limited to, the demolition of existing concrete block walls and a free standing cooler. The contractor will supply all materials not noted as NIC required to complete work on the lab renovations.

1.2 CONTRACT METHOD

- .1 Construct Work under a stipulated price contract.

1.3 CONTRACT DOCUMENTS

- .1 The Contract documents, drawings and specifications are intended to complement each other, and to provide for and include everything necessary for the completion of the work.
- .2 Drawings are, in general, diagrammatic and are intended to indicate the scope and general arrangement of the work.
- .3 It will be the responsibility of the contractor to review the contract documents prior to the Submission of Tender, make themselves thoroughly acquainted with the requirements of the contract and to make whatever inquiries that are necessary to familiarize themselves with all conditions likely to affect the work.

1.4 DIVISION OF SPECIFICATIONS

- .1 The specifications are subdivided in accordance with the current 6-digit National Master Specifications System.

- .2 A division may consist of the work of more than 1 subcontractor. Responsibility for determining which subcontractor provides the labour, material, equipment and services required to complete the work rests solely with the Contractor.
- .3 In the event of discrepancies or conflicts when interpreting the drawings and specifications, the specifications govern.

1.5 DOCUMENTS REQUIRED

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

1.6 WORK SCHEDULE

- .1 Provide a schedule of work within 5 days of contract award and observe the following requirements
 - .1 Work must be completed by March 25 2019
 - .2 Whenever variation from the schedule in excess of 3 working days occurs or is expected to occur, notify the Departmental Representative and provide a revised schedule
 - .3 Hours of work other than 8:00 AM to 5:00 PM Mondays to Fridays to be coordinated and confirmed acceptable with Departmental representative.

1.7 COST BREAKDOWN

- .1 Before submitting the first progress claim, submit a breakdown of the Contract lump sum prices in detail as directed by the Departmental Representative and aggregating Contract price.

1.8 SITE CONDITIONS

- .1 It will be the responsibility of the contractor to visit the site prior to the Submission of Tenders and make themselves thoroughly acquainted with the conditions at the site and to make whatever inquiries that are necessary to familiarize themselves with all conditions likely to affect the work.

1.9 CONTRACTOR USE OF PREMISES

- .1 The contractor's use of site will be limited to the immediate area of the work and areas assigned by the Departmental Representative for site office placement, equipment, material stock piles, sanitary facilities, etc. Refer to drawings for proposed staging areas.

- .2 Co-ordinate use of premises under direction of Departmental Representative.
- .3 The contractor will provide sanitary facilities for the work force in accordance with governing regulations and ordinances.
- .4 Departmental Representative will designate areas for parking, material storage, recycling storage and a site office. Maintain these areas clean and free of construction related debris. Make good damages resulting from contractors use of these areas at no cost to the contract.
- .5 Site roads adjacent area's of work needs to be kept clear at all times for fire truck and user access to the site.
- .6 Access to, and exit from, the building adjacent interior lab renovation work must be kept clear and accessible for use by building occupants during the work.

1.10 REFERENCES AND CODES

- .1 Perform Work in accordance with National Building Code of Canada (NBC) including amendments up to tender closing date and other codes of provincial or local application provided that in case of conflict or discrepancy, more stringent requirements apply.
- .2 Meet or exceed requirements of:
 - .1 Contract documents.
 - .2 Specified standards, codes and referenced documents.
- .3 All work is to be performed in accordance with Worksafe B.C. regulations, Labour Canada regulations, and all applicable municipal statutes and authorities having jurisdiction. In the event of conflict between any provisions the most stringent provision will apply.
- .4 Ensure that all employees have received appropriate WHIMIS training and that all necessary MSDS information is available on site.

1.11 PERMITS, FEES AND NOTIFICATIONS

- .1 Obtain and pay for all permits and fees. Municipal building permit not required.

1.12 SUBMITTALS

- .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 Where specified, submit drawings stamped and signed by professional engineer registered or licensed in British Columbia.
- .3 Submit shop drawings in .PDF format.
- .4 Allow 5 working days for Consultant review of shop drawings.

1.13 ADDITIONAL DRAWINGS

- .1 The Departmental representative may furnish additional drawings for clarification. These additional drawings have the same meaning and intent as if they were included with plans referred to in the contract documents.

1.14 RECORD DRAWINGS

- .1 As work progresses, maintain accurate records to show all deviations from the contract documents. Record these changes on a clean set of drawings used only for this purpose. Record changes in red ink. At completion, supply the Departmental Representative with one set of drawings and specifications with all changes clearly marked

1.15 ENVIRONMENTAL PROTECTION

- .1 Comply with Federal, Provincial and Municipal laws orders and regulations concerning the protection of the environment and the control and abatement of soil, water, and air pollution.
- .2 Place all waste, debris and lightweight materials in enclosed bins or under secure covers.
- .3 Do not dispose of wastes or volatile materials into water courses, storm or sanitary sewers.
- .4 All construction equipment to be in good working order, free of leaks that would contaminate the site

1.16 TEMPORARY FACILITIES

- .1 Owner will provide continuous supply of potable water for construction use at no cost. Departmental Representative will determine delivery points. Contractor to provide all temporary equipment and hoses to bring the supply to the work. Exercise conservation whenever using the water supply. Do not leave hoses running unattended.
- .2 Owner will supply electrical power at no cost. Departmental Representative will determine delivery points. Contractor to provide all temporary equipment and lines to bring the power supply to the work at no additional cost to the contract. Exercise conservation whenever using the power supply.
- .3 Provide and maintain temporary fire protection required by the governing codes, bylaws and regulations during the performance of the work.
- .4 Provide appropriate sanitary facilities for the workforce. Locate where directed by Departmental Representative.
- .5 Contractor to provide temporary office of sufficient size to accommodate site meetings and store documents required on site. Furnish with a drawing laydown table.
- .6 Provide and maintain, in clean and orderly condition, lockable weatherproof sheds for storage of tools, equipment and materials.
- .7 Provide and maintain scaffolding and ladders.
- .8 Provide fencing, hoarding and barriers as required to prevent public access to the worksite and as required by the Departmental Representative.

- .9 Remove any temporary services or facilities after completion of the work and make good any damage to conditions previously existing or to match new work as acceptable to the Departmental Representative.

1.17 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 Fit Work to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- .8 Conceal pipes, ducts and wiring in floor, wall and ceiling construction of finished areas except where indicated otherwise.

1.18 MATERIALS AND EQUIPMENT

- .1 Use new materials unless otherwise specified

1.19 OWNER FURNISHED ITEMS

- .1 Owner Responsibilities:
 - .1 Provide shop drawings and materials necessary to construct the aluminum structure and insulated panels.
 - .2 Aluminum Structure & Insulated Panels: Arrange for delivery of shop drawings, product data, samples, manufacturer's instructions, and certificates to the contractor's representative.
 - .1 Arrange and pay for delivery to the contractor's site in accordance with Progress Schedule.
 - .2 Inspect deliveries with contractor; record shortages, and damaged or defective items.
- .2 Contractor Responsibilities for Owner supplied items:
 - .1 Designate submittals and delivery date for each product in progress schedule.
 - .2 Review shop drawings, product data, samples, and other submittals. Submit to Consultant notification of observed discrepancies or problems anticipated due to non-conformance with Contract Documents.
 - .3 Aluminum structure & insulated panels:
 - .1 Arrange for replacement of damaged, defective or missing items.
 - .2 Submit claims for transportation damage.
 - .3 Handle products at site, including unloading, uncrating and storage.
 - .4 Protect products from damage, and from exposure to elements.

- .4 Assemble, install, connect, adjust, and finish products.
- .5 Provide installation inspections required by public authorities.
- .6 Repair or replace items damaged by Contractor or subcontractor on site (under his control).

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 NOT USED

- .1 Not used.

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE

- .1 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.

1.2 HEALTH AND SAFETY PLAN

- .1 Submit site specific Health and Safety Plan, MSDS and WHMIS documents requested in Section 01 35 30 - Health and Safety

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.
- .2 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been co-ordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
- .3 Allow 5 days for Departmental Representative's review of each submission.

- .4 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.
- .5 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.
- .6 Accompany submissions with electronic transmittal, containing:
 - .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Indicate the specification section and paragraph number that applies to the shop drawing that is being submitted.
 - .1 Ensure that each shop drawing clearly refers to the requirements of the stated specification section.
 - .5 Identification and quantity of each shop drawing, product data and sample.
 - .6 Other pertinent data.
- .7 Submissions include:
 - .1 Date and revision dates.
 - .2 Project title, number and applicable specification section.
 - .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.
- .8 After Departmental Representative's review, distribute copies.
- .9 Submit electronic copy of shop drawings for each requirement requested in specification Sections and as Departmental Representative may reasonably request.

- .10 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.
- .11 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.
- .12 Submit electronic copies of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Departmental Representative
- .13 Submit 2 hard copies and electronic copy of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Departmental Representative.
- .14 Delete information not applicable to project.
- .15 Supplement standard information to provide details applicable to project.
- .16 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.
- .17 The review of shop drawings by the Departmental Representative is for sole purpose of ascertaining conformance with general concept.
 - .1 This review shall not mean that the Departmental Representative approves detail design inherent in shop drawings, responsibility for which shall remain with Contractor submitting same, and such review shall not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting requirements of construction and Contract Documents.
 - .2 Without restricting generality of foregoing, Contractor is responsible for dimensions to be confirmed and correlated at job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of work of sub-trades.

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, one of each sample to Departmental Representatives office and Prime Consultant's office.
- .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 PHOTOGRAPHIC DOCUMENTATION

- .1 Submit electronic copy of digital photography in jpg format, standard resolution as directed by Departmental Representative.
- .2 Project identification: name and number of project and date of exposure indicated.
- .3 Number of viewpoints: 4 locations.
 - .1 Viewpoints and their location as determined by Departmental Representative.
- .4 Frequency of photographic documentation: weekly and as follows
 - .1 Upon completion of: Framing and services before concealment.

1.6 CERTIFICATES AND TRANSCRIPTS

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

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .3 Province of British Columbia
 - .1 Workers Compensation Act, RSBC 1996 - Updated 2006.
 - .2 Occupational Health and Safety Regulation.
- .4 National Building Code of Canada (NBC)
 - .1 Part 8, Safety Measures at Construction and Demolition Sites.

1.2 WORKERS COMPENSATION BOARD COVERAGE

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

1.3 COMPLIANCE WITH REGULATIONS

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

1.4 SUBMITTALS

- .1 Submit to Department Representative submittals listed for review.
- .2 Work effected by submittal will not proceed until review is completed.
- .3 Submit the following:
 - .1 Health and Safety Plan.
 - .2 Copies of reports or directions issued by Federal, Provincial and Territorial health and safety inspectors.
 - .3 Copies of incident and accident reports.
 - .4 Copies of Material Safety Data Sheets and all other documents required by Workplace Hazardous Materials Information System (WHMIS) requirements.
 - .5 Emergency procedures

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

1.5 WORK PERMITS

- .1 Obtain speciality permit(s) related to the project before start of work

1.6 FILING OF NOTICE

- .1 Complete and submit Notice of Project as required by Provincial authorities.
- .2 Provide copies of all notices to Department Representative.

1.7 SAFETY ASSESSMENT

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

1.8 MEETINGS

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

1.9 GENERAL REQUIREMENTS

- .1 Develop written site-specific Health and Safety Plan based on hazard assessment prior to beginning site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications.
- .2 Departmental Representative may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns.

1.10 GENERAL CONDITIONS

- .1 Provide safety barricades and lights at work site as required to provide safe working environment for workers
- .2 Ensure that non-authorized persons are not allowed in designated construction areas and work site.
 - .1 Provide appropriate means by use of barricades, fences, and warning signs.

1.11 REGULATORY REQUIREMENTS

- .1 Comply with specified codes, acts, bylaws, standards, and regulations to ensure safe operations at site.
- .2 In the event of conflict between any provision of above authorities, the most stringent provision will apply.

1.12 RESPONSIBILITY

- .1 Be responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.
- .2 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, territorial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

1.13 UNFORSEEN HAZARDS

- .1 When unforeseen or peculiar safety-related factor, hazard, or condition occur during performance of Work, follow procedures in place for Employee's Right to Refuse Work in accordance with Acts and Regulations having jurisdiction and advise Departmental Representative verbally and in writing.

1.14 HEALTH AND SAFETY CO-ORDINATOR

- .1 Employ and assign to Work, competent and authorized representative as Health and Safety Co-ordinator. Health and Safety Co-ordinator must:
 - .1 Have site-related working experience specific to activities associated with the work outlined in the Contract.
 - .2 Have working knowledge of occupational safety and health regulations.
 - .3 Be responsible for completing Contractor's Health and Safety Training Sessions and ensuring that personnel not successfully completing required training are not permitted to enter site to perform Work.
 - .4 Be responsible for implementing, enforcing daily and monitoring site-specific Contractor's Health and Safety Plan.
 - .5 Be on site during execution of work.

1.15 HAZARDOUS PRODUCTS

- .1 Comply with the 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 Departmental Representative and in accordance with Canada Labour Code.

1.16 POSTING OF DOCUMENTS

- .1 Ensure applicable items, articles, notices and orders are posted in conspicuous location on site in accordance with Acts and Regulations having jurisdiction, and in consultation with Departmental Representative.

1.17 CORRECTION OF NON-COMPLIANCE

- .1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by Departmental Representative.
- .2 Provide Departmental Representative with written report of action taken to correct non-compliance of health and safety issues identified.
- .3 Departmental Representative may stop Work if non-compliance of health and safety regulations is not corrected. The Contractor will be responsible for costs arising from such "stop work order".

1.18 CONFINED SPACES

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

1.19 OVERLOADING

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

1.20 SCAFFOLDING

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

1.21 FIRE SAFETY REQUIREMENTS

- .1 Store oily/paint soaked rags, waste products, 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 inflammable and combustible materials in accordance with the National Fire Code of Canada.

1.22 FIRE PROTECTION

- .1 Do not use fire hydrants, standpipes, and hose systems for purposes other than firefighting
- .2 Be responsible/liable for cost incurred from fire department, building owner, and tenants, resulting from false alarms

1.23 WORK STOPPAGE

- .1 Give precedence to safety and health of public and site personnel and protection of environment over cost and schedule considerations for Work.

END OF SECTION

Part 1 General

1.1 QUALITY

- .1 Products, materials, equipment and articles incorporated in Work shall be new, not damaged or defective, and of best quality for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.
- .2 Procurement policy is to acquire, in cost effective manner, items containing highest percentage of recycled and recovered materials practicable consistent with maintaining satisfactory levels of competition. Make reasonable efforts to use recycled and recovered materials and in otherwise utilizing recycled and recovered materials in execution of work.
- .3 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.
- .4 Should disputes arise as to quality or fitness of products, decision rests strictly with Departmental Representative based upon requirements of Contract Documents.
- .5 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.
- .6 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

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

1.3 TRANSPORTATION

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

1.4 MANUFACTURER'S INSTRUCTIONS

- .1 Unless otherwise indicated in specifications, install or erect products in accordance with manufacturer's instructions.
- .2 Notify Departmental Representative in writing, of conflicts between specifications and manufacturer's instructions. Departmental Representative will establish course of action.
- .3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes Departmental Representative to require removal and re-installation at no increase in Contract Price or Contract Time.

1.5 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.
- .2 Do not employ anyone unskilled in their required duties.
- .3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with Departmental Representative whose decision is final.

1.6 CO-ORDINATION

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

1.7 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.

1.8 REMEDIAL WORK

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

1.9 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.

- .3 Submit field drawings to indicate relative position of various services and equipment when required by Departmental Representative.

1.10 FASTENINGS

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

1.11 FASTENINGS - EQUIPMENT

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

1.12 PROTECTION OF WORK IN PROGRESS

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

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

1 PROJECT CLEANLINESS

- .1 Maintain Work in tidy condition, free from accumulation of waste products and debris, other than that caused by Coast Guard personnel and by Other Contractors.
- .2 Remove waste materials from site at regularly scheduled times or dispose of as directed by Departmental Representative.
- .3 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .4 Provide on-site containers for collection of waste materials and debris. Locate where directed by Departmental Representative.
- .5 Provide and use clearly marked separate bins for recycling wherever facilities are available. Refer to Section 01 74 19 - Waste Management and Disposal for additional requirements.
- .6 Remove waste material and debris from site and deposit in waste containers at end of each working day. Dispose of waste materials and debris off site.
- .7 Clean interior areas prior to start of finishing work, and maintain areas free of dust and other contaminants during finishing operations.
- .8 Store volatile waste in covered metal containers and remove from premises at end of each working day.
- .9 Provide adequate ventilation during use of volatile or noxious substances. Do not use building ventilation system for this purpose.
- .10 Use only cleaning materials recommended by manufacturer of surface to be cleaned and as recommended by cleaning material manufacturer.
- .11 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

2 FINAL CLEANING

- .1 When Work is substantially completed, 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 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate and mechanical/electrical fixtures. Replace broken, scratched and disfigured glass.
- .5 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls and floors.
- .6 Clean lighting reflectors, lenses and other lighting surfaces.
- .7 Vacuum clean and dust building interiors, behind grilles, louvres and screens.
- .8 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.
- .9 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.
- .10 Remove dirt and other disfiguration from exterior surfaces.
- .11 Clean and sweep roofs, gutters, areaways and sunken wells.
- .12 Sweep and wash clean paved areas and all pavement parking/storage areas used by Contractor to remove all traces of construction spillage, stains and residue. Do not blast dirty water onto adjacent buildings and site features.
- .13 Clean equipment and fixtures to sanitary condition; clean or replace filters of mechanical equipment.
- .14 Clean roofs, downspouts and drainage systems.
- .15 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.

3 WASTE MANAGEMENT AND DISPOSAL

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

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Waste goals.
- .2 Waste management plan.
- .3 Waste management plan implementation.
- .4 Disposal of waste.

1.2 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.

1.3 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.

1.4 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.
 - .1 Uncontaminated packaging (wood, metal banding, cardboard, paper, plastic wrappings, polystyrene).
 - .2 Wood pallets (recycle or return to shipper).
 - .3 Batt insulation.
 - .4 Metals (pipe, conduit, ducting, wiring, miscellaneous cuttings)
 - .5 Wood (uncontaminated).
 - .6 Gypsum board (uncontaminated).
 - .7 Paint, solvent, oil.
 - .8 Other materials as indicated in technical sections.
 - .2 Administration/worker waste (uncontaminated): including but not limited to following types.
 - .1 Paper, cardboard.

- .2 Plastic containers and lids marked types 1 through 6.
- .3 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.
- .4 Locate separated materials in areas which minimize material damage.

1.5 STORAGE, HANDLING AND PROTECTION

- .1 Store, materials to be reused, recycled and salvaged.
- .2 All materials for recycling must be source separated into separate bins to be accepted by the local processing authority.
- .3 Separate non-salvageable materials from salvaged items. Transport and deliver non-salvageable items to licensed disposal facility.
- .4 Protect surface drainage, storm sewers, sanitary sewers, and utility services from damage and blockage.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 PREPARATION

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

3.2 USE OF SITE AND FACILITIES

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

3.3 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 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.

3.4 DISPOSAL OF WASTE

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

3.5 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

Part 1 General

1.1 ADMINISTRATIVE REQUIREMENTS

- .1 Acceptance of Work Procedures:
 - .1 Contractor's Inspection: Contractor and all subcontractors to 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 inspection and submit verification that corrections have been made.
 - .2 Request Departmental Representative's inspection.
 - .2 Departmental Representative's Inspection:
 - .1 Departmental Representative and Contractor to inspect Work and identify defects and deficiencies.
 - .2 Contractor to correct Work as directed.
 - .3 Completion Tasks: submit written certificates in English that tasks have been performed as follows:
 - .1 Work: completed and inspected for compliance with Contract Documents.
 - .2 Defects: corrected and deficiencies completed.
 - .3 Certificates required by authorities having jurisdiction have been submitted.
 - .4 Operation of systems have been demonstrated to the owner's personnel
 - .5 Work is complete and ready for final inspection.
 - .4 Declaration of Substantial Performance: When Departmental Representative considers deficiencies and defects corrected and requirements of Contract substantially performed, make application for Certificate of Substantial Performance.
 - .5 Commencement of warranty period: Date of Departmental Representatives acceptance of substantial performance to be the date for commencement for warranty period.
 - .6 Payment of Holdback: after issuance of Substantial Performance of work, submit application for payment of holdback amount in accordance with contractual agreement.
 - .7 Final Inspection:
 - .1 When completion tasks are done, request final inspection of Work by Departmental Representative.
 - .2 If work is deemed incomplete by Departmental Representative, complete outstanding items and request re-inspection.
 - .8 Final Payment

- .1 When Departmental Representative considers final deficiencies and defects corrected and requirements of contract met, make application for final payment.
- .2 When work deemed incomplete by Departmental Representative complete outstanding items and request re-inspection.

1.2 FINAL CLEANING

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

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Closeout submittals
- .2 Operation and maintenance manual format.
- .3 Contents each volume.
- .4 Recording actual site conditions.
- .5 Record (as-built) documents and samples.
- .6 Record documents.
- .7 Warranties and bonds.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.

1.3 CLOSEOUT SUBMITTALS

- .1 Prepare instructions and data using personnel experienced in maintenance and operation of described products.
- .2 Submit preliminary copy for consultant review
- .3 Copy will be returned with Consultant's comments.
- .4 Revise content of documents as required prior to final submittal.
- .5 Two weeks prior to Substantial Performance of the Work, submit to the Consultant, four final copies of operating and maintenance manuals in Canadian English.
 - .1 One copy of the manual to be provided in digital form on CD rom, in Canadian English.
- .6 Ensure spare parts, maintenance materials and special tools required in individual specification sections are new, undamaged or defective, and of same quality and manufacture as products provided in Work.
- .7 If requested, furnish evidence as to type, source and quality of products provided.
- .8 Defective products will be rejected, regardless of previous inspections. Replace products at own expense.
- .9 Pay costs of transportation.

1.4 OPERATION AND MAINTENANCE MANUAL FORMAT

- .1 Organize data in the form of an instructional manual.

- .2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 219 x 279 mm with spine and face pockets.
- .3 When multiple binders are used, correlate data into related consistent groupings. Identify contents of each binder on spine.
- .4 Cover: Identify each binder with type or printed title "MAINTENANCE MANUAL"; list title of project and identify subject matter of contents.
- .5 Arrange content by systems, under Section numbers and sequence of Table of Contents.
- .6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
- .7 Text: Manufacturer's printed data, or typewritten data.
- .8 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- .9 Provide both .PDF electronic copy and hard copy submissions
- .10 Coordinate with commissioning specification to include all related close out documentation, warranty and test reports.

1.5 CONTENTS - EACH VOLUME

- .1 Table of Contents: provide title of project;
 - .1 date of submission;
 - .2 names, addresses, and telephone numbers of Consultant and Contractor with name of responsible parties; and
 - .3 schedule of products and systems, indexed to content of volume.
- .2 For each product or system, 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. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.
- .4 Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.

1.6 RECORDING ACTUAL SITE CONDITIONS

- .1 Record information on set of black line opaque drawings, and within the Project Manual, provided by Owner.
- .2 Annotate with coloured felt tip marking pens, maintaining separate colours for each major system, for recording changed information.
- .3 Record information concurrently with construction progress. Do not conceal Work of the Project until required information is accurately 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 inspection certifications, field test records, required by individual specifications sections.
- .7 Submit copy of record drawings and specifications to the Departmental Representative.

1.7 WARRANTIES AND BONDS

- .1 Separate warranties and bonds with individual tab sheets keyed to the table of contents listing in the maintenance manual.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 08 11 00 Metal Doors and Frames
- .2 09 21 16 Gypsum Board Assemblies

1.2 REFERENCES

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

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures
- .2 In accordance with Construction/Demolition Waste Management Disposal 01 74 19.
 - .1 Submit detailed Waste Reduction Workplan (WRW) prior to starting Work, in accordance with Section 01 74 19 - Construction/Demolition Waste Management and Disposal.
 - .2 Indicate, not limited to, the following:
 - .1 Descriptions of and anticipated quantities of materials to be salvaged, re-used, recycled or landfilled.
 - .2 Name and address of destination waste facilities.

1.4 SITE CONDITIONS

- .1 If material resembling spray or trowel-applied asbestos, lead paint, or other designated substance be encountered during demolition, stop work, take preventative measures, and notify Departmental Representative immediately.
 - .1 Proceed only after receipt of written instructions have been received from Departmental Representative.
- .2 Notify Departmental Representative before disrupting building access or services.

1.5 EQUIPMENT

- .1 Leave equipment and machinery running only while in use.
- .2 Demonstrate to Departmental Representative that tools and machinery are being used in manner which allows for salvage of materials in best condition possible.

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 EXAMINATION

- .1 Inspect building 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 Disconnect, cap, plug or divert, as required, existing public 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 Immediately notify Departmental Representative and utility company concerned in case of damage to any utility or service, designated to remain in place.
 - .2 Immediately notify the Departmental Representative should uncharted utility or service be encountered, and await instruction in writing regarding remedial action.

3.2 PREPARATION

- .1 Protection of In-Place Conditions:
 - .1 Prevent movement, settlement, or damage to adjacent structures, utilities, and landscaping features 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 30 - Health and Safety Requirements.
- .2 Demolition/Removal:
 - .1 Remove items as indicated on drawings to accommodate work.
 - .2 Trim edges of partially demolished building elements to tolerances as defined by Departmental Representative to suit future use.
- .3 Interior Demolition Requirements
 - .1 Existing cooler in room 129C;
 - .1 Remove all wall and floor panels and dispose of in accordance with Section 01 74 19.

- .2 Decommission and remove cooling unit in accordance with Federal Halocarbon regulations. Provide documentation to Departmental Representative.
- .2 Concrete block wall:
 - .1 Remove concrete block wall between rooms 131 and room 129C as detailed to allow for installation of new GWB wall and door and window assemblies.
- .3 Remove GWB on left wall of room 129C to allow for installation of framing for new door.
- .4 Remove double door between rooms 131 and 129A to allow for installation of GWB wall.

3.3 DISPOSAL

- .1 Separate materials for recycling and for disposal.
- .2 Refer to 01 74 19 - Construction/Demolition Waste Management and Disposal.

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 Refer to demolition drawings and specifications for items to be salvaged for reuse.
- .4 Waste Management: separate waste materials in accordance with Section 01 74 19 - Construction/Demolition Waste Management and Disposal
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 03 41 00: Concrete Blocks.
- .2 Section 05 12 23: Structural Steel for Buildings.

1.2 REFERENCES

- .1 All referenced standards to 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 A283, Qualification Code for Concrete Testing Laboratories.
 - .3 CSA A3000, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
 - .4 CSA S413, Parking Structures.
- .3 ASTM International Inc.:
 - .1 ASTM C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - .2 ASTM C920 – Standard Specification for Elastomeric Joint Sealants
 - .3 ASTM D1751, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
- .4 Canadian General Standards Board (CGSB):
 - .1 CGSB-51.34, Vapour Barrier, Polyethylene Sheet for Use in Building Construction.

1.3 QUALITY CONTROL

- .1 Minimum two weeks prior to starting concrete work, provide valid 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.
- .2 For concrete with high volume of supplementary cementing materials (HVSCM concrete, as defined in CSA A23.1), perform trial mixes to ensure that the required properties are achieved.
- .3 Minimum four weeks prior to starting concrete work, provide proposed quality control procedures on following items:
 - .1 Finishing.
 - .2 Protection.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Minimum 2 weeks prior to starting concrete work, submit all concrete mix designs, and indicate where each concrete mix is to be used.
- .3 Minimum submission requirements for each concrete mix design shall include the following:
 - .1 Minimum specified compressive strength at 28 day (or at the time specified on drawings).
 - .2 Maximum aggregate size.
 - .3 Aggregate type (if not normal density).
 - .4 Concrete density range, wet and dry (if not normal density).
 - .5 CSA exposure class.
 - .6 Cement type (if not type GU).
 - .7 Percentage and type of supplemental cementing materials.
 - .8 Maximum water/cementitious materials ratio.
 - .9 Assumed method of placement of concrete.
 - .10 Corrosion inhibitor (name and quantity, if applicable).
 - .11 Plastic or steel fibres (type, name and quantity, if applicable).
 - .12 Alkali-aggregate resistance.
 - .13 Architectural requirements (colour of cement and aggregate, if applicable).
 - .14 Maximum time from batching to placing concrete (if retarding admixtures are used).
- .4 On completion of the works, provide written report to WSP-S certifying that the concrete in place meets performance requirements established in **PART 2 - PRODUCTS**.

Part 2 Products

2.1 DESIGN CRITERIA

- .1 To CSA A23.1/A23.2, Alternative 1 – Performance, and as described under Mixes and on Structural Drawings.

2.2 PERFORMANCE CRITERIA

- .1 Concrete supplier to meet the concrete performance criteria established by WSP-S and to provide verification of compliance.

2.3 MATERIALS

- .1 Portland cement: to CSA A3001.
- .2 Cementitious hydraulic slag: to CSA A3000.
- .3 Fly ash: to CSA A3001, Type CI.
- .4 Water: to CSA A23.1.
- .5 Aggregates: to CSA A23.1/A23.2. Do not use recycled concrete as aggregate.

- .6 Admixtures: not to contain chlorides.
- .7 Corrosion-inhibiting admixture: calcium nitrite solution.
- .8 Plastic fibre additive: fibrillated polypropylene fibres at least 19 mm (3/4") in length.
- .9 Shrinkage compensating grout: premixed compound consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agents to CSA A23.1/A23.2. Minimum compressive strength: 40 MPa at 28 days.
- .10 Non-premixed dry pack grout: composition of non-metallic aggregate and Portland cement with sufficient water for mixture to retain its shape when made into ball by hand and capable of developing compressive strength of 40 MPa at 28 days.
- .11 Curing/sealing compound: to CSA A23.1/A23.2 and ASTM C309, Type 1, Class B, water based acrylic, compatible with surface hardener where hardener is used.
- .12 Pre-moulded joint fillers: min. 12 (1/2") bituminous impregnated fiber board to ASTM D1751.
- .13 Penetrating sealer: water based, clear water repellent, at least equivalent to AT&U Type 1b as specified in Alberta Infrastructure and Transportation Publication B388.
- .14 Bonding adhesive: synthetic latex.
- .15 Crack Filler: low viscosity epoxy resin

2.4 CONCRETE MIXES

- .1 Use ready-mix concrete. Proportion concrete in accordance with CSA A23.1, Alternative 1 - Performance Method for Specifying Concrete.
- .2 Set performance characteristics of concrete in plastic state in coordination with all trades involved.
- .3 Meet performance criteria of concrete in hardened state as shown on Structural Drawings and provide verification of compliance.
- .4 Use water-reducing agent in all concrete.
- .5 Do not use admixtures containing chlorides.
- .6 Supplementary cementing materials (SCM):
 - .1 Conform to CSA A23.1.
 - .2 Follow slag and fly ash manufacturers' directions for proportioning and mixing of concrete.
 - .3 Do not use concrete with more than 40% of SCM when ambient temperature is forecast to be below +10°C at the time of concrete pour and during the seven days after the pour, except for footings, walls and columns.
 - .4 Reduce W/C ratio to 0.45 where using more than 40% of SCM in concrete for slabs and other horizontal finished surfaces, in order to reduce bleed water and to increase rate or strength gain.

Part 3 Execution

3.1 PREPARATION

- .1 Remove water and disturbed soil from excavations before placing concrete.

3.2 PLACING CONCRETE

- .1 Place concrete in accordance with CSA A23.1.
- .2 Delivery and place concrete with minimum re-handling.
- .3 If concrete is pumped or placed pneumatically, control discharge velocity to prevent separation or scattering of concrete mix ingredients.
- .4 Place concrete in a continuous operation without cold joints. If cold joints develop inadvertently, notify WSP-S to obtain instructions for required remedial work.
- .5 Do not overload forms.
- .6 Maintain accurate records of all poured concrete including extent, date and location of each pour, concrete mix used, ambient air temperature, test samples taken and falsework removal date and mark on a set of Structural Drawings.

3.3 FINISHING CONCRETE

- .1 Finish concrete to CSA A23.1/A23.2.
- .2 Cooperate with any trade applying finishes to concrete surfaces and provide surfaces which will ensure adequate bond. Provide chases and reglets where required.
- .3 Finishing Formed Surfaces:
 - .1 Completely fill holes left by through-bolts with grout.
 - .2 Do not patch surfaces until instructed in writing by WSP-S.

3.4 CONCRETE CURING AND PROTECTION

- .1 At a minimum cure and protect concrete in accordance with CSA A23.1
- .2 Extend curing and protection period until concrete has reached following strength levels for structural safety:
 - .1 Footings: 50% of specified 28 day strength
- .3 For concrete containing supplementary cementing materials, curing and protection times may need to be extended beyond those outlined by CSA A23.1 to achieve the required structural properties.
- .4 Do not load concrete until sufficient strength is developed.

3.5 GROUTING UNDER BASE PLATES AND BEARING PLATES

- .1 Grout under base plates and bearing plates using procedures in accordance with manufacturer's recommendations.
- .2 Provide 100% contact over grouted area.
- .3 Do not add load on aluminum framing until grouting is completed and grout strength has reached at least 20 MPa.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 05 12 23 - Structural Steel for Buildings

1.2 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM A 1064/A 1064M-16b , Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
- .2 CSA Group
 - .1 CSA-A23.4-16, Precast Concrete - Materials and Construction.

1.3 DESIGN REQUIREMENTS

- .1 Design precast elements to carry handling stresses.

1.4 PERFORMANCE REQUIREMENTS

- .1 Tolerance of precast elements to CSA-A23.4.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00- Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for proprietary materials used in Precast Structural Concrete and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit shop drawings prepared in accordance with CSA-A23.4 and include following items:
 - .1 Design calculations for items designed by manufacturer.
 - .2 Finishing schedules.
 - .3 Dimensions of finished units
- .4 Quality Assurance Submittals:
 - .1 Submit concrete supplier's certification.

1.6 QUALIFICATIONS

- .1 Fabricate and erect precast concrete elements by manufacturing plant certified in appropriate category according to CSA-A23.4

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, handle and store precast units according to manufacturer's instructions.

1.8 WARRANTY

- .1 Warrant precast element not to spall or show visible evidence of corrosion of embedded steel and cracking, except for normal hairline shrinkage cracks, for 1 year.

Part 2 Products

2.1 CONCRETE BLOCK

- .1 Pre cast concrete blocks to sizes and shapes indicated. Flat top. Recessed lifting hooks.

2.2 MATERIALS

- .1 Cement to CAN/CSA-A3001, Type [GU].
- .2 Water: potable .
- .3 Reinforcing steel: to CAN/CSA-G30.18.
- .4 Anchors and supports: to CAN/CSA-G40.21 Type 300 W galvanized after fabrication.

2.3 MIXES

- .1 Concrete:
 - .1 Provide concrete mix to meet following hard state requirements:
 - .1 Minimum compressive strength at 28 days age: 20 MPa.
 - .2 Surface texture: steel trowel finish.

2.4 DIMENSIONS

- .1 Blocks to be 750mm x 750mm mm x 1500mm,+/- 50mm.
- .2 Top of block to be flat.
- .3 Lifting hook to be recessed.
- .4 Serial number and name of manufacturer shall be cast into the block.

2.5 FABRICATION

- .1 Manufacture units in accordance with CSA-A23.4.
- .2 Cast members in accurate rigid moulds designed to withstand high frequency vibration. Set reinforcing anchors and auxiliary items to indicated on shop drawings. Cast in anchors, blocking and inserts as required. Vibrate concrete during casting for full thickness.
- .3 Provide lifting hooks and other inserts or fittings required for a complete and rigid installation. Each to conform to requirements of local codes. Lift hooks

adequately sized to safely handle blocks according to member dimension and weight. Recess anchors.

- .1 Lifting hook to have a minimum breaking strength of 15,000Kg and be designed by a professional engineer.

2.6 FINISHES

- .1 Finish units to standard grade, to CSA-A23.4.

Part 3 Execution

3.1 INSTALLATION

- .1 Install blocks in locations indicated.

3.2 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11- Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00- Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 06 10 00 – Rough Carpentry

1.2 REFERENCES

- .1 ASTM International Inc.
 - .1 ASTM A36/A36M-08, Standard Specification for Carbon Structural Steel.
 - .2 ASTM A193/A193M-08, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature or High-Pressure Service and Other Special Purpose Applications.
 - .3 ASTM A307-07b, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .4 ASTM A325M-08, Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength Metric.
 - .5 ASTM A992, Standard Specifications for Structural Steel Shapes.
 - .6 ASTM F593 – 17, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-85.10-99, Protective Coatings for Metals.
- .3 Canadian Institute of Steel Construction (CISC)/Canadian Paint Manufacturers Association (CPMA).
 - .1 Handbook of the Canadian Institute of Steel Construction.
 - .2 CISC/CPMA Standard 2-75, Quick-Drying Primer for use on Structural Steel.
- .4 Canadian Standards Association (CSA International)
 - .1 CSA G40.20/G40.21-04, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .2 CAN/CSA-S16-01(R2007), Limit States Design of Steel Structures.
 - .3 CSA W47.1-03, Certification of Companies for Fusion Welding of Steel.
 - .4 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding.
 - .5 CSA W55.3-1965(R2003), Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings.
 - .6 CSA W59-03, Welded Steel Construction (Metal Arc Welding).
- .5 Master Painters Institute
 - .1 MPI-INT 5.1-08, Structural Steel and Metal Fabrications.
 - .2 MPI-EXT 5.1-08, Structural Steel and Metal Fabrications.
- .6 The Society for Protective Coatings (SSPC) and National Association of Corrosion Engineers (NACE) International
 - .1 NACE No. 3/SSPC SP-6-06, Commercial Blast Cleaning.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings:
 - .1 Submit shop drawings showing layout, components and connections.
- .3 Source Quality Control Submittals:
 - .1 When requested submit two copies of mill test reports 4 weeks prior to fabrication of structural steel.
 - .1 Mill test reports to show chemical and physical properties and other details of steel to be incorporated in project.
 - .2 Provide mill test reports certified by metallurgists qualified to practice in Province of BC, Canada.
- .4 Fabricator Reports:
 - .1 When requested provide structural steel fabricator's affidavit stating that materials and products used in fabrication conform to applicable material and products standards specified and indicated.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials in manufacturer's original, undamaged containers with identification labels intact.
- .3 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, packaging materials in accordance with Section 01 74 19 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 MATERIALS

- .1 Structural steel: to CSA-G40.20/G40.21 Grade as indicated 350W.
- .2 Anchor rods: stainless steel to ASTM F593 Group 1, minimum yield strength of 206 MPa.
- .3 Bolts, nuts and washers: to ASTM A325M or, stainless steel, to match rod or bolt material.
- .4 Welding materials: to CSA W48 Series and CSA W59 and certified by Canadian Welding Bureau.
- .5 Shop paint primer: to CISC/CPMA2-75 solvent reducible alkyd.
- .6 Hot dip galvanizing: galvanize steel, where indicated, to CAN/CSA-G164, minimum zinc coating of 600 g/m².

2.2 FABRICATION

- .1 Fabricate structural steel in accordance with CAN/CSA-S16 and in accordance with reviewed shop drawings.
- .2 Continuously seal members by continuous welds where indicated. Grind smooth.
- .3 Provide holes in flanges.

2.3 SHOP PAINTING

- .1 Clean, prepare surfaces and shop prime structural steel in accordance with CAN/CSA-S16 CAN/CSA-S136 except where members to be encased in concrete MPI INT 5.1.
- .2 Clean members, remove loose mill scale, rust, oil, dirt and foreign matter. Prepare surface according to NACE No.3/SSPC-SP-6.
- .3 Apply one coat of primer in shop to steel surfaces:
 - .1 Surfaces to be encased in concrete.
 - .2 Surfaces and edges to be field welded.
 - .3 Faying surfaces of slip-critical connections.
- .4 Apply paint under cover, on dry surfaces when surface and air temperatures are above 5 degrees C.
- .5 Maintain dry condition and 5 degrees C minimum temperature until paint is thoroughly dry.
- .6 Strip paint from bolts, nuts, sharp edges and corners before prime coat is dry.

Part 3 Execution

3.1 APPLICATION

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

3.2 GENERAL

- .1 Structural steel work: in accordance with CAN/CSA-S16.
- .2 Welding: in accordance with CSA W59.
- .3 Companies to be certified under Division 1 or 2.1 of CSA W47.1 for fusion welding of steel structures and/or CSA W55.3 for resistance welding of structural components.

3.3 CONNECTION TO EXISTING WORK

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

3.4 MARKING

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

3.5 ERECTION

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

3.6 FIELD QUALITY CONTROL

- .1 Inspection and testing of materials and workmanship will be carried out by testing laboratory designated by Departmental Representative.
- .2 Provide safe access and working areas for testing on site, as required by testing agency and as authorized by Departmental Representative.
- .3 Submit test reports to Departmental Representative within two weeks of completion of inspection.

3.7 FIELD PAINTING

- .1 Paint in accordance with Section 09 90 00 - Painting.
 - .1 Touch up damaged surfaces and surfaces without shop coat with primer to NACE No.3/SSPC-SP-6 except as specified otherwise. Apply in accordance: MPI Architectural Painting Specification Manual.

3.8 CLEANING

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

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 09 90 00 - Painting.
- .2 Section 07 41 16 Pre-Fabricated Wall and Roof Panels

1.2 REFERENCES

- .1 Aluminum Association, Inc. (AA)
 - .1 Designation System for Aluminum Finishes [1997].
- .2 American Welding Society (AWS)
 - .1 A5.10/A5.10M[1999], Specification for Bare Aluminum and Aluminum Alloy Welding Electrodes and Rods.
- .3 Canadian Standards Association (CSA International)
 - .1 CAN3-S157-M83(R2000), Strength Design in Aluminum.
 - .2 CSA W47.2-M1987(R1998), Certification of Companies for Fusion Welding of Aluminum.
 - .3 CSA W59.2-M1991(R1998), Welded Aluminum Construction.
- .4 Master Painters Institute (MPI)
 - .1 MPI - EXT 5.5D, Bituminous Paint.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Divert unused metal from landfill to metal recycling facility.
- .2 Dispose of unused paint material at official hazardous material collections site.
- .3 Do not dispose of unused paint material into sewer system, into streams, lakes, onto ground or in other locations where it will pose health or environmental hazard.

Part 2 Products

N/A.

Part 3 Execution

3.1 GENERAL

- .1 Structural aluminum work: in accordance with CAN3-S157.
- .2 Welding: in accordance with CSA W59.2.
- .3 Companies to be certified under Division 1 or 2.1 of CSA W47.2 for fusion welding of aluminum and/or CSA W55.3 for resistance welding of structural components.

3.2 CONNECTION TO EXISTING WORK

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

3.3 ERECTION

- .1 Erect structural aluminum as indicated and in accordance with CAN3-S157 and approved erection drawings.
- .2 Field cutting or altering structural members: to approval of Departmental Representative.

3.4 JOINT SEALING AND PAINTING

- .1 Surface preparation of aluminum in contact with or embedded in dissimilar materials: to CAN3-S157. All locations to be treated as if they are in presence of moisture.
- .2 Paint in accordance with CAN3-S157.

3.5 FIELD PAINTING

- .1 Paint in accordance with Section 09 90 00 - Painting.
 - .1 Touch up damaged surfaces with one coat of zinc chromate primer followed by one coat of compatible paint.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 05 41 11 - Structural Aluminum Assembly
- .2 Section 07 13 26 - Self Adhered Sheet Membrane
- .3 Section 07 41 16 – Pre –Fabricated Wall and Roof Panels

1.2 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM A653/A653M-01a, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .2 ASTM A792/A792M-01a, Specification for Steel Sheet, 55%Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- .3 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-S16.1-94(R2000), Limit States Design of Steel Structures.
 - .2 CSA-S136-94(R2001), Cold Formed Steel Structural Members.
- .4 Canadian Sheet Steel Building Institute (CSSBI)
 - .1 CSSBI 10M-96, Standard for Steel Roof Deck.
 - .2 CSSBI 12M-96, Standard for Composite Steel Deck.

1.3 DESIGN REQUIREMENTS

- .1 Design steel deck using limit states design in accordance with CSA S136 and CSSBI 10M.
- .2 Steel deck and connections to steel framing to carry dead, live and other loads including lateral loads, diaphragm action, composite deck action, and uplift as indicated.
- .3 Deflection under specified live load not to exceed 1/360 of span.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 Submittal procedures.
- .2 Indicate deck plan, profile, dimensions, base steel thickness, metallic coating designation, connections to supports and spacings, projections, openings, reinforcement details and accessories.

1.5 WASTE MANAGEMENT AND DISPOSAL

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

- .2 Divert unused metal from landfill to metal recycling facility.

Part 2 Products

2.1 MATERIALS

- .1 Steel deck units shall be formed of zinc-coated sheet steel minimum CSSBI 10M Grade A with a base nominal thickness of 0.91mm or greater. Unless noted otherwise, zinc coatings shall be:
 - .1 Interior Exposure: Floors ZF75 - wipe coat
 - .2 Exterior Exposure: Z275.
- .2 Touch-up paint shall conform to CGSB - 1.181 Ready-Mixed Organic Zinc Rich Coating.
- .3 Cover plates, cell closures and flashings: shall be the same material as the deck with a minimum nominal thickness of 0.76 mm.
- .4 Deck shall conform to the depths and dimensions shown on the drawings
- .5 Attachment screws: Hex head self tapping 12-14 x 19mm steel screws.

Part 3 Execution

3.1 GENERAL

- .1 Structural steel work: in accordance with CAN/CSA-S136 and CSSBI 10M.

3.2 ERECTION

- .1 Erect steel deck as indicated and in accordance with CSA S136 and CSSBI 10M and in accordance with approved erection drawings.
- .2 Isolate steel deck from aluminum structure with strips of self adhesive membrane
- .3 Fasten steel decking to aluminum frame using self tapping screws
- .4 Immediately after deck is permanently secured in place, touch up metallic coated top surface with compatible primer where necessary.

3.3 OPENINGS AND AREAS OF CONCENTRATED LOADS

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 09 90 00 - Painting

1.2 REFERENCES

- .1 ASTM International
 - .1 ASTM A53/A53M-07, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - .2 ASTM A307-07b, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- .2 CSA International
 - .1 CSA G40.20/G40.21-04(R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .2 CAN/CSA G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .3 CSA W59-M03(R2008), Welded Steel Construction (Metal Arc Welding) Metric.
- .3 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .4 The Master Painters Institute (MPI)
 - .1 Architectural Painting Specification Manual - [current edition].

1.3 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit copies of WHMIS MSDS in accordance with Section 01 35 30 - Health and Safety Requirements.
 - .1 For finishes, coatings, primers, and paints applied on site: indicate VOC concentration in g/L.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province British Columbia, Canada.
 - .2 Indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.

1.4 CLOSEOUT SUBMITTALS

- .1 Make submissions in accordance with Section 01 78 10 - Closeout Submittals.
- .2 Provide certification under seal of same engineer responsible for sealing shop drawings that steel decks have been installed in accordance with sealed shop drawings.

1.5 DELIVERY, STORAGE AND HANDLING

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

1.6 SYSTEM DESCRIPTION

- .1 Design metal deck, stair, ramp and railing construction and connections to NBC vertical and horizontal live load requirements.

1.7 MATERIALS

- .1 Steel sections and plates: to CSA G40.20/G40.21, Grade 300W
- .2 Floor plate: to CSA G40.20/G40.21, Grade 260W
 - .1 Thickness: as indicated.
 - .2 Width: as indicated.
 - .3 Design: as indicated.
- .3 Steel pipe: to ASTM A53/A53M standard weight, schedule 40, seamless black.
- .4 Welding materials: to CSA W59.
- .5 Bolts and anchor bolts: to ASTM A307.

1.8 STEEL DECKING

- .1 11 Gauge safety tread decking, with perforated dimples.

1.9 STEEL MESH

- .1 Expanded boiler plate, de-burred, hot dip galvanized.

1.10 FABRICATION

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

- .2 Use self-tapping shake-proof flat headed screws on items requiring assembly by screws or as indicated.
- .3 Where possible, fit and shop assemble work, ready for erection.
- .4 Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush.
- .5 Weld connections where possible, otherwise bolt connections. Countersink exposed fastenings, cut off bolts flush with nuts. Make exposed connections of same material, colour and finish as base material on which they occur.
- .6 Shop fabricate deck and railings in sections as large and complete as practicable.

1.11 FINISHES

- .1 All metal to be hot dipped galvanized
 - .1 Galvanizing: hot dipped galvanizing with zinc coating 600 g/m² to CAN/CSA-G164.
- .2 Zinc primer: zinc rich, ready mix to CAN/CGSB-1.181.
- .3 Shop coat primer: MPI-EXT 5.

Part 2 Execution

2.1 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.
 - .2 Inform Departmental Representative] of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied

2.2 ERECTION

- .1 Do welding work in accordance with CSA W59 unless specified otherwise.
- .2 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.
- .3 Provide suitable means of anchorage.
- .4 Exposed fastening devices to match finish and be compatible with material through which they pass.
- .5 Supply components for work by other trades in accordance with shop drawings and schedule.
- .6 Touch-up rivets, field welds, bolts and burnt or scratched surfaces with primer after completion of assembly

2.3 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 21 - 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.

2.4 PROTECTION

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

END OF SECTION

PART 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 06 41 11 Architectural Woodwork and Finish Carpentry

1.2 REFERENCES

- .1 ASTM International
 - .1 ASTM A123/A123M-15, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .2 ASTM A153/A153M-16 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - .3 ASTM A653/A653M-15e1, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.
 - .4 ASTM D1761-12, Standard Test Methods for Mechanical Fasteners in Wood.
 - .5 ASTM D5055-13e1, Standard Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-Joists.
 - .6 ASTM D5456-14b, Standard Specification for Evaluation of Structural Composite Lumber Products.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-11.3-[M87], Hardboard.
 - .2 CAN/CGSB-71.26-[M88], Adhesive for Field-Gluing Plywood to Lumber Framing for Floor Systems.
- .3 CSA International
 - .1 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.
 - .2 CSA O86 Consolidation-14, Engineering Design in Wood.
 - .3 CSA O112.9-10(R2014), Evaluation of Adhesives for Structural Wood Products (Exterior Exposure).
 - .4 CSA O121-08(R2013), Douglas Fir Plywood.
 - .5 CSA O141-05(R2014), Softwood Lumber.
 - .6 CSA O151-09(R2014), Canadian Softwood Plywood.
 - .7 CSA O325-07(R2012), Construction Sheathing.
 - .8 CSA O437 Series-93(R2011), Standards on OSB and Waferboard.
- .4 Forest Stewardship Council (FSC)
 - .1 FSC-STD-01-001-(version 4-0), FSC Principle and Criteria for Forest Stewardship.
- .5 National Lumber Grades Authority (NLGA)
 - .1 Standard Grading Rules for Canadian Lumber 2014.

- .6 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
 - .1 SCAQMD Rule 1113-[A2011], Architectural Coatings.
 - .2 SCAQMD Rule 1168-[A2005], Adhesives and Sealants Applications.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for wood products and accessories and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 QUALITY ASSURANCE

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

1.5 DELIVERY, STORAGE AND HANDLING

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

1.6 COORDINATION AND COOPERATION

- .1 Cut, trim, drill, frame and make good rough carpentry work for passage of work of other sections except where otherwise specified.
 - .1 Provide location, centering and bracketing for all trades and wood framing for plumbing, heating, electrical and other trades. Make good all defects and fully complete the rough carpentry.

- .2 Provide solid backing where required for mounting accessories, including grab bars.

PART 2 Products

2.1 FRAMING, STRUCTURAL AND PANEL MATERIALS

- .1 Lumber: softwood, S4S, moisture content 19% (S-dry) or less in accordance with following standards:
 - .1 CSA O141.
 - .2 NLGA Standard Grading Rules for Canadian Lumber.
- .2 Glued end-jointed (finger-jointed) lumber [NLGA Special Products Standard] SPS, are not acceptable for exterior wall and shear wall framing.
- .3 Framing and board lumber: in accordance with National Building Code of Canada (NBCC) and CSA O86.
- .4 Furring, blocking, nailing strips, grounds, rough bucks, cants, curbs, fascia backing and sleepers:
 - .1 Board sizes: "Standard" or better grade.
 - .2 Dimension sizes: "Standard" light framing or better grade.
- .5 Plywood, OSB and wood based composite panels: to CSA O325.
- .6 Canadian softwood plywood (CSP): to CSA O151, standard construction.

2.2 ACCESSORIES

- .1 Air seal: closed cell polyurethane or polyethylene.
- .2 Sealants: in accordance with Section 07 92 00 - Joint Sealing.
 - .1 Sealants: VOC limit 250 g/L maximum to SCAQMD Rule 1168.
- .3 Subflooring adhesive: to CAN/CGSB-71.26, cartridge loaded.
- .4 General purpose adhesive: to CSA O112.9.
- .5 Nails, spikes and staples: to CSA B111.
- .6 Bolts: 12.5 mm diameter unless indicated otherwise, complete with nuts and washers.
- .7 Self tapping screws: Stainless steel, countersink head, of appropriate length.
- .8 Proprietary fasteners: toggle bolts, expansion shields and lag bolts, screws and lead or inorganic fibre plugs, explosive actuated fastening devices, recommended for purpose by manufacturer.
- .9 Fastener Finishes:
 - .1 Galvanizing: to ASTM A153/A153M, use galvanized fasteners for exterior work, and interior highly humid areas

PART 3 Execution

3.1 EXAMINATION

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

3.2 MATERIAL USAGE

- .1 Floor sheathing:
 - .1 Plywood, DFP, select sheathing grade, square edge, 19 mm thick.
- .2 Subfloor:
 - .1 Plywood, DFP, G1S square edge, 8mm thick
- .3 Electrical equipment mounting boards:
 - .1 Plywood, DFP G1S grade, or, square edge 19 mm thick.

3.3 INSTALLATION

- .1 Install floor sheathing as indicated, at right angles to insulated floor panels. Attach into top skin of floor panels with #8 x38mm PHF TEK screws set flush with top of plywood. Screws to be spaced approximately
- .2 Attach subfloor to floor sheathing using adhesive and staples as indicated.
- .3 Install rough bucks, nailers and linings to rough openings as required to provide backing for windows, door frames and other work.
- .4 Install wood cants, fascia backing, nailers, curbs and other wood supports as required and secure using galvanized steel fasteners.
- .5 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.
- .6 Countersink bolts where necessary to provide clearance for other work.

3.4 FURRING AND BLOCKING

- .1 Co-ordinate and Install proper furring and solid blocking as shown on the drawings and as specified to space-out and/or support:
 - .1 Anchoring and mounting cabinets
 - .2 Hardware
 - .3 Electrical equipment
 - .4 Fittings and fixtures not supplied with backing attachments

- .5 Washroom accessories
- .6 All grab bars as per layout specified in Architect's detail drawings.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - 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 rough carpentry installation.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Custom shop fabricated locker unit.
- .2 Millwork cabinets and shelves.
- .3 Countertops.
- .4 Cabinet hardware.
- .5 Interior window trim

1.2 RELATED SECTIONS

- .1 Section 06 41 00 Architectural Woodwork and Finish Carpentry
- .2 Section 09 90 00 - Painting.

1.3 REFERENCES

- .1 BHMA A156.9-2010 - Cabinet Hardware.
- .2 NPA A208.2-2009 - Medium Density Fibreboard (MDF) for Interior Applications.
- .3 AWMAC - Architectural Woodwork Standards (AWS) – 1st Edition, 2009.
- .4 CAN/CSA O141-91(R1999), Softwood Lumber.
- .5 NEMA LD3-2005 - High Pressure Decorative Laminates (HPDL).
- .6 Green Seal Environmental Standards
 - .1 Standard GC-03-97, Anti-Corrosive Paints.
 - .2 Standard GS-11-93, Architectural Paints.
 - .3 Standard GS-36-00, Commercial Adhesives
- .7 South Coast Air Quality Management District (SCAQMD), California State
 - .1 SCAQMD Rule 1113-04, Architectural Coatings.
 - .2 SCAQMD Rule 1168-05, Adhesives and Sealants Applications
- .8 EN 438-2:25 - Standard Test Method for Resistance to Scratch.
- .9 EN 438-2:16 - Standard Test Method for Resistance to Dry Heat.
- .10 EN 12721 - Standard Test Method for Resistance to Wet Heat
- .11 EN 438-2:17 - Standard Test Method for Dimensional Stability in Elevated Temperature.
- .12 EN ISO 178/ASTM 790-08 - Standard Test Method for Flexural Strength
- .13 EN ISO 1183/ASTM 792-08 - Standard Test Method for Density
- .14 ASTM E-84/UL 723 - Standard Test Method for Surface Burning Characteristics

1.4 SUBMITTALS

- .1 Section 01 33 00: Submission procedures.
- .2 Shop Drawings: Indicate materials, component profiles and elevations, assembly methods, joint details, fastening methods, accessory listings, hardware location and schedule of finishes.
- .3 Product Data: Provide data for hardware accessories.
- .4 Provide samples of solid surface and plastic laminate materials for selection by Departmental Representative.
 - .1 Provide samples from manufacturers standard colour range.

1.5 QUALITY ASSURANCE

- .1 Perform cabinet construction to AWMAC Custom quality.

1.6 DELIVERY, STORAGE, AND PROTECTION

- .1 Deliver, store and handle materials in accordance with manufacturers recommendations..

1.7 ENVIRONMENTAL REQUIREMENTS

- .1 During and after installation of work of this section, maintain the same temperature and humidity conditions in building spaces as will occur after occupancy.

Part 2 Products

2.1 LUMBER MATERIALS

- .1 Lumber: To the requirements of AWMAC, Custom grade.
- .2 Hardwood Lumber: plain sawn, maximum moisture content of 6%; with plain sawn grain, of quality suitable for transparent finish.

2.2 SHEET MATERIALS

- .1 Sheet Materials: To the requirements of AWMAC custom grade.
- .2 Softwood Plywood: Veneer core; Douglas of grade to suit application; sanded faces.
 - .1 Plywood resin to include no added urea formaldehyde
- .3 Maple plywood: 7-ply all hardwood veneer core plywood with no voids, to AWMAC/AWI Custom Grade requirements, no added urea-formaldehyde.
 - .1 Top veneers (facers): White Maple, plain-sliced/flat-cut, 'A Grade' to AWS Manual 4.2a.16.2 requirements and selected for uniform consistent colour across face.

2.3 STANDING AND RUNNING TRIM MATERIALS

- .1 19mm x 89mm kiln dried finger joint pine, pre primed. To CAN/CSA O141-91.

2.4 LAMINATE MATERIALS

- .1 High Pressure Laminate: NEMA LD3, high pressure laminate, solid chosen from manufacturers standard colour range, satin finish.

2.5 SOLID SURFACE COUNTERTOP MATERIALS

1. Solid phenolic composite; chemical resistant surface; composed of a self-supporting flat panel based on thermosetting resins, homogeneously reinforced with cellulose fibers and manufactured under high pressure. The panels have a pigmented resin core with a decorative surface that is electron-beam cured.
 - .1 Solid phenolic composite material comprised mounted to plywood substrate.
 - .1 Composition: 25mm thick built up.
 - .2 Outside corners: radius
 - .3 Submittals:
 - .1 Show field-verified dimensions, surfacing dimensions, locations and dimensions of cutouts, required locations of support and blocking members, edge profiles, and installation details and methods. Identify colour(s) and finish(es).
 - .2 Samples for Colour and edge treatment approval: Submit two (2) samples 10 x 10 inches (250 x 250 mm) of colour and finish selected.
 - .3 Stone Adhesive: Submit two (2) samples of an adhesive joint for colour quartz surfacing selected. Show colour match of adhesive.

2.6 ACCESSORIES

- .1 Adhesive: Type recommended by laminate and phenolic solid surface material manufacturer to suit application.
 - .1 Adhesives to SCAQMD Rule 1168-05
- .2 Plastic Edge Trim (PVC): Extruded flat shaped; smooth finish; self locking serrated tongue; of width to match component thickness; colour as selected. Minimum 3 mm thickness.

2.7 HARDWARE

- .1 Hardware: BHMA A156.9
- .2 Shelf Standards and Rests: Formed steel channels and rests, cut for fitted rests spaced at 25 mm centres; satin finish.
- .3 Shelf Brackets: Formed steel brackets, formed for attachment with lugs; satin finish.
- .4 Drawer and Door Pulls: Extruded aluminum pull, U-shaped satin finish; 100 mm centres.
- .5 Cabinet and Locker Locks: Keyed cylinder, two keys per lock, master keyed.
- .6 Cabinet Catches: Magnetic.
- .7 Drawer Slides: Galvanized steel construction, ball bearings separating tracks, full extension type.

- .8 Hinges: European type, satin finish.
- .9 Piano hinges: 19mm butt, stainless steel construction. Satin finish, lengths as detailed
- .10 Hanging rods:
 - .1 Rods: chrome plated 25 mm o.d x minimum 1.9 mm wall thickness seamless steel tubing.
 - .2 Flanges: chrome plated steel round "captured" flanges to prevent unauthorized rod removal, complete with chromed plated mounting screws.
 - .3 Intermediate supports required when rod exceeds 1m length

2.8 PLASTIC LAMINATE CASEWORK

- .1 Cabinet Construction: Flush overlay, adjustable shelving plywood core.
- .2 Exposed Surfaces:
 - .1 Drawers and Drawer Fronts: High pressure laminate.
 - .2 Edges: PVC.
- .3 Semi-exposed Surfaces:
 - .1 Surfaces (other than drawer bodies) Thermofused melamine.
 - .2 Shelves: High pressure laminate.
 - .3 Edges: PVC.
 - .4 Drawer Sides and Backs: Edgebanded.
 - .5 Drawer Bottoms: Melamine.

2.9 VENEER PLYWOOD CASEWORK

- .1 Plywood materials as detailed
- .2 Solid wood edging to AWMAC - Architectural Woodwork Standards (AWS) – 1st Edition, 2009, Custom grade.

2.10 FABRICATION

- .1 Shop prepare and identify components for matching during site assembly.
- .2 Shop assemble casework for delivery to site in units easily handled and to permit passage through building openings.
- .3 When necessary to cut and fit on site, provide materials with ample allowance for site cutting and scribing.
- .4 Apply plastic laminate finish in full, uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises.
- .5 Fabricate solid surface countertops with integral backsplash and front and side edging as detailed. Pre-cut for sink openings.

2.11 WOOD FINISHES

- .1 Factory Finishing:

- .1 Finishing System: AWMAC, Custom grade, acrylic lacquer finish system.
- .2 Sheen: Satin.

Part 3 Execution

3.1 INSTALLATION

- .1 Install Work to AWMAC Custom Grade.
- .2 Set and secure casework in place; rigid, plumb, and level.
- .3 Use fixture attachments in concealed locations for wall mounted components.
- .4 Use concealed joint fasteners to align and secure adjoining counter tops.
- .5 Secure cabinet to floor using appropriate angles and anchorages.

3.2 INTERIOR STANDING / RUNNING TRIM

- .1 Install in accordance with details and to AWMAC/AWI Custom Grade requirements unless more stringent requirements are specified in this Section.
- .2 Job site conditions for installation to be in accordance with AWS Manual requirements at time of installation.
- .3 Install items in accordance with details using finishing nails throughout.
- .4 Countersink all fixings and fill flush with wood filler.
- .5 Site measure, cut and install items using longest practical length pieces to avoid splice joints.
- .6 Use one length per location to avoid splice joints.
- .7 Caulk junctions between standing/running trim and adjacent walls with sealant make junctions filled and smooth for "painting out".
- .8 Co-ordinate application of 1st coat of finishes prior to installation.

3.3 ADJUSTING

- .1 Test installed work for rigidity and ability to support loads.
- .2 Adjust moving or operating parts to function smoothly and correctly.

3.4 CLEANING

- .1 Do cleaning in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Self-adhesive sheet membrane for isolating dissimilar materials.
- .2 Self-adhesive sheet membrane for use in window and door installation.

1.2 RELATED SECTIONS

- .1 Section 05 31 00 Steel Decking.
- .2 Section 08 11 00 Metal Doors and Frames
- .3 Section 08 53 13 Vinyl Windows

1.3 REFERENCES

- .1 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB 37-GP-56M, Standard for Modified Bituminous Sheet Membranes.
- .2 ASTM C1193 - Standard Guide for Use of Joint Sealants.
- .3 ASTM E96 - Test Methods for Water Vapour Transmission of Materials.

1.4 SUBMITTALS

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Provide data indicating material characteristics, performance criteria and limitations.
- .3 Manufacturer's Installation Instructions: Indicate preparation and installation requirements, techniques.

1.5 WHMIS

- .1 Comply with WHMIS requirements when handling and using sealant materials.

Part 2 Products

2.1 SELF ADHESIVE MEMBRANE

- .1 Modified Bituminous Membrane: Asphalt and polymer modifiers of styrene-butadiene-styrene (SBS) type, reinforced with non-woven cross laminated polyethylene; smooth surfaced; .8 mm thick; 920 mm wide roll. To CAN/CGSB 37-GP-56M

2.2 ACCESSORIES

- .1 Primer: Water based surface conditioner as recommended by self adhesive membrane manufacturer.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify condition of substrate and adjacent materials.

3.2 PREPARATION

- .1 Remove loose or foreign matter which might impair adhesion.
- .2 Verify substrate surface is flat, free of honeycomb, fins, irregularities, materials or substances that may impede installation.

3.3 SELF ADHESIVE MEMBRANE

- .1 Apply membrane at intersection of dissimilar materials as detailed.
 - .1 Apply where steel decking meets aluminum floor beams
- .2 Apply membrane at door and window installations as detailed.
- .3 Apply primer at a rate recommended by the materials manufacturer. Protect surface conditioner from rain or frost until dry.
- .4 Roll out membrane. Minimize wrinkles and bubbles.
- .5 Remove release paper layer. Roll out on substrate with a mechanical roller to encourage full contact bond.

END OF SECTION

Part 1 General

1.1 APPLICATION OF SECTION

- .1 Insulated panels are to be provided by owner and installed by contractor.
- .2 Information in this section related to panel composition is for Contractor information.
- .3 Information in this section related to delivery and installation of panels is applicable to Contractors work.

1.2 RELATED SECTIONS

- .1 Section 05 14 11 - Structural Aluminum Assembly.
- .2 Section 07 92 00 – Joint Sealing.
- .3 Section 08 11 00 - Metal Doors and Frames.
- .4 Section 08 53 13 - Vinyl Windows
- .5 Section 09 90 00 - Painting.

1.3 REFERENCES

- .1 ASTM A792/A792M-10 Standard Specification for Sheet Steel, 55% Aluminum-Zinc Alloy-Coated by the Hot Dip Process
- .2 ASTM A775: Standard specification for Sheet Steel, Metallic Coated by the Hot Dip Process and Prepainted by the Coil Coating Process for Exterior Exposed Building Products.
- .3 ASTM D1621:D Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
- .4 ASTM E72; Standard Test Methods of Conducting Strength Tests of Panels for Building Construction
- .5 ASTM E84; Standard Test Method for Surface Burning Characteristics of Building Materials
- .6 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
- .7 ASTM E331; Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
- .8 ASTM E1646; Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference
- .9 ASTM E1680; Standard Test Method for Rate of Air Leakage Through Exterior Metal Roof Panel Systems
- .10 UL 580; Tests for Uplift Resistance of Roof Assemblies
- .11 FM 4471; Approval Standard for Class 1 Panel Roofs

1.4 SUBMITTALS

- .1 The following submittals will be provided by the owner & panel manufacturer for contractor use.
- .2 Shop Drawings: detailed drawings and panel analysis showing:
 - .1 Profile
 - .2 Gauge of both exterior and interior sheet
 - .3 Location, layout and dimensions of panels on structure
 - .4 Location and type of fasteners
 - .5 Shape and method of attachment of all trim
 - .6 Locations and type of sealants
 - .7 Coordination Drawings: 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.
 - .8 Snow and Wind Design loads
 - .1 Engineered per NBC for building location.
 - .2 Provide drawings and calculations under the seal of a Structural Engineer registered in the Province of British Columbia.
 - .9 Other details as may be required for a weathertight installation
- .3 Roof Panel Analysis: 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
- .4 Wall Panel Analysis: 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.
- .5 Quality Assurance Submittals
 - .1 Design Data, Test Reports: Provide manufacturer test reports indicating product compliance with requirements.
 - .2 Manufacturer Erection Instructions: Provide manufacturer's written installation instructions including proper material storage, material handling, installation sequence, panel location(s), and attachment methods, details and required trim and accessories.

1.5 QUALITY ASSURANCE

- .1 Installer Qualifications:
 - .1 The work shall be supervised by a person having a minimum of five (5) years experience in construction supervision and the application of good trade practice in constructing pre-fabricated building assemblies.
 - .2 Installation shall be in accordance with manufacturer's installation guidelines and recommendations.
- .2 Fire Classifications:
 - .1 Factory Mutual Class 1A Approval when installed at a maximum roof slope of 5:12.

1.6 DELIVERY STORAGE AND HANDLING

- .1 Contractor is responsible for receiving delivery of panels to site and directing storage / staging location. Panels are supplied by:
 - Mansonville Plastics, Korolite Engineering Panel Structures Ltd. Surrey B.C. (604-534-8626)
- .2 Materials and components are to arrive on site in manufacturer's original, unopened, undamaged packaging with identification labels intact.
- .3 Store roofing, wall and flooring panel materials on dry, level, firm, and clean surface using the three inch factory provide foam supports under the panels. Use of wood substitute is not acceptable. Stack no more than two bundles high. Elevate and ventilate to allow air to circulate and moisture to escape.

1.7 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: Ten (10) 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: Ten (10) years from date of Substantial Completion.

1.8 WASTE MANAGEMENT AND DISPOSAL

- .1 In accordance with Section 01 74 19 Construction Waste Management and Disposal.
- .2 Divert unused metal from landfill to metal recycling facility.
- .3 Dispose of unused paint material at official hazardous material collections site.
- .4 Do not dispose of unused paint material into sewer system, into streams, lakes, onto ground or in other locations where it will pose health or environmental hazard.

Part 2 Products

2.1 STANDING SEAM ROOF AND FLOOR PANELS

- .1 Roof and Floor Panel Description
 - .1 Minimum R Value: R20
 - .2 Panel width: 42 inch wide
 - .3 Panel length: full length no seams
 - .4 The side joint shall consist of a 2 inch vertical sidelap, mechanically seamed, with fasteners and thermally broken attachment clip completely concealed within the side joint.
 - .5 Exterior Face of Panel
 - .1 Material: AZ150 Galvalume per ASTM A792.
 - .2 Metal thickness: 24 gauge.

- .3 Texture: smooth, embossed
- .4 Yield: 33 ksi minimum
- .5 Exterior Finish: 1.0 mil Silicone Modified Polyester (SMP)
 - .1 Roof colour: Coast Guard Red. Submit for approval by Departmental Representative.
 - .2 Floor colour: Imperial White.
- .6 Interior Face of Panel
 - .1 Material: AZ150 Galvalume per ASTM A792.
 - .2 Metal thickness: 24 gauge.
 - .3 Profile: stucco, embossed
 - .4 Yield: 33 ksi minimum
 - .5 Interior Finish: 1.0 mil Silicone Modified Polyester (SMP)
 - .1 Colour: Imperial White
- .7 Insulating Core:
 - .1 Consists of expanded polystyrene eps
 - .2 Panel shall provide a nominal R-value of 4 per inch thickness.
 - .3 Compressive Strength: 10psi
 - .4 Flexural Strength: 25 psi
 - .5 Water Vapour: Permeability: 3.50 perm-in
 - .6 Water Absorption % by volume: 6.0
 - .7 Dimensional Stability % linear change: 1.5%(max)

2.2 WALL PANELS

- .1 Wall Panel Description
 - .1 Minimum R Value: R-24
 - .2 Metal thickness: 24 gauge.
 - .3 Panel Attachment: Shall consist of fasteners and stainless steel attachment clip completely concealed within the panel side joint.
 - .4 Exterior Face of Panel
 - .1 Material:
 - .1 Steel coil material shall be in accordance with ASTM A755: AZ150 Galvalume in accordance with ASTM A792.
 - .2 Profile : embossed
 - .3 Texture: Non Directional stucco
 - .4 Exterior paint Finish Colour:
 - .1 TBD
 - .2 Finish System
 - .1 1.0 mil Silicone modified Polyester (SMP)
 - .5 Interior Face of Panel
 - .1 Material
 - .1 Steel coil material shall be in accordance with ASTM A755: AZ150 Galvalume in accordance with ASTM A792. .

- .2 Metal thickness: 24 gauge.
- .3 Profile: embossed
- .4 Texture: non-directional stucco
- .5 Interior Finish: 1.0 mil Silicone Modified Polyester (SMP)
- .1 Colour: TBD

2.3 PANEL CHARACTERISTICS (ROOF, WALL AND FLOOR PANELS)

- .1 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 for roof panels and l/180 for wall panels.
 - .2 Thermal Properties: The panel shall provide a nominal R-value of 4 per inch thickness when tested in accordance with ASTM C518 at a mean temperature of 75 deg. F.
 - .3 Fatigue Test: There shall be no evidence of metal/insulation interface delamination when the panel is tested by simulated wind loads of 20 psf (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 140 deg. F 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 137 pa 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 6300 pa air pressure differential when tested in accordance with ASTM E283 and ASTM E1680. Tested assembly must include endlap and sidelap conditions.
 - .7 Hailstorm Rating: Factory Mutual 1 SH hailstorm rating.
- .2 Finish Characteristics
 - .1 Film Thickness: The exposed surface shall have a dry film thickness of 0.1 mils. Test Method: ASTM D5796
 - .2 Film Cure: The baked film shall withstand one hundred and fifty (150) MEK double rubs. Test Method: ASTM D5402
 - .3 Film Hardness (Pencil Method): The hardness of the paint film may be measured by means of Eagle/Berol turquoise T-2375 or equivalent pencils using a flat cylindrical head applied at a 45deg. angle to the paint film. A minimum hardness of F shall be obtained. Pencil Hardness is specified as the hardest pencil number that will not rupture the paint film when tested as described above. Test Method: ASTM D3363
 - .4 Formability/Adhesion Test: When testing a representative sample at 20oC } 1oC and using #610 Scotch cellophane tape, the paint system will show no loss of adhesion when subjected to a 3T 180deg. bend and tape pull test. Test Method: ASTM D4145.
 - .5 Gloss: The specular gloss shall be 30 ± 5 gloss units when measured with a Gardner 60o Glossmeter.

- .6 Humidity Resistance: The humidity resistance test shall be conducted at 100% relative humidity at a temperature of 38oC. After 1000 hours of exposure, the surface shall show no field blisters. Test Method: ASTM D2247
- .7 Film Integrity: During the first forty (40) years of exposure, the paint film shall have no evidence of cracking, flaking, or checking to an extent that is apparent on ordinary outdoor visual observations.
- .8 Chalking: For the first thirty (30) years, vertical installations will not chalk more than a #8 rating and non-vertical installations will not chalk more than #6 when measured per ASTM D4214, Method A.
- .9 Colour Change: For the first thirty (30) years, vertical installations will not change colour more than five (5) and non-vertical installations will not change more than eight (8) delta E colour units.

2.4 ACCESSORIES

- .1 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 side joint. Base clip shall be a minimum 14 gauge galvanized, and top clip shall be a minimum 20 gauge 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.
- .2 Perimeter Trim and Penetration Treatments
 - .1 As provided by the panel manufacturers as a complete package with the panel system.
 - .2 All required trim and metal flashing with same coating, colour, and gauge as the exterior face of the insulated metal roof panel.
- .3 Butyl Tape: Per panel manufacturer's recommendations for panel to panel and panel to trim seal.
- .4 Butyl Sealants: Non-skinning type per panels manufacturer's recommendations.

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 inches inward, plus 13mm outward
 - .2 All deviations from structural tolerances shall be corrected by the responsible 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 Assembly instructions for panel system to be provided by the panel manufacturer with the shop drawings.
- .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 vapour 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 reseal 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 center with 1/4 inch by 7/8 inch low profile vibration resistant stitch fasteners.

3.4 CLEANING

- .1 Do cleaning in accordance with Section 01 74 11 - Cleaning.
- .2 Progress Cleaning:
 - .1 Remove dirt and marks caused by installation.
- .3 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.
- .4 Waste Management: separate waste materials for recycling.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

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END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 08 11 00 - Metal Doors and Frames
- .2 Section 08 53 13 – Vinyl Windows

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A240/A240M-07e1, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - .2 ASTM A653/A653M-07, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .3 ASTM B32-04, Standard Specification for Solder Metal.
 - .4 ASTM D523-89(1999), Standard Test Method for Specular Gloss.
 - .5 ASTM D822-01(2006), Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings.
 - .6 ASTM C920-08, Standard Specification for Elastomeric Joint Sealants.
- .2 Aluminum Association (AA)
 - .1 AA DAF 45-03(R2009), Designation System for Aluminum Finishes.
- .3 American Architectural Manufacturers Association (AAMA)
 - .1 AAMA 611-98, Voluntary Specifications for Anodized Finishes Architectural Aluminum.
- .4 NBC, National Building Code of Canada (issue date listed in Section 01 41 00 Regulatory Requirements)
- .5 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 for sheet metal flashing systems materials, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Samples:
 - .1 Submit duplicate samples of each type of sheet metal material, finishes and colours for Departmental Representative color selection.

1.4 PERFORMANCE REQUIREMENTS

- .1 Provide metal flashings that will withstand wind uplift conditions listed in NBC for building location, unless more stringent values are identified on drawings.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturers recommendations.
- .2 Protect pre finished materials from scratching
- .3 Stack pre-formed materials in manner to prevent twisting, bending and rubbing.

1.6 WASTE MANAGEMENT AND DISPOSAL:

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

Part 2 Products

2.1 MATERIALS

- .1 Zinc coated sheet steel: to ASTM A653/A653M, commercial quality, Grade 33, with not less than Z275 designation zinc coating, pre-finished.
 - .1 Pre-finish: coil stock finished with polyvinylidene fluoride gloss paint on epoxy primer prior to profile fabrication, with colour coat containing not less than 70% pvdf resin. Include permanent-type treatment to reverse side of coil stock to prevent corrosion of backside surfaces.
 - .1 Specular gloss: 30 units +/- in accordance with ASTM D523.
 - .2 Coating thickness: not less than 22 micrometres
 - .3 Resistance to accelerated weathering for chalk rating of 8, colour fade 5units or less and erosion rate less than 20% to ASTM D822 as follows:
 - .1 Outdoor exposure period 2500 hou
 - .2 Humidity resistance exposure period 5000 hours
 - .4 Colours: As selected by Departmental Representative.
 - .2 Sheet steel to be produced by North American mills to ensure compliance with above-referenced standards. Submit evidence of North American mill source upon Departmental Representative request.
- .2 Touch-up paint: type compatible with and matching pre-finish paint/colour.
- .3 Flashing fasteners: #8-18x19mm, self-tapping screws
- .4 Sealants: non-sag polyurethane, one part formulation, to ASTM C 920 Type S, Grade NS, Class 35, Use NT, M, A and O; colours selected by DCC Representative where exposed to view.
- .5 Self-adhesive SBS membrane: minimum 1 mm thick self-adhering composite sheet membrane comprised of 0.8 mm thick rubberized asphalt integrally bonded to 0.1 mm thick film of polyethylene, bottom surface protected with silicone release sheet.

2.2 FABRICATION OF FLASHING

- .1 Fabricate in accordance with detail drawings.
- .2 Fabricate typical flashings using not less than 0.61 mm thick pre-finished zinc coated sheet steel, unless detailed/indicated otherwise. Use greater metal thickness at locations of wider span to prevent "oil-canning" and deformation of flashings.
- .3 Fabricate flashings accurately with true crisp lines and quality metalwork joinery suitable for exposed installation.
- .4 Pre-fabricate corners with mitred joints. Form watertight lock-seams set in sealant for all mitred corner joints.
- .5 Maintain 1:6 minimum slope on horizontal surfaces.
- .6 Hem exposed edges. Fold under minimum 10 mm.
- .7 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.
- .8 Refer to drawings for self-adhesive SBS membrane locations under metal flashings.
- .9 Fabricate specialized flashings including but not limited to hot pipe flashings, storm collars, pressure rings and flue caps using not less than 0.38 mm (AISI 28 gauge) metal thickness stainless steel sheet. Use greater metal thickness at locations of wider span to prevent "oil-canning" and deformation of flashings.
 - .1 Colour match welding material to parent metal in stainless steel fabrications.
 - .2 Use welding material with same corrosion resistance properties as parent metal.
 - .3 Grind and polish welds to match parent metal.

2.3 FABRICATION OF WINDOW FLASHINGS

- .1 Fabricate in straight sections as indicated.

2.4 GUTTERS

- .1 .1 Material: ASTM B209M utility sheet aluminum, shop pre-coated with high molecular weight polyester (hmp) gloss paint on epoxy primer prior to profile fabrication, colours selected by Departmental Representative.
- .2 Components:
 - .1 Gutters: 125 mm size rectangular profile, not less than 0.80 mm metal thickness.
 - .2 Downspouts: 75 mm o.d. round profile, not less than 0.48 mm metal thickness.
 - .3 End caps, downspout outlets, straps, support brackets, downspout strainers: profiled to suit gutters and downspouts.
- .3 Accessories:
 - .1 Anchorage devices: stainless steel alloy screws and washers.
 - .2 Gutter supports: designed to fit into, engage and support gutters; non-corroding plated finish stamped metal or aluminum alloy casting fabrications.
 - .3 Downspout supports: straps.

- .4 Downspout adapters: ABS plastic units sized to downspouts and to drain pipes, offset and straight designs, colours selected by Departmental Representative.
- .4 Fabrication:
 - .1 Form gutters and downspouts of profiles and sizes detailed/indicated.
 - .2 Form sections square, true and accurate in size, in maximum possible lengths and free of distortion or defects detrimental to appearance or performance.

Part 3 Execution

3.1 INSTALLATION

- .1 Metal Flashings
 - .1 Install in accordance with detail drawings.
 - .2 Fit flashings together so that one end of each section is free to move in joint.
 - .3 Fit flashings secure in place. Make corners square, surfaces true and straight in all planes, and all lines accurate to profiles.
- .2 Gutters and downspouts
 - .1 Install in accordance with detail drawings.

3.2 CLEANING

- .1 Do cleaning in accordance with Section 01 74 11 - Cleaning.
- .2 Clean flashings to remove handling marks and smudges.
- .3 Progress cleaning: leave Work area clean at end of each day.
- .4 Final cleaning: on completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools, equipment and barriers.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 07 41 16 - Pre-Fabricated Wall and Roof Panels
- .2 Section 07 62 00 Sheet Metal Flashing and Trim
- .3 Section 09 90 00 Painting

1.2 REFERENCES

- .1 ASTM International
 - .1 ASTM C919-08, Standard Practice for Use of Sealants in Acoustical Applications.
- .2 Canadian General Standards Board (CGSB)
 - .1 CGSB 19-GP-5M-1984, Sealing Compound, One Component, Acrylic Base, Solvent Curing (Issue of 1976 reaffirmed, incorporating Amendment No. 1).
 - .2 CAN/CGSB-19.13- M87, Sealing Compound, One-component, Elastomeric, Chemical Curing.
 - .3 CAN/CGSB-19.17-M90, One-Component Acrylic Emulsion Base Sealing Compound.
 - .4 CAN/CGSB-19.24-M90, Multi-component, Chemical Curing Sealing Compound.
- .3 General Services Administration (GSA) - Federal Specifications (FS)
 - .1 FS-SS-S-200-E(2)1993, Sealants, Joint, Two-Component, Jet-Blast-Resistant, Cold Applied, for Portland Cement Concrete Pavement.
- .4 AAMA 809 Voluntary Specifications and Test Methods for Sealants.
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .6 Green Seal Environmental Standards
 - .1 Standard GS-36-00, Commercial Adhesives
- .7 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
 - .1 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.

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 joint sealants and include product characteristics, performance criteria, physical size, finish and limitations.

- .2 Manufacturer's product to describe:
 - .1 Caulking compound.
 - .2 Primers.
 - .3 Sealing compound, each type, including compatibility when different sealants are in contact with each other.
- .3 Samples:
 - .1 Submit samples of each type of material and colour.
 - .2 Cured samples of exposed sealants for each colour where required to match adjacent material.
- .4 Manufacturer's Instructions:
 - .1 Submit instructions to include installation instructions for each product used.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturers recommendations.
- .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 accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

1.5 WHMIS

- .1 Submit 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.

1.6 WASTE MANAGEMENT AND DISPOSAL

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

1.7 SITE CONDITIONS

- .1 Environmental Conditions:
 - .1 Proceed with installation of joint sealants only when:
 - .1 Ambient and substrate temperature conditions are within limits permitted by joint sealant manufacturer or are above 4.4 degrees C.
 - .2 Joint substrates are dry.
 - .3 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.
- .2 Joint-Width Conditions:
 - .1 Proceed with installation of joint sealants only where joint widths are more than those allowed by joint sealant manufacturer for applications indicated.

- .3 Joint-Substrate Conditions:
 - .1 Proceed with installation of joint sealants only after contaminants capable of
- .4 Where sealants are qualified with primers use only these primers.

Part 2 Products

2.1 SEALANT MATERIALS

- .1 Sealant materials to conform to the requirements of :
 - .1 Green Seal Environmental Standards
 - .1 Standard GS-36-00, Commercial Adhesives
 - .2 South Coast Air Quality Management District (SCAQMD), California State
 - .1 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.
- .2 VOC limit maximum 250 g/L for sealers used within the building envelope.
- .3 Where sealants are qualified with primers, use only these primers

2.2 SEALANT MATERIAL DESIGNATIONS

- .1 Polyurethanes: colours selected by Departmental Representative.
 - .1 Non-sag formulation: 1-part, to CAN/CGSB-19.13, Type 2, MCG-2-25, MCG-2-40.
 - .2 Self-levelling formulation:
 - .3 1-part: to CAN/CGSB-19.13, Type 1.
 - .4 2-part: to CAN/CGSB-19.24, Type 1, Class B.
- .2 Non-drying butyl sealant to AAMA 809
- .3 Silicones one part: to CAN/CGSB-19.13.
- .4 Structural silicones to CAN/CSGB 19.13 M87
- .5 Acrylics one part: to CGSB 19-GP-5M.
- .6 Acrylic latex: one part, non sag siliconized acrylic polymer to CAN/CGSB-19.17.
- .7 Preformed compressible and non-compressible back-up materials:
 - .1 Polyethylene, urethane, neoprene or vinyl foam:
 - .1 Extruded closed cell foam backer rod.
 - .2 Sized as required.
 - .2 Neoprene or butyl rubber:
 - .1 Round solid rod, Shore A hardness 70.
 - .3 High density foam:
 - .1 Extruded closed cell polyvinyl chloride (PVC), extruded polyethylene, closed cell, Shore A hardness 20, tensile strength 140 to 200 kPa, extruded polyolefin foam, 32 kg/m³ density, or neoprene foam backer, size as recommended by manufacturer.
 - .4 Bond breaker tape:

- .1 Polyethylene bond breaker tape which will not bond to sealant.

2.3 SEALANT SELECTION

- .1 Roof and wall panel connections
 - .1 Non -drying, self-healing, butyl rubber sealant.
- .2 Flashings applied at wall and roof junctions.
 - .1 High performance single component neutral cure structural silicone to CAN/CSGB 19.13 M87, Clear colour
- .3 Junctions between subfloor floor edges and exterior wall panels to produce permanent sealed vapour-resistant joints.
 - .1 Polyurethane, self-levelling.
- .4 Penetrations in exterior walls to fill joints watertight including but not limited to exterior perimeters of door frames, window frames, curtain wall frames; exterior perimeters of wall vents; exterior perimeters of all other wall penetrations.
 - .1 Polyurethane, non-sag.
- .5 Interior perimeters of door frames and trims, window and curtain wall frames to make junctions filled, smooth and invisible suitable for subsequent "painting out" with interior wall finishes.
 - .1 Acrylic latex.
- .6 Gypsum board control joints: to make joints suitable for subsequent "painting out" with interior wall finishes.
 - .1 Acrylic latex.
- .7 Junctions between counter tops and walls to produce permanent sanitary and watertight seal; junctions between plumbing fixtures and walls, floors and counter tops/vanities to produce permanent sanitary and watertight seal. Co-ordinate with plumbing trade to avoid omission/duplication.
 - .1 Mildew-resistant silicone.

2.4 JOINT CLEANER

- .1 Non-corrosive and non-staining type, compatible with joint forming materials and sealant in accordance with sealant manufacturer's written recommendations.
- .2 Primer: in accordance with sealant manufacturer's written recommendations.

Part 3 Execution

3.1 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.

3.2 PRIMING

- .1 Where necessary to prevent staining, mask adjacent surfaces prior to priming and caulking.
- .2 Prime sides of joints in accordance with sealant manufacturer's instructions immediately prior to caulking.

3.3 BACKUP MATERIAL

- .1 Apply bond breaker tape where required to manufacturer's instructions.
- .2 Install joint filler to achieve correct joint depth and shape, with approximately 30% compression.

3.4 MIXING

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

3.5 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.

3.6 CLEANING

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

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- .1 Non-rated, fire rated and thermally insulated steel frames.
- .2 Non rated metal window and sidelight frames
- .3 Non-rated, fire rated and thermally insulated steel doors.
- .4 Cooler door: thermally insulated, steel door and frame.

1.2 RELATED SECTIONS

- .1 Section 08 71 00 - Door Hardware: Hardware, silencers, and weather-stripping.
- .2 Section 09 90 00 - Painting: Field painting of frames.

1.3 REFERENCES

- .1 ASTM A653/A653M - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .2 CSDFMA (Canadian Steel Door and Frame Manufacturers Association).
- .3 DHI - Door Hardware Institute: The Installation of Commercial Steel Doors and Steel Frames, Insulated Steel Doors in Wood Frames and Builder's Hardware.
- .4 NFPA 80 - Fire Doors and Windows.
- .5 NFPA 252 - Fire Tests for Door Assemblies.
- .6 UL 10B - Fire Tests of Door Assemblies.
- .7 SDI-100 - Standard Steel Doors and Frames.
- .8 ASHRAE 90.1 2013- Energy Standard for Buildings Except Low Rise Residential Buildings

1.4 SUBMITTALS

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

1.5 QUALITY ASSURANCE

- .1 Conform to requirements of CSDFMA SDI-100.

1.6 REGULATORY REQUIREMENTS

- .1 Fire Rated Frame Construction: Conform to UL 10B.
- .2 Installed Door and Frame Assembly: Conform to NFPA 80 for fire rated class as scheduled.

1.7 PROJECT CONDITIONS

- .1 Coordinate the work with frame opening construction, door, and hardware installation.

PART 2 PRODUCTS

2.1 DOORS

- .1 Exterior doors: Air infiltration to comply with ASHRAE Standard 90.1 2010 & 2013 requirements of less than .4 CFM/FT²
- .2 Insulated Core Doors:
 - .1 Door faces, top and bottom end channels: minimum 1.2 mm.
 - .2 Cores: Polyurethane to CAN/ULC-S701 Rigid, modified polyisocyanurate, closed cell board. Density 32kg/m³.
- .3 Interior honeycomb core doors: minimum ,1.2 mm surface sheets and top and bottom end channels; cores filled with honeycomb material laminated under pressure to surface sheets.
- .4 Fire Rated Doors: Minimum , 1.2 mm surface sheets and, top and bottom end channels, of ULC label requirements indicated on drawings.
- .5 Reinforcement for hardware:
 - .1 Locks: minimum 1.52 mm steel.
 - .2 Butts: minimum 3.42 mm steel.
 - .3 Flush Bolts: minimum 3.42 mm steel.
 - .4 Door Closures: minimum 1.9 mm steel.
- .6 Glazing Stops: 0.9 mm rolled steel channel shape, butted corners; 16 mm high profile; prepared for countersink screws.
- .7 Cooler door: pre-painted, 26 gauge embossed steel pans front and back with reinforcement for hardware attachment. 100mm non-CFC polyurethane insulation core. Integral frame and hardware. Frame; metal clad pre-painted, 26 gauge embossed steel with insulation to match door. Hardware: self rising hinges, interior safety release, latching exterior handle. Gasket to sides and head of door, sweep type sill gasket. Door, frame, hardware and all components to be complete package from single manufacturer.

2.2 FABRICATION DOOR AND WINDOW FRAMES

- .1 Frame material not less than 1.6 mm metal thickness for openings to 1220 mm in unsupported width; not less than 2.0 mm metal thickness for openings exceeding 1220 mm in unsupported width.
- .2 Fabricate frames in accordance with CSDMA specifications and following requirements
- .3 Fabricate frames with hardware reinforcement plates welded in place.
- .4 Reinforce frames wider than 1 200 mm with roll formed steel channels fitted tightly into frame head, flush with top.
- .5 Prepare frames for silencers. Provide three single silencers for single doors and mullions of double doors on strike side. Provide two single silencers on frame head at double doors without mullions.
- .6 Prepare frames for Doors 100 and 116 for installation of electric strikes.
- .7 Attach fire rated label to each fire rated door unit.
- .8 Glazing Stops: 0.9 mm rolled steel channel shape, butted corners; 16 mm high profile; prepared for countersink screws.
- .9 Provide drywall returns on all frames.
- .10 Attach channel spreaders at bottom of frames for shipping.

2.3 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

2.4 FRAMES: KNOCKED-DOWN TYPE

- .1 Ship knocked-down type frames unassembled.
- .2 Provide frames with mechanical joints which inter-lock securely and provide functionally satisfactory performance when assembled and installed in accordance with CSDMA Recommended Installation Guide for Steel Doors and Frames.
- .3 Securely attach floor anchors to inside of each jamb profile.

2.5 FABRICATION - DOORS

- .1 Fabricate hollow metal doors and panels in accordance with requirements of "Canadian Manufacturing Standards for Steel Doors and Frames" produced by the Canadian Steel

Door and Frame Manufacturer's Association and as indicated on Drawings. Fabricate doors with hardware reinforcement welded in place.

- .2 Fabricate fire rated hollow metal doors in accordance with requirements of Underwriters Laboratories of Canada (ULC). Place ULC labels where visible when in installed position.
- .3 Longitudinal seams: Mechanically interlocked, continuously welded, filled and sanded with no visible edge seams. Top and bottom of doors closed with end channels recessed and spot welded in place.
- .4 Reinforce and prepare doors to receive hardware. Refer to Section 08 71 00 for hardware requirements.

2.6 COOLER DOOR & FRAME

- .1 Cooler door: pre-painted, 26 gauge embossed steel pans front and back with reinforcement for hardware attachment. 100mm non-CFC polyurethane insulation core. Integral frame and hardware. Frame; metal clad pre-painted, 26 gauge embossed steel with insulation to match door. Hardware: self rising hinges, interior safety release, latching exterior handle. Gasket to sides and head of door, sweep type sill gasket. Door, frame, hardware and all components to be complete package from single manufacturer.
- .2 Product specifications based on Jamison Plyfoam II cooler door.

2.7 ROOM 131 WINDOW FRAME

- .1 Window frame in room 131 to be glazed with double glazed tempered glass.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verify existing conditions before starting work.
- .2 Verify that opening sizes and tolerances are acceptable.

3.2 INSTALLATION

- .1 Install frames in accordance with CSDFMA.
- .2 Coordinate with gypsum board wall construction for anchor placement.
- .3 Coordinate installation of glass and glazing.
- .4 Coordinate installation of doors and frames with installation of hardware specified in Section 08 71 00
- .5 Install roll formed steel reinforcement channels between two abutting frames. Anchor to structure and floor.
- .6 After installation, touch up all scratched or damaged surface and prime.

.7 Insulate all frames exposed to the exterior.

.8 Install door louvers, plumb and level.

3.3 ERECTION TOLERANCES

.1 Maximum Diagonal Distortion: 1.5 mm measured with straight edges, crossed corner to corner.

.2 Clearance on steel doors at head and jambs shall be: 3 mm maximum, maximum between pairs of doors

3.4 ADJUSTING

.1 Adjust door for smooth and balanced door movement.

3.5 CLEANING

.1 Do cleaning in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Aluminum Association (AA).
 - .1 DAF 45-03(R2009), Designation System for Aluminum Finishes.
- .2 American Architectural Manufacturers Association (AAMA)
 - .1 AAMA CW-10-04, Care and Handling of Architectural Aluminum From Shop to Site.
 - .2 AAMA 609/610-09, Cleaning and Maintenance Guide for Architecturally Finished Aluminum.
- .3 CSA International
 - .1 CSA G40.20/G40.21-04(R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .2 CAN/CSA G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .3 ANSI/BHMA A156.19-2007, Power Assist and Low Energy Power Operated Doors.
- .4 NBC, National Building Code of Canada 2010
- .5 ASHRAE 90.1 2013- Energy Standard for Buildings Except Low Rise Residential Buildings
- .6 AAMA/WDMA/CSA 101/I.S.2/A44 - North American Fenestration Standard/Specification for windows, doors and skylights

1.2 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature specifications and data sheets data sheets.
 - .2 Catalogue details:
 - .1 For each type of door and frame: Illustrating profiles, dimensions, and methods of assembly
- .3 Shop Drawings:
 - .1 Indicate door types, sizes, construction, finishes.
 - .2 Indicate hardware types, sizes, construction, finishes.
 - .3 Indicate glazing preparations.
 - .4 Include schedule identifying each unit, with door marks and numbers relating to numbering on drawings and door schedule.
- .4 Manufacturer instructions

- .1 Submit manufacturers installation instructions

1.3 QUALITY ASSURANCE

- .1 Manufacturer qualifications: company specializing in manufacturing products specified in this section, with not less than 5 years of documented experience. Provide such evidence upon Departmental Representative request.
- .2 Installer qualifications: company specializing in performing work of this section and approved by manufacturer. Provide such evidence upon Departmental Representative request.
- .3 Health and safety requirements: do construction occupational health and safety in accordance with Section 01 35 30 - Health and Safety Requirements.

1.4 DELIVERY, STORAGE, AND PROTECTION

- .1 Deliver and store materials in accordance with Section 01 61 00-Common Product Requirements unless more stringent care is required by the respective material manufacturer.
- .2 Handle the work of this section in accordance with AAMA CW-10

1.5 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 all packaging materials at appropriate recycling facilities.

1.6 WARRANTY

- .1 For Work of this Section 08 11 16 - Aluminum Doors and Frames, 12 months warranty period is extended to:
 - .1 60 months for door closers of this Section will be free from manufacturing defects.
 - .2 Manufacturing defects will be deemed to occur if any of following conditions are noted.
 - .3 Defects of material and factory workmanship.
- .2 Defective products to be corrected, replaced or maintained without cost to Canada as necessary to enable such products to perform as warranted.
- .3 Start warranties at date of Final Certificate of Completion.

1.7 CLOSEOUT SUBMITTALS

- .1 Make submissions in accordance with section 01 78 10 – Closeout submittals
- .2 Provide following for inclusion in Project operating and maintenance manuals.
 - .1 Maintenance data for cleaning and maintenance of aluminum finishes for inclusion in project operating and maintenance manuals.

- .2 Identification of materials installed including parts numbers.
 - .3 Name, address and telephone numbers of manufacturer and local supplier.
 - .4 Name, address and telephone numbers of installer.
 - .5 Scheduled maintenance requirements.
 - .6 Warranty certificates.
- .3 Provide special tools:
- .1 Special tools include, but are not limited to, wrenches and drivers required for disassembly and adjustment of door hardware items.

Part 2 Products

2.1 MATERIALS

- .1 Aluminum extrusions: to Aluminum Association alloy AA6063-T5 of T6 anodizing quality.
- .2 Steel reinforcement: to CSA G40.20/G40.21, grade 300 W.
- .3 Fasteners: stainless steel alloy, finished to match adjacent material.

2.2 SYSTEM DESCRIPTION

- .1 Factory fabricated sliding mall front style door system with parallel stacking capability. System to include flush mounted bottom track with stainless steel cap, one sliding door and one fixed panel, heavy-duty tandem roller assembly. Door and fixed panel to be double glazed with tempered glass.
 - .1 Factory fabricated components.

2.3 ALUMINUM DOORS AND SIDELIGHTS

- .1 Door stiles nominal 89 mm wide, plus or minus 6 mm.
- .2 Top rail nominal 89 mm wide, plus or minus 6 mm.
- .3 Bottom rail nominal 165 mm wide plus or minus 6 mm.
- .4 Framing member profile 3.4 mm plus or minus 6mm.
- .5 Glazing components: Door manufacturer recommended resilient and rigid components for use with glass arrangements scheduled.
- .6 Hardware
 - .1 Flush pulls on each side of lead panel
 - .2 Thresholds: Manufacturer provided stainless steel cap for slider track. Door and threshold assembly to be flush with finished floor.

2.4 FABRICATION

- .1 Fabricate items in accordance with reviewed shop drawings.

- .2 Construct doors of porthole extrusions of not less than 2.4 mm wall thickness using dual moment welded corner construction.
- .3 Fit joints tightly.
- .4 Conceal fastenings.
- .5 Mortise, reinforce, drill and tap doors and reinforcements to receive hardware using companion templates provided with hardware.

2.5 ALUMINUM FINISHES

- .1 Finish exposed surfaces of aluminum components in accordance with DAF 45
 - .1 Door surfaces: Clear anodic finish: to designation AA- M12C22A41 – Architectural class 1 for 18Um (0.0007”) of finish thickness.
 - .2 Balance of anodized finish aluminum hardware: clear anodic finish designation AA-M12C22A31 - Architectural Class 2 for 10 um (0.0004") of finish thickness.
- .2 Protective film: clear plastic strippable film protective covering applied to aluminum finishes to protect surfaces from damage during fabrication, shipping and erection.
- .3 Hot dip galvanized reinforcing steel with not less than 600 g/m² zinc coating, to CAN/CSA-G164.

Part 3 Execution

3.1 MANUFACTURERS INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install doors in accordance with reviewed shop drawings.
- .2 Install doors and hardware in accordance with hardware templates and manufacturer's instructions.
- .3 Adjust operable parts for correct function.

3.3 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Perform cleaning of aluminum components in accordance with AAMA 609.1 - Voluntary Guide Specification for Cleaning and Maintenance of Architectural Anodized Aluminum.
 - .2 Perform cleaning as soon as possible after installation to remove construction and accumulated environmental dirt.
 - .3 Clean aluminum with damp rag and approved non-abrasive cleaner.

- .4 Clean glass and glazing materials with approved non-abrasive cleaner.

END OF SECTION

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.
 - .4 Access doors in building surfaces shall be at least as large as duct access panels accessed through them and shall be oversized when necessary.
- .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 Wet wall construction: 14 gauge bonderized steel, flush with wall or ceiling, with concealed flange.
- .5 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.
- .6 Acoustical tile ceiling and similar block materials: 14 gauge bonderized steel, recessed in ceiling.
- .7 Feature wall construction: Recessed wall type that is selected to complement and conform to the architectural module, treatment, or panelling. The size shall conform to adjacent finishes.
- .8 Access panels in fire separations and firewalls shall have a compatible fire rating and ULC label, a tamper-proof latch and shall be self closing.

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

1.0 GENERAL

1.1 WORK INCLUDED

- .1 Window frames and sashes consisting of extrusions of polyvinyl chloride (PVC).
- .2 Windows as pre-assembled units, including factory installation of glass and glazing.
- .3 Furnish all labour, materials, equipment and services required for the design, fabrication, supply and installation of windows as shown on the drawings and as specified. Furnishment to include, but not be limited to the following:
 - .1 Fully glazed vinyl window assemblies including vinyl shapes and glass.
 - .2 All glazing accessories for window assemblies including gaskets, setting blocks, and sealants as required to meet the air and water tightness requirements of the section.
 - .3 All necessary reinforcing members, brackets, anchors, fasteners and other accessories as required to meet the structural requirements of the installation and specifications in this section.
 - .4 Shop applied galvanizing and electrolytic barrier painting of all steel parts.
 - .5 All perimeter closures, membranes, sealants, flashings, and trim required to integrate the window assemblies with other cladding and finishing materials.
 - .6 Assessment of the alignment of the existing façade elements as required to allow design and layout of the work in this section.
 - .7 All fastening of the window assemblies to the rough openings
- .4 Include also the following:
 - .1 Checking of building lines and levels as required for the proper layout and installation of all work included in this section.
 - .2 Shop painting of all steel shapes and ferrous metal used in attachment or reinforcing of window and field painting after steel shapes are installed.
- .5 Window systems of the following types:
 - .1 Single fixed lites.
 - .2 Composite, with fixed lites and operable casement lites.

1.2 REFERENCE STANDARDS (Most recent version unless noted otherwise.)

- .1 AAMA/WDMA/CSA101/I.S.2/A440-08-NAFS- North American Fenestration Standard/ Specification for windows, doors, and skylights
- .2 CSA A440S1 – 09 “Canadian Supplement to AAMA/WDMA/CSA101/I.S.2/A440-08 – NAFS – North American Fenestration Standard/Specification for windows, doors, and skylights”
- .3 British Columbia Energy Efficiency Act – Energy Efficiency Standards Regulation (BCEEA)
- .4 CAN/CSA-A440-Windows; A440.1 User Selection Guide to A440; A440.2 Energy Performance Evaluation; A440.3 User Guide to A440.2; A440.4 Window and Door Installation.

- .5 CAN/CSA-G164-Hot-Dip Galvanizing of Irregularly Shaped Articles
- .6 CAN/CGSB-1.40-Primer, Structural Steel, Oil Alkyd Type.
- .7 ASTM D4216, Standard Specification for Rigid Polyvinyl Chloride (PVC) and Related PVC and Chlorinated Polyvinyl Chloride (CPVC) Building Products Compounds.
- .8 ASTM D4726, Standard Specification for Rigid Polyvinyl Chloride (PVC) Exterior-Profile Extrusions Used for Assembled Windows and Doors
- .9 Glazing Contractor's Association of B.C. (GCABC) publication: Glazing Systems Specifications Manual
- .10 IGMA Glazing Recommendations for Sealed Insulating Glass Units.

1.3 DEFINITIONS

- .1 Single Unit Window: a window consisting of one fixed or one operable lite.
- .2 Composite Window: a window consisting of a maximum of three lites in one main frame. Composite windows may consist of fixed or operable windows, or a combination of both.

1.4 DESIGN CRITERIA

- .1 Materials, fabrications, attachments, accessories, assembly and performance, other than thermal performance, shall meet or exceed applicable requirements of CSA-A440, Windows, including appendices. The more stringent of CSA-A440 or this specification shall apply.
- .2 Thermal performance shall be determined in conformance with CSA-A440.2, Thermal Performance Evaluation of Windows and Sliding Glass Doors, and Appendix A – Overview of the Procedure for Determining the U-Value by Computer Simulation.
- .3 Design windows to be glazed from the interior.
- .4 Design windows to equalize both positive and negative pressure between outside air and:
 - .1 cavities surrounding insulating glass units, and
 - .2 cavities surrounding operable sash.
- .5 Design windows to provide drainage from spaces around operable sash and around insulating glass units to exterior.
- .6 Design windows to provide for the continuity of the air seal from the inside face of the sealed unit to the surrounding frame.
- .7 Design window anchorage to withstand wind load equal to or greater than calculated loads as per CSA A440S1-09 in accordance to the Performance Class specified herein or to Part 4 of the BC Building Code.
- .8 Design vinyl components to accommodate thermally induced movement and to prevent

creep deflection. Limit of creep deflection 3mm per meter in any member or assembly.

- .9 Design assembly to accommodate structure movements due to wind, seismic, creep and live loads where applicable and/or as noted.

1.5 PERFORMANCE REQUIREMENTS

- .1 This is a performance specification issued in conjunction with the drawings for the work. The drawings show the general arrangement of the finished work and these specifications described the minimum requirements of the finished system. The Contractor is responsible for designing and furnishing a window system that will fulfill the requirements of the specifications and drawings including items which may not be shown or specified but are required for performance of the system.
- .2 The window shall be designed, fabricated and installed to meet or exceed the criteria in this subsection.
- .3 Structural
 - .1 Wind Load Resistance to NAFS in conjunction with CSA A440.09.
 - .2 The window assembly and fasteners shall be designed to withstand negative and positive wind loads in accordance to BCBC using an annual probability factor of **1/50 years** for the reference wind velocity, and 8 per 1000 glass failure rate under this load.
 - .3 The glass and window frames shall be designed to withstand guard loads at locations required by the BCBC.
 - .4 The glass shall be designed to withstand thermal stresses imposed in service. In calculation, assume the use of blinds located not less than 50 mm from the inside surface of the glass.
 - .5 The window system shall be designed to limit deflection orthogonal to the plane of the glass under wind or guard loads to **L/175** in all clear span dimensions of glass and framing members.
 - .6 Anchors and fasteners shown on the drawings do not represent the required location or types required for installation of the new window. Any attachment points must be shown on shop drawings for review by the Consultant.
 - .7 All fastenings and attachments shall be concealed.
 - .8 Movement and Tolerances
 - .1 The window installation shall accommodate a building structure live load deflection of 9 mm at midspan of longest project window header/lintel without transferring load to the window.
 - .2 The window shall accommodate expansion and contraction of component materials over an exterior air temperature range of -18°C to 35°C and a possible solar heating range to 70°C, and an interior temperature range of 0°C to 30°C without causing:
 - .1 failure of joint seals necessary for air and water tightness of the system,
 - .2 failure of perimeter seals at interfaces to adjacent wall systems,
 - .3 overstressing of fasteners,
 - .4 pinching or distortion or breakage of glass,
 - .5 distortion of aluminum members,
 - .6 or other harmful effects.

- .4 The window shall be fabricated and installed square, level and plumb as follows:
 - .1 Plumb to within 3 mm of vertical over the height of each unit.
 - .2 Within 3.0 mm of level relative to a datum established for frames at the same floor.
 - .3 Within 1.5 mm of level relative to an adjacent frame.
 - .4 Each frame shall be within 3.0 mm of square when measured across the diagonals.
 - .5 Clearances required for installation should be considered and indicated on the shop drawings.
 - .6 All movements of the window system shall be noiseless.

- .5 Weather Tightness
 - .1 Water Tightness to NAFS in conjunction with CSA A440.09 .
 - .2 The glazing system shall be installed so that it forms a continuous unbroken air seal on the room side of the assembly. The air seal shall extend from the glazing assembly to adjoining wall components at all interfaces. Airtightness of the window and interfaces shall restrict infiltration and exfiltration of air through the system in accordance to NAFS.
 - .3 The window system shall be designed in accordance with rainscreen principles, incorporating venting and drainage mechanisms and separate air and water barriers, effective so that any water entering the system past exterior seals drains harmlessly to the exterior via pressure equalized drainage cavities.
 - .4 Vent and drain holes shall be present in inconspicuously locations and shall not contribute to staining or marking of glass, mullions, or spandrels.

- .6 Durability
 - .1 The window frames and integral seals shall be designed to have an expected service life of 30 years. All seals, gaskets, corrosion protection, coatings and attachments are expected to be serviceable at the end of this service period.

 - .2 The glazing shall have a guaranteed service life of five years. Any glazing failing to meet this service life shall be removed and replaced at no cost to the Owner under guarantee by the Contractor. Failure of any glazing shall be deemed to occur if any of the following are noted:
 - .1 Chipping, cracking, or breakage of glass panes occurring due to manufacturing defects or under specified service conditions.

 - .3 Seals between unitized components of the glazing system shall be formed with clamped rubber gaskets. Seals between frame units made with field applied sealants alone will not be accepted.

1.6 RESPONSIBILITY FOR MEETING PERFORMANCE REQUIREMENTS

- .1 Meeting the performance requirements of this section during the design fabrications and installation of the work shall be the complete responsibility of the Contractor.

- .2 The details shown on associated drawings show dimensions and profiles similar to those expected to be required to meet the specifications of this section. The Contractor may submit design proposals with minor changes to the details shown on the drawings in order to meet or exceed the performance requirements of this section by using proprietary

technology. Every effort has been made to show on the drawings and in the specification items of the design that may not be altered or altered only to limited extents.

- .3 The structural and energy use requirements of this section shall be certified by an Engineer employed by the Contractor using standards recognized by the local authority having jurisdiction, the product manufacturer and current trade associations.
- .4 The design of the product and the responsibility of the Contractor's Engineer shall extend to accommodate all temporary conditions associated with fabrication, transport, storage, lifting, installation and temporary closure of the building without detrimental effect on the performance requirements of these contract documents.
- .5 The Consultant's review of the Contractor's submittals and the work is of the benefit only of the Owner. The Contractor shall remain responsible for the design, fabrication, installation and performance of the product.

1.7 SUBMITTALS

- .1 Submittals to be made in accordance with Section 01 33 00 - Submittals.
- .2 Product Data: Submit catalogue details for each type of window and framing system illustrating profiles, dimensions and methods of assembly, installation procedures, recommendations and data that products have been tested and comply with performance requirements.
- .3 Submit test reports from an independent testing agency acceptable to the Consultant, indicating windows to be supplied for the project meet specified requirements, including compliance with AAMA/WDMA/CSA101/I.S.2/A440-08- NAFS. Testing conducted by manufacturer to follow all required product test and sequence tests as described under Clause 5 in AAMA/WDMA/CSA101/I.S.2/A440-08- NAFS in conjunction with CSA A440S1-09.
- .4 Energy Conformance: Supply documentation sufficient to confirm conformance of project window sizes and configurations with the British Columbia Energy Efficiency Act, using one of the following testing agencies or persons.
 - .1 A person or organization accredited by the Standards Council of Canada
 - .2 National Fenestration Rating Council accredited Inspection Agency
 - .3 Architect or Professional Engineer, authorized to practice in British Columbia.
- .5 Shop Drawings:
 - .1 Submit shop drawings of windows prepared under the supervision and bearing the seal of a Professional Engineer of the Province of BC. Submit completed BC Building Code Letters of Assurance (Schedules B1 and B2) together with the initial shop drawing submission. Upon request, provide structural calculations per conformance to Building Codes, By-Laws and CAN/CGSB 12.20.
 - .2 Clearly indicate each type of window, hardware and locations, framing system, extrusion profiles, methods of assembly, section and hardware reinforcement, anchorages and location of exposed fasteners, isolation coatings, finishes, glazing components, insect screens, and location of manufacturer's name plates (if applicable).

- .3 Provide scaled elevations, sections, plans, dimensions and quantity of units. Indicate rough opening requirements and tolerances of adjacent construction.
 - .4 Provide full size details for head, sill and jamb conditions, junctions between combination units (coupling mullions), and interior and exterior trim. Clearly indicate method and location of connection and continuity of the envelope air, vapour and water seals. Clearly indicate drainage and ventilation paths within the window assembly and at the interface to the building envelope. Confirm compatibility of materials that form the air/vapour/water barrier of the integrated system.
 - .5 Provide manufacturer's assembly instructions for operable units if they will be supplied demounted from main frame.
 - .6 Shop drawings are submitted to allow the Departmental Representative to review conformance of the proposed system. Review of the shop drawings by the Departmental Representative shall not relieve the Contractor of any responsibilities to perform under the terms of this specification. Notify the Departmental Representative of any sequencing of submittals and reviews that will expedite the Contractor's delivery of the project
 - .7 No materials shall be purchased or units fabricated until final review of shop drawings is completed by the Departmental Representative.
- .6 Samples: If requested, make the following samples available for Departmental Representative review at least one week prior to shop drawing preparation:
- .1 150 mm long corner sections of head, jamb, sill, mullions, and coupling mullions to indicate profile.
 - .2 One (1), 4'x 4' with 2' operable section, representative model of each type of window.
- .7 Letters of Assurance: The Registered Professional Engineer who signed and sealed the shop drawings shall perform sufficient field reviews in order to provide a letter of professional assurance after completion of the Work, giving assurance that the Work has been fabricated and installed in general conformance with the sealed shop drawings. Approved forms are BC Building Code Letters of Assurance (Schedule C). Written inspection reports of field reviews shall be submitted to the Architect promptly as the field reviews are made.
- .8 Maintenance Data: Provide in accordance with Section 01 78 10 Closeout Submittals – Maintenance Manual, the following data for incorporation into specified maintenance manual:
- .1 A recommended inspection procedure and schedule and component replacement schedule.
 - .2 Data for cleaning and maintenance of framing finishes, glazing and hardware.
- .9 Warranties:
- .1 Provide a written warranty signed and issued in the name of the Owner stating:
 - .1 All windows will be free from defects in material and workmanship for a period of two (2) years from the date of substantial Performance of the Work.
 - .2 All windows will continue to provide satisfactory resistance to water penetration for a period of five (5) years from the date of Substantial

Performance of the Work.

- .3 All insulating sealed double glazing units shall be covered for a period of ten (10) years from the date of Substantial Performance of the Work, against material obstruction of vision as a result of hermetic seal failure and dust or film formation on inner glass surfaces.
- .2 If a 3rd party warranty is provided then the warranty requirements are to be the most stringent of the 3rd party warranty or the requirements listed above.
- .3 Satisfactory performance means compliance with the performance criteria and the testing and construction standards of this specification, and with the reviewed shop drawings. This includes the performance of finishes, hardware glass and glazing materials, structural attachment, sealants and flashings.
- .4 Correct all deficiencies that appear during the warranty period at no cost to the Owner.

1.8 QUALITY ASSURANCE

- .1 Sealed insulation unit manufacturer to be a member in good standing of the Insulating Glass Manufacturers Alliance (IGMA).
- .2 Glass and glazing work under this section to conform to IGMA standards.
- .3 Window manufacturer and installation contractor to be a member in good standing of the Glazing Contractors Association of BC (GCABC) and have a minimum of 5 years uninterrupted experience in successfully carrying out projects of similar size. Contractor to document past experience on request.

2.0 PRODUCTS

2.1 WINDOWS

- .1 Description: sash comprised of purpose-made vinyl extrusions, thermally broken, rain screen design with pvc sub sill, exterior flange mount, fitted with insulated glass unit glazing and rigid extruded vinyl snap-in glazing stop, in sizes and arrangements detailed/indicated.

2.3 SINGLE UNIT WINDOWS

- .1 Meet or exceed requirements of selected Performance Class and Performance Grade as per AAMA/WDMA/CSA101/IS.2/A440-08- NAFS- North American Fenestration Standard/Specification for windows, doors, and skylights and CSA A440S1- 09 – Canadian Supplement to NAFS and the secondary performance requirements:
 - .1 All windows shall conform to:
 - .1 Class **CW – PG30 (metric)** - Fixed

- .2 Class **CW – PG30 (metric)** – Casement and Awning
- .2 Water Penetration: Water penetration test pressures shall be **400 Pa**.
- .3 Air Tightness Rating, Fixed Windows: Fixed Level.
- .4 Air Tightness Rating, Operable Windows: A3 Level
- .5 Operation Force for: Casement window - Normal Use (Clause 5.3.1.1, Table 6)
- .6 Energy Performance: Overall Window U-Value averaged over all fenestration products within the scope of work to be no more than **1.8 W/m²•K**.
- .7 All windows are to be labeled with the AAMA, CSA or WDMA label and have sash, leaf and size shown on the drawings.

2.4 COMBINATION WINDOWS

- .1 Meet or exceed requirements of selected Performance Class and Performance Grade as per AAMA/WDMA/CSA101/I.S.2/A440-08- NAFS- North American Fenestration Standard/Specification for windows, doors, and skylights and CSA A440S1- 09 - Canadian Supplement to NAFS, and the secondary performance requirements. Refer to Clause 2.1.1 for Window Performance Grades and Energy Performance.
- .2 Air and water tightness of joints along frames mullered together, and at mullions where lites within one main frame join, shall meet or exceed performance ratings specified for the higher rated adjacent single unit windows.
- .3 Lateral deflection of mullered frames shall not exceed **L/175** of span when subjected to loading equivalent to wind load resistance of the adjacent single unit windows.

2.5 WINDOW TYPES

- .1 Fixed: with removable double-glazed insulated sealed units. Minimum performance standard to meet AAMA/WDMA/CSA 101/I.S.2/A440-08 – NAFS Class CW-PG30.
- .2 Casement (Outswing sash): with removable double-glazed insulated sealed units. Minimum performance standard to meet AAMA/WDMA/CSA 101/I.S.2/A440-08 – NAFS Class CW-PG30.
- .3 Casement (Outswing sash): with removable triple-glazed insulated sealed units. Minimum performance standard to meet AAMA/WDMA/CSA 101/I.S.2/A440-08 – NAFS Class CW-PG30.
- .4 Screens: provide on ventilating portions of windows.

2.6 FRAME AND SASH REQUIREMENTS

- .1 Frame and sash profiles and glazing detailed on drawings are not intended to restrict product types conforming to these specifications.
- .2 Provide PVC frame and sash conforming to the following standards:
 - .1 ASTM D4726, Standard Specification for Rigid Poly Vinyl Chloride (PVC) Exterior-Profile Extrusions Used for Assembled Windows and Doors.
 - .2 ASTM D4216, class 1 32021 42 4040 or equivalent standard for weathering and mechanical properties.
 - .3 Can/CGSB 41-GP-19MA, Rigid Vinyl Extrusions for Windows and Doors. The material shall show no reduction in surface gloss or colour after 10,000 hours in a UV arc weather-o-meter.

- .4 Minimum external wall thickness of extrusions: 2.5 mm nominal, exceeding requirements of CSA-A440 for vinyl (PVC) window wall types A, B, and C.
- .3 Seal sash perimeter continuously at three locations minimum, with primary seal located between operator and interior seal.
- .4 Secure hardware and attachments using screws into H-ports or penetrating minimum of two walls of framing or internal steel reinforcement.
- .5 Join single units to form combination units with joints at combination unit frame perimeter finished with sealant and steel plate, 75 mm x 75% of depth of framing. Plate shall be screw fastened with a minimum of four screws through plastic into steel reinforcing.
- .6 Anchor using metal retaining clips at head, nailing flanges at jambs and continuous back angle at sill.

2.7 GLASS AND GLAZING MATERIAL

- .1 Insulating Glass Units: meet or exceed requirements as described in AAMA/WDMA/CSA101/1.S.2/A440-08- NAFS and CSA A440S1- 09 - Canadian Supplement to NAFS . Units shall be certified by the Insulating Glass Manufacturers Alliance (IGMA). Overall unit thickness shall be a minimum of 20 mm using a minimum of 4 mm glass thickness. Triple pane units overall unit thickness shall be a minimum of 36 mm using a minimum of 4 mm glass thickness. In combination and composite units use the greater glass thickness throughout. Use two-stage seal method of manufacture, as follows:
 - .1 Primary Seal: polyisobutylene or hot-melt butyl.
 - .2 Secondary Seal: polyisobutylene, silicone or polysulphide based sealant, filling gap between the two lites of glass at the edge up to the spacer/separator and primary seal.
 - .3 Spacer/separator: non-conductive, as required to suit performance requirements.
- .3 Insulated glass unit assembly to provide following minimum performance requirements. Following is based on 6 mm thick Low E glass in 25 mm thick insulating unit with 13 mm thick Argon gas filled space and 6 mm thick clear inner glass.
 - .1 Transmittance:
 - Ultra-violet (UV) light: 19%
 - Visible daylight: 70%
 - Total solar energy: 33%
 - .2 Reflectance:
 - Visible light: 11%
 - Total solar energy: 30%
 - .3 U-values (Imperial):
 - Winter night time: 0.29
 - Summer day time: 0.28
 - .4 Shading coefficient factor: 0.44

- .5 Solar heat gain coefficient: 0.38
- .6 Light-to-solar gain (LSG): 1.84
- .2 Clear Float Glass: to CAN/CGSB-12.3, glazing quality, for inner and outer lite.
- .4 Glazing Gaskets for PVC Sections: neoprene, thermoplastic rubber or EPDM, flexible at minimum design temperature, and as follows:
 - .1 Profiles with a minimum of two (2) fins to contact glazing at interior and exterior of glass units
 - .2 Designed to maintain pressure contact against glass units through design temperature range.
 - .3 Co-extruded gaskets are not acceptable on the main frame or sash.
 - .4 Foam or butyl glazing tapes are not acceptable.
- .5 Other Glazing Accessories: setting blocks to AAMA/WDMA/CSA101/I.S.2/A440-08-NAFS.

2.8 HARDWARE

- .1 Exposed Hardware Components: cast metal, in finish selected by Consultant from hardware manufacturer's standard range.
- .2 Hardware exposed to exterior environment with sash in closed and open positions shall be corrosion-resistant stainless steel or bi-chromated steel composites.
- .3 Secure hardware and attachments using screws into H-ports or penetrating a minimum of two walls of framing. Wherever possible provide metal reinforcement embedded in vinyl frames at screw attachment locations.
- .4 Equip operable windows with hardware as follows:
 - .1 Casement: concealed dual arm operator and stainless steel tracks, with under screen roto operator assembly. Provide multi-point locking with single handle operation.
 - .2 Hardware to be adjustable to accommodate compression set of weather and air seals.
- .5 Provide ADA approved handles for roto operators.
- .6 Force to operate locking devices shall not exceed 20 N.
- .7 Provide pole operated hardware where window latching devices are located in excess of 1900 mm above floor level:

2.9 ACCESSORIES

- .1 Weatherstripping for operable sash: neoprene, thermoplastic rubber or EPDM, flexible at minimum design temperature, and as follows:
 - .1 Profiled to mechanically key into window and sash framing members, at interior and exterior of sash.

- .2 Removable without special tools and without dismantling of frames.
 - .3 Designed to maintain pressure contact against frame through design temperature range.
 - .4 Provide a minimum of one weather seal gasket to the exterior and one air seal gasket to the interior of drained and vented cavities.
- .2 Steel Reinforcement: sheet steel to ASTM A653M, hot dip galvanized, minimum Z275 coating designation.
 - .3 Transition membrane: minimum 1.6 mm thick SBS membrane sheet reinforced with non-woven polyester or glass fleece. Stripping to be a minimum 150mm wide. Approved products are:
 - .1 Soprema – Sopraseal 60 F/F or Sopralene Flam Stick
 - .2 Protectowrap Jiffyseal 140/60.
 - .3 Bakor Blueskin TG.
 - .4 Joint Sealants: as specified in Section 07 92 00, as recommended for substrates.
 - .5 Foam Backer Rod: extruded closed cell backer rod, oversize 30 to 50%.
 - .6 Screens: To CAN/CGSB-79.1.
 - .1 Insect screening mesh: count 18 x 16.
 - .2 Fasteners: tamper proof.
 - .3 Screen frames: vinyl or aluminum, colour to match window frames.

2.10 FRAME AND SASH FINISHES

- .1 Vinyl: as selected by the Consultant from the manufacturer's colour range.

2.10 AIR/VAPOUR RETARDER

- .1 Ensure continuity of air/vapour retarder and seal from walls to window frame.

3.0 EXECUTION

3.1 FABRICATION

- .1 Fabricate window units square and true with maximum tolerance of plus or minus 1.5 mm for units with a diagonal measurement over 1800 mm.
- .2 Mitre and heat weld full length of vinyl frame and sash joints at corners. All welding flash to be neatly removed.
- .3 Fasten steel reinforcement to extruded vinyl mullions with concealed stainless steel fasteners at maximum 300 mm o/c.
- .4 Continuously and uniformly compress length of gaskets during installation, to compensate for linear shrinkage.

3.2 GLAZING

- .1 Clean sealing surfaces at perimeter of glass and sealing surfaces of rabbets and stop beads before applying tape, splines or gaskets. Use solvents and cleaning agents recommended by manufacturer of sealing materials.
- .2 Install glazing gaskets uniformly with accurately formed corners and bevels. Ensure that proper contact is made with glass and rabbet interfaces.
- .3 Support both lites of glass thermal units on levelled setting blocks, 4 or 6 mm minimum, spaced as recommended by glass manufacturer. Provide at least one setting block at quarter points from each corner. For casement windows, locate setting blocks closer to corners as recommended by manufacturer.
- .4 Centre glass thermal units in glazing rabbet to maintain 6 mm minimum clearance between edges of glazing and plastic framing at sill or 4 mm minimum clearance between edges of glazing and plastic framing at sill if glazing bite incorporates a drainage channel with depth of 3 mm minimum.
- .5 Size glass thermal units to ensure exposed face of spacer is in line with glazing stops.
- .6 Use spacers and shims in accordance with glass manufacturer's recommendations.
- .6 Immediately replace damaged or broken glass.

3.3 WINDOW INSTALLATION

- .1 Install in accordance with CAN/CSA-A440 and reviewed shop drawings.
- .2 Arrange components to prevent abrupt variation in colour.
- .3 Erect and secure window units in prepared openings, plumb and square, free from warp, twist or superimposed loads.
- .4 Secure work accurately to structure and in a manner not restricting thermal movement of materials.
- .5 Transfer window dead load to wall construction by anchors alone or in combination with plastic shims. Wood shims are not acceptable.
- .6 Place shims under sill frame at exact setting block locations, and as marked on frames by window frame manufacturer.
- .7 Conceal all anchors and fitments. Exposed heads of fasteners are not permitted.
- .8 Maintain dimensional tolerances after installation. Maintain alignment with adjacent work.

- .9 Provide seal around interior perimeter of window frame using foam joint sealant or foam backer rod, size as required to lightly compress between frame and rough opening, and sealant. Ensure continuity of air/vapour retarder and seal to window frame.
- .10 Provide seal at head and jamb of exterior perimeter of window frame using foam joint sealant or foam backer rod, size as required to lightly compress between frame and rough opening, and sealant. Do not seal sill at exterior.
- .11 Install jamb extensions, casings, brick moulds and trim as indicated on drawings.
- .12 Install sealant, in accordance with Section 07 92 00, and related materials as indicated on drawings.
- .13 Adjust operable sash and hardware to operate smoothly.
- .14 Temporary installations of windows if needed are to meet all requirements for occupant and public safety, such as but not limited to, operable unit restrictors, fastening, sharp edges etc.

3.5 CAULKING

- .1 Seal joints between windows and window sills with sealant. Bed sill expansion joint cover plates in bedding compound. Caulk butt joints in continuous sills.
- .2 Apply sealant in accordance with Section 07 92 00 - Sealants. Conceal sealant within window units except where exposed use is permitted by the Consultant.

3.6 PROTECTION AND CLEANING

- .1 Do cleaning in accordance with Section 01 74 11 - Cleaning.
- .2 Protect windows/doors from damage/staining during and after installation.
- .3 Clean interior and exterior surfaces as soon as adjacent contaminating activities are completed, to recommendations of window manufacturer.

3.7 ENERGY CERTIFICATE

- .1 Site certificates to be supplied in accordance with the British Columbia Energy Efficiency Act.
- .2 Certificates to include the following information:
 - .1 The whole-product U-value for each fenestration product provided on site (in W/m²K).
 - .2 The overall average U-value for the whole project, averaged over every fenestration product in the scope of work (in W/m²K).
 - .3 The name of the person or agency acting as verifier for the fenestration products.
- .3 Certificates are to be posted in plain view at the project site for a period of at least 120 days after the last manufactured fenestration product is installed in the building.

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END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Hardware for hollow and insulated steel doors.
- .2 Thresholds
- .3 Weatherstripping, seals, and door gaskets.

1.2 RELATED SECTIONS

- .1 Section 08 11 00 - Metal Doors and Frames.

1.3 REFERENCES

- .1 American National Standards Institute (ANSI).
 - .1 ANSI/BHMA A156.1-2006, American National Standard for Butts and Hinges.
 - .2 ANSI/BHMA A156.2-2003, Bored and Preassembled Locks and Latches.
 - .3 ANSI/BHMA A156.4-2000, Door Controls - Closers.
 - .4 ANSI/BHMA A156.13-2002, Mortise Locks and Latches Series 1000.
 - .5 ANSI/BHMA A156.18-2006, Materials and Finishes.
 - .6 ANSI/BHMA A156.31- 2013, Electric Strikes and Frame Mounted Actuators
- .2 Canadian Steel Door and Frame Manufacturers' Association (CSDFMA).
 - .1 CSDFMA Canadian Metric Guide for Steel Doors and Frames (Modular Construction): standard hardware location dimensions.
- .3 NBC, National Building Code of Canada (2015).

1.4 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00: Submission procedures.
- .2 Samples:
 - .1 Provide hardware samples requested by Departmental Representative.
 - .2 Identify each sample by label indicating applicable specification paragraph number, brand name and number, finish and hardware package number.
- .3 Shop Drawings:
 - .1 Provide product data sheets to describe fully to Departmental Representative all products of this Section.
 - .2 Include descriptions of materials, composition, cautions, installation requirements.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

- .1 Submittals in accordance with Section 01 78 10: Submittal procedures.

- .2 Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.
- .3 Special tools:
 - .1 Provide 2 sets of wrenches for each type of door closer and lock set installed, for project maintenance use.
 - .2 At completion of installations and adjustments turn over to Departmental Representative all tools supplied by hardware manufacturers with hardware items installed for later use in hardware maintenance. Seal tools together with respective hardware data/installation sheets supplied with hardware in clear plastic bags.

1.6 QUALITY ASSURANCE

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum 10 years documented experience.
- .2 Regulatory Requirements:
 - .1 Hardware for doors in fire separations and exit doors certified by a Canadian Certification organization accredited by Standards Council of Canada.

1.7 DELIVERY, STORAGE, AND PROTECTION

- .1 Deliver, store and handle materials in accordance with respective material manufacturer's requirements.
- .2 Package each item of hardware including fastenings, separately or in like groups of hardware, label each package as to item definition and location.
- .3 Store door hardware in locked, clean and dry area.
- .4 Include hardware templates and full installation/adjustment information.
- .5 Supply hardware complete with all factory supplied mounting fasteners required for installation.
- .6 Replace defective or damaged materials with new.

1.8 WASTE DISPOSAL AND MANAGEMENT

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

1.9 WARRANTY

- .1 For Work of this Section 08 71 00 - Door Hardware, 12 months warranty period is extended to:
 - .1 60 months for door closers of this Section will be free from manufacturing defects.
 - .2 Manufacturing defects will be deemed to occur if any of following conditions are noted.
 - .1 Defects of material and factory workmanship.

- .2 Fluids leaks.
- .2 Defective products to be corrected, replaced or maintained without cost to Canada as necessary to enable such products to perform as warranted.
- .3 Start warranties at date of Final Certificate of Completion.

Part 2 Products

2.1 MANUFACTURERS

- .1 Hardware items to be of the best grade, free from defect and of first line quality production suitable for this level of project.
- .2 Use one hardware manufacturer product only for each similar hardware item.
- .3 Acceptable manufacturers:
 - .1 Hinges: McKinney, Stanley, Ives.
 - .2 Locks: Schlage, Sargent, Corbin/Russwin.
 - .3 Closers: LCN, Sargent, Corbin/Russwin.
 - .4 Exit Device: Von Duprin, Sargent, Corbin/Russwin
 - .5 Door stops, Overhead: Glynn Johnson, Sargent, Corbin/Russwin.
 - .6 Other wall and floor stops: CBH, Gallery, Ives
 - .7 Thresholds and weatherstrip: Draft Seal, Pemko, National
 - .8 Pocket track: Kris Track, de Jong, K N Crowder
 - .9 Pocket Lock: KN Krowder, Baldwin, Emtek
 - .10 Electric strikes/power supply: Von Duprin, Sargent, RCI.

2.2 HARDWARE - GENERAL

- .1 General: Refer to paragraph **3.6 Hardware Schedule** for further description and finishes of following items.
- .2 Locks and latches:
 - .1 Mortise locks and latches: to ANSI/BHMA A156.13, series 1000 mortise lock, grade 1, designed for functions scheduled and keyed as stated in Hardware Schedule.
 - .2 Lever handles, Plain design
 - .3 Escutcheons: round.
 - .4 Normal strikes: box type, lip projection not beyond jamb.
 - .5 Cylinders: keyed into keying system directed by Departmental Representative.
 - .6 Finishes: finished to 626
- .3 Butts and hinges:
 - .1 Butts: to ANSI/BHMA A156.1, 5-knuckle, sizes x finishes scheduled, concealed bearing for scheduled doors, NRP for scheduled doors.
- .4 Exit devices: to ANSI/BHMA A156.3 and as scheduled.

- .5 Door closers and accessories:
 - .1 Door controls (closers): to ANSI/BHMA A156.4, designated by letter C, sizes as required by NBC and to provide following requirements.
 - .2 Maximum degree of opening required.
 - .3 Size to door.
- .6 Architectural door trim: to ANSI/BHMA A156.6, designated by letter J and as scheduled.
 - .1 Door protection plates: Kick plate type 1.27 mm thick stainless steel finish to 630
 - .2 Push plates: 1.27 mm thick finished to 630
 - .3 Pull units: stainless steel finished to 630
- .7 Thresholds: 127 mm wide x full width of door opening, extruded aluminum mill finish, serrated surface.
- .8 Weatherstripping:
 - .1 Head and Jamb seal:
 - .1 Extruded aluminum frame and solid closed cell neoprene insert, clear anodized finish.
 - .2 Adhesive backed neoprene material
 - .2 Door bottom seal:
 - .1 Extruded aluminum frame with closed cell neoprene, vinyl sweep, clear anodized finish.

2.3 KEYING

- .1 Obtain final keying from Departmental Representative before ordering.
- .2 Prepare keying schedule in co-operation with Departmental Representative.
- .3 Supply keys in duplicate for every lock in this contract.
- .4 Supply 3 master keys for each master key or grand master key group.
- .5 Stamp Keying code numbers on keys and cylinders.
- .6 Supply construction cores
- .7 Use a bonded locksmith for all keying work. Stamp all keys "Do Not Copy".

2.4 FINISHES

- .1 Finishes: Stainless steel 630.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify that doors and frames are ready to receive work and dimensions are as indicated on shop drawings.

3.2 FASTENINGS

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

3.3 INSTALLATION

- .1 Install hardware in accordance with manufacturer's instructions.
- .2 Install hardware to standard hardware location dimensions in accordance with Canadian Metric Guide for Steel Doors and Frames (Modular Construction) prepared by Canadian Steel Door and Frame Manufacturers' Association.
- .3 Use templates provided by hardware item manufacturer.
- .4 Use only manufacturer supplied fasteners. Failure to comply may void manufacturer warranties and applicable licensed labels. Use of "quick" type fasteners, unless specifically supplied by manufacturer, is unacceptable.
- .5 Provide metal door and frame manufacturers with complete instructions and templates for preparation of their work to receive hardware.
- .6 Remove construction locks when directed by the Departmental Representative.
 - .1 Install permanent cores and ensure locks operate correctly

3.4 ADJUSTING

- .1 Adjust hardware for smooth operation.

3.5 PROTECTION OF FINISHED WORK

- .1 Do not permit adjacent work to damage hardware or finish.

3.6 CLEANING

- .1 Do cleaning in accordance with Section 01 74 11 - Cleaning.
- .2 Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3 Clean hardware with damp rag and approved non-abrasive cleaner, and polish hardware in accordance with manufacturer instructions.

3.7 HARDWARE SCHEDULE

- .1 Hinges
 - .1 A1–Hinge5Knuckle-.180gauge-114mmx101mmx NonRemovablePinx630
 - .2 A2 – Hinge 5 Knuckle-.134 gauge- 114mm x 101mm x Non Removable Pin x 652
- .2 Locks, Deadbolts and Privacy
 - .1 B1 – Cylinder Type x length x cam to suit 626
 - .2 B2 - Privacy set ANSI F22 with indicator 626
 - .3 B3 - Lock set ANSI F09 626
 - .4 B4- Lock set ANSI F07 626
 - .5 B5- Passage set ANSI F75 626
 - .6 B6-Classroom lock ANSI F05 626
 - .7 B7- Electric strike BHMA Grade 1 626
 - .8 B8- Deadbolt cylinder only 626
- .3 Closers
 - .1 C1 Institutional, non sized, compression spring buffer arm x delayed action 689.
 - .2 Include through bolts and grommet nut fasteners
- .4 Auxilliary hardware
 - .1 D1-Kick Plate 1.27 mm thickness x 254mm height x width less 38mm X 630
 - .2 D2 - Wall stop Cast concealed mount, concave bumper with back plate x 626
 - .3 D3-Over Head stop Surface mount, single acting, non handed with slide track for medium traffic and weight doors
 - .4 D4- Push plates, push/pull units.
- .5 Threshold , seals door bottoms, astragal:
 - .1 E1- Thresholds: as scheduled, one length per door opening without joins or splices.
 - .2 E2- Weatherstripping/Seals: Adjustable jamb type with silicone insert.
 - .3 E3-Astragal: overlapping, extruded aluminum, neoprene weather seal, finished to match doors.
 - .4 E4 –Flush bolts

Hardware Set 01 for Exterior double doors 1

- 6 Hinges A1
- 1 Ea. Passage set B5
- 1 Deadbolt B8
- Cylinder on inside of active door, blank plate outside
- 1 Ea. Closer C1
- 1 Ea. Kick Plate D1
- 1 Threshold E1
- 1 Ea. Weatherstripping E2
- 1 Astrigal E3

2 Flush bolts E4

Hardware Set 02 for cooler door 2

Door hardware by door manufacturer to include:

- 1 Latching exterior handle
- 1 Interior safety release

Hardware Set 03 for Exterior single door 3

3 Hinges A1
1 Ea. Lock set B3
1 Ea. cylinder B1
1 Ea. Closer C1
1 Ea. Kick Plate D1
1 Ea. Threshold E1
1 Ea. Weatherstripping E2
1 Ea. Deadbolt B8

Hardware Set 04 Corridor doors 4

3 Hinges A2
1 Ea. Closer C1
2 Ea. Kick plate D1
1 Ea. Passage set B5

Hardware set 05 Door 5

3 Hinges A2
1 Ea. Kick plate D1
1 Ea. Door stop D2
1 Ea. Passage set B5

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- .1 Gypsum board and joint treatment.
- .2 Metal stud wall framing.
- .3 Rubber Base

1.2 RELATED SECTIONS

- .1 Section 09 90 00 – Painting.

1.3 REFERENCES

- .1 ASTM C475/C475M-12 - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
- .2 ASTM C645-11a - Standard Specification for Nonstructural Steel Framing Members.
- .3 ASTM C754-11 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
- .4 ASTM C1002-07 - 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.
- .5 ASTM C1396/C1396M-09a, Standard Specification for Gypsum Wallboard.
- .6 Gypsum Association GA-214-10 - Recommended Levels of Gypsum Board Finish.
- .7 ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

1.4 REGULATORY REQUIREMENTS

- .1 Conform to applicable code for fire rated assemblies.
 - .1 Fire Rated Partitions: Listed assembly by ULC .

1.5

PART 2 PRODUCTS

2.1 FRAMING MATERIALS

- .1 Studs and Tracks: ASTM C645; galvanized sheet steel, 0.91 mm thick, C shape, with knurled faces.
- .2 Slip joint head track: 0.91 thick, galvanized sheet steel, 50 mm deep.
- .3 Fasteners: ASTM C1002.

- .4 Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.

2.2 GYPSUM BOARD MATERIALS

- .1 Standard Gypsum Board: ASTM C1396; 16 mm thick, Type X, maximum available length in place; ends square cut, tapered edges.
- .2 Fire rated gypsum board: to ASTM C1396/C1396M Type X, thicknesses detailed/indicated on drawings x widths to suit framing centres x maximum practical lengths, wrapped tapered edges, square cut ends, bearing ULC fire rating labels.
 - .1 Paper facing: no less than 75% recycled.
 - .2 Gypsum core: no less than 10% recycled content.

2.3 ACCESSORIES

- .1 Corner Beads: 0.45 mm thick, galvanized sheet steel, paper faced; tapable
- .2 Edge Trim: GA-201 and GA-216; Galvanized steel or rigid vinyl with 'J' type bead, tapable.
- .3 Joint Materials: ASTM C475; reinforcing tape, joint compound, adhesive, and water.
- .4 Fasteners: ASTM C1002

2.4 ACCESS PANELS

- .1 Proprietary access panels consisting of a GWB face housed in an aluminum framework.
 - .1 Mounting frame bedded into GWB joint material.
 - .2 Concealed hardware (frame, latch and hinge).
 - .3 Removable door panel with safety cable.
 - .4 Sized as indicated in mechanical specification and drawings.

PART 3 EXECUTION

3.1 METAL STUD INSTALLATION

- .1 Install studs in accordance with ASTM C754 Metal Stud Spacing: 400mm on center.
- .2 Install slip joint head track where stud walls meet structure. Allow for 40 mm deflection.
- .3 Coordinate installation of bucks, anchors, blocking, electrical and mechanical work placed in or behind partition framing.

3.2 GYPSUM BOARD INSTALLATION

- .1 Install gypsum board in accordance with manufacturer's instructions.
- .2 Erect single layer standard gypsum board horizontally with ends and edges occurring over firm bearing.

- .3 Use screws when fastening gypsum board to metal furring or framing.
- .4 Place corner beads at external corners. Use longest practical length. Place edge trim where gypsum board abuts dissimilar materials.
 - .1 Install edge trim in all areas where the GWB abuts the exterior wall and ceiling panels.
 - .2 Metal trims are supplied in areas where the interior walls abut structural posts.
- .5 Install gypsum board to underside of the interior of the structure.

3.3 JOINT TREATMENT

- .1 Tape, fill, and sand exposed joints, edges, and corners three coats minimum to produce smooth surface ready to receive finishes.
- .2 Feather coats on to adjoining surfaces so that camber is maximum 0.8 mm.

3.4 ACCESS PANELS

- .1 Install access panels where indicated

3.5 TOLERANCES

- .1 Maximum Variation of Finished Gypsum Board Surface from True Flatness: 3 mm in 3 m in any direction.

3.6 CLEANING

- .1 Do cleaning in accordance with Section 01 74 11 - Cleaning.
- .2 Dispose of waste materials in accordance with Section 01 74 19 - Const. Waste Management And Disposal.
- .3 Dispose of excess GWB at the appropriate waste management facility

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 ASTM F1861-08(2012)e1 - Standard Specification for Resilient Wall Base.
- .2 ASTM D2047 - Standard Test Method for Static Coefficient of Friction of Polish-Coated Flooring Surfaces as Measured by the James Machine
- .3 CAN/ULC-S102.2-10 - Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings and Miscellaneous Materials and Assemblies.
- .4 Resilient Floor Covering Institute
 - .1 Floorscore Certification

1.2 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submittal procedures.
- .2 Submit Workplace hazardous materials information system (WHIMS) Material Safety Data Sheets (MSDS)
 - .1 Indicate precautions for workers when handling flooring preparation and installation products.
 - .2 Indicate VOC content of flooring preparation and installation products.
- .3 Product Data: Provide data on specified products, describing performance, physical characteristics, sizes, patterns and colours available.
- .4 Shop Drawings: Indicate seaming plan.
- .5 Samples:
 - .1 Submit two (2) samples of manufacturer's standard colour range, one (1) to Departmental Representative and one (1) to Consultant, for colour selection.

CLOSEOUT SUBMITTALS

- .6 Section 01 78 10: Closeout submittals.
- .7 Operation and Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

1.3 MAINTENANCE MATERIAL SUBMITTALS

- .1 Section 01 78 10: Closeout submittals.
- .2 Extra Stock Materials: Provide 5 sq.m of flooring, 15 lin m of base material specified.

1.4 QUALITY ASSURANCE

- .1 Installer Qualifications: Company specializing in performing the work of this section with minimum three (3) years documented.

1.5 DELIVERY, STORAGE, AND PROTECTION

- .1 Transport, handle, store, and protect products. In accordance with manufacturers specifications
- .2 Protect roll materials from damage by storing on end.

1.6 ENVIRONMENTAL REQUIREMENTS

- .1 Store materials for three (3) days prior to installation in area of installation to achieve temperature stability.
- .2 Maintain ambient temperature required by adhesive manufacturer three (3) days prior to, during, and twenty-four (24) hours after installation of materials.

1.7 WARRANTY

- .1 Provide flooring manufacturers 5 year written material warranty against excessive wear under normal usage.
- .2 Warranties to start at date of substantial completion.

Part 2 Products

2.1 MATERIALS - SHEET FLOORING

- .1 Multi-Purpose slip resistant flooring with stain resistant surface treatment:
 - .1 Description: pre-fabricated flooring with a PVC wear layer and imbedded mineral crystal particles.
 - .2 Backing: Non-woven polyester/cellulose glass fiber reinforcement and scrim.
 - .3 Coefficient of friction to ASTM D2047
 - .1 .78 dry,.80 wet
 - .4 Surface: permanent no-wax finish.
 - .5 Appearance: solid background colours with random marbled pattern throughout wear layer.
 - .6 Thickness; Not less than 2 mm
 - .7 Colour: to be selected from manufacturers standard colour range.
 - .8 Flooring systems installed in the building interior shall meet the requirements of the following standards
 - .1 Floorscore Certification
 - .2 CAN/ULC-S102.2-10

2.2 MATERIALS - BASE

- .1 Base: ASTM F1861, Type TV thermoplastic rubber; coved profile; top set; premoulded end stops and external corners:
 - .1 Thickness: minimum 3 mm.
 - .2 Heights: 102 mm, unless noted otherwise.
 - .3 Lengths: roll.

- .4 Colours: selected by Departmental Representative from standard colour range.

2.3 ACCESSORIES

- .1 Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.
- .2 Primers and Adhesives: Waterproof; types recommended by flooring manufacturer.
- .3 Edge Strips: Stainless steel.
- .4 Adhesives: solvent-free waterproof types recommended by respective flooring manufacturer to suit each flooring material and each application condition, with low emission and odour levels.
- .5 Joint sealing/welding material: purpose-made welding thread (rod) of type recommended by respective flooring manufacturers to suit application, colours to match flooring.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify floor and lower wall surfaces are free of substances that may impair adhesion of new adhesive and finish materials.

3.2 PREPARATION

- .1 Remove sub-floor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with sub-floor filler to achieve smooth, flat, hard surface.
- .2 Prohibit traffic until filler is cured.
- .3 Ensure wall to receive base is smooth, level, free from waves and other defects, and ready for base installation, refer to section 09 21 16 – Gypsum Board Assemblies.
- .4 Vacuum clean substrate.

3.3 INSTALLATION - SHEET FLOORING

- .1 Install sheet flooring to manufacturers written instructions.
- .2 Spread only enough adhesive to permit installation of materials before initial set.
- .3 Set flooring in place, press with heavy roller to attain full adhesion.
- .4 Lay flooring with joints and seams to produce minimum number of seams.
- .5 Install sheet flooring parallel to length of room. Provide minimum of one third (1/3) full roll width. Double cut sheet; provide butt joint.
- .6 Seal joints of sheet flooring, including self-coved bases, using welding thread (rod). Form joints uniform in width, appearance and as inconspicuous as possible. Form joints flush, well adhered in place, watertight and free of peaking or projections.
- .7 Terminate flooring at centreline of door openings where floor finish is dissimilar.
- .8 Install edge strips at unprotected or exposed edges, and where flooring terminates.

- .1 Secure metal strips after installation of flooring with stainless steel screws.
- .9 Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.
- .10 Clean and seal in accordance with manufacturers recommendations when installation complete.

3.4 INSTALLATION - BASE

- .1 Fit joints tight and vertical. Maintain minimum measurement of 450 mm between joints.
- .2 Mitre internal corners. At external corners and exposed ends, use premoulded units.
- .3 Install base in full bed of adhesive using full spread notched trowel. Cut and fit base neatly at corners, to tight fitting tolerances.
- .4 Install base straight and level to maximum variation of 1:1000.
- .5 Install base on toe kick of cabinets which occur in rooms and areas where resilient flooring is scheduled.
- .6 Scribe and fit to door frames and other interruptions.
- .7 Keep joints tight and well fitted.

3.5 CLEANING

- .1 Do cleaning in accordance with Section 01 74 11 - Cleaning.
- .2 Clean installed work.
- .3 Remove access adhesive from floor, base, and wall surfaces without damage.
- .4 Clean and seal floor in accordance with manufacturers written instructions.

3.6 PROTECTION OF FINISHED WORK

- .1 Prohibit traffic on floor finish for forty-eight (48) hours after installation.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 09 65 10 Resilient Flooring- Rubber baseboard installation.

1.2 REFERENCES

- .1 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .2 National Fire Code of Canada – 1995
- .3 South Coast Air Quality Management District (SCAQMD), California State
 - .1 SCAQMD Rule 1113-04, Architectural Coatings.
 - .2 SCAQMD Rule 1168-05, Adhesives and Sealants Applications.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit product data and instructions for epoxy flooring products to be used.
 - .2 Submit product data for the use and application of solvents to be used.
 - .3 Submit 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.
- .3 Samples:
 - .1 Submit colour samples for the full range of colours available for the Departmental Representatives use.
 - .2 Submit cured samples of each epoxy flooring colour selected by Departmental Representative applied to 6 mm thick plywood substrate for Departmental Representative's confirmation of colours. Incorporate non-slip aggregate.
 - .3 Retain reviewed samples on-site to demonstrate acceptable standard of quality for appropriate on-site surface.
 - .4 Manufacturer's Instructions:
 - .1 Submit manufacturer's installation application instructions.
 - .5 Closeout Submittals: submit maintenance data for incorporation into manual specified in Section 01 78 10 - Closeout Submittals include following:
 - .1 Product name, type and use.
 - .2 Manufacturer's product number.
 - .3 Colour numbers and information necessary for re ordering touch up materials.
 - .4 Care and maintenance recommendations.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Packing, Shipping, Handling and Unloading:
 - .1 Pack, ship, handle and unload materials in accordance with Section 01 61 00 - Common Product Requirements and manufacturer's written instructions.
- .2 Acceptance at Site:
 - .1 Identify products and materials with labels indicating:
 - .1 Manufacturer's name and address.
 - .2 Type of coating.
 - .3 Compliance with applicable standard.
 - .4 Colour number in accordance with established colour schedule.
- .3 Remove damaged, opened and rejected materials from site.
- .4 Storage and Protection:
 - .1 Provide and maintain dry, temperature controlled, secure storage.
 - .2 Store materials and supplies away from heat generating devices.
 - .3 Store materials and equipment in well ventilated area.
- .5 Store temperature sensitive products above minimum temperature as recommended by manufacturer.
- .6 Keep areas used for storage, cleaning and preparation clean and orderly. After completion of operations, return areas to clean condition.
- .7 Remove coating materials from storage only in quantities required for same day use.
- .8 Handle, store, use and dispose of flammable and combustible materials in accordance with National Fire Code of Canada requirements.

1.5 WASTE MANAGEMENT AND DISPOSAL:

- .1 Separate waste materials for recycling 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 Unused coating materials must be disposed of at official hazardous material collections site as approved by Departmental Representative.

1.6 SITE CONDITIONS

- .1 Surface and Environmental Conditions:
 - .1 Apply products in accordance with manufacturers requirements.
 - .2 Apply epoxy flooring in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.
 - .3 Apply epoxy flooring to adequately prepared surfaces and to surfaces within moisture limits.
 - .4 Provide ventilation during application and curing to WHMIS and epoxy flooring manufacturer's requirements, whichever more stringent.

1.7 QUALITY ASSURANCE

- .1 Use experienced applicators trained and approved by the system manufacturer
- .2 Provide proof of experience and manufacturers approval upon Departmental Representative's request.
- .3 Produce finished flooring surfaces within 1.5 mm over 3000 mm with variance not exceeding 0.8 mm in any 300 mm lineal direction.
- .4 Slope finished flooring to existing floor drains.
- .5 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 30 - Health and Safety Requirements.

1.8 MOCK-UPS

- .1 Prepare minimum 1000 x1000 mm size portable sample mock-up for review by Departmental Representative.
- .2 Mock-ups will be reviewed by Departmental Representative to verify conformance with specified requirements, workmanship and appearance.
- .3 Notify Departmental Representative at least 5 working days in advance to review mock-ups.
- .4 Approved mock-ups will establish minimum acceptable standard for remaining work.

Part 2 Products

2.1 EPOXY FLOORING SYSTEM

- .1 Description: purpose-made proprietary liquid/trowel applied epoxy quartz flooring system with all components from one manufacturer.
 - .1 Surface preparation and epoxy bond coat.
 - .2 Coloured aggregate and epoxy matrix troweled-on over bond coat.
 - .3 Clear epoxy topcoats with semi-gloss finish, roller applied.
- .2 Matrix: 100% solids clear epoxy resin.
- .3 Decorative colour flakes:
 - .1 Composed of water based resinous materials, inorganic minerals, additives and various pigments. clean and free of dust or other impurities, less than 1.6 mm size; colours selected by Departmental Representative from supplied samples.
 - .1 Acceptable product: B818 Torginol Decoflake or equal.
 - .2 Non-slip aggregate: silica sand.

2.2 MIXES

- .1 Mix matrix ingredients in strict accordance with manufacturer's recommendations.
- .2 Mix aggregates to obtain custom blended colours directed by Departmental Representative.

2.3 ACCESSORIES

- .1 Divider strips: zinc, 1.6 mm metal thickness x depth of epoxy flooring.
- .2 Cap strips: zinc, 1.6 mm metal thickness x shapes required.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 EXAMINATION

- .1 Test existing surfaces scheduled to receive epoxy flooring for conformance with flooring manufacturers requirements.
- .2 Correct any defective substrates until they are acceptable to receive epoxy flooring

3.3 PREPARATION

- .1 Protection:
 - .1 Protect existing building surfaces and adjacent structures from epoxy spatters, markings and other damage by use of suitable non-staining covers or masking. If damaged, clean and restore surfaces as directed by Departmental Representative
 - .2 Protect factory finished products and equipment.
 - .3 Protect building occupants and general public in and about the building.

3.4 INSTALLATION

- .1 Apply epoxy flooring system to scheduled areas.
- .2 Apply epoxy flooring system to achieve minimum 4.8 mm uniform cured thickness.
- .3 Apply coatings with care to ensure that no laps, voids, skips or other visible irregularities occur and that finished flooring will be of consistent and uniform appearance, colour, texture and sheen.
- .4 Apply non-slip aggregate into flooring.
- .5 Divider strips:
 - .1 Install in accordance with flooring manufacturers directions. Set at correct depth to be flush with finished epoxy flooring surface.
 - .2 Install using longest practical length. Use single sections for doorways. Do not splice.
 - .3 Locate divider strips to correspond with floor control joints.
- .6 Cap strips
 - .1 Install in accordance with flooring manufacturers directions. Set at correct depth to be flush with finished epoxy flooring surface.

- .2 Install using longest practical length.
- .3 Slope epoxy flooring to existing floor drains.
- .4 Upon completion, repair and make good minor defects in epoxy flooring installations as directed by Departmental Representative. Re-finish entire epoxy floors which Departmental Representative has deemed beyond repair.

3.5

CLEANING

- .1 Do cleaning in accordance with Section 01 74 11 - Cleaning.
- .2 Remove spills and smears as soon as they occur using methods that will not damage affected surfaces.
- .3 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 08 11 00- Metal Doors and Frames
- .2 Section 09 21 16 – Gypsum Board Assemblies

1.2 REFERENCES

- .1 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .2 Master Painters Institute (MPI)
 - .1 MPI Architectural Painting Specifications Manual, 2004.
- .3 National Fire Code of Canada – 1995
- .4 Green Seal Environmental Standards
 - .1 Standard GC-03-97, Anti-Corrosive Paints.
 - .2 Standard GS-11-93, Architectural Paints.
 - .3 Standard GS-36-00, Commercial Adhesives
- .5 South Coast Air Quality Management District (SCAQMD), California State
 - .1 SCAQMD Rule 1113-04, Architectural Coatings.
 - .2 SCAQMD Rule 1168-05, Adhesives and Sealants Applications.
- .6

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit product data and instructions for each paint and coating product to be used.
 - .2 Submit product data for the use and application of paint thinner.
 - .3 Submit 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.
- .3 Samples:
 - .1 Submit duplicate 200 x 300 mm draw down samples of each scheduled paint colour with specified paint colours, gloss/sheen and textures required to MPI Architectural Painting Specification Manual standards.
 - .2 Retain reviewed samples on-site to demonstrate acceptable standard of quality for appropriate on-site surface.
 - .3 Manufacturer's Instructions:
 - .1 Submit manufacturer's installation application instructions.

- .4 Closeout Submittals: submit maintenance data for incorporation into manual specified in Section 01 78 10 - Closeout Submittals include following:
 - .1 Product name, type and use.
 - .2 Manufacturer's product number.
 - .3 Colour numbers and information necessary for re ordering paint.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Packing, Shipping, Handling and Unloading:
 - .1 Pack, ship, handle and unload materials in accordance with Section 01 61 00 - Common Product Requirements and manufacturer's written instructions.
- .2 Acceptance at Site:
 - .1 Identify products and materials with labels indicating:
 - .1 Manufacturer's name and address.
 - .2 Type of paint or coating.
 - .3 Compliance with applicable standard.
 - .4 Colour number in accordance with established colour schedule.
- .3 Remove damaged, opened and rejected materials from site.
- .4 Storage and Protection:
 - .1 Provide and maintain dry, temperature controlled, secure storage.
 - .2 Store materials and supplies away from heat generating devices.
 - .3 Store materials and equipment in well ventilated area.
- .5 Store temperature sensitive products above minimum temperature as recommended by manufacturer.
- .6 Keep areas used for storage, cleaning and preparation clean and orderly. After completion of operations, return areas to clean condition.
- .7 Remove paint materials from storage only in quantities required for same day use.
- .8 Handle, store, use and dispose of flammable and combustible materials in accordance with National Fire Code of Canada requirements.

1.5 Waste Management and Disposal:

- .1 Separate waste materials for recycling 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 Unused coating materials must be disposed of at official hazardous material collections site as approved by Departmental Representative.

1.6 SITE CONDITIONS

- .1 Surface and Environmental Conditions:

- .1 Apply paint finish in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.
- .2 Apply paint to adequately prepared surfaces and to surfaces within moisture limits.
- .3 Apply paint when previous coat of paint is dry or adequately cured.
- .2 Additional interior application requirements:
 - .1 Apply paint finishes when temperature at location of installation can be satisfactorily maintained within manufacturer's recommendations.

Part 2 Products

2.1 MATERIALS

- .1 Paint materials listed in the MPI Approved Products List (APL) are acceptable for use on this project.
- .2 Provide paint materials for paint systems from single manufacturer.
- .3 Conform to latest MPI requirements for interior and exterior painting work including preparation and priming.
- .4 Materials (primers, paints, coatings, varnishes, stains, lacquers, fillers, thinners, solvents, etc.) in accordance with MPI Architectural Painting Specification Manual "Approved Product" listing.
- .5 Linseed oil, shellac, and turpentine: highest quality product from approved manufacturer listed in MPI Architectural Painting Specification Manual, compatible with other coating materials as required
- .6 Paint materials to conform to the requirements of :
 - .1 Green Seal Environmental Standards
 - .1 Standard GS-11-93, Architectural Paints.
 - .2 South Coast Air Quality Management District (SCAQMD), California State
 - .1 SCAQMD Rule 1113-04, Architectural Coatings.

2.2 COLOURS

- .1 Departmental Representative to provide interior colour schedule after Contract award
- .2 Selection of colours from manufacturers full range of colours.
- .3 Where specific products are available in restricted range of colours, selection based on limited range.

2.3 GLOSS/SHEEN RATINGS

- .1 Paint gloss is defined as sheen rating of applied paint, in accordance with following values:

	Gloss @ 60 degrees	Sheen @ 85 degrees
Gloss Level 1 - Matte Finish (flat)	Max. 5	Max. 10

Gloss Level 2 - Velvet-Like Finish	Max.10	10 to 35
Gloss Level 3 - Eggshell Finish	10 to 25	10 to 35
Gloss Level 4 - Satin-Like Finish	20 to 35	min. 35
Gloss Level 5 - Traditional Semi-Gloss Finish	35 to 70	
Gloss Level 6 - Traditional Gloss	70 to 85	
Gloss Level 7 - High Gloss Finish	More than 85	

2.4 PAINTING SYSTEMS

- .1 Galvanized metal: Interior doors and frames
 - .1 INT 5.3M - High performance architectural latex G3 gloss level finish.
- .2 Galvanized metal: Exterior doors and frames.
 - .1 EXT 5.3J- W.B.Light industrial coating: G5 gloss level finish
- .3 Plaster and gypsum board: gypsum wallboard, drywall, "sheet rock type material", and textured finishes:
 - .1 INT 9.2M – Institutional low odor/low VOC; G3 gloss level finish (over latex sealer).

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 GENERAL

- .1 Perform preparation and operations for interior painting in accordance with MPI Architectural Painting Specifications Manual except where specified otherwise.
- .2 Apply paint materials in accordance with paint manufacturer's written application instructions.

3.3 EXAMINATION

- .1 Investigate existing substrates for problems related to proper and complete preparation of surfaces to be painted. Report to Departmental Representative damages, defects, unsatisfactory or unfavourable conditions before proceeding with work.

3.4 PREPARATION

- .1 Protection:
 - .1 Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage by suitable non-staining covers or masking. If damaged, clean and restore surfaces as directed by Departmental Representative

- .2 Protect items that are permanently attached such as Fire Labels on doors and frames.
- .3 Protect factory finished products and equipment.
- .4 Protect building occupants and general public in and about the building.
- .2 Surface preparation: clean and prepare surfaces in accordance with MPI Architectural Painting Specification Manual requirements. Refer to MPI Manual in regard to specific requirements
- .3 Sand and dust between coats as required to provide adequate adhesion for next coat and to remove defects visible from a distance up to 1000 mm.
- .4 Clean metal surfaces to be painted by removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with MPI requirements. Touch up of shop primers with primer as specified.

3.5 APPLICATION

- .1 Conform to manufacturer's application instructions unless specified otherwise.
- .2 Brush and Roller Application:
 - .1 Apply paint in uniform layer using brush and/or roller type suitable for application.
 - .2 Work paint into cracks, crevices and corners.
 - .3 Paint surfaces and corners not accessible to brush using spray, daubers and/or sheepskins. Paint surfaces and corners not accessible to roller using brush, daubers or sheepskins.
 - .4 Brush and/or roll out runs and sags, and over-lap marks. Rolled surfaces free of roller tracking and heavy stipple.
 - .5 Remove runs, sags and brush marks from finished work and repaint.
- .3 Spray application:
 - .1 Provide and maintain equipment that is suitable for intended purpose, capable of atomizing paint to be applied, and equipped with suitable pressure regulators and gauges.
 - .2 Keep paint ingredients properly mixed in containers during paint application either by continuous mechanical agitation or by intermittent agitation as frequently as necessary.
 - .3 Apply paint in uniform layer, with overlapping at edges of spray pattern. Back roll first coat application.
 - .4 Brush out immediately all runs and sags.
 - .5 Use brushes and rollers to work paint into cracks, crevices and places which are not adequately painted by spray.
- .4 Use dipping, sheepskins or daubers only when no other method is practical in places of difficult access.
- .5 Apply coats of paint continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.

- .6 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.
- .7 Sand and dust between coats to remove visible defects.
- .8 Finish surfaces both above and below sight lines as specified for surrounding surfaces, including such surfaces as tops of interior cupboards and cabinets and projecting ledges.

3.6 SITE TOLERANCES

- .1 Walls: no defects visible from a distance of 1000 mm at 90 degrees to surface.
- .2 Ceilings: no defects visible from floor at 45 degrees to surface when viewed using final lighting source.
- .3 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

3.7 CLEANING

- .1 Do cleaning in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section includes materials and requirements for chemical fire extinguishers.

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.
- .2 Closeout Submittals
 - .1 Provide maintenance data for incorporation into Operational and Maintenance manual.

Part 2 Products

2.1 MULTI-PURPOSE DRY CHEMICAL EXTINGUISHERS (FE1)

- .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 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.

Part 3 Execution

3.1 INSTALLATION

- .1 Mount extinguishers on brackets as indicated.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA-G40.20-04/G40.21-04, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .2 ASTM International
 - .1 ASTM B650 Standard Specification for Electrodeposited Engineering Chromium Coatings on Ferrous Substrates.

1.2 ACTION AND INFORMATIONAL 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.
 - .2 Submit manufacturers cut sheets for proposed shelving units.
 - .3 Submit manufacturer's installation instructions and installation sequence.

1.3 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 recycling in accordance with Section 01 74 19 – Construction Waste Management and Disposal.

1.4 EXTRA MATERIALS

- .1 Provide any specialty tools for assembly and disassembly, as required by metal storage shelving manufacturer.

Part 2 Products

2.1 MATERIALS

- .1 Chrome wire knock down, free standing, shelving consisting of wire shelves with wire truss front, side, and back rails to provide support.
 - .1 Shelves supported from four chrome plated steel corner posts.
 - .2 Shelves adjustable in 26mm increments.
 - .3 Minimum shelf capacity; 362kg
 - .4 Chrome plated to ASTM B60

- .2 Shelving:
 - .1 Sizes:
 - .1 2 units width: 610 mm, length: 915 mm height: 2184mm.
 - .2 1 unit width: 610 mm, length: 1829 mm height: 2184mm.
 - .3 1 unit width: 610 mm, length: 915 mm height: 2184mm.
 - .1 Designed to make a right angle unit in combination with 1829mm unit.

2.2 COMPONENTS

- .1 Uprights:
 - .1 Chrome plated steel tubes, plastic floor protectors, plastic closures at top
 - .2 Size and thickness designed to support specified total load.
- .2 Shelves:
 - .1 Chrome plated steel wire shelves designed to support specified load.
 - .2 Adjustable connection to uprights.
- .3 Accessories:
 - .1 S hook hardware to connect shelving units together at a right angle, as detailed.

2.3 FINISH

- .1 Finish: Chrome plated

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 metal storage shelving in accordance with reviewed layout.

3.3 CLEANING

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

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Section 06 10 00 - Rough Carpentry: wood blocking.

1.2 DESIGN REQUIREMENTS

- .1 Design blinds to following requirements:
 - .1 Be designed in manner that allows wear susceptible parts to be replaceable by either user or manufacturer.
 - .2 Guarantee of at least 5 years of available replacement parts following discontinuation of product manufacture.
 - .3 Be accompanied by instructions for replacing or repairing worn parts, including inventory numbers for parts and procedures for ordering replacement parts.
 - .4 Program that allows for the refurbishing or return of used blinds.
 - .5 Designed in manner that permits effective disassembly of components in order to permit recycling of materials for which recycling markets exist.

1.4 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product data:
 - .1 Submit manufacturer printed product literature, specifications and data sheets.
- .3 Shop drawings:
 - .1 Indicate dimensions in relation to window jambs, operator details, head anchorage details, hardware and accessories details.
- .4 Samples:
 - .1 Submit one representative working sample of horizontal louvre blind, if requested by Departmental Representative.
 - .2 Submit duplicate samples of manufacturer standard colours for selection by Departmental Representative.
 - .3 Samples will be returned after approval.
- .5 Manufacturer instructions:
 - .1 Submit manufacturer installation instructions.

1.6 WASTE MANAGEMENT AND DISPOSAL

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

1.7 CLOSEOUT SUBMITTALS

- .1 Make submissions in accordance with Section 01 78 10 - Closeout Submittals.
- .2 Provide following for inclusion in Project operating and maintenance manuals:
 - .1 Full identification of each type of window blind installed (i.e., model and model/series number) for later use in obtaining service and replacement parts.
 - .2 Name, address and telephone numbers of installer and of local service/repair agent.

PART 2 - PRODUCTS

2.1 MATERIALS AND FABRICATION

- .1 Slats: 25 mm wide, with rounded corners and rough edges removed.
 - .1 Aluminum alloy, corrosion resistant spring-tempered.
 - .2 Colour and finish: selected by Departmental Representative.
- .2 Ladders: braided polyester yarn designed for full tilting action while retaining the same level and position of each slat. Ladders spaced not more than 150 mm from end of slats and 550 mm o.c.
- .3 Headrails: one piece aluminum/steel channel with rolled edges, formed to provide sufficient strength to support blind without sagging, twisting or distorting. Metal minimum 0.50 mm thick.
- .4 Bottom rails: lock seam tubular steel section, 0.36 mm thick.
- .5 Bottom rail end caps: soft moulded plastic fitted snugly over ends of rails, colour to match slats.
- .6 Tilt rods: steel construction.
- .7 Tassels: soft moulded plastic, colour to match slats.
- .8 Pulleys: designed to permit ease of operation with minimum wear to cord.
- .9 Tilters: fully enclosed and lubricated, with positively locked to drum to prevent slippage and ensure accurate timing. Use anti-friction materials for worm and gear.

- .10 Cord locks: designed to provide smooth operation with feature to prevent accidental dropping of blinds.
- .11 Ladder caps: designed to provide sufficient retention when snapped onto bottom rail to hold ladders in proper position.
- .12 Installation brackets: end and centre type complete with safety locking caps to secure headrail and valance.
- .13 Lift cords: minimum 1.98 mm dia., minimum tensile strength 689 kPa, fitted with tassels.
- .14 Tilter controls: transparent wand, minimum 8 mm dia.

PART 3 - EXECUTION

3.1 MANUFACTURER INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install blinds at all windows, unless detailed/indicated otherwise.
- .2 Use non-corroding metal fasteners for installation, concealed in final assembly.
- .3 Include centre brackets where necessary to prevent headrail deflection.
- .4 Install brackets to resist pulling away and loosening.
 - .1 Fix in place using screws of sufficient length to hold secure through wall finish into stud framing/blocking.
 - .2 Co-ordinate wall framing to include intermediate blocking as required for attachment of components.
 - .3 Direct fastening to gypsum board alone not acceptable.
- .5 Adjust to provide operation without binding.
- .6 Leave blinds in up position.

3.3 CLEANING

- .1 Do cleaning in accordance with Section 01 74 11 - Cleaning.

- .2 Remove finger marks caused during installation.
- .3 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 - GENERAL

A. SUMMARY

1. Furnish and install work under this section including but not limited to the following
 - a. Laboratory tables, laboratory storage cabinets.

B. SUBMITTALS

1. Product data including C- Qualification Data, D- Shop drawings, E- quality assurance data and H- warranty information for each type of specified product.
2. Submit for record product test reports from and based on tests performed by a qualified independent testing laboratory evidencing compliance of laboratory casework top finishes with requirements specified for chemical and physical resistance as specified.

3. ACTION SUBMITTALS

- a. Product Data: For each type of product.
- b. Shop Drawings: For laboratory casework. Include plans, elevations, sections, and attachment details. (Drawings provided must indicate casework layout in order to assist and describe the basic lab fit up requirements only)
 - 1) Indicate types and sizes of cabinets.
 - 2) Indicate locations of hardware.
 - 3) Indicate locations and types of service fittings.
 - 4) Indicate locations of blocking and reinforcements required for installing laboratory casework.
 - 5) Include details of utility spaces showing supports for conduits and piping.
 - 6) Include details of support framing system.
 - 7) Include details of exposed conduits, if required, for service fittings.
 - 8) Indicate locations of and clearances from adjacent walls, doors, windows, other building components, and other laboratory equipment.
 - 9) Include coordinated dimensions for laboratory equipment that will be supplied by the Owner.
- c. Samples for Initial Selection: For factory-applied finishes and other materials requiring color selection.
- d. Samples for Verification: For each type of cabinet finish and each type of countertop material, with manufacturer's standard sizes

- ### **C. Qualification Data: Submit for record installers or firms specified to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.**

- ### **D. Shop drawings for laboratory casework, casework support systems, and laboratory casework tops, modular storages showing plan layout, location and type of service fittings.**

1. Submit shop drawings as one complete submittal that includes all items specified in this section. Submittals that include only part of the specified items of this section are not acceptable and will be rejected.
2. Include details and location of anchorages and fitting walls and base, including required blocking or back blocking.

3. Include layout of units with relation to surrounding walls, doors, windows, and other building components.
4. Coordinate shop drawings with other work involved.
5. Include manufacturer's recommendations for blocking and securing of laboratory casework tops.
6. Sample units will be used to demonstrate aesthetic effects as well as other qualities of materials and execution. Sample units may not be incorporated in work.

E. QUALITY ASSURANCE

1. The work of this technical specification section and related Contract Documents shall conform to Quality Requirements as per Department of Fisheries and Oceans. The QA requirements shall apply to, but shall not be limited to the work indicated in the standards and qualifications of this section and for Code mandated Special Inspections as required.
2. Single Source Responsibility: Provide laboratory casework tops manufactured or furnished by same laboratory Furniture Company for single responsibility. Provide specified laboratory items by company with minimum of 10 years' experience in the manufacture of laboratory casework, laboratory countertops, accessories and modular storage units of the type specified for this project.
3. Installer: Installer of laboratory casework tops shall be trained and certified by the manufacturer of the casework.
4. Testing Laboratory Qualifications: To qualify for acceptance, an independent testing laboratory must demonstrate to Architect's satisfaction, based on evaluation of laboratory-submitted criteria conforming to ASTM E 699, that it has the experience and capability to conduct satisfactorily the testing indicated.

F. DELIVERY, STORAGE, AND HANDLING

1. Deliver laboratory casework, laboratory casework tops and laboratory elements only after building is enclosed, weathertight, and wet operations in building are completed.
2. Protect finished surfaces from soiling and damage during handling and installation. Cover with polyethylene film or other protective covering.

G. PROJECT CONDITIONS

1. Environmental Limitations: Do not install casework until HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.

H. WARRANTY

1. Project Warranty: Submit a written warranty for 5 years after the date of Substantial Completion, executed by the manufacturer, agreeing to repair or replace laboratory casework that fails in materials or workmanship within the specified warranty period. This warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents.

PART 2 - PRODUCTS

2.1 METAL LABORATORY CASEWORK

Metal laboratory casework including, but not limited to, items listed under the following list

- 2.4 Tables - A - Free-standing (adjustable height table frames with work surfaces),
2.6 Modular Storage Systems- B Tall Cabinets: Floor-Mounted.

A. MATERIAL

1. A standard integrated system that consists of a core and panel support structure must be provided with the following:
2. Core structure must be supported by structural leg frames.
3. Components must be suitable for single faced wall conditions or double faced peninsula conditions on the Casework System Frame.
4. All core assemblies must have removable panels on all sides.
5. Minimum Metal Thickness: Provide steel laboratory casework components of following minimum thickness, expressed in mm. Manufacturers proposing substitutions for the material thickness listed below shall submit warranty of equivalent performance for the owner's review.
 - a. 0.91mm (0.036") 19 gauge thick:
 - 1) Back panels.
 - 2) Inner door panels.
 - 3) One-piece drawer body and drawer front.
 - 4) Shelves; add hat channel reinforcement or use 1.30 mm (0.0516") 16 gauge thick material for shelves over 914mm (36") long.
 - b. 1.30 mm (0.0516") 16 gauge thick:
 - 1) Sides, ends, and fixed backs.
 - 2) Bottoms, tops, and soffits.
 - 3) Door fronts.
 - 4) Base.
 - 5) Filler panels.
 - 6) Items not otherwise noted.
 - c. 1.60 mm(0.0635") 14 gauge thick:
 - 1) Top front rails and intermediate horizontal rails.
 - 2) Center posts.
 - 3) Top gussets.
 - d. 1.99 mm (0.0785") 12 gauge thick:
 - 1) Front corner reinforcement (4 corners).
 - 2) Top back rail.
 - 3) Drawer suspension.
 - 4) Sink supports
 - 5) Hinge reinforcements.
 - e. 2.75 mm (0.1084") thick: Leveling and corner gussets.

B. FABRICATION

1. General: Complete assembly and finishing at point of manufacture. Perform unit assembly on precision jigs to provide units which are square; fully reinforced with

angles, gussets, and channels; integrally framed and welded to form a dirt and vermin- retardant enclosure. Grind exposed welds smooth. Where applicable, reinforce base cabinets for sink support. Maintain uniform clearance around door and drawer fronts of between 1.58 mm (1/16") minimum to 2.38 mm (3/32") maximum.

2. Fabricate units to permit interchangeability of drawers, hinged doors, and similar pieces of like sizes.
 - a. Top Rail: Interlock and overlap end panels. Form with rabbeted offset.
 - b. Intermediate Horizontal Rails (Base Cabinets): Required for recessed and concealed locks.
 - c. Provide anti-tipping hardware for mobile base cabinet.
 - d. Fabricate cabinets without center posts to permit complete access to interior.
3. Acoustical Lining: Acceptable manufacturer's nonabsorbent lining.
4. Wall Cases: Form ends and back as one-piece, wrap-around design with rear internal reinforcing channels that incorporate shelf clip adjustment holes; fabricate with recess at back to accommodate mounting brackets; form case to conceal mounting brackets or furnish filler strips for the purpose; fabricate with double bottom assembly using finished soffit piece to conceal bottom of case.
5. Flush Doors: Double wall construction; outer and inner pans formed and telescoped into box formation, with welded hat channel reinforcement full height on center of each pan. Fill doors solid with fire-resistant, sound-deadening material. Inner pan formation of door shall be indented for in-field installation of locks when required. Paint interior surfaces before assembly.
6. Hinges: Attach 5-knuckle hinges, semi-concealed or concealed with screws to 1.99 mm (0.0785") thick tapped reinforcement strips, welded to inside of inner pan and to case.
7. Adjustable Shelves: Front, back and ends formed down, with returns at front and back edges.
8. Pull-Out Shelves: Turn front, sides and back edges up to form lip.
9. Filler Panels: Provide at exposed-to-view areas, between back of cabinets and walls, knee opening spaces, and scribed where required to enclose gaps; easily removed for access to utility chase; fabricate with 12mm (1/2") return at four sides.
10. Utility Space: Provide space, cutouts, and holes for pipes, conduits, and fittings in cabinet bodies to accommodate services and their support-strut assemblies.
11. Cabinet Base: Flanged metal strip welded to case bottom forming a fully enclosed toe space --approximately 100 mm (4") high by 75mm (3") deep without gaps or pockets; inside corners mitered and outside corners wrapped.
12. Rubber Bumpers: Provide 9.5 mm diameter. soft rubber buttons attached to case for doors and drawers to close against.

C. HARDWARE, METAL LABORATORY CASEWORK

1. Drawer and hinged door pulls:
 - a. Flush aluminum.
 - b. All pulls are mounted horizontally on drawers and horizontally on doors, inset nominally 25 mm (1") from edge.

2. Hinges: Institutional construction, 5 knuckles, 63.5mm (2-1/2") long; type 304 stainless steel, brush finish with hinge barrel only projected beyond face of cabinet. Furnish two per door 914mm (36") high and less, three per door over 914 mm (36") high.
3. Door Catch: Twin ball catch with screwdriver adjusted holding power; ball is chrome steel, catch and strike are brass; screw mounted.
4. Elbow catches and strike plates shall be used on left-hand doors of double door cases where locks are used and are to be burnished cast aluminum with bright brass finish.
5. Locks: Optional if selected - Pin tumbler with heavy duty interchangeable cylinder. Exposed lock noses shall be dull nickel (stain) plated and stamped with identifying numbers. Locks shall have a capacity of atleast 2000 primary key changes and the capacity to Master keyed, grand –master keyed, sub-master keyed and mason keyed.
6. Label Holders: Label holders shall be self-adhesive type aluminum with satin finish and designed for 2 -1/2" X 1-1/8" cards nominal sizes.
7. Number plates:
8. Number plates, where shown or called for, shall be self-adhesive type aluminum with indented back lettering.
9. Shelf Clips: Seismic shelf clips, double pin type.

D. CASEWORK FINISH

1. Provide laboratory casework with a factory-applied finish that is capable of withstanding the tests specified in this article with no permanent change in gloss, color, film hardness, adhesion, or film protection.
 - a. Acids:
 - 1) Not less than 10 drops (0.50 cc) of the following reagents applied to finish surface, covered with watch glass, convex side down, for 60 minutes, then washed and dried.
 - 2) Hydrochloric acid (37 percent), sulfuric acid (85 percent), nitric acid (25 percent), phosphoric acid (75 percent), acetic acid (98 percent).
 - b. Solvent:
 - 1) Not less than 10 drops (0.5 cc) of the following reagents applied to finish surface, covered with watch glass, convex side up, for 60 minutes, then washed and dried.
 - 2) Ethyl alcohol, butyl alcohol, methyl alcohol, toluene, acetone, benzene, carbon tetrachloride, formaldehyde (37 percent), gasoline, ethyl acetate, ethyl ether, methyl ethyl ketone, naphtha, kerosene, xylene, glycerin, furfural.
 - c. Bases and Salts:
 - 1) Not less than 5 drops (0.25 cc) of the following reagents applied to finish surface, covered with watch glass, convex side up, for 60 minutes, then washed and dried.
 - 2) Sodium hydroxide (25 percent), ammonium hydroxide (28 percent), potassium hydroxide (40 percent), saturated zinc chloride, saturated

- sodium chloride, saturated sodium sulphide, saturated sodium carbonate, poultice of "Tide" laundry detergent and water.
- d. Salt Spray: Withstand 200 hours salt spray exposure conforming to ASTM-B117-59T procedure.
 - e. Moisture Resistance: No visible effect when finish surface exposed to the following:
 - 1) Hot water at a temperature of 190 degrees F (91 degrees C) to 205 degrees F (96 degrees C), trickled down surface at 45-degree angle for 5 minutes.
 - 2) Constant moisture using a 50 mm (2") by 75mm (3") by 25 mm (1") cellulose sponge, soaked with water, in contact with surface for 100 hours.
 - f. Cold Crack: No effect when subjected to 10 cycles of temperature change from 20 degrees F (14 degrees C) for 60 minutes to 125 degrees F (52 degrees C) for 60 minutes.
 - g. Adhesion and Flexibility: No peeling or cracking or exposure of metal when metal is bent 180 degrees over a 12 mm (1/2") diameter mandrel.
 - h. Abrasion: Maximum weight loss of 5.5 mg. per 100 cycles as tested on a Taber abrasion tester #E4010 with 1000 GM wheel pressure and calibrate #CS10 wheels.
 - i. Hardness: Hard surface equivalent to 6H pencil lead.
 - j. Impact: Withstand forward impact of 64 pounds without chipping or crazing using a Gardner #167 Impact Tester with a 15.875 mm (5/8") diameter spherical punch.
 - k. Humidity Resistance: Withstand 1000 hours exposure in saturated humidity at 100 degrees Fahrenheit.
2. Provide steel laboratory casework with a factory-applied enamel finish that complies with chemical and physical resistance requirements specified.
 - a. Pretreatment: After assembly, thoroughly clean surfaces of grease, dirt, oil, flux, and other foreign matter by physical and chemical means. Treat entire unit with metallic phosphate process leaving surfaces with uniform, fine-grained, crystalline phosphate coating providing excellent bond for subsequent finish.
 - b. Finish Coats: One or more coats of high-bake chemical-resistant enamel to provide a hard and smooth, satin luster finish applied to treated surfaces. Apply finish in powder form, electrostatically charged, (or use dip-tank method) to interior and exterior surfaces, and average thickness of 0.038mm (1.5 mils) and minimum thickness of 0.0304mm (1.2 mils).
 - 1) Backs of cabinets and other surfaces not exposed to view: 1.0 mil average.
 - 2) Color: Provide entire range of manufacturer's color range

2.2 TABLES

A. TABLE-BASED METAL LABORATORY CASEWORK:

Free-standing table, constructed of tubular frame, with telescoping inner leg, and leg levelers. Height adjustable on minimum 25 mm (2") increments. Provide full length horizontal rear cabinet stop under work surface frame.

1. Tubular table frame: Type 304 stainless steel where indicated, cold-rolled steel with powder coat finish elsewhere.
2. Four leg table shall consist of a worksurface support frame as described above in A.1. Nominal lengths are 42", 48", 60", 72" and 96". Two additional leg members shall be bolted to the rear attachment collars to provide a four leg self-supporting table frame., adjustable in height from 31" to 37" AFF including 1" work surface.
3. Front and rear leg members shall be 11 gauge steel tubes, 2" outside diameter and 1.75" inner telescoping leg capable of vertical adjustment in 2" increments
4. Legs shall include non-marring, 3/8" diameter, levelers.
5. Load rating shall be SEFA Cat 4, 1200lbs for frames up to 72" in length and SEFA Cat 3, 1000 lbs. for frames over 72" in length. With uniformly distributed load, the maximum allowable deflection shall be .125" measured at the center of the front rail.
6. Provide full extension drawer slides fastened to table supports, and selected laboratory countertop.

B. FREE-STANDING WORKSTATION :

1. Free-standing, 50 mm (2") tubular legs with levelers, 2134 mm (84") high slotted uprights complete service chase for service lines, data and electrical. Separate plumbed services and data in one upright, and electrical cabling in opposite uprights. Separate high voltage from low voltage cabling. Table height adjustable on minimum 25 mm (1") increments from 737mm (29") to 915 mm (36") where indicated.

2.3 LABORATORY COUNTER TOPS

This section list the minimum performance specifications for Laboratory worktops.

A. CAST EPOXY RESIN TOPS:

1. Factory molded tops of modified epoxy resin formulation, uniform mixture throughout full thickness; especially compounded and cured to provide optimum physical and chemical resistance; smooth, non-specular finish of color indicated.
2. Weld and Grind joints for tops in Island arrangement to provide one seamless surface.
3. Notch and seal around casework support and service frame.
4. Provide front and end overhang of 25 mm (1") over base cabinets, form with continuous drip groove on under surface 12 mm (½ ") from edge; tolerance not exceeding plus or minus 0.80 mm. Provide in longest practical lengths.
 - a. Thickness: 25mm (1")
 - b. Color: Black.
5. Backsplash: Applied butt type; 100mm (4") high, unless indicated otherwise; provide end curbs where tops abut walls, fume hoods, and other fixed surfaces.
6. Edge Profile: Square with eased edges.

7. Physical Properties: Comply with the following minimum requirements:
 - a. Compressive Strength (ASTM D695): 36,500 PSI
 - b. Flexural Strength (ASTM D790): 16,000 PSI
 - c. Tensile Strength (ASTM D638): 10,500 PSI
 - d. Density (ASTM D792): 196 KG/M3
 - e. Rockwell M. Hardness (ASTM D785): 110
 - f. Heat Distortion (ASTM D648): 350 deg F (Temp. at 264 PSI)
 - g. Fire Resistance (ASTM D635): self-extinguishing
 - h. Water Absorption (ASTM D570): 0.0076 percent
 - i. Thermal Coefficient of Expansion (ASTM D696): 1.1509×10^{-5} in./o F
8. Chemical Resistance:
 - a. Spot test with the following reagents in the listed laboratory concentrations, in contact with finished top for 16 hours; with the following ratings:
 - b. No Effect: Glacial acetic acid, acetone, ammonium hydroxide 28%, benzene, carbon tetrachloride, citric acid 10%, diethyl ether, dimethyl formamide, ethyl acetate, ethyl alcohol 95%, ethylene dichloride, heptane, hydrochloric acid 20%, hydrogen peroxide 28%, iso-octane, methyl alcohol, nitric acid 70%, phenol, sodium carbonate 2%, sodium hydrochlorite 5%, sulfuric acid 60%, toluene.
 - c. Slight Spot: Chromic acid 40%, hydrochloric acid 37%, sodium hydroxide 10%, sodium hydroxide 50%.
 - d. Spot: Dichromate cleaning solution, sulfuric acid 96%.
9. Workmanship: Cast surfaces smooth, with drip grooves; provide factory cutouts for sinks. Fabricate plain butt_type joints assembled with epoxy adhesive and prefitted, concealed metal spline.
10. Fabrication Tolerances: Measure top in unrestrained condition.
 - a. Thickness: Plus or minus 0.8mm (1/32").
 - b. Size: Length: Plus or minus 3.2 mm (1/8").
 - c. Width: Plus or minus 1.59 mm (1/16").
11. Squareness: Difference between diagonals shall not exceed 0.40mm (1/64") for each 300mm (12") of length.
 - a. Warp: 1.59mm (1/16") in 914mm (36") of length; 2.38mm (3/32") maximum in 2438 mm (96") length.
 - b. Location of Cutouts: Plus or minus 3.2 mm (1/ 8").
 - c. Size of Cutouts: Plus 3.2mm (1/8"). Minus 0.

B. INSTALLATION REQUIREMENTS

1. Work surface installation:
 - a. Where required due to field conditions, scribe or caulk to abutting surfaces.
 - b. Secure joints in the field, where practicable, in the same manner as in factory, with dowels, adhesive or fasteners recommended by manufacturer.

- c. Secure work surfaces to casework and equipment components with material and procedures recommended by the manufacturer.
 - d. Provide cutouts for service connected and coordinate work with other trades.
2. Field Jointing of Epoxy Tops: Locate field joints as shown on approved shop drawings; factory prepare mating surfaces so there is no jobsite processing of top and edge surfaces. Join using adhesives recommended by manufacturer and that match the color of the top.
3. Fastening Tops to Base Cabinets:
4. Stainless Steel Tops: Secure tops to cabinets with "Z" type fasteners or equivalent, using 2 or more fasteners at each front, end, and back.
5. Epoxy and Solid Phenolic Tops: Secure tops to cabinets with silicone adhesive, applied at each corner and continuously along perimeter edges.
6. Maximum penetration of screws into underside of countertops shall not be installed closer than 6.35mm (1/4") below the top surface, unless instructed otherwise by countertop manufacturer.
7. Fastening Tops to Metal Wall-Hung Brackets:
 - a. Stainless Steel Tops: Secure tops to cabinets with "Z" type fasteners or equivalent, using 2 or more fasteners at each front, end, and back.
 - b. Epoxy and Solid Phenolic Tops: Secure tops to brackets with screws, applied at each corner by screwing through top bracket arm into underside of countertop. Provide pre-drilled holes for field installed stainless steel flathead torx or square head screws.
 - c. Maximum penetration of screws into underside of countertops shall not be installed closer than 6.35mm (1/4") below the top surface, unless instructed otherwise by countertop manufacturer.
8. Tolerance: Install countertops with no more than 3.175mm (1/8") in 2438mm (96") sag, bow, or other variation from a straight line.
9. Abut top and edge surfaces in one true plane, with internal supports placed to prevent deflection.
10. Join tops using clamping devices to create flush hairline joints. At joints in epoxy tops, use manufacturer's recommended adhesives and clamping devices to create joint widths of not more than 1.59mm (1/16"), completely filled and flush with abutting surfaces.
11. Where necessary to penetrate epoxy tops with fasteners, countersink heads approximately 3.175mm (1/8") and plug hole flush with material equal in chemical resistance, color, hardness, and texture to top surface.
12. Provide holes and cutouts as required for mechanical and electrical service fittings.
13. Carefully dress joints smooth, remove surface scratches, and clean and polish entire surface.
14. Provide scribe moldings for closures at junctures of top, curb, and splash with walls as recommended by manufacturer for materials involved.
15. Caulk space between wall and countertops with mildew-resistant silicone sealant.

C.

2.4 MODULAR STORAGE SYSTEMS

A. TALL CABINETS: FLOOR-MOUNTED.

1. General

- a. Back: fixed.
- b. Glazed doors shall be 3/4" thick and consist of an inner and outer door pan welded together to form a single unit. Outer door pan shall be pierced and formed to create a 3" wide frame with a beveled edge around the glass opening in the center of the door. Inner door pan shall be 18 gauge steel, flanged at all four sides, and pierced for a glass opening
- c. Framed glass doors: 6 mm (1 / 4") thick tempered safety glass. (If indicated by owner in annexure A)
- d. Shelves: adjustable.
- e. Where indicated, fasten to support frame of benching.
- f. Self-supporting units.
- g. Inset construction: surfaces of doors, drawers, and panel faces to align with cabinet fronts without overlap. Horizontal and vertical case shell members to meet in same plane without overlap, cracks or crevices.

2. Construction:

- a. Materials: painted metal construction, except stainless steel (Type 304) where indicated.
- b. Doors and drawers: reinforced double pan construction with sound deadening material, 19 mm (3/4") minimum thick, square edged.
- c. Provide reinforcement for hardware attachment on doors and drawer front to inner pan.
- d. Toe space rails shall interlock in back of bottom rail and with end panel to provide a welding plate, and shall extend to the floor with a flange turned back and up for support.
- e.
- f. Drawers: one piece body. Provide nylon roller channel suspension with front rollers set into drawer channels. Case channels shall maintain alignment of drawer and provide an integral drawer stop to prevent inadvertent removal of drawer.
- g. Shelves in cabinets: one piece, adjustable at 13 mm (1 / 2") oc.
- h. Height, depth and width: as indicated

B. INSTALLATION

1. PREPARATION

- a. Examine roughed-in mechanical and electrical services, installation of floors, walls, columns, and ceilings, and other conditions affecting installation of fittings and fixtures. Verify dimensions and locations of services and substrates before fabricating work.
- b. Notify Architect of unsatisfactory conditions preventing proper installation of fittings and fixtures. Do not proceed with fabrication and installation until unsatisfactory conditions have been corrected in manner satisfactory

to Architect and Owner. Start of work shall indicate acceptability of related work.

- c. Coordinate with other trades to provide anchor to supporting substrate where indicated and where required for proper operation. Conceal anchorages where possible.

C. FIELD QUALITY CONTROL

1. Testing: Coordinate fittings and fixtures and similar requirements have been properly adjusted.
2. Test each item to demonstrate that it is operating properly and that controls and safety devices are functioning. Repair or replace accessories found to be defective in operation.

D. CLEANING

1. Touch-up minor abrasions and imperfections in painted finishes with coating which matches factory-applied finish.
2. Clean and sanitize equipment, and repair or replace deteriorated or defective equipment to a condition free of damage and deterioration at time of Owner's final acceptance of the equipment.

PART 3 - ON-SITE PROJECT EXECUTION REQUIREMENTS

A. EXAMINATION

1. Examine areas, with the Departmental Representative present, for compliance with requirements for installation tolerances, location of reinforcements, and other conditions affecting performance of the Work.

B. CLEANING AND PROTECTING

1. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Owner.
2. Protect countertop surfaces during construction with 6-mil (0.15-mm) plastic or other suitable water-resistant covering. Tape to underside of countertop at a minimum of 48 inches (1200 mm) o.c.

END OF SECTION

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 within the renovation areas.
- .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 B and C-B (for Detailed Design) to the Municipality.
 - .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; 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 Valves, fittings and couplings.
 - .2 Wet sprinklers:
 - .1 Sprinkler heads and escutcheon plates.
- .2 Record Drawings
 - .1 Provide Record Drawings. Record Drawings shall include revised CAD electronic drawings files and PDF electronic copies on CD, DVD, or flash drive.
- .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.

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.

Part 3 Execution

3.1 ACCESS DOORS

- .1 Install at concealed sprinkler heads, unions, expansion joints, valves, control valves and special equipment.
- .2 Locate access doors so that all concealed items are readily accessible for adjustment, operation and maintenance.
- .3 Do not locate access doors in feature wall or ceiling construction without the prior approval of the Departmental Representative. Locate in service areas wherever possible.
- .4 In concealed ceiling spaces containing upright heads and exposed supply piping below the ceiling, a hole around the sprinkler head riser large enough to allow passing the entire sprinkler head through the ceiling with an oversized escutcheon plate to cover the hole is an acceptable alternative to providing an access panel.

3.2 GRADING AND DRAINING OF PIPING

- .1 Grade all fire protection piping so that it can be drained through drain cocks.

3.3 CORE DRILLING

- .1 Arrange and pay for the cost of all core drilling for the fire protection work under Division 21.
- .2 Verify the location of existing service runs and structural reinforcement within existing concrete floors and walls prior to core drilling and cutting. Coring and cutting of structural building components shall only take place upon the receipt of specific written approval of the Departmental Representative. Repairs to existing services damaged as a result of core drilling is included in this section of the work.

3.4 PIPE SLEEVES AND ESCUTCHEONS

- .1 Supply and installation of pipe sleeves is included in this section of the specification. Refer to Section 23 0505 - Installation of Pipework.

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.
- .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

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 to 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 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].
 - .3 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 "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 Steel tubing:
 - .1 To ASTM A135, A795 or A53
 - .2 Schedule 5 pipe with cold drawn steel fittings with integral "O" rings.
- .3 Copper tube, drawn, seamless to ASTM B75, seamless water tube to ASTM B88, wrought seamless and alloy type to ASTM B251, brazing filler metal (Classification BcuP-3 or BcuP-4) to AWS A5.8 and solder 95/5 (tin/antimony grade 95TA) solder to ASTM B32 of wall thickness type 'K', 'L', or 'M'.

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]: Open by counter-clockwise rotation.
- .2 Check - 1210 kPa [175 psi]: Provide spool piece to ensure full check valve opening where adjacent an alarm or gate valve.
- .3 Drain Valve: 25 mm [1"] complete with hose end adaptor, cap and chain.
- .4 If the system working pressure exceeds 1035 kPa [175 psi] all valves shall be 2070 kPa [300 psi] rated.

- .5 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 sheet metal shields, 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.
- .4 Sprinkler deflector elevations shall be within 12 mm [1/2"] of each other in the same room.
- .5 All sprinklers finishes shall match base building standard.
- .6 Escutcheons used on T-bar ceilings shall allow ceiling panel removal without removing the sprinkler head.
- .7 Escutcheons shall be provided by the sprinkler manufacturer to suit the model of sprinkler and maintain the approvals.
- .8 Baffles: Baffles to be located and installed as per NFPA 13 requirements.

2.6 PIPE HANGERS

- .1 All hangers and supports shall be ULC listed for fire protection services.
- .2 Toggle hangers are unacceptable.

2.7 ESCUTCHEONS AND PLATES

- .1 Provide on pipes passing through walls, partitions 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 Do not install escutcheons and plates in concealed locations.

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 Consultant'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 and NFPA 25.
- .2 All grooved end valves, fittings and couplings etc. shall be of one manufacturer.
- .3 Pipe Installation:
 - .1 Install piping straight and true to bear evenly on hangers and supports. Do not hang piping from plaster ceilings.
 - .2 Keep interior and ends of new piping and existing piping thoroughly cleaned of water and foreign matter.
 - .3 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.
 - .4 Inspect piping before placing into position.
 - .5 All welding shall be performed off site using welding fittings. Field welding is not permitted.
 - .6 Adjust sprinkler piping up or down if conflicts occur between structure, lighting, electrical, plumbing piping or ductwork.
 - .7 Arrange piping routing to provide sufficient access to mechanical and electrical equipment.
 - .8 A wrap around hanger or other approved means shall be provided at the end of each branch sprinkler line to prevent excessive movement.
- .4 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.
- .5 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.
- .6 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 pipelines so effluent is clear and free of debris.
- .3 Rate of flushing flows shall be as per NFPA 13 requirements.
- .4 Provide proper drainage for this flushing operation.

END OF SECTION

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.

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:
 - .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 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 Solders and fluxes shall not contain lead.

- .3 Teflon tape for threaded joints.

2.4 VALVES - GENERAL

- .1 All valves shall be rated for 860 kPa [125 psi] service unless noted otherwise.

2.5 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 Sweat ends to ANSI/ASME B16.18, Class 150.
 - .3 Threaded ends to Class 150.

2.6 DRAIN VALVES

- .1 Ball type with bronze body and trim, suitable for maximum system operating pressure, c/w cap and chain.

2.7 SWING CHECK VALVES

- .1 50 mm [2"] and smaller:
 - .1 Bronze body, bronze or stainless steel disc holder and Teflon disc.
 - .2 Threaded ends to MSS-SP-80, Class 150, 1 MPa.
 - .3 Sweat ends to MSS-SP-80, 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.

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 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.
 - .3 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.

3.3 PRESSURE TESTS

- .1 Perform a hydrostatic test on all domestic water piping at 1380 kPa [200 psi] for 8 hours.
- .2 Comply with all requirements of the Building Code and local Authority Having Jurisdiction.

3.4 FLUSHING AND CLEANING

- .1 Flush entire system for 8 hours. 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

Part 1 General

1.1 SUMMARY

- .1 Section includes the installation of drainage waste and vent piping.
- .2 Existing sanitary waste piping as indicated on the drawings.
- .3 Existing storm drainage piping as indicated on the drawings.
- .4 Redundant existing interior sanitary waste and storm drainage piping shall be removed where access is readily available or capped off and abandoned in place as referenced on the drawings. All vents through the roof shall be capped.

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 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.
- .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 Pressure waste piping from pumping stations and other equipment shall be pressure piping and fittings as specified for domestic water.
 - .2 Copper to cast iron joints shall be male brass adaptors with tapped fittings.

- .3 Nipples shall be cast iron or heavy brass.
- .4 Class 4000 mechanical joint cast iron soil pipe and mechanical joint couplings shall be of one manufacturer.
- .5 Use acceptable reduced outside diameter DWV piping in confined locations inside the building; wall spaces, duct spaces, ceiling spaces, etc. where there is not sufficient room for cast iron pipe.
- .6 Plastic (PVC or 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.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section includes the installation of acid waste and vent piping.
- .2 Existing acid waste piping as indicated on the drawings.

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 ACID WASTE AND VENT PIPE AND FITTINGS

- .1 Polypropylene Acid Waste System
 - .1 Drainage systems for acid waste and venting system shall be manufactured from flame-retardant polypropylene pipe and fittings conformance to ASTM F1412.
 - .2 Pipe and fittings shall be joined using no-hub/plain end coupling.
 - .3 Fittings shall meet or exceed Schedule 40 dimensions. Couplings shall have 300 series stainless steel outer band and bolts, nuts and washers plated to meet a 100-hour salt spray test per ASTM B117.
 - .4 The polypropylene material shall conform to ASTM D4101.
 - .5 Pipe shall be marked for identification as a chemical waste system.
 - .6 Mechanical connections for special equipment connection or transition to existing acid waste system shall be as specified by the polypropylene system manufacturer.
 - .7 Flame & Smoke Conformance Rating: All fittings and pipe shall be tested and listed for flame spread of less than 25 and smoke development of less than 50.

Part 3 Execution

3.1 INSTALLATION

- .1 Acid waste piping shall adapt to the existing pipe material with acceptable fittings.
- .2 Installation of acid waste piping system shall be in strict accordance with the manufacturer's instructions and to their accepted tolerance and using the required specialized cutting equipment.

3.2 TESTING

- .1 Hydraulically pressure test all new drainage systems to 3000 mm [10 feet] for 8 hours to verify grades and freedom from obstructions.

- .2 New systems shall be tested disconnected from existing.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section includes materials and installation for piping, fittings, equipment used in compressed air 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 all compressed air equipment and accessories.
 - .2 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 COMPRESSED AIR PIPE

- .1 General:
 - .1 860 kPa [125 psi] rating.
 - .2 Conformity with ANSI B31 standards for steel, cast iron, brass.
 - .3 Do not use thread protection couplings, close nipples, running ripples, or street elbows.
- .2 Galvanized Steel:
 - .1 Schedule 40 to ASTM A53/A53M and CSA B63.
- .3 Copper tubing:
 - .1 Type L, hard drawn seamless type to CSA HC.7.6. Minimum 6 mm I.D complete with flared fittings.

2.2 FITTINGS

- .1 Steel pipe:
 - .1 Screwed of galvanized steel.
 - .1 20 mm to 45 mm [3/4" to 1-3/4"] to ASME B16.11.
 - .2 Plugs 2,070 kPa [300 psi] solid steel or forged to ASTM-105-77 Grade II.

- .2 Copper pipe:
 - .1 Wrought copper fittings to ANSI B16.22 and 95/5 Sn/Sb solder under 25 mm [1"], Sil-fos 25 mm [1"] and over.
 - .2 Reducing fittings.
 - .3 Silver solder fittings for silver solder.
- .3 Unions:
 - .1 Steel pipe: Malleable iron, ground joint and brass to iron seat, 1,035 kPa [150 psi].
 - .2 Copper pipe: Dielectric couplings.

2.3 VALVES

- .1 Ball Valves:
 - .1 Three piece design or top entry for ease of in-line maintenance.
 - .2 To ASTM A181/A181M, Class 70, carbon steel body socket welded or screwed ends, carbon steel ball and associated trim suitable for compressed air application.
 - .3 To withstand 1034 kPa maximum pressure.

2.4 COUPLERS/CONNECTORS

- .1 Industrial interchange series, full-bore.
- .2 Maximum inlet pressure: 1700 kPa.
- .3 Valve seat: moulded nylon.
- .4 Body: zinc plated 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 COMPRESSED AIR PIPING CONNECTIONS AND INSTALLATION

- .1 All piping shall be sized to suit the system requirements.
- .2 Conceal piping wherever possible, run parallel to building lines wherever exposed.
- .3 Ream all pipe ends.
- .4 Install tubing using standard connectors and adaptor fittings.

- .5 For copper tubing all joints in main air lines and connections to branch lines shall be soldered. Connections to instruments shall be made with standard connectors and adaptor fittings.
- .6 Particular care shall be exercised in applying the flux on copper pipe installations to avoid leaving any excess inside the completed joints.
- .7 Make screwed joints with full cut standard tapes pipe threads. Provide pipe dope or teflon tape to male threads.
- .8 Support copper independent of piping, ductwork and equipment.
- .9 Grading
 - .1 All air lines must be generally sloped towards the compressor.
 - .2 Grade piping at 1% slope minimum.
- .10 Terminate protective conduit, pipe and tray in a standard junction/distribution box from which tubing shall leave through standard bulkhead fittings and conduit connectors.
- .11 Make all tray systems and junction/distribution boxes accessible.
- .12 Make branch connections from top of main.
- .13 Install shut-off valves at outlets, major branch lines.
- .14 Install unions to permit removal or replacement of equipment.
- .15 Install tees in lieu of elbows at changes in direction of piping. Install plug in open ends of tees.
- .16 Install compressed air trap and pressure equalizing pipe at moisture collecting points. Drain pipe to nearest floor drain.

3.3 TESTS AND INSPECTION

- .1 After pipe installation but before outlet valve installation blow the line clear with dry air or nitrogen.
- .2 Provide a pressure-tight workable system. The piping system shall be tested by placing it under 1380 kPa [200 psi] for 8 hours.
- .3 The pressure drop during this test shall not exceed 70 kPa [10 psi].
- .4 Soap shall be used on all joints being tested pneumatically.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section includes the installation of domestic water heaters and tanks.

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 Enamelled steel jacket.
- .4 Fully automatic controls, manually adjustable thermostat, 120 volt control circuit with fused transformer.
- .5 3 year extended warranty certificate.

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 Provide seismically rated, wall hung support structure.
- .5 Install a drain valve in the tank drain connection and pipe to drain.
- .6 Pipe relief valve at full size to drain.
- .7 Provide vacuum relief valve on cold water supply.
- .8 Provide isolating valves at tank connections.
- .9 Provide a drain pan piped to drain for installations other than slab on grade.
- .10 Fit thermometer, pressure gauge and temperature sensor in tapping connections provided.

END OF SECTION

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) [membrane]:
 - .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 FD1 (surface membrane floors):
 - .1 Cast iron floor drain with surface clamping ring and grate and 175 mm [7"] diameter nickel bronze strainer. Cast iron non-plated parts to be epoxy coated.

2.2 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 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.

2.3 WALL HYDRANTS AND HOSE BIBBS

- .1 Hose Bibb (HB-1) - 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.

2.4 WATER HAMMER ARRESTORS

- .1 Piston style with stainless steel casing or bellows style with welded stainless steel nesting bellows, ANSI approved and PDI certified.

2.5 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.

2.6 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 atmospheric applications provide a unit size to match the pipe size it serves.
- .4 Pressure Applications: Vacuum breakers shall meet the requirements of the latest edition of CAN/CSA B64.
- .5 Atmospheric Applications: Vacuum breakers shall meet the requirements of the latest edition of CAN/CSA B64.

2.7 VACUUM RELIEF VALVES

- .1 20 mm [3/4"] and smaller: Domestic hot water tank relief.

2.8 TEMPERATURE AND PRESSURE RELIEF VALVES

- .1 Minimum requirements:
 - .1 All water exposed parts shall be stainless steel or copper.
 - .2 ASME rated.

2.9 TRAP SEAL PRIMING DEVICES

- .1 Provide flow actuated devices piped to the closest plumbing fixture.

2.10 STRAINERS

- .1 50 mm [2"] and smaller:
 - .1 Threaded ends, bronze body, 'Y' pattern, 304 stainless steel screen, 1034 kPa [150 psi] rating.
 - .2 Standard of Acceptance: Wilkins YB.
 - .3 Acceptable Products: Armstrong, Crane, Kitz, Muessco, Sarco (Canada), Toyo.

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 Union and flanges shall be 1035 kPa [150 psi] rated.
- .3 Provide on connections to all fixtures and appliances.

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 Changes of direction of more than 45 degrees in drainage piping.
 - .2 Nominally horizontal branch or building drain at intervals of not more than 15 m [50 ft] for 100 mm [4"] and smaller.

- .3 Fixture drain of a sink at intervals not exceeding 7.5 m [25 ft] for pipe all sizes.
- .4 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 unless exposed in an accessible crawlspace.
- .5 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.

3.5 HOSE BIBBS

- .1 Provide an accessible isolation valve upstream of hose bibbs.

3.6 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.

3.7 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.

3.8 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 Pressure vacuum breakers shall be installed with a drain pan and enclosure piped to drain.
- .5 Test all vacuum breakers and submit a signed declaration to that effect prior to substantial completion.

3.9 TRAP SEAL PRIMING DEVICES

- .1 Provide trap seal priming for all sanitary floor drains.
- .2 Install devices in areas that are readily accessible. Provide access panels as required.
- .3 Provide isolation valves on all piping serving trap seal primers.

3.10 STRAINERS

- .1 Install with sufficient room to remove basket.

3.11 TESTING AND ADJUSTING

- .1 General:
 - .1 Tests on the sanitary waste and storm 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.
- .3 Vacuum Breakers, Backflow Preventers, Backwater Valves:
 - .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 operation of vacuum breakers.
- .8 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

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 Polypropylene fixtures shall be high density and black.
- .3 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 Handicapped fixtures and fittings shall comply with the British Columbia 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 Provide an individual stop or valve on each domestic water service serving a plumbing fixture.

2.2 SINKS

- .1 S1 - Single Compartment Acid Resistant Laboratory Use
 - .1 Black HDPE drop-in single bowl, size: 450mm x 400mm x 250mm deep [18" x 16" x 10" deep].
 - .2 Faucet: 225mm [9"] gooseneck with V.B. to give approximate 200 mm [8"] clear to counter, 6.4 mm [1/4"] hose end outlet. All C.R. finish. Deck mount.
 - .3 Lab sink waste assembly.
 - .4 40 mm [1-1/2"] acid waste P-trap.
 - .5 12 mm [1/2"] hot and cold with stops.
- .2 S2 - Double Compartment, Ledge-Back, 300 mm [12"] Deep
 - .1 Double compartment, stainless steel sink complete with basket strainer, tail piece, clamps. Confirm punchings. Compartment size: 597 x 445 x 305 mm [17.5" x 12.5" x 12"], overall size: 1276 x 560 mm [50" x 22].
 - .2 Faucet: 225mm [9"] gooseneck to give approximate 200 mm [8"] clear to counter, lever handles.
 - .3 40 mm [1-1/2"] cast brass P-trap.
 - .4 12 mm [1/2"] hot and cold supplies with stops.

2.3 EMERGENCY EQUIPMENT

- .1 Emergency devices: to ANSI Z358.1.
- .2 EW1 - Emergency Eye Wash – Counter Mounted
 - .1 Countertop mounted eye wash, head with inverted directional laminar flow with zero vertical velocity supplied by an integral flow control, polished chrome-plated brass single action swing-out valve body. Eyewash shall include yellow plastic pop-off dust cover for eyewash head, universal sign, 12mm [1/2"] supply.
 - .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 EW2 - 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.
- .4 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 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.
- .5 Mixing Valve:
- .1 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 for the mixing valve.
 - .2 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 for the mixing valve.

2.4 FUME HOODS

- .1 Coordinate locations of service connections, top or bottom of hood, with the drawings.
- .2 Provide the following connections:
 - .1 12mm [1/2"] Cold Water – two pipe connections per hood.
 - .2 40mm [1-1/2"] Acid Waste - two connections per hood.
 - .3 50mm [2"] Acid Waste P-trap – one per hood.
 - .4 12mm [1/2"] Natural Gas – one pipe connections per hood.

- .5 12mm [1/2"] Compressed Air – one pipe connections per hood.

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 Double waste fittings for 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 Gooseneck spouts shall have a clearance of 200 mm [8"] from nozzle tip to countertop, unless otherwise specified.
 - .5 Plastic control handles and spouts are unacceptable.

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 HANDICAP FIXTURES

- .1 Confirm mounting heights with the Departmental Representative.

3.4 EXISTING FIXTURES

- .1 Existing fixtures and trim to be removed shall be disposed of off the site.

3.5 CLEAN-UP

- .1 All fixtures and trim shall be left in a clean and polished condition.

3.6 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

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 Work means material and labour.
- .3 Departmental Representative means PSPC or DFO.
- .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. Natural Gas and Propane Installation Code.
 - .3 Canadian Standards Association
 - .1 CSA Standard B52 Mechanical Refrigeration Code.
 - .4 National Fire Codes
 - .1 NFPA 10 Portable Fire Extinguishers.
 - .2 NFPA 13 Sprinkler System Installation.
 - .5 National Research Council of Canada
 - .1 NRCC National Building Code of Canada - 2015.
 - .2 NRCC National Fire Code of Canada - 2015.
 - .6 Province of British Columbia
 - .1 BC Industrial Health & Safety Regulations, WorkSafeBC.
 - .7 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.

1.7 PERMITS AND FEES

- .1 Obtain all required permits and pay all 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.

1.8 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.

1.9 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.

1.10 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.

1.11 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.

1.12 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.
 - .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 SI 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 Motor efficiencies on motors 1 HP and larger.
- .6 List of the manufacturers and figure numbers for all valves, traps and strainers.
- .7 Detailed drawings of bases, supports and anchor bolts.
- .8 Control explanation and internal wiring diagrams for packaged equipment.
- .9 Control system drawings.
- .10 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 Larger drawings may be submitted on reproducible sepia with space for stamps and signatures - master set plus one working copy.
 - .3 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.
 - .4 A brochure for plumbing fixtures between covers with the contents named with model numbers listed on the front cover with item identification numbers
- .4 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.
- .5 Keep one (1) copy of shop drawings and product data, on site, available for reference
- .6 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 Operating 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 Departmental Representative 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 Departmental Representative:
 - .1 Three (3) hard copies - organized in binders, refer to below.

- .2 Two (2) PDF electronic copies (minimum of 600 DPI scanning quality) 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 Departmental Representative by the time of Substantial Performance, submit at Substantial Performance a draft copy to the Departmental Representative with clear indication that it is a draft copy, not a final copy, for interim use by the Departmental Representative. When the final copies are submitted to the Departmental Representative, retrieve the draft copy and modify it to match the other final copies.
- .7 The binders shall be 3-ring binder. The maximum overall thickness of the filled binder shall be 100 mm [4"]. Provide multiple binders for each manual as required.
- .8 Each binder shall have large clear lettering in a clear label insert on the front cover indicating the name of the project and "OPERATING AND MAINTENANCE MANUAL - MECHANICAL".
- .9 Provide an index and tab each section.
- .10 The manual shall include:
 - .1 Air and water balance report.
 - .2 Commissioning report.
 - .3 Copy of any required approvals, certifications and acceptance by Authorities Having Jurisdiction.
 - .4 All shop drawings.
 - .5 List of local source of supply.
 - .6 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 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 prepared by a qualified draftsman to the same standards as the original drawings.

1.13 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; they are used as follows to be equivalent to the NPS sizes (Nominal Pipe Size).
- .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.
- .6 Sheet metal thickness is shown in gauges (ga) only as it is not generally referred to in its metric or imperial thickness.

Part 2 Products

2.1 MAINTENANCE

- .1 Obtain signed receipt from the Departmental Representative 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 Departmental Representative as a spare.

2.2 PRODUCT QUALIFICATION

- .1 Multiple items of equipment material of the same type shall be of the same manufacturer.
- .2 Install and test all equipment and material in accordance with the detailed instructions and recommendations of the manufacturer.
- .3 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 If any existing asbestos containing material not identified in the Contract Documents is discovered and it will be disturbed or affected by the work of the Contract or if it poses a health concern, do no further work involving risk due to the asbestos until the Departmental Representative has been notified and until all notifications, arrangements and approvals with the Authorities Having Jurisdiction are in place.
- .3 All work related to existing asbestos shall be handled and/or removed in accordance with the requirements of Ministry of Environment, WorkSafeBC and any other Authorities Having Jurisdiction.
- .4 All work performed on systems with asbestos containing material must be reported in advance to WorkSafeBC.
- .5 If instructions concerning asbestos are specified elsewhere in the Contract Documents then the most stringent specified requirements shall be followed.

2.4 ACCESS DOORS

- .1 Provide in accordance with Section 08 31 00 - Access Doors and Panels.

2.5 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.

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 Departmental Representative without 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 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 existing service runs and structural components within existing concrete floors and walls prior to core drilling and/or cutting. The Contractor is responsible to repair existing 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.

3.7 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.

3.8 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.

3.9 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.

3.10 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 Automatic control dampers.

3.11 EXISTING SERVICES

- .1 Protect existing services from the work of this contract. Where the location of existing services was known they have been shown. However, the removal of concealing surfaces may reveal different locations or other existing services. Work with the Departmental Representative's staff to trace to the originating source and to all points served. Obtain instructions from the Departmental Representative when existing services must be relocated or modified, except where shown in the Contract Documents.
- .2 Arrange work to avoid shutdowns of existing services. Where shutdowns are unavoidable, obtain the Departmental Representative's approval of the schedule of shutdowns and arrange work to minimize any interruptions.
- .3 Shutdowns will be carried out by the Departmental Representative's maintenance staff.
- .4 To maintain existing services in operation, temporary relocations and/or bypasses of piping may be required.
- .5 The Contractor is responsible for any damages to existing services by this work.

3.12 DEMOLITION

- .1 All piping, ducting and equipment which becomes redundant and is no longer required due to the work shall become the property of the Contractor and shall be completely removed from the site.
- .2 Demolition of existing air conditioning units shall include proper disposal of existing refrigerant. Contractor shall provide a halocarbon receipt from a registered collection facility.

3.13 SALVAGE

- .1 The items listed here shall be carefully removed to avoid damaging them and shall remain the property of the Departmental Representative. Move the items to a location as directed by the Departmental Representative. Obtain a written receipt from the Departmental Representative for each item.
 - .1 Cooler evaporator and condenser.
- .2 All piping, ducting and equipment that is not salvaged, becomes redundant and is no longer required due to the work shall become the property of the Contractor and shall be completely removed from the site.

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. 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.

3.15 DEMONSTRATION AND INSTRUCTION TO OWNER

- .1 Provide certified personnel to demonstrate plant operation and to instruct operating staff on operation of mechanical equipment. 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.
- .2 The demonstration shall include:
 - .1 Operation and sequencing of all automatic control dampers and automatic temperature control devices.
 - .2 Operability of randomly selected fire dampers.
 - .3 Operation and maintenance requirements of all equipment and systems under each mode of operation including:
 - .1 Automatic controls.
 - .2 Fans.
 - .3 Fire protection systems.
 - .4 Heat recovery systems.
- .3 Provide instruction during regular work hours prior to acceptance and turnover to operating staff for regular operation.
- .4 Use Operating and Maintenance manuals for instruction purposes.

- .5 Submit the proposed instructional agenda for approval.
- .6 Finalize demonstration and instructions by obtaining a signed statement from the Departmental Representative that the demonstration and instructions have been given satisfactorily.

END OF SECTION

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.
- .5 Standard of Acceptance: Capital, Walter Vallet, EPCO.

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.
- .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 Use ball valves at branch take-offs for isolating purposes except where otherwise specified.

3.6 PIPE SLEEVES

- .1 Provide pipe sleeves for all piping passing through rated walls and floors. Sleeves to be concentric with pipe.
- .2 Pipes and ducts passing through non-rated fire rated separations do not require a sleeve, but the insulation at the separation shall be wrapped with 24 ga. galvanized sheet steel band to which to apply the flexible caulking compound.
- .3 Pipe sleeves for floors and interior walls shall be minimum 24 ga. galvanized sheet steel with lock seam joints.
- .4 Pipe sleeves for perimeter walls and foundation walls shall be cast iron sleeve or Schedule 40 steel pipe with annular fin continuously welded at midpoint. Annular fin shall be embedded into centre of wall.
- .5 Except as otherwise noted pipe sleeves are not required for holes formed or cored in interior concrete walls or floors.
- .6 Pipe sleeves shall extend 50 mm [2"] above floors in unfinished areas and wet areas and 6 mm [1/4"] above floors in finished areas.
- .7 Pipe sleeves shall extend 25 mm [1"] on each side of walls in unfinished areas and 6 mm [1/4"] in finished areas.
- .8 Pipe sleeves shall extend 25 mm [1"] beyond exterior face of building. Caulk with flexible caulking compound.
- .9 Sleeve Size: 12 mm [1/2"] clearance all around, between sleeve and pipe or between sleeve and pipe insulation.
- .10 Paint exterior surfaces of ferrous sleeves with heavy application of rust inhibiting primer.
- .11 Packing of Sleeves:
 - .1 Where sleeves pass through rated fire separations install fire-stopping and smoke seal materials and components in accordance with ULC certification and manufacturer's instructions and recommendation.
 - .2 Where sleeves pass through foundation walls and perimeter walls the space between sleeve and pipe or between sleeve and pipe insulation shall be caulked with waterproof, fire retardant, non-hardening mastic.
 - .3 Pack future-use sleeves with mineral wool insulation and then seal with ULC approved fire stop sealant for rated fire separations.

3.7 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.

3.8 HEAT TRACING FOR PIPING

- .1 Provide complete, CSA approved system of heat tracing on piping exposed to outdoors where indicated.
- .2 The entire design and installation of the system shall comply with the Canadian Electrical Code and the requirements of the local inspection authority.
- .3 Comply with all manufacturer's instructions/recommendations regarding the installations. Provide all necessary materials to provide a complete system.
- .4 System shall be thermostatically controlled with a thermostat with a non-adjustable set point of 5°C [40°F] complete with a 900 mm [36"] capillary.
- .5 Prior to installing heating cables, ensure the pipe systems are complete and have passed all necessary tests.
- .6 Cables to be secured to pipes using tape at 300 mm [12"] intervals on pipe.
- .7 After pipes are traced test all lengths prior to installation of pipe insulation.
- .8 Provide suitable identification for those pipe systems provided with heat tracing. At 6 m [20 ft] intervals provide an adhesive backed nameplate "Caution - Heat Tracing".

END OF SECTION

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.

- .2 Design for Seismic Events
 - .1 Design supports platforms, catwalks, and hangers, to withstand seismic events of the magnitude prescribed for the area in the Building Code.

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 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.
- .3 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.
- .4 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.

2.3 WALL SUPPORTS

- .1 Welded angle for iron brackets for equipment.

2.4 INSULATION PROTECTION SHIELDS

- .1 Insulated cold piping: Insulation with uninterrupted vapour barrier plus insulation protection shield to: MSS-SP69, galvanized sheet carbon steel. Grinnell Fig. 167. 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.

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 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

3.3 HANGER SPACING

- .1 Plumbing piping: most stringent requirements of Building Code or Authority Having Jurisdiction.
- .2 Fire protection: to applicable Fire Code (no toggle hangers).
- .3 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 Within 300 mm [12"] of each horizontal elbow.
- .6 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"].
- .7 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.

END OF SECTION

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 or they 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 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.
 - .6 Shop drawings shall include the Seismic Engineer's requirements for any additional members required for attachment to the structure.
 - .7 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 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 Concrete inertia bases shall be provided where recommended by the equipment manufacturer or where specifically indicated in this specification. Refer to the structural specifications for the concrete work.
- .11 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 Schedules B and 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 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 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.

2.6 SEISMIC RESTRAINTS

- .1 Slack cable restraints may be as detailed in the SMACNA Guidelines.
- .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 Ensure 50 mm [2"] clearance all around vibration isolated equipment.
- .3 Ensure flexible service connections are not stressed and operate freely when vibration isolated equipment is operated.
- .4 Fill any space between anchor bolt and the attachment bolt hole with fast epoxy putty to prevent movement.
- .5 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.
- .6 Where threaded nuts secure vibration isolators or seismic restraints use double nuts, locking nuts or Loctite.
- .7 Ensure vibration from piping and ductwork does not transfer to floors, structure or walls. Provide resilient protection as required.
- .8 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 Restraint of fire protection piping where included in NFPA-13 is not included in this Section of the specification.
- .3 Restraint of natural gas piping shall be in accordance with this section or National Standard of Canada CAN/CGA-B149.1 whichever is more restrictive.
- .4 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 outside of Mechanical Rooms smaller than 65 mm [2-1/2"] and smaller.
 - .3 Piping and ducts with hangers less than 300 mm [12"].
 - .4 Rectangular duct less than 0.55 square metres [6 sq. ft] in cross-section.
 - .5 Round duct less than 700 mm [28"] in diameter.
 - .6 For above exemptions refer for specifics to the SMACNA Guidelines.
- .5 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.
- .6 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.
- .7 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 suspended equipment with Type 4B isolators and slack cable restraint. Actual static deflection shall be 25 mm [1"] minimum unless otherwise specifically indicated.

- .3 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.
- .4 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.
- .5 with the instructions and recommendations of the isolation manufacturer.

END OF SECTION

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 EXISTING IDENTIFICATION SYSTEMS

- .1 Apply existing identification system to new work.
- .2 Where existing identification system does not cover for new work, use identification system specified this section.
- .3 Before starting work, obtain written approval of identification system from Departmental Representative.

2.4 PIPING SYSTEMS GOVERNED BY CODES

- .1 Natural gas: to CSA/CGA B149.1 and Authority Having Jurisdiction.
- .2 Sprinklers: to NFPA 13.

2.5 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 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 Adhesive labels:
 - .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
Acid Waste	ACID	Yellow	Black
Cold Water Service	CW	Green	--
Compressed Air	COMP.A.	Green	--
Distilled Water	Dist.W.blue	--	--
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
Natural Gas	Gas	Yellow	Orange

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.

Part 3 Execution

3.1 TIMING

- .1 Provide identification only after painting has been completed.

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3.2 LOCATION OF IDENTIFICATION ON PIPING 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 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.
- .6 Label the outlet end of the drain from the automatic air vents with a lamicoïd label. AAV, LOCATION.

3.3 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.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 TAB is used throughout this Section to describe the process, methods and requirements of testing, adjusting and balancing for HVAC.
- .2 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.

1.2 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 Submit names of personnel to perform TAB to the Departmental Representative within 90 days after award of the Contract.
- .2 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 TESTS

- .1 Scope of Tests:
 - .1 The pressure testing of piping systems shall be the responsibility of the installing trade. The tests are specified under the appropriate specification section.
 - .2 The pressure/leakage testing of air handling systems shall be the responsibility of the installing trade. The tests are specified under the appropriate specification section.
 - .3 The performance testing of equipment shall be the responsibility of the supplying trade. For certain larger, or complex or specialized equipment the start-up and/or

testing shall be performed by a manufacturer's qualified representative. The tests are specified under the appropriate specification section.

- .4 The testing of fire dampers shall be the responsibility of the Balancing Agency responsible for balancing. The tests are specified in this section of the specification.
- .2 General Requirements:
 - .1 Give written minimum 48 hour notice of date for tests to Departmental Representative and to any Authorities Having Jurisdiction.
 - .2 Do not externally insulate or conceal work until tested and reviewed.
 - .3 Make good and retest as required until test is successful.
 - .4 Prior to tests, isolate all equipment or other parts which are not designed to withstand test pressures.
 - .5 Tests shall be to applicable Codes, to the requirements of Authorities Having Jurisdiction and in accordance with recognized industry standards.
 - .6 Obtain and provide certificates of approval where applicable from Authorities Having Jurisdiction.

1.7 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 and final air quantities obtained.
- .5 Pre-load filters using blanket material to midway between clean and dirty static pressure drop at system balance.

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 ASHRAE Standard 1 "Guideline for Commissioning of HVAC Systems".

- .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 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 Set up air diffusers, registers and grilles for optimum distribution/comfort.
 - .3 Set up constant volume fans.
 - .4 Adjust mixing boxes and air valves as necessary.
 - .5 Plug all air pressure and flow measuring holes.
 - .6 Adjust vibration isolators and earthquake restraints for optimum performance.
 - .7 Verification and certification of the sealing of all HVAC penetrations through fire separations (rated & non-rated) and sound separations.
 - .8 Verification of water tightness of all roof and exterior wall penetrations.
 - .9 Verification that all coil drain pans operate.
 - .10 Set up all automatic control valves/dampers and automatic temperature control devices.
 - .11 Testing and debugging of BAS (Building Automation System).
 - .12 Set up and test all alarm and protective devices.
- .6 At the conclusion of commissioning, demonstrate the operation of the systems to the Departmental Representative's Operating Staff. For demonstration and instruction to Operating staff requirements, refer to this section of the specification and also to Division 25 (Controls Systems).
- .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 Proper response of all mixing boxes and air valves to thermostats and volume adjustment controls.
 - .6 Operability of randomly selected fire dampers.
 - .7 Noise level from typical mixing boxes and air valves under extreme operating conditions.

- .8 Operation of all equipment and systems under each mode of operating, and failure, including:
 - .1 BAS (Building Automation System) control features.
 - .2 Refrigeration systems.
 - .3 All heat recovery systems.
 - .4 Fans.
 - .5 Tanks - domestic hot water.
- .8 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 Gas Inspection Department approval.
 - .5 A list of all alarm and protective devices tested, with the final operating settings.

Part 2 Products

- .1 NOT APPLICABLE

Part 3 Execution

- .1 NOT APPLICABLE

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 TAB is used throughout this Section to describe the process, methods and requirements of testing, adjusting and balancing for fume hood exhaust systems.
- .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 REFERENCES

- .1 American National Standards Institute (ANSI)
 - .1 ANSI/ASHRAE 110, Method of Testing Performance of Laboratory Fume Hoods.

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 QUALIFICATIONS OF TAB PERSONNEL

- .1 Submit names of personnel to perform TAB to the Engineer within 90 days after award of the Contract.
- .2 Provide documentation confirming qualifications, successful experience.

1.5 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.

1.6 FUME HOOD BALANCING

- .1 Certifying and balancing of all exhaust fume hood systems shall be carried out as follows:
 - .1 Set fume hood sash in maximum allowable open operating position. 400 mm [16"] shall be used if no other information is available. The sash opening is as measured from the work surface to the bottom of the sash frame.
 - .2 Check room condition in front of the fume hood using an anemometer and a smoke source to verify that the velocity of cross drafts does not exceed 20% of

the specified average fume hood face velocity. Any cross drafts that exceed these values shall be eliminated before proceeding with the fume hood test.

- .3 Determine specified average face velocity 0.508 m/s [100 ft/min] (unless otherwise noted) by averaging the velocity of ten readings taken at the fume hood face. Readings shall be taken at the centres of a grid five sections wide and two sections high of equal size across the open face of the fume hood. Adjust dampers and exhaust fan speed as required to achieve specified average face velocities within -0% and +10% and -0% and +10% within each grid.
- .4 Smoke tests shall be conducted at hood face openings. These tests are to be used as an evaluation of spillage or backdraft conditions at all levels and positions across the face opening.
- .5 Upon completion of these tests, a report analysis shall be prepared which will list the following final conditions:
 - .1 Exhaust fan operating characteristics including speed, static pressures, motor amperages and total exhaust flow.
 - .2 Position of hood sash.
 - .3 Face velocity readings taken at hood opening.
 - .4 Results of smoke test spillage tests.
 - .5 Confirmation of exhaust from all storage cabinets.
 - .6 Operating condition of supply air system serving the room in which the fume hood is located.

Part 2 Products

- .1 NOT APPLICABLE

Part 3 Execution

- .1 NOT APPLICABLE

END OF SECTION

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.

Part 2 Products

2.1 FIRE AND SMOKE RATING

- .1 In accordance with BC 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 specified includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C [75°F] mean temperature when tested in accordance with ASTM C335.
- .3 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 Acceptable Products: Johns Manville Micro Lok Ap-T Plus, Manson Alley K, Owens Corning SSL-11, Partek Paroc 1200 ASJ/SSL.

- .4 Refrigerant Piping:
 - .1 Flexible Foamed Elastomeric Insulation:
 - .1 Maximum thermal conductivity per 25 mm [1"]: 0.039 W/m-°C at 24°C [0.27 Btu-in/(hr-ft²-°F) at 75°F].
 - .2 Acceptable Products: AP Armaflex, Rubatex R-180-FS.
 - .2 Flexible Closed Cell Insulation:
 - .1 Maximum thermal conductivity per 25 mm [1"]: 0.036 W/m-°C at 24°C [0.25 Btu-in/(hr-ft²-°F) at 75°F].
 - .2 Acceptable Products: Tubolit Armacell, Therma-Cel.

2.3 REINFORCING MEMBRANE

- .1 Glass reinforcing membrane as commercially available.

2.4 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.

2.5 VAPOUR RETARDER FINISH

- .1 Vinyl emulsion type acrylic, compatible with insulation.

2.6 JACKETS

- .1 All Service Jacket:
 - .1 Securement: Staples (flare type), compatible jacket finishing tape, contact adhesives recommended by the jacket manufacturer.
- .2 Polyvinyl Chloride (PVC):
 - .1 One-piece moulded type and sheet to CAN/CGSB-51.53 with pre-formed shapes as required.
 - .2 Minimum service temperatures: -20°C.
 - .3 Maximum service temperature: 65°C.
 - .4 Moisture vapour transmission: 0.02 perm.
 - .5 Thickness: 0.38 mm [0.015"].
 - .6 Fastenings: Use solvent weld adhesive compatible with insulation to seal laps and joints, tacks and staples, plastic pop rivets., pressure sensitive vinyl tape of matching colour.
- .3 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.
- .4 Aluminum:
 - .1 To ASTM B209.
 - .2 Thickness: 22 ga.
 - .3 Finish: Corrugated or smooth.
 - .4 Joining: longitudinal and circumferential slip joints with 50 mm [2"] laps.

- .5 Fittings: die-shaped fitting covers with factory-attached protective liner.
- .6 Securement: Sheet metal screws, pop rivets, bands.

2.7 PIPING INSULATION SCHEDULES

2.8 PIPING INSULATION SCHEDULES

- .1 Thickness of insulation as listed in following table (to NECB).

Service	Temperature	Pipe Size in mm [inch]			
		Up to 25 [1]	30 to 50 [1.25 to 2]	65 to 100 [2.5 to 4]	Over 100 [Over 4]
Domestic Cold Water	5°C	25	25	25	25
Domestic Hot Water Supply and Recirculation	41-60°C	25	25	40	40
Domestic Hot Water Supply and Recirculation	61 to 93°C	25	25	40	40
Drip Pan Drains - Unit Coolers	1°C and above	None	None	None	None
Hot Water Heating	61 to 93°C	25	25	40	40
Rainwater Storm Drainage (above grade, interior)	5°C	25	25	25	25
Rainwater Storm Drainage (buried & exterior)	5°C	None	none	none	none
Refrigerant Suction and Hot Gas	Above 4°C	25	25	25	25

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 Condensate piping.
 - .4 Hot gas piping.
 - .5 Heat traced piping.
 - .2 Do not insulate the following, unless otherwise noted:
 - .1 Piping inside heating fixture cabinets.
 - .2 Relief piping.
 - .3 Drain lines.
 - .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 Refrigerant suction and hot gas piping.
 - .2 Domestic cold water system including:
 - .3 Rainwater piping above grade and roof drain bodies.
 - .4 All piping containing water or for draining water in unheated spaces.
 - .5 Heat traced piping.
 - .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 WORK ON EXISTING PIPING

- .1 Make good insulation on existing piping where affected by the work of this contract.

3.2 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.

3.3 INSTALLATION

- .1 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.
- .2 Install in accordance with TIAC National Standards.
- .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

3.4 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.

3.5 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.

3.6 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.

3.7 REFRIGERATION SUCTION AND HOT GAS PIPING

- .1 Install flexible foamed elastomeric or flexible closed cell preformed piping insulation.

- .2 Secure longitudinal and butt joints with adhesive.
- .3 Insulate all fittings and components.
- .4 To obtain the specified thickness, apply in layers with staggered joints.
- .5 Finish with flexible elastomeric or flexible closed cell insulation coating

3.8 HEAT TRACED PIPING

- .1 All piping which is heat traced shall be insulated and the heat tracing shall be inside the insulation.

3.9 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 Finish fabric with one (1) coat of fabric coating.
- .3 "Exposed" outdoor insulation shall be finished as follows:
 - .1 Insulation shall have a vapour sealed vapour barrier jacket.
 - .2 Over the pipe insulation jacket apply aluminum or PVC weather protecting jacket. The longitudinal seam shall be located to shed water. Secure the jacket using necessary fastenings on approximately 150 mm [6"] centres.
 - .3 Locate seams on underside and seal all outdoor jacketing watertight.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section includes materials, requirements and installation for piping, valves and fittings for 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 natural gas equipment.
- .2 Closeout Submittals:
 - .1 Provide maintenance data for incorporation into Operational and Maintenance manual.

1.4 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 gas installation before the work commences.
- .2 Approvals must be received prior to commencing work.

Part 2 Products

2.1 PIPE

- .1 Schedule 40 seamless Carbon Steel to ASTM A53/A53M and CSA B63.
- .2 Copper tube to ASTM B837.

2.2 FITTINGS

- .1 Steel pipe fittings, screwed, flanged or welded:
 - .1 Malleable iron: screwed, banded, Class 150.
 - .2 Steel pipe flanges and flanged fittings: to ASME B16.5.
 - .3 Welding: butt-welding fittings.
 - .4 Unions: malleable iron, brass to iron, ground seat, to ASTM A47/A47M.
 - .5 Bolts and nuts: to ASME B18.2.1.
 - .6 Nipples: schedule 40, to ASTM A53/A53M.
- .2 Copper pipe fittings, screwed, flanged or soldered:
 - .1 Cast copper fittings: to ASME B16.18.
 - .2 Wrought copper fittings: to ASME B16.22.

2.3 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.

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 05, Installation of Pipework, Building Code, CAN/CSA B149.1 and Authorities Having Jurisdiction.
- .2 Install drip points:
 - .1 At low points in piping system.
 - .2 At connections to equipment.

3.3 PIPE JOINTING

- .1 Interior gas service - screw or weld up to 50 mm [2"], weld 65 mm [2-1/2"] and larger.
- .2 Interior gas 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 thredolets.
- .5 Remake all leaking joints.
- .6 Do not paint dielectric isolating couplings.

3.4 VALVES

- .1 Install gas shut-off valves complete with handle at the following locations:
 - .1 At each branch to an individual item of equipment or appliance.
 - .2 Note that individual shut offs are required to each individual outlet in all fume hoods.

3.5 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.

3.6 PIPING TESTS

- .1 In accordance with the National Standard of Canada "Natural Gas Installation Code" CAN/CGA-B149.1.

END OF SECTION

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 DUCTS - 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.
 - .1 Nomasco Ductmate System or Exanno Nexus System or Lockformer TDC, TDF system may be used for rectangular duct joints.
 - .2 At least two opposite faces of all rectangular ducts must be joined together using a type of joint, which cannot pull apart.
- .4 All ductwork shall be constructed and sealed to withstand without damage or permanent deformation at least 150% of the working static pressure.
- .5 Construct rectangular ducts in accordance with Section I of the SMACNA Duct Standards.
- .6 Construct round ducts in accordance with Section III of the SMACNA Duct Standards but excluding beaded crimp joints and snaplock seams.
- .7 500 Pa [2" w.g.] working static pressure on:
 - .1 All supply ductwork.
 - .2 All return air ductwork.
 - .3 All exhaust and relief air ductwork.

2.2 FITTINGS

- .1 Construct rectangular duct fittings in accordance with Section II of the SMACNA Duct Standards.

- .2 Construct round duct fittings in accordance with Section III of the SMACNA Duct Standards.
- .3 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.
- .4 Square throated - radius heel elbows shall not to be used.
- .5 Adjustable elbows are not permitted.
- .6 Radiused elbows.
 - .1 Rectangular: Centerline 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: Centerline radius of 1.0 times duct diameter.
- .7 Mitered elbows, rectangular: Construct with single wall turning vanes.
- .8 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.
- .9 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°.
- .10 Offsets: Full radiused elbows.

2.3 DUCTWORK - STAINLESS STEEL

- .1 The following ductwork shall be fabricated from stainless steel:
 - .1 Laboratory fume hood exhaust ducts and stacks.
- .2 Rectangular Ductwork:
 - .1 Material: 18 ga. 304 stainless steel, with No. 2B finish where concealed and No. 4 finish where exposed to the room or exposed outdoors. Exposed areas shall include finished occupied areas of the building.
 - .2 Do not cross break duct panels. Grade to drain as indicated.
 - .3 All joints on ductwork and fittings shall be butt seams continuously T.I.G. welded. Lap type joints are not acceptable. All welded joints in exposed locations must be ground and polished. Do not penetrate stainless steel with screws, bolts or rivets.
 - .4 Provide gasketed companion flange connections where necessary to connect to equipment. Flanged connections shall be made up by slipping a formed 14 ga. matching stainless steel welded angle frame over the end of the duct, leaving space for continuously welding the frame to the duct on the inside.
 - .5 Provide escutcheon trim bands around all duct ceiling penetrations.

- .6 Provide gasketed cleanouts, not smaller than 450 x 300 mm [18" x 12"], with formed 14 ga. matching stainless steel welded angle reinforcing frames, in the side of the ducts at not more than 6 m [20 ft.] intervals, changes in direction and base of risers. Cleanouts shall be fastened with wing nuts at 150 mm [6"] centres. Cleanouts openings shall terminate not less than 40 mm [1-1/2"] from the bottom of the duct.
- .7 Gaskets shall be 3 mm [1/8"] thick teflon or an approved alternate.
- .8 Support exposed ductwork with 50 x 1.8 mm [2" x 14 ga.] matching stainless steel (No. 4 finish) U-strap hangers on 2.4 m [8 ft] centres.
- .9 Support concealed ductwork with 50 x 1.8 mm [2" x 14 ga] galvanized steel U-strap hangers on 2.4 m [8 ft] centres.

2.4 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.

2.5 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.

2.6 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 Where a duct is to be internally insulated, size the duct so as to provide the free area duct dimensions shown on the drawings.
- .4 Where ducts penetrate roofs, install sleeves and roof curb c/w flashing and counterflashing. Pack sleeves in roof with fibreglass insulation and provide sheet metal below to hold it in place.
- .5 Flash and counterflash ducts through roofs and exterior walls.
- .6 Arrange openings for ductwork through floors and walls to accommodate insulation, packing, sleeves, and fire dampers as appropriate.
- .7 During construction, protect ductwork openings from the entry of dirt, dust and debris with suitable covers.
- .8 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.

3.2 DUCTWORK INSTALLATION

- .1 Square throated - radius heel elbows shall not to be used.
- .2 Where a duct contains a fire, construct the duct so that the free area of the duct is maintained through the fire or smoke 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

Part 1 General

1.1 SUMMARY

- .1 Section includes materials, requirements and installation for duct accessories including flexible connections, access doors, vanes and collars.

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.

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.

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 Length of connection: 100 mm [4"].
- .2 Minimum distance between metal parts when system in operation: 75 mm [3"].
- .3 Install in accordance with recommendations of SMACNA.
- .4 Install in following locations:
 - .1 Inlets and outlets of exhaust fans.
 - .2 As indicated.
- .5 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 Elsewhere as indicated.

3.4 TURNING VANES

.1 Install in accordance with recommendations of SMACNA and as indicated.

END OF SECTION

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.

1.3 SUBMITTALS

- .1 Closeout Submittals:
 - .1 Provide maintenance data for incorporation into Operational and Maintenance manual.

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

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 assemblies to be fire tested in accordance with CAN4-S112.
- .3 Meet requirements of:
 - .1 Building Code.
 - .2 ANSI/NFPA 90A.
 - .3 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 Mild steel, factory fabricated for fire rating requirement to maintain integrity of firewall and/or fire separation.
 - .4 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical airflow.
 - .5 Install retaining angle, on full perimeter of fire damper, on both sides of fire separation being pierced to meet SMACNA guidelines.

- .6 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 Ensure access doors/panels, fusible links, damper operators are easily observed and accessible.
- .6 Install break-away joints of approved design on each side of fire separation.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section includes materials, requirements and installation of flexible ductwork.

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 ductwork.
- .2 Closeout Submittals:
 - .1 Provide maintenance data for incorporation into Operational and Maintenance manual.

Part 2 Products

2.1 GENERAL

- .1 Factory fabricated to CAN/ULC-S110.

2.2 FIRE AND SMOKE RATING

- .1 In accordance with BC Building Code, NFPA 90A and CAN/ULC-S102.
 - .1 Maximum flame spread rating: 25.
 - .2 Maximum smoke developed rating: 50.

2.3 FLEXIBLE, NON-METALLIC DUCTWORK - UNINSULATED

- .1 Non-corrosive, non-collapsible, spiral wire reinforcing with flexible vinyl coated fiberglass cloth membrane.
- .2 UL or ULC labelled, Class 1, duct connector.
- .3 Suitable for up to 2500 Pa [10" w.g.] positive static pressure and 250 Pa [1" w.g.] negative static pressure.
- .4 Performance:
 - .1 Factory tested to 2.5 kPa without leakage.
 - .2 Maximum relative pressure drop coefficient: 3.0.

Part 3 Execution

3.1 FLEXIBLE DUCTWORK INSTALLATION

- .1 Flexible duct shall be insulated unless indicated otherwise and shall only be used as detailed.
- .2 Flexible duct length may not exceed 1000 mm [40"] and may not bend more than 30° or offset the centreline more than 100 mm [4"] per 1000 mm [40"] length.
- .3 Connect flexible duct to ducts with stainless steel worm drive clamps. Hang at maximum 450 mm [18"] centres with 25 mm [1"] x 22 ga galvanized steel straps, which shall wrap completely around the duct.

END OF SECTION

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 BC 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.
- .2 Fasteners: Weld pins, length to suit thickness of insulation. Polymer, nylon or metal retaining clips.
- .3 Reinforcing Membrane: Glass fibre-reinforcing membrane.

2.4 SCOPE OF INSULATION

	Thickness	
	mm	[ins]
.1 Scope 1: Internal Duct Liner - Flexible.		
.1 All ductwork where indicated by single hatching.	25	[1]
.2 All ductwork where noted on the drawings.	refer to drawings	

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 Engineer.
- .4 Protect leading and trailing edges of duct sections with sheet metal nosing having 15 mm overlap and fastened to duct.

END OF SECTION

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 Engineer. 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 Engineer 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 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.

Part 2 Products

2.1 FANS GENERAL

- .1 Refer to drawings for motor position, rotation and discharge arrangements.
- .2 Motors:
 - .1 Equipment supplemented as specified herein.
 - .2 Premium efficiency motors.
 - .3 Sizes as scheduled.
- .3 Accessories and Hardware:
 - .1 Matched sets of V-belt drives.
 - .2 Adjustable slide rail motor bases.
 - .3 Belt guards.
 - .4 Coupling guards.
 - .5 Fan inlet and/or outlet safety screens.
- .4 Factory primed before assembly in colour standard to manufacturer.
- .5 Scroll casing drain.
- .6 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.

2.2 FUME HOOD EXHAUST

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 belt guards on belt driven fans.
- .6 Provide and install sheaves and belts required for final air balance.
- .7 Mount roof mounted fans on curbs 200 mm [8"] minimum above roof.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section includes materials, requirements and installation for supply, return and exhaust grilles and registers, diffusers 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 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 Frames:
 - .1 Full perimeter gaskets.
 - .2 Plaster frames where set into plaster or gypsum board.
 - .3 Concealed fasteners.
- .2 Concealed manual volume control damper operators where scheduled.

- .3 Coordinate with ceiling type and grid size.
- .4 Means of attachment for two seismic restraint wires unless screwed to sheet metal duct.
- .5 Refer to Air Terminal schedules for terminal details and to drawings for sizes, air quantities and location.

2.3 LAMINAR FLOW DIFFUSER (LFD-1)

- .1 The laminar flow diffusers shall be non-aspirating, unidirectional type, providing a uniform vertical projection of air with controlled low velocities and minimal entrainment of room air.
- .2 All aluminum construction.
- .3 The plenum shall be divided into an upper and lower chamber utilizing an equalization baffle and perforated basket to promote consistent airflow and uniform face velocity.
- .4 Air shall be admitted to the top plenum chamber through an inlet collar and a face adjustable cone style volume control damper.
- .5 The internal equalization baffle and perforated basket shall be fully removable without tools to allow cleaning of the entire diffuser plenum. Diffusers without full access to internal surfaces for cleaning shall not be permitted.
- .6 The perforated equalization baffle shall be secured to the face frame using quarter-turn fasteners with anti-slip, snap-in retainers and stainless steel retainer cables for ease of installation and removal.
- .7 The diffuser plenum shall have continuously welded corners.
- .8 Damper: Aluminum cone style damper. The damper shall be supplied with an access plug in the diffuser face for room-side access to the cone damper without removing the diffuser face.

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

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.
 - .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 of same generic type shall be the product of one manufacturer.

2.2 FIXED LOUVRES - ALUMINUM

- .1 Material: extruded aluminium alloy (6063-T5).
- .2 Blades: 100 mm [4"] deep at 45° and 90 mm [3-1/2"] centres. Uprturned 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, colour to Architect's approval.
- .8 Note the custom shape of the louvre. Submit dimensioned shop drawings.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 LOUVRE INSTALLATION

- .1 Install in accordance with manufacture's and SMACNA's recommendations.
- .2 Reinforce and brace louvres 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

Part 1 General

1.1 SUMMARY

- .1 Section includes materials, requirements and installation for electric duct 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 duct heaters.
 - .2 Include, at minimum, the following:
 - .1 Element support details.
 - .2 Heater: total kW rating, voltage, phase.
 - .3 Heater element watt/density and maximum sheath temperature.
 - .4 Maximum discharge temperature.
 - .5 Physical size.
 - .6 Unit support.
 - .7 Performance limitations.
 - .8 Clearance from combustible materials.
 - .9 Internal components wiring diagrams.
 - .10 Minimum operating airflow.
 - .11 Pressure drop at operating airflow.
- .2 Closeout Submittals:
 - .1 Provide maintenance data for incorporation into Operational and Maintenance manual.

Part 2 Products

2.1 DUCT HEATERS - ELECTRIC

- .1 Coils:
 - .1 Flanged type for connecting to ductwork.
 - .2 CSA approved.
 - .3 Open coil resistance wire elements.
- .2 Control Panels:
 - .1 Factory attached panels.
 - .2 Power and control wiring terminals.
 - .3 Unfused disconnect.

- .4 SCR controller complete with integral electronic air proving switch.
- .5 Control transformer with secondary fuse.
- .6 Overheat protection - manual reset with external button.
- .7 Automatic reset linear thermal cut-out.
- .8 Control wiring terminals for airflow proving switch and SCR controls.

Part 3 Execution

3.1 INSTALLATION

- .1 Install to manufacturer's recommendations.
- .2 Make power and control connections to CSA C22.2 No.46.

END OF SECTION

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 Departmental Representative when spare parts are handed over.
- .2 Provide the following spare parts:
 - .1 Spare set of filters.

1.6 QUALITY ASSURANCE

- .1 Unit shall be constructed in accordance with industrial design practices.

- .2 All units shall be factory tested before shipment.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Units shall be stored and handled per manufacturer's recommendations.

Part 2 Products

2.1 HEAT RECOVERY VENTILATOR (HRV-1)

- .1 General:
 - .1 Capacity: as scheduled.
 - .2 Unit shall consist of dual fans, one fore each airstream, aluminum heat recovery core, positively draining pan (no standing water), automatic defrost function, in an acoustically insulated cabinet.
- .2 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.
- .3 Core:
 - .1 The energy recovery component shall be of fixed-plate cross-flow construction, with no moving parts.
 - .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 plate material.

- .4 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.
 - .3 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.
 - .4 Unit shall have single-point power connection and a single-point 24 VAC contactor control connection.
 - .5 Blower motors shall be EPACT compliant for energy efficiency and be thermally protected or supplied with external starters.
 - .6 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.
 - .7 Blowers shall be statically and dynamically balanced. Heavy duty shaft and pre-lubricated self-aligning bearings, rubber mounted, rubber isolated motor.
 - .8 Vibration Isolation: Unit shall be spring isolated and seismically restrained with flexible connection between fan and cabinet.
- .5 Accessories:
 - .1 Provide unit and duct connection as per drawings.
 - .2 Provide seismic roof curbs as scheduled.
 - .3 Wall mounted programmable controller to maximize energy recovery, modulate electric heating coil operation to maintain room temperature set point.

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

Part 1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.46-M1988, Electric Air-Heaters.

1.2 PRODUCT DATA

- .1 Submit product data sheets for baseboard convectors. Include:
 - .1 Mounting methods.
 - .2 Physical size.
 - .3 kW rating, voltage, phase.
 - .4 Cabinet material thicknesses.
 - .5 Limitations.
 - .6 Colour and finish.
- .2 Manufacturer's Instructions: Provide to indicate special handling, installation and maintenance procedures.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit operation and maintenance data for baseboard convectors in accordance with Section 01 78 00 - Closeout Submittals.

Part 2 BASEBOARD CONVECTORS

- .1 Heaters: to CSA C22.2 No.46 latest edition standard wattage density as indicated with connection box.
 - .1 Element through-type fitted with aluminum convector vanes and resistor wire enclosed in mineral insulation in copper sheath.
- .2 Element: locked to cabinet and supported at additional points throughout length to allow for linear expansion with non metallic supports.
- .3 Cabinet: to CSA C22.2 No.46 latest edition pre-drilled back for securing to wall. Integral air diffusion reflector with wireway at bottom and built-in clamps.
 - .1 Bottom inlet/front outlet.
 - .2 Sloping front outlet.
 - .3 Panel: steel, metal thickness, bottom 0.8 mm, front 1.6 mm thick.
 - .4 Finish: phosphatized and finished with 2 coats air-dry, baked enamel, white colour.

- .4 Blank cabinet sections and inside corners complete with wireway in sections including splice plates, to match heater cabinets in respects for continuous baseboard effect as indicated.

2.2 CONTROLS

- .1 Wall mounted thermostats: type low voltage.

Part 3 Execution

3.1 INSTALLATION

- .1 Install baseboard convactor heaters, blank sections and controls.
- .2 When wireway is used, remove knock-outs and insert insulating bushing between units.
- .3 Install grounding wire to maintain ground integrity between heating, blank, and auxiliary sections.
- .4 Install thermostats in locations indicated.
- .5 Make power and control connections.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Ensure heaters and controls operate correctly.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 This Section applies to walk-in cooler box evaporator fan coil unit, air cooled condenser, refrigeration tubing including, coils, cabinet, electrical devices, fans, motors and control devices.
- .2 For walk-in cooler refer to Architectural 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 QUALITY ASSURANCE

- .1 ULC listed.
- .2 Rated in accord with ARI Standards.
- .3 Materials new and without defect. Workmanship of highest quality. Fully factory tested.
- .4 Comply with applicable Codes, Standards, and regulatory requirements. Including, but not limited to:
- .5 Safety Code Compliance: Comply with applicable portions of ANSI/ASHRAE 15-2001, "Safety Standard for Refrigeration Systems."
- .6 ANSI Code Compliance: Comply with applicable provisions of ANSI B 31.5, "Refrigeration Piping."
- .7 Equipment manufacturer is responsible for quality of brazing done by its organization and shall employ skilled craftsmen following qualified brazing procedures.
- .8 Leak check each evaporator coil unit, pressure test to 250 psig, and evacuate prior to shipment. Ship evaporator coils leak free with holding charge of dry nitrogen.

1.4 SUBMITTALS

- .1 Submit complete Shop drawings, installation instructions. Shop drawings shall include:
 - .1 Hanging and lifting instructions.
 - .2 Rigging and hoisting instructions.
 - .3 Dimensioned general arrangement and elevation drawings showing piping connection locations.
 - .4 Complete Installation and Operating Manuals.
 - .5 Electrical wiring and controls drawings with nomenclature.

1.5 SELECTION CRITERIA

- .1 Cooler room temperature: 15°C [59°F], Low profile coil.

- .2 Defrost: Cooler evaporator coils: Off time (air) defrost.
- .3 Air Cooled Condenser Design requirements:
 - .1 Ambient temperature: 38°C [100°F].
 - .2 Design for proper elevation above sea level.

1.6 WARRANTY

- .1 Refrigeration equipment warranties shall cover against defective materials and workmanship for a minimum period of one year from Substantial Performance.
- .2 Manufacturer, at their own expense, must immediately correct defects due to faulty workmanship, materials or shipping.

Part 2 Products

2.1 EVAPORATOR

- .1 Provide factory assembled and tested, low profile type unit coolers suitable for use with non CFC and HCFC refrigerants.
- .2 Unit Casings:
 - .1 Design units for flush mounting against a ceiling, independently baffled fan sections and low throw fan guards.
 - .2 Units shall have aluminum drain pan sloped to a single drain point, on back side.
 - .3 Provide electric pan heaters on units designed for electric defrost.
- .3 Coils:
 - .1 Provide staggered seamless copper tube, aluminum fin coil and distributor, circuited for the direct expansion refrigerant. Fin spacing shall be 6 fins per inch for units in spaces above 0°C [32°F] and 4 fins per inch for units in spaces at or below 0°C [32°F].
 - .2 Balanced port expansion valve and distributor to be manufacturer selected for the specific application and factory mounted.
 - .3 Provide a factory installed liquid line filter-drier per evaporator coil.
 - .4 Include a factory installed refrigeration service valve on suction outlet connection of each coil. Schrader taps are not acceptable. Provide forged brass body valve with seal caps. Service valve shall be brazed directly into piping, flare fittings are not to be used for the installation of service valves.
- .4 Fans and Drive Motors:
 - .1 Provide direct drive evaporator fan assemblies pre-wired to a terminal strip as follows:
 - .1 Fan motors to be, 208/230 volt 1 phase for evaporator coils with electric defrost elements, 115 volt 1 phase for off time and gas defrost evaporator coils, high efficiency ECM type with permanently lubricated ball bearings.
 - .2 Fan blades to be balanced, low noise type, constructed of heavy gage aluminum paddles mechanically attached to a plated steel hub.

- .5 Controls:
 - .1 Provide factory mounted adjustable thermostat for units equipped for defrost. Thermostat to control fans and defrost pan heaters during defrost.
 - .2 Provide factory mounted defrost sensor for all electric defrost unit coolers.

2.2 AIR COOLED CONDENSER

- .1 Provide factory assembled and tested, multi-circuit, air cooled condensers suitable for use with non CFC and HCFC refrigerants.
- .2 Unit Casings:
 - .1 Design for outdoor installation with weatherproof control panels and hinged fan panels.
 - .2 Construct of galvanized frame, legs, tube sheets, internal fan baffles and motor rails, painted aluminum or galvanized housings, and PVC coated steel fan guards.
- .3 Coils:
 - .1 Provide minimum of two independent refrigerant circuits per unit, staggered copper tubes with bonded corrugated aluminum fins, maximum 10 fins per inch.
 - .2 Provide a polyester protective coating on coil fins to protect against salt-water corrosion in accord with manufacturer's recommendation.
- .4 Fans and Drives Motors:
 - .1 Provide direct drive condenser fan assemblies pre-wired to condenser control panel.
 - .1 Fan motors to be drip-proof, 600 volt 3 phase, high efficiency with internal thermal overload protection, drip shield, and double sealed permanently lubricated ball bearings.
 - .2 Fan blades to be low noise type constructed of heavy gage aluminum paddles mechanically attached to a plated steel hub.
- .5 Control Panel, Electrical Components, and Controls:
 - .1 Include a weather tight control panel.
 - .2 Include a factory mounted, non-fused disconnect factory wired to condenser fan contactors and fuse blocks.
 - .3 Include individual fuse blocks, fuses and contactors for each condenser fan motor in the condenser control panel.

2.3 REFRIGERANT TUBING AND FITTINGS

- .1 Tubing:
 - .1 Processed tubing for refrigeration installation, deoxidized, dehydrated and sealed.
 - .2 Hard copper tube, type L, to ASTM B88M.
 - .3 Annealed copper tube to ASTM B280, with minimum wall thickness as per CSA B52.

- .2 Fittings
 - .1 Service: design pressure 300 psig and temperature 250°F.
 - .2 Brazed: wrought copper to ANSI B16.22 or cast bronze to MIL-F-1183E.
 - .3 Flanged: bronze or brass, Class 150 and Class 300 to ANSI B16.24.
 - .4 Flare: Bronze or brass, for refrigeration, to ANSI B16.26.
 - .5 Long radius type for elbows and return bends.
- .3 Joints
 - .1 Brazing materials shall be SIL-FOS-15 phosphor-copper-silver alloy for copper piping jointed by copper fittings and silver solder for brass fittings.

Part 3 Execution

3.1 GENERAL

- .1 Locations of equipment on Drawings are approximate. Field verify exact locations before roughing in piping and electrical work.
- .2 Accurately layout, mark, and drill hole necessary holes in walk-in box panels. Cut holes only with drill bits and hole saws.
- .3 Cut holes only as large as required to accommodate pipes, hanger rods, and conduits.
- .4 Prior to installation of condenser on the roof coordinate and verify placement of air cooled condenser support rails and piping penetration boxes.

3.2 EVAPORATOR INSTALLATION

- .1 Hang or mount evaporator coils plumb and level in accord with manufacturer's published instructions and the drawings.
- .2 Maintain manufacturer's recommended clearances so as to not restrict air flow.
- .3 Support piping separately so that piping is not supported off evaporator coil units.
- .4 Install electrical devices furnished by manufacturer.
- .5 Install interconnecting refrigeration suction and liquid piping between cooler evaporator coils and associated condenser/compressor units.
- .6 Install liquid line drier between the liquid connection and isolation valve.
- .7 Provide condensate lines for cooler: 25mm [1"] copper with traps.
- .8 Fit condensate lines with a union to facilitate cleaning of condensate line and removal of evaporator coil drain pan.

3.3 CONDENSER INSTALLATION

- .1 Install air cooled condensers plumb and level in accord with manufacturer's published instructions and drawings.
- .2 Maintain manufacturer's recommended clearances for service and maintenance.
- .3 Support piping separately so that it is not supported off equipment piping connections.

- .4 Install devices or parts furnished by manufacturer.

3.4 CONTROLS

- .1 Provide a room temperature sensor within the cooler. The cooling unit's controller shall control the operation of the evaporator and condenser units.
- .2 Provide all required wiring between the evaporator and condenser units.

3.5 TESTING

- .1 Prior to charging a refrigeration system perform a complete system pressure and leak test with dry nitrogen or other acceptable inert gas in accord with ANSI/ASME B 31.5 and the following protocol:
 - .1 Isolate electronic pressure transducers and relief valves.
 - .2 Systematically pressurize each individual branch with suction and liquid line isolation valves closed. Increase pressure on branch to 15 psig with an approved tracer gas. Increase pressure on branch to 150 psig for low side and 300 psig for high side, including liquid lines, with dry nitrogen. Inspect accessible joints with an approved leak detection device.
 - .3 Systematically pressurize each refrigeration component and piping to 15 psig with an approved tracer gas. Raise pressure to 150 psig for low side and 300 psig for high side, including liquid lines, with dry nitrogen, and leak check each joint whether mechanical or welded with an approved leak detection device.
 - .4 Repair detected leaks and re-pressurize.
 - .5 Entire low side of system must hold 150 psig and high side of system, including liquid lines, must hold 300 psig for minimum of 24 hours prior to purging.
 - .6 Upon successful conclusion of test, reduce pressure on system to 0 psig using approved and legal methods.

3.6 START-UP

- .1 Follow manufacturer's published start up procedures.
- .2 Test and adjust controls to ensure a refrigeration system operation.

3.7 CONDENSER START-UP

- .1 Evacuate air cooled condensers and associated piping prior to adding refrigerant charge.
- .2 Verify line voltage and check motor rotation prior to operation.
- .3 Operate equipment controls and safeties to verify proper function. Adjust controls to place air cooled condensers in full operation.
- .4 Verify that motor amperages and air flow rates for air cooled condensers agree with Manufacturer's data.
- .5 Provide written start-up reports to the Departmental Representative identifying controls test, electrical test results, and air flow.

3.8 EVAPORATOR COIL START-UP

- .1 Evacuate evaporator units and associated piping prior to adding refrigerant charge.
- .2 Verify line voltage and check motor rotation prior to operation.
- .3 Operate equipment controls and safeties to verify proper function. Adjust controls to place evaporator units in full operation.
- .4 Verify that motor amperages and air flow rates for evaporator units agree with Manufacturer's data.
- .5 Provide written start-up reports to the Departmental Representative identifying controls test, electrical test results, and defrost settings.

END OF SECTION

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 Control System (EMCS).
- .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 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.
- .4 Controls 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.
- .5 The control system shall be installed and programmed by the Controls Contractor using competent personnel directly and regularly employed by that company.
- .6 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.

- .7 All new controls shall be consistent with the installation; format and standards of the existing building EMCS and all work shall meet or exceed existing controls standards. This shall include graphics, hardware, programming, nomenclature, etc.
- .8 The new controls shall be a seamless addition to the existing system.
- .9 All new and existing control system components shall be compatible with the new and existing panels. Replace existing sensors and system components as required.
- .10 Remove existing controls not re-used or not required.
- .11 The Controllers' outputs shall be equipped with HOA switches.

1.5 EQUIPMENT SUPPLIED FOR INSTALLATION UNDER OTHER SECTIONS

- .1 Hand over control valves, and automatic control dampers to the appropriate trade sections for installation.
- .2 The Controls Contractor shall be responsible for arranging, coordinating and supervising the installation of the above devices in a suitable manner and readily accessible location.

1.6 GRAPHICS, CALIBRATION AND DEMONSTRATION

- .1 Set up and calibrate all sensors during the initial start-up of the systems and check, recalibrate and readjust and debug operation as necessary.
- .2 Update the existing system graphics to incorporate the controls additions and modifications.
- .3 Demonstrate the controls system to the satisfaction of the Consultant and the Owner.

Part 2 Products

2.1 ELECTRICAL COMPONENTS, WIRING AND CONDUIT

- .1 By Control Contractor:
 - .1 All control circuit transformers (120/1/60 or 24/1/60 and as designated).
 - .2 All control wiring and metallic conduit for mechanical system controls.
 - .3 Supply, installation and connection of all electric control items.
 - .4 All wiring and conduit from power distribution system to any control devices needing power.
 - .5 Coordinate with the Electrical Contractor.
 - .6 Electrical work installed under this Section shall be to the standards specified under Division 26.
 - .7 Obtain electrical permit.
- .2 Carrier System:
 - .1 All wiring in mechanical service spaces, where exposed to view and all 120 volt wiring shall be run in EMT conduit except the final 900mm [36"] of wiring to all

operators and to all sensors subject to vibration shall be run in flexible metallic conduit.

- .2 Run wiring not installed in conduit parallel to building lines and support every one meter independent of piping, ductwork, and equipment.
- .3 Provide steel fittings with nylon throats for all conduit connections.
- .4 Identify each wire and cable at every termination point. Identify conduit with colour bands at no more than 7.5m [25'] intervals and on both sides of walls and floor

2.2 Products

2.3 TEMPERATURE SENSORS

- .1 Room Temperature Sensors:
 - .1 User adjustable, suitable for wall mounting, with or without protective guard. Element length of 10-50 mm with ceramic tube or equivalent mode of mechanical protection.
- .2 Duct Temperature Sensors:
 - .1 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.

2.4 CONTROL DAMPERS

- .1 Parallel type blade, extruded aluminum or formed galvanized steel blades, frames, gussets and blade stops.
- .2 Shafts - galvanized steel with keyways for securing blades to shafts.
- .3 Hardware - keyed to prevent blade slippage and to provide smooth blade movement.
- .4 Bearings - oil impregnated sintered bronze. Provide additional thrust bearings for vertical blades. Confirm in advance with Engineer any vertical blade dampers.
- .5 Assemblies - rigid and adequately braced with corner gussets.
- .6 Bearings and seals - suitable for exposure to a minimum of -30°C [-22°F] and a maximum of 100°C [212°F].
- .7 Low leakage type with blade and frame seals. 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.
- .8 Galvanized coating on all sheared edges of galvanized steel frames and blades exposed to outside atmosphere.

- .9 Damper Actuators
 - .1 Spring return for "fail-safe" in Normally Open or Normally Closed position where required.
 - .2 Size actuators to control dampers against maximum pressure or dynamic closing pressure whichever is greater.
 - .3 Size damper actuators so that they will provide smooth and full travel of the dampers while stroking in both directions.
 - .1
 - .2 Low leakage Ruskin CD-50 or Tamco with failure to last position or spring return electronic actuator as required by the controls sequence.
 - .3 Size damper actuators so that they will provide smooth and full travel of the dampers while stroking in both directions.

Part 3 Execution

3.1 MANUFACTURER'S RECOMMENDATIONS

- .1 Installation: to manufacturer's recommendations.

3.2 INSTALLATION

- .1 All equipment shall be installed according to manufacturers' published instructions.
- .2 Adjust all existing and new damper blades to ensure that they close tightly against seals and stops.
- .3 All sensors shall be stabilized to such a level as to permit on-the-job installations that will require minimum field adjustments or calibration.
- .4 Install labels on all sensors and actuators identifying the point name.

END OF SECTION

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 PSEC LAB

- .1 The system consists of:
 - .1 Existing water source heat pump units (HP-39, HP-42).
 - .2 Existing outdoor air valves (AV-38, AV-42).
 - .3 Room Temperature Sensors.
 - .4 Fume hood (FH-131), associated exhaust fan (EF-131) and control damper (CD-131).
- .2 Room Temperature Control:
 - .1 Provide a new room temperature sensor for each heat pump and monitor them. Coordinate the exact location of the sensors on site with the Departmental Representative.
 - .2 Control the heat pump operation shall match existing to maintain space temperature control.
- .3 Fume hood and outdoor air valve:
 - .1 Provide a manual ON/OFF switch with a pilot light on the fume hood to control the operation of the fume hood's exhaust fan. Label the switch.
 - .2 Provide a 2 position, stainless steel, exhaust air control damper inside the Lab which shall be OPEN when the fan is ON and CLOSED when the fan is OFF.
 - .3 When the fume hood is OFF the fume hood alarm/monitor shall be deactivated.
 - .4 When the fume hood is ON then AV-38 and AV-42 shall be at their maximum setpoint. When the fume hood is OFF then AV-38 and AV-42 shall be at their minimum setpoint

3.2 FEED LAB

- .1 Domestic Hot Water System
 - .1 The internal controls of the Domestic Hot Water Tank shall control the operation of the system to maintain a water temperature of 60°C [140°F] within the tank.
- .2 Heat Recovery Ventilator:
 - .1 Mount the wall mounted unit controller.
 - .2 Program the controller to cycle the HRV ON/OFF on an OCCUPIED/UNOCCUPIED schedule and maintain both OCCUPIED/UNOCCUPIED room temperature set points.
 - .3 During the OCCUPIED it shall RUN and be OFF during the UNOCCUPIED periods.
 - .4 If the space is calling for cooling then the HRV shall go into bypass mode to provide free cooling.
 - .5 Modulate the electric heating coil to maintain room temperature.
 - .6 Hardwire the motorized control dampers CD-HRV1 to open when the fan starts.
- .3 Cooler
 - .1 The cooler controller and temperature sensors provided with the cooler cooling system shall control the operation of the system to maintain a room temperature of 15°C [59°F] within the cooler.

3.3 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.

3.4 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 fail position is the position on a loss of power, control signal [and/or pneumatic control pressure].

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 This Section describes the Common Work Results applicable to electrical disciplines.

1.2 GENERAL

- .1 The general conditions and general requirements together with all amendments and supplements contained in the General Specifications shall form an integral part of the electrical specification and will be made part of this contract.
- .2 Reference to “Electrical Divisions” shall mean all Divisions 26, 27, 28, 33, 34 and 48 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 Confirm with the architectural plans and specifications the extent and nature of the work and how it will affect the electrical work. Include in the tender sum for any complications or additional work described therein.
- .5 Review mechanical plans and specifications for the extent of electrical work required to make mechanical systems complete and include this work in the tender sum.
- .6 Review structural plans for limitations of penetrations or inclusions of electrical equipment. In the tender sum, allow for avoiding critical areas with electrical equipment.
- .7 Review existing site conditions for limitations of penetrations or inclusions of electrical equipment. In the tender sum, allow for avoiding critical areas with electrical equipment.
- .8 Comply with the requirements of the General Contract, and coordinate the installation with all other trades on site.
- .9 Confirm on-site the exact location of equipment, outlets, and fixtures and the location of outlets for equipment supplied by other trades.

1.3 WORK INCLUDED

- .1 This work shall include the supply and installation of all the necessary materials and apparatus for complete operating systems as indicated on the plans or mentioned in this specification, with the exception of materials or apparatus specifically mentioned to be omitted or to be supplied by owner.
- .2 Items obviously necessary or reasonably implied to complete the work, shall be included as if shown on drawings and noted in the specifications.

- .3 All materials, tools, appliances, scaffolding, apparatus and labour necessary for the execution, erection and completion of the systems described herein shall be furnished. This includes providing lighting and power for own work.
- .4 This contract shall include, but is not confined to, the following scope of work:
 - .1 Incoming services
 - .2 All electrically related civil works, trenching, backfilling, resurfacing
 - .3 Power distribution equipment
 - .4 Power connections and outlets
 - .5 Surface wireways
 - .6 Mechanical equipment connections
 - .7 Lighting system
 - .8 Exit signs
 - .9 Emergency lighting
 - .10 Data/Communications system
- .5 Complete all electrical connections to equipment and accessories pertaining to this contract and leave all in operating condition to the electrical Consultant's satisfaction.

1.4 WORK EXCLUDED

- .1 The contract scope of work shall not include the following:
 - .1 Low voltage mechanical systems control wiring where indicated in electrical and mechanical specifications to be done by controls contractor shall be excluded from the electrical contractor work as noted.

1.5 DRAWINGS AND SPECIFICATIONS

- .1 The drawings and specifications compliment each other and what is called for by one is binding as if called for by both. If there is any doubt as to meaning or true intent due to a discrepancy between the electrical drawings and specifications, and all other contract documents, obtain written ruling from Consultant prior to tender closing. **Failing this, the most expensive alternative is to be allowed for.**
- .2 The plans show the approximate location of outlets and apparatus but the right is reserved to make such changes in location as may be necessary to meet the emergencies of construction in any way. No extra will be allowed for such changes to any piece of electrical equipment unless the distance exceeds 3 metres, or if the relocation is required after initial installation is complete.
- .3 It is imperative that the contractor visit the site and completely familiarize himself as to the work to be undertaken.

1.6 CODES AND STANDARDS

- .1 All electrical work shall be carried out in accordance with the latest edition of the CEC C22.1 (Canadian Electrical Code) as amended and adopted by the Province of British Columbia and to the satisfaction of the Electrical Inspection Authority having jurisdiction, except where specified or specifically stated otherwise.
- .2 Do underground systems in accordance with CSA C22.3 No.1 latest edition, except where specified or specifically stated otherwise.
- .3 All work shall be carried out in accordance with the National Building Code current edition (including all local amendments) to the satisfaction of local building inspector authority having jurisdiction.
- .4 Any electrical material and/or equipment supplied by any contractor or sub-contractor for installation on this project must bear evidence of CSA approval or special CSA certification acceptable to the Authorities having Jurisdiction.

1.7 CARE, OPERATION AND START-UP

- .1 Instruct Operating Personnel in the operation, care and maintenance of systems, system equipment and components.
- .2 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with all aspects of its care and operation.

1.8 VOLTAGE RATINGS

- .1 Operating voltages: to CAN3-C235 latest 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.

1.9 PERMITS, FEES AND INSPECTION

- .1 Submit to Electrical Inspection Department and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.
- .2 Pay all associated fees.
- .3 Fees will cover all routine inspections by the District Electrical Inspector. Any fees for follow-up inspections found to be necessary by the District Electrical Inspectors as a result of incorrect work shall be borne by this contractor without any cost to the owner.
- .4 Notify Consultant of changes required by Electrical Inspection Department prior to making changes.

- .5 Furnish Certificates of Acceptance from Electrical Inspection Department Authorities having Jurisdiction on completion of work to Consultant.
- .6 Submit to Electrical Inspection Department and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work. Obtain electrical permit and pay associated fees.
- .7 Consultant will provide drawings and specifications required by Electrical Inspection Department and Supply Authority at no cost to the Contractor.
- .8 Furnish to Consultant on completion of work Certificates of Acceptance from Electrical Inspection Department.

1.10 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with the Construction Waste Management Plan as established by the Construction Manager.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal: paper, plastic, polystyrene, corrugated cardboard and packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Consultant.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

1.11 LOCATION OF OUTLETS

- .1 Locate outlets in accordance with these specifications and as indicated on the Architectural and Electrical drawings.
- .2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000mm, and information is given before installation.
- .4 Locate light switches on latch side of doors. Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

1.12 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

- .3 Install electrical equipment at following heights unless indicated otherwise on the Architectural and Electrical drawings.
 - .1 Local switches: 1400 mm.
 - .2 Wall receptacles:
 - .1 General: 300 mm.
 - .2 Above top of continuous baseboard heater: 200 mm.
 - .3 Above top of counters or counter splash backs: 175 mm.
 - .4 In mechanical rooms: 1400 mm.
 - .3 Panelboards: as required by Code or as indicated.
 - .4 Telephone and data outlets: 300 mm.

1.13 LOAD BALANCE

- .1 Measure phase current to panelboards with normal loads (lighting and mechanical) 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 Submit, at completion of work, report listing phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load. State voltage, time and date at which each load was measured.

1.14 EXTRA WORK

- .1 Any extra work ordered to be done shall be governed by this specification unless specific instructions or clauses are contained in the Change Order. In such cases, these instructions or clauses shall supersede those of the specification for this particular application only.

1.15 FIELD QUALITY CONTROL

- .1 All electrical work to be carried out by qualified, licensed electricians or supervised apprentices as per the conditions of the Provincial Act respecting manpower vocational training and qualification. Employees registered in a provincial apprentice's program shall be permitted, under the direct supervision of a qualified licensed electrician, to perform specific tasks. The activities permitted shall be determined based on the level of training attained and the demonstration of ability to perform specific duties.
- .2 The work of this division to be carried out by a contractor who holds a valid Master Electrical Contractor License as issued by the Province that the work is being conducted.
- .3 Conduct and pay for 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 lighting control.
- .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
- .5 Systems: fire alarm system, communications.
- .4 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.
- .5 Insulation resistance testing:
 - .1 Megger circuits, feeders and equipment up to 350V with a 500V instrument.
 - .2 Check resistance to ground before energizing.
- .6 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .7 Submit test results for Consultant's review.

1.16 CO-ORDINATION OF TRADES

- .1 Consult with Construction Manager and all subtrades involved to confirm the location of the various outlets and equipment, and cooperate fully to ensure that no conflict arises during the installation.
- .2 Special care shall be taken that equipment, outlets, junction boxes or pullboxes will not be obstructed by other structure, equipment, pipes or ducts installed under this general contract by other trades.
- .3 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 Consultant's written approval.
- .4 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.
- .5 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 the Consultant and all affected parties.

- .6 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 Consultant of space problems before installing any material or equipment. Demonstrate to the Consultant on completion of the work that all equipment installed can be properly, safely serviced and replaced, if and when required.

1.17 PROTECTION OF EQUIPMENT

- .1 This contractor shall provide and ensure maximum protection of electrical equipment on the site. Electrical equipment, including existing electrical equipment, shall be kept clean and dry at all times and caution shall be taken to ensure no mechanical damage is done to the equipment. Equipment shall not be delivered to the site until it can be stored safely or placed in final position and the space is clean.

1.18 DAMAGES

- .1 If the finish of electrical equipment is damaged either when received or during installation, have such equipment completely refinished and restored to its original condition at no cost to the owner.
- .2 Irreparably damaged equipment shall be replaced at no cost to the owner.

1.19 SHOP DRAWINGS

- .1 Submit electronic shop drawings, product data and samples in accordance with the contract specifications.
- .2 Shop drawings to have been reviewed and stamped by contractor prior to submittal.
- .3 Shop drawings and product data shall indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.
- .4 Where applicable, include wiring, single line and schematic diagrams.
- .5 Include wiring drawings or diagrams showing interconnection with work of other sections.
- .6 Prior to manufacture of any item made specifically for this job, submit detailed drawings of the item through the Construction Manager.
- .7 Shop drawings must be received by the Consultant at a date early enough to permit reasonable study prior to approval and manufacture, or to permit alterations where necessary. Late submissions of shop drawings will be sufficient reason for a stoppage of construction pending approval, or removal and replacement of any unsatisfactory item at the contractor's expense.
- .8 Shop drawings/product data content:
 - .1 Shop drawings submitted title sheet.
 - .2 Data shall be specific and technical.
 - .3 Identify each piece of equipment.

- .4 Information shall include all schedule 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.

1.20 CUTTING AND PATCHING

- .1 This contractor is responsible for all cutting or blocking out required to install electrical equipment.
- .2 If this contractor makes excessive cuts or does not coordinate work so that finished work requires cutting or patching, then this contractor shall pay for all patching to original condition.
- .3 Any dispute resulting from this shall be referred to the Consultant for decision.
- .4 Prior to any major cutting of walls or floor, review the proposed location, size and method with the Consultant. This includes notification when cutting or coring into any fire rated construction.

1.21 PROTECTION OF EXPOSED LIVE EQUIPMENT

- .1 Protect exposed live equipment during construction for personnel safety.
- .2 Shield and mark live parts "LIVE 120 VOLTS", or with appropriate voltage.
- .3 Arrange for installation of temporary doors for rooms containing electrical distribution equipment. Keep these doors locked except when under direct supervision of electrician.

1.22 INSPECTIONS AND TESTS

- .1 Notify the Consultant and authorities having jurisdiction at least five (5) working days in advance when the installations will be ready for inspection or testing.
- .2 Test reports, signed by all attending authorities, shall be submitted to the Consultant through the General Contractor after successful completion of an inspection or test.
- .3 Conduct all tests in a thorough and complete manner to the satisfaction of the Consultant and pay for any fees incurred to complete tests.

- .4 Furnish the Consultant with a copy of Certificate of Inspection from Authorities having Jurisdiction indicating that all work has been satisfactorily completed and issued prior to final connection.

1.23 CLEAN UP

- .1 Vacuum clean all new raceways and any electrical equipment. Ensure that no debris or spare parts are left in any electrical equipment.
- .2 Any scrap material shall be removed from the site and disposed of by the Contractor.
- .3 At time of final cleaning, clean lighting reflectors, lenses and other lighting surfaces that have been exposed to construction dust and dirt.

1.24 SURPLUS MATERIALS

- .1 All material removed from existing site and not being reused in this contract shall be the property of the owner and delivered as directed by the owner's representative. Material as it becomes surplus shall be reviewed by the owner or owner's representative and that part considered of value to the owner shall be classed as surplus material, all other becomes scrap material, and shall be disposed of by the contractor.

1.25 SPARE PARTS

- .1 This contract calls for spare parts or material. These are to be provided new in unopened cartons to the owner at the time of substantial completion of the contract.
- .2 Obtain a signed receipt from the owner's representative for all these parts or materials and include a copy in the front of the maintenance manual. Without this receipt these items will be treated as a deficiency and the cost withheld at twice the estimated value by the Consultant, or Owner Representative.

1.26 AS BUILT DRAWINGS

- .1 Obtain two (2) sets of white prints for the sole purpose of recording changes in installation as they occur. One (1) set is to be used in the field for day-to-day recording, and one (1) set for submittal after completion.
- .2 These plans shall be kept up-to-date as changes occur and shall be available to be inspected by the Consultant.
- .3 Arrange and pay for the incorporation of any "as-built" changes to digital PDF plans and AutoCAD (Revit) plans on disks. These changes shall be of similar quality of presentation as the original plans. NOTE: All plans whether requiring as-built changes or not, shall be included in this disk.
- .4 **Should the contractor require the Electrical Consultant to prepare the as-built CAD disk, the cost would be \$275 per plan**, unless excessive changes have been required. Costs associated with such excessive changes should be included with the change orders.
- .5 These amended drawings shall be given to the Consultant at time of final inspections.

- .6 "As-built" drawings shall include the location and circuit numbers of junction boxes in ceiling spaces, and all conduit placed in or under poured concrete. Note normal depth of conduits below top of concrete slab.

1.27 OPERATING AND MAINTENANCE MANUALS

- .1 Submit **four sets** of operating and maintenance manuals for equipment or as requested by the general section of the contract. Include descriptive and technical data, all shop drawings, operating procedures, routine and preventative maintenance, wiring diagrams, spare parts lists, warranties, service companies, suppliers for replacement parts, test results, fire alarm certificate of verification, electrical inspection authority certificate and contract guarantee.
- .2 Submit documentation in **green colored** heavy duty three ring binders, with lettering on spine identifying: "OPERATING AND MAINTENANCE MANUAL", project title and system names.
- .3 Submit one copy for approval by Consultant prior to assembly of final sets.

1.28 DEMONSTRATION OF SYSTEMS

- .1 Instruct operating personnel in the operation, care and maintenance of equipment.
- .2 Arrange and pay for services of manufacturer's factory service Consultant to supervise start-up of installation, check, adjust, balance and calibrate components of generator system.
- .3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with all aspects of its care and operation.

1.29 WARRANTY

- .1 Within a period of one year from the date of final acceptance of work, replace or repair at own expense any defect in workmanship or material. Reused material shall be operating satisfactorily at the time of final acceptance but subsequent failures are not the responsibility of this contractor.
- .2 Warranties for equipment having more than one year guarantee shall be made out to owner, and copies shall be provided in the maintenance manuals.
- .3 Maintenance from manufacturer and contractor of all equipment shall be included for first year, including all lamps except incandescent.

1.30 PAINTING

- .1 Arrange and pay for the painting of the devices noted in these specifications, in particular:
 - .1 exposed conduits and conduit fittings.
- .2 Painting shall be to match colour and finish of adjacent walls, with at least two coats of sprayed enamel paint to the satisfaction of the Architect.

1.31 CO-ORDINATION OF PROTECTIVE DEVICES

- .1 Provide a coordination/protective study and short circuit study of all equipment specified herein and submit for review.
- .2 Include the following:
 - .1 120/208V panelboards, transformer, and connecting feeder cables.
 - .2 Any additional data necessary for successful completion of the coordination and short circuit study.

1.32 ARC FLASH HAZARD ASSESSMENT

- .1 The Electrical Contractor is to include in tender sum a cash allowance to retain the services of an Electrical Engineer to perform an arc flash hazard assessment of electrical power distribution equipment installed under this contract in accordance with NFPA-70E requirements and IEEE-1584 Guidelines. Refer to “Cash Allowances and Separate Prices” in this Section.
- .2 Arc flash hazard assessment is to take place at time of completion of power distribution equipment installation and is to include power system wide short circuit and protective device coordination study of the electrical equipment installed to determine arc flash hazard threshold incident energy level boundaries and PPE requirements at each distribution panel installed.
- .3 Printed warning labels to be provided for installation by the Electrical Contractor at each panel indicating the following:
 - .1 Flash hazard boundary (inches)
 - .2 Cal/cm² Flash hazard at 18 inches
 - .3 PPE level and required protective equipment
 - .4 Shock hazard in KV when cover is removed
 - .5 Available fault current level in KA
- .4 Include copy of arc flash assessment in with maintenance manuals.

Part 2 Products

2.1 MANUFACTURERS AND CSA LABELS

- .1 Visible and legible, after equipment is installed.

2.2 MATERIALS AND EQUIPMENT

- .1 Equipment and material to be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Inspection Department.
- .2 Factory assemble control panels and component assemblies.

2.3 WARNING SIGNS

- .1 As specified and to meet the requirements of the BC Electrical Inspection Authority and the Consultant.
- .2 Decal signs, minimum size 175mm x 250mm.

2.4 FINISHES

- .1 Shop finish metal enclosure surfaces by 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 paint.
- .3 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

2.5 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates and labels as follows:
- .2 Nameplates:
 - .1 Lamicoid 3mm thick plastic engraving sheet, mechanically attached with self tapping screws.
 - .2 Nameplate colors shall be as follows:
 - .1 Normal power: Black face with white letters;
 - .2 Life safety emergency power: Red face with white letters;
 - .3 Standby power: Blue face with white letters.
 - .3 Nameplate sizes shall be as follows

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 Labels:
 - .1 Embossed plastic labels with 6mm high letters unless specified otherwise.
- .4 Wording on nameplates and labels to be approved by Consultant prior to manufacture.
- .5 Allow for average of twenty-five (25) letters per nameplate and label.
- .6 Identification to be English
- .7 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.

- .8 Identify equipment with Size 3 labels engraved "ASSET INVENTORY No. [____]".
Number as and if directed by Consultant.
- .9 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .10 Terminal cabinets and pull boxes: indicate system and voltage.
- .11 Transformers: indicate capacity, primary and secondary voltages.

2.6 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 latest edition.
- .4 Use colour coded wires in communication cables, matched throughout system.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 This section specifies materials and installation for seismic restraint systems for electrical installations.

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 Engineer shall be able to provide a proof of professional insurance and the related practice credentials, upon request. The Seismic Engineer shall be familiar with SMACNA, ECABC & NFPA guidelines as well as the BC Building Code requirements.
- .3 The Contractor's Seismic Engineer shall submit original signed BC Building Code "Letters of Assurance" "Model Schedules S-B and S-C" to the Prime Consultant or Electrical Consultant.
- .4 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 33 00 – Submittal Procedures.
- .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 Engineer, 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 Engineer 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 Engineer shall provide inspections during and after installation. The Contractor shall correct any deficiencies noted without additional cost to the contract.
- .9 Include all costs associated with the Seismic installation and certification in the base tender.

1.4 SHOP DRAWINGS & SUBMITTALS

- .1 Submit shop drawings of all seismic restraint systems including details of attachment to the structure, either tested in an independent testing laboratory or approved by the seismic Engineer.
- .2 Submit all the proposed types and locations of inserts or connection points to the building structure or support slabs. Follow the directions and recommendations of the Seismic Engineer.

Part 2 Execution

2.1 GENERAL

- .1 All seismic restraints systems shall conform to local authority having jurisdiction and all applicable code requirements.

2.2 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.
- .3 Horizontal Conduits:
 - .1 Supports - Horizontal conduit shall be supported at sufficiently close intervals to keep it in alignment and prevent sagging.
 - .2 EMT tubing - tubing shall be supported at approximately 1.2 m [4 ft] intervals for tubing.
- .4 Provide transverse bracing at 12.2 m [40 ft] intervals maximum unless otherwise noted. Provide bracing at all 90° bend assemblies, and pull box locations.

- .5 Provide longitudinal bracing at 24.4 m [80 ft] intervals maximum unless otherwise noted.
- .6 Do not brace conduit runs against each other. Use separate support and restraint system.
- .7 Support all conduits in accordance with the capability of the pipe to resist seismic load requirements indicated.
- .8 Trapeze hangers may be used. Provide flexible conduit connections where conduits pass through building seismic or expansion joints, or where rigidly supported conduits connect to equipment with vibration or seismic isolators.
- .9 A conduit system shall not be braced to dissimilar parts of a building or two dissimilar building systems that may respond in a different mode during an earthquake. Examples: wall and a roof; solid concrete wall and a metal deck with lightweight concrete fill.
- .10 Provide large enough conduit sleeves through walls or floors to allow for anticipated differential movements with firestopping where required.
- .11 It is the responsibility of the contractor to ascertain that an appropriate size restraint device be selected for each individual piece of equipment. Submit details on shop drawings. Review with seismic Engineer and submit shop drawings to consultants for their reference.

2.3 FLOOR MOUNTED EQUIPMENT

- .1 Bolt down all equipment, including kiosk, 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 All floor mounted equipment to be on a 100mm concrete pad.

2.4 LIGHT FIXTURES

- .1 LED 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 seismic cables which are connected to the fixture at diagonal points.
- .2 Surface and recessed style fixtures shall be hung independently of the ceiling system. Fixtures shall be secured to concrete or structural deck above by seismic 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

Part 1 General

1.1 SECTION INCLUDES

- .1 This section specifies the materials and installation for wire and box connectors, rated to 1000V.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-C22.2No.18 latest edition, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.
 - .2 CSA C22.2No.65 latest edition, Wire Connectors.
- .2 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 to consist of:
 - .1 Connector body and stud clamp for stranded copper conductors.
 - .2 Clamp for stranded copper conductors.
 - .3 Stud clamp bolts.
 - .4 Bolts for copper conductors.
 - .5 Sized for conductors as indicated.

Part 3 Execution

3.1 NOT USED

- .1 Not Used

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 This section specifies copper rated 0-1000 Volts and the most common electrical insulation and covering materials.
- .2 This section does not include fire rated building wire to ULC S139 and CSA C83, marine, hazardous, mining, instrumentation, communication and fire alarm wiring.

1.2 REFERENCES

- .1 CSA C22.2 No .0.3 latest edition, Test Methods for Electrical Wires and Cables.
- .2 CAN/CSA-C22.2 No. 131 latest edition, Type TECK 90 Cable.

1.3 GENERAL REQUIREMENTS

- .1 Typically use insulated 98% conductivity copper conductor wiring enclosed in conduit for the general wiring systems unless otherwise indicated.
- .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 AC90 armoured cabling (BX) shall not be used for the general wiring system other than final drops to recessed light fixtures in concealed locations.
- .4 Provide all control wiring except HVAC controls as specified in Mechanical Divisions.
- .5 Refer to Equipment Schedule(s) for detailed responsibilities.
- .6 Non-metallic sheathed wiring is not to be used on this project.

Part 2 Products

2.1 WIRE AND CABLE GENERAL

- .1 Conductors: stranded for 10 AWG and larger. Minimum size #12 AWG.
- .2 Insulation to be 600 volt RW90XLPE (X link) for the general building wiring in conduit.
- .3 Use RWU90XLPE for underground installations.
- .4 Site services sub-circuits, including site lighting, to be minimum #10 AWG for power and #12 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 latest edition.

- .5 Main feeders to be conduit and copper insulated wiring unless otherwise noted on drawings. Provide ground wiring for all conduits in or below slabs. Increase conduit size as required.
- .6 Armoured AC90 (BX) cable may only be utilized for luminaire to luminaire recessed tee bar luminaire drops from ceiling mounted outlet boxes. Use anti-short connectors.

2.2 **TECK CABLE**

- .1 Cable: to CAN/CSA-C22.2 No. 131 latest edition.
- .2 Conductors:
 - .1 Grounding conductor: copper.
 - .2 Circuit conductors: copper, size as indicated.
- .3 Insulation:
 - .1 Type: ethylene propylene rubber.
 - .2 Chemically cross-linked thermosetting polyethylene rated type RW90, 600V.
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: interlocking galvanized steel or aluminum.
- .6 Fastenings:
 - .1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
 - .2 Channel type supports for two or more cables at 1000 mm centers.
 - .3 Threaded rods: 6 mm dia. to support suspended channels.
- .7 Connectors:
 - .1 Watertight approved for TECK cable.

2.3 **ARMOURED CABLES**

- .1 Conductors: insulated, copper, size as indicated.
- .2 Type: AC90.
- .3 Armour: interlocking type fabricated from galvanized steel or aluminum strip.

Part 3 Execution

3.1 INSTALLATION OF BUILDING WIRES

- .1 Install wiring as follows:

- .1 In conduit systems in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Fittings.
- .2 In underground ducts in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Fittings.
- .3 All wires are to be pulled in together in a common raceway, using liberal amounts of Compound 77 lubricant.
- .4 All power circuits connected to isolated ground type receptacles are to have individual separate neutral c/w insulated bonding conductor.
- .5 No combining of circuits onto common neutral will be permitted. Use 2 pole or 3 pole breakers for combined circuits, no connector clips will be allowed.
- .6 Ensure that all single phase loadings are reasonably closely balanced over the main feeders.
- .7 All dimmer circuits are to have individual neutral conductors for each circuit.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 This section specifies U shape support channels either surface mounted. Suspended or set in poured concrete walls or ceilings.

Part 2 Products

2.1 SUPPORT CHANNELS

- .1 U shape, size 41 x 41mm, 2.5mm thick, surface mounted, suspended, or set in poured concrete walls and ceilings.

Part 3 Execution

3.1 INSTALLATION

- .1 Secure equipment to surfaces with lead anchors or nylon shields as required.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Secure equipment to suspended ceilings with toggle bolts.
- .4 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .5 Fasten exposed conduit or cables to building construction or support system using straps.
 - .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
 - .2 Two-hole steel straps for conduits and cables larger than 50 mm.
 - .3 Beam clamps to secure conduit to exposed steel work.
- .6 Suspended support systems.
 - .1 Support individual cable or conduit runs with 6 mm 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.
- .7 For surface mounting of two or more conduits use channels at 1.5m on centre spacing.
- .8 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .9 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

- .10 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .11 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Consultant.
- .12 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 This section specifies materials and installation for splitters, junction boxes, pull boxes and cabinets.

1.2 PRODUCT DATA

- .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data: submit manufacturer's product data sheets indicating dimensions, materials, and finishes, including classifications and certifications.
- .3 Shop Drawings: submit shop drawings for custom manufactured items showing materials, finish, dimensions, accessories, layout, and installation details.

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 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 minimum extension all around, for flush-mounted pull and junction boxes.

Part 3 Execution

3.1 SPLITTER INSTALLATION

- .1 Install splitters 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 locations.

- .2 Mount cabinets with top not higher than 2 m above finished floor.
- .3 Install terminal blocks as required.
- .4 Only main junction and pull boxes are indicated. Install pull boxes so as not to exceed 30 m of conduit run between pull boxes.

3.3 IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results - Electrical.
- .2 Install size 2 identification labels indicating system name, voltage and phase, as appropriate to clearly indicate the enclosure use.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 This section specifies rigid and flexible wiring fasteners, fittings and installation.

Part 2 Products

2.1 OUTLET AND CONDUIT BOXES - GENERAL

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm square or larger outlet boxes as required 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 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 SHEET STEEL OUTLET BOXES

- .1 Electro-galvanized steel single and multi-gang device boxes for flush installation, minimum size 76 x 51 x 38 mm or as indicated. For 347 V switches, use 347 V type device boxes.
- .2 Larger 102 mm square x 54mm deep outlet boxes to be used for single gang when more than one conduit enters one side, for telecommunication outlets (for slack storage), or for flush mounting devices in finished plaster and/or tile walls. Provide raised device covers as required.
- .3 For larger boxes (those requiring more wiring space, MUTOAs, etc.) use pre-ganged 102 mm high x 51 mm deep solid type as required. Allow extra gang for telecommunication outlets.
- .4 For larger boxes for special receptacles (multi-phase, high ampacity) use 102 mm square or 119 mm square boxes 54 mm deep with appropriate cover(s).
- .5 Boxes for surface mounted switches, receptacles, or telecommunications outlets to be 102 mm square, or 102 mm high utility, boxes, with rounded corners and raised surface covers. Minimum 38 mm (54 for telecom.) deep
- .6 Lighting fixture outlets: 102 mm square outlet boxes or octagonal outlet boxes.
- .7 Provide extension and plaster rings as required.

2.3 SURFACE CONDUIT BOXES

- .1 Cast FS or FD aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacles.

2.4 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. Use pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

Part 3 Execution

3.1 INSTALLATION

- .1 Typical outlet box mounting heights are indicated in Section 26 05 00 - Common Work Results – Electrical 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 Fill open boxes with paper, sponges, foam or similar approved material to prevent entry of construction material. Remove upon completion of work.
- .4 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .5 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are 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 No sectional or handy boxes to be installed.
- .8 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.
- .9 Outlets installed back to back in party stud walls to be off-set by one stud space.
- .10 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.

- .11 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.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 This section specifies rigid and flexible conduits, fasteners, fittings and installation.

1.2 REFERENCES

- .1 Outlet Boxes, Conduit Boxes, and Fittings and Associated Hardware: to CSA C22.2 No. 18.
- .2 Epoxy coated conduit: to CSA C22.2 No. 45, with zinc coating and corrosion resistant epoxy finish inside and outside.
- .3 Electrical metallic tubing (EMT): to CSA C22.2 No. 83.
- .4 Rigid PVC conduit: to CSA C22.2 No. 211.2.
- .5 PVC (DB2) conduit: to CSA #C22.1 211-1.
- .6 Flexible PVC conduit: to CAN/CSA-C22.2 No. 227.3.

1.3 BASIC WIRING METHODS

- .1 Underground or in concrete exterior to building:
 - .1 All wiring shall be in Schedule 40 RPVC conduit.
- .2 Partition walls and ceilings:
 - .1 All wiring to be run in EMT conduit for:
 - .1 Branch circuits.
 - .2 Low voltage systems.
 - .3 Distribution feeders and sub-feeders.
 - .4 Surface wiring in electrical and mechanical rooms.
- .3 Motors, transformers and all vibrating equipment:
 - .1 Short (600mm to 1200mm) PVC jacketed flexible conduit with liquid tight connectors shall be used. Allow sufficient slack to avoid strain on connectors at extreme extension of equipment movement.
- .4 Surface raceways - interior:
 - .1 All surface raceways shall be EMT, except if located without protection in areas susceptible to damage, which shall be rigid steel conduit.
- .5 Surface raceways - exterior:
 - .1 All surface raceways shall be UV compensated Schedule 40 RPVC conduit, protected from damage and excessive heating to the Consultant's satisfaction.

1.4 LOCATION

- .1 Electrical drawings are diagrammatic and do not show all conduits, wire, cable, etc. Electrical contractor to provide conduit, wire cable, etc., for a complete operating job to meet in all respects the intent of the drawings and specifications.
- .2 Outlet positions shown on architectural drawings (plans and elevations) to take precedence over locations and mounting heights indicated on electrical plans or in specifications.
- .3 Locate electrical devices on walls with regard given for convenience of operation and conservation of wall space. Switches, receptacles, fire alarm pull stations, etc. generally to be vertically lined up where items are in the same general location. Adjacent common devices to be installed in common outlet box.
- .4 Review the exact location criteria of each electrical outlet and device with the Architect and Consultant prior to rough-in. Relocate any item installed without architectural confirmation as required by the architect or Consultant at no cost to the owner as long as the relocation is within 3m of the location originally shown on the electrical drawings.
- .5 Do not install outlets back-to-back in party walls; allow a minimum of one stud space horizontal clearance between boxes. Install behind all outlets in party walls a Lowry Acoustic backing pad.
- .6 Locate light switches on latch side of doors. Locate disconnect devices in mechanical rooms on latch side of door.
- .7 All outlets located on exterior walls to be complete with moulded plastic vapour barriers to maintain integrity of wall vapour barrier system.
- .8 All raceways and wiring shall be installed concealed in building fabric, except for mechanical and electrical rooms where they shall be installed on the surface.
- .9 All outlet boxes, junction boxes, and cabinets to hold electrical devices shall be mounted so the equipment can be flush mounted unless indicated otherwise.
- .10 All junction boxes and other raceway access devices shall be mounted to avoid being visible from public areas. Obtain approval from Architect or Consultant for any and all junction boxes that, due to the building design, cannot be concealed.
- .11 All junction boxes mounted, out of necessity, on surface of solid walls shall be painted to match adjacent surface, with junction boxes painted to match designated systems.

Part 2 Products

2.1 RIGID PVC RACEWAY SYSTEM

- .1 Rigid PVC fittings shall be of the same manufacturer as the conduit.
- .2 PVC boxes and covers shall be Sceptre "F" Series or equivalent complete with all components and adaptors.

- .3 PVC junction boxes exceeding the size of “F” Series shall be Sceptre: “JB” Series boxes and be complete with junction box adaptors.
- .4 All fittings with removable covers shall be complete with VC gaskets and brass securing screws and inserts. All metal components shall be brass or stainless steel.

2.2 PVC DUCT RACEWAY

- .1 PVC duct fittings shall be of the same manufacturer as duct.
- .2 PVC duct shall be colour coded white for communications, grey for power.

2.3 EMT RACEWAY

- .1 Electrical Metallic Tubing (EMT) shall be galvanized steel of sufficient quality and thickness to allow smooth field formed bends.
- .2 EMT couplings, connectors and fittings shall be steel. Cast type units shall not be used on this installation.

2.4 PVC JACKETED FLEXIBLE CONDUIT

- .1 PVC jacketed flexible conduit (liquid tight) shall be interlocking spiral aluminum conduit with continuous extruded PVC jacket.
- .2 Conduit fittings shall be steel liquid tight type that fit over PVC jacket and seal uniformly all round.

2.5 OUTLET BOXES AND JUNCTION BOXES

- .1 Except as noted for rigid PVC raceways, all outlet boxes and junction boxes shall be one piece formed or welded.
- .2 Outlet boxes to be galvanized steel.
- .3 Junction boxes to be galvanized steel or aluminum.

2.6 ACCESS HATCHES

- .1 Provide and install access hatches in drywall ceilings to access junction boxes. Coordinate with other trades and check locations with architect before installing.
- .2 Access hatches shall have the following specifications:
 - .1 Door: aluminum frame with gypsum board inlay.
 - .2 Frame: Recessed aluminum
 - .3 Finish: to receive the same finish and paint as the surrounding surface.
 - .4 Hinge: concealed, non-corroding.
 - .5 Latch: flush screwdriver cam latch.
- .3 Access hatches to be of a size to suit but not less than 305mm square.

2.7 CONDUIT FASTENINGS

- .1 One hole steel straps to secure surface conduits 50 mm and smaller. Two hole steel straps for conduits larger than 50 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at 1500mm oc.
- .4 Threaded rods, 6 mm dia., to support suspended channels.

2.8 CONDUIT FITTINGS

- .1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.
- .2 Factory "ells" where 90° bends are required for 25 mm and larger conduits.
- .3 Watertight connectors and couplings for EMT in all exterior applications. Set-screws are not acceptable.

2.9 EXPANSION FITTINGS FOR RIGID CONDUIT

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 100mm linear expansion.
- .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection in all directions.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel.

2.10 FISH CORD

- .1 Polypropylene.

Part 3 Execution

3.1 INSTALLATION

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in mechanical and electrical service rooms and in unfinished areas.
- .3 Use rigid galvanized steel threaded conduit except where specified otherwise.
- .4 Use epoxy coated conduit underground corrosive areas.
- .5 Use electrical metallic tubing (EMT) except in cast concrete and above 2.4 m not subject to mechanical injury.

- .6 Use rigid PVC conduit underground, in corrosive areas, and surface mounted in wet areas not subject to damage.
- .7 Use flexible metal conduit for connection to motors in dry areas, connection to recessed incandescent fixtures without a prewired outlet box, connection to surface or recessed fluorescent fixtures and work in movable metal partitions.
- .8 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.
- .9 Use explosion proof flexible connection for connection to explosion proof motors.
- .10 Install conduit sealing fittings in hazardous areas. Fill with compound.
- .11 Minimum conduit size for lighting and power circuits: 19mm.
- .12 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .13 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .14 Install fish cord in empty conduits.
- .15 Run 2-25 mm spare conduits up to ceiling space and 2-25 mm spare conduits down to ceiling space from each flush panel. Terminate these conduits in junction boxes in ceiling.
- .16 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.
- .17 Dry conduits out before installing wire.
- .18 Conduits shall be installed mechanically continuous from outlet to outlet and without pockets. All the necessary standard bushings, elbows and bends shall be provided. All conduit bends shall have a radius of not less than six (6) times the internal diameter of the conduit and in no case shall the equivalent of more than four quarter bends from outlet to outlet be made. For all conduit sizes to be used for low voltage raceway, the conduits shall have a minimum bending radius of 230mm.
- .19 Conduit bends shall be made with no more than 10% flattening of the conduit. Bends shall be smooth throughout deformations.
- .20 On surface wall runs, all conduit shall be installed in true vertical or horizontal direction and on ceilings in true 90 degree angles or parallel to the walls. Crossings of conduits shall also be made at 90 degree angles. Parallel running conduit shall be kept on equal spacing on the entire length of run including bends.
- .21 All conduits shall be fastened to structure with steel straps (no cast type straps allowed).
- .22 Where more than three conduits are run parallel in ceiling cavity, they shall be installed on cantruss type channel, complete with all manufacturer's fittings to secure channel to structure and to conduit.

- .23 Raceways extending out concrete slabs shall be securely protected using rebar stubs or similar material. All duct stubs are to be kept sealed during construction

3.2 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on suspended or surface channels.
- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.3 CONCEALED CONDUITS

- .1 Run parallel or perpendicular to building lines.

END OF SECTION

Part 1 Generals

1.1 SECTION INCLUDES

- .1 This section specifies the installation of direct buried cables and cables in ducts including protection, markers and testing.

1.2 REFERENCES

- .1 Canadian Standards Association, (CSA International)
- .2 Insulated Cable Engineers Association, Inc. (ICEA)

Part 2 Products

2.1 MARKERS

- .1 Concrete type cable markers: 600 x 600 x 100 mm with words: cable, joint or conduit impressed in top surface, with arrows to indicate change in direction of duct runs.

Part 3 Execution

3.1 CABLE INSTALLATION IN DUCTS

- .1 Install cables as indicated in ducts.
 - .1 Do not pull spliced cables inside ducts.
- .2 Install multiple cables in duct simultaneously.
- .3 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.
- .4 To facilitate matching of colour coded multiconductor control cables reel off in same direction during installation.
- .5 Before pulling cable into ducts and until cables are properly terminated, seal ends of lead covered cables with wiping solder; seal ends of non-leaded cables with moisture seal tape.
- .6 After installation of cables, seal duct ends with duct sealing compound.

3.2 FIELD QUALITY CONTROL

- .1 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.
- .2 Acceptance Tests
 - .1 Ensure that terminations and accessory equipment are disconnected.

- .2 Ground shields, ground wires, metallic armour and conductors not under test.
- .3 Leakage Current Testing.
 - .1 Raise voltage in steps from zero to maximum values as specified by manufacturer for type of cable being tested.
 - .2 Hold maximum voltage for specified time period by manufacturer.
 - .3 Record leakage current at each step.
- .3 Provide Departmental Representative with list of test results showing location at which each test was made, circuit tested and result of each test.
- .4 Remove and replace entire length of cable if cable fails to meet any of test criteria.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 This Section specifies standard and custom panelboards and their installation.

1.2 SCOPE OF WORK

- .1 Provide and install panelboards as indicated on the drawings, single line diagram, panel schedules and these specifications.
- .2 Types of panelboards in this section include the following:
 - .1 CDP type Power distribution panelboards.
 - .2 Lighting and power panelboards

1.3 PRODUCT INFORMATION

- .1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Shop drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.
- .3 Shop drawings to include matching tub and trim details for factory installed low voltage relay cabinets where specified.

1.4 PLANT ASSEMBLY

- .1 Install circuit breakers in panelboards before shipment from plant.
- .2 In addition to CSA requirements, manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.
- .3 All panelboards to be of a common manufacturer.

1.5 FINISH

- .1 Apply finishes in accordance with Section 26 05 00 – Common Work Results - Electrical.
- .2 Panel finish in electrical and equipment rooms and closets to be standard ASA Grey baked enamel. Confirm with Consultant prior to shop finishing panels.

Part 2 Products

2.1 PANELBOARDS, DOORS AND TRIMS

- .1 Panelboards: to CSA C22.2 No. 29 and product of one manufacturer.
- .2 Bus and breakers unless otherwise indicated on the drawings and in the specifications, shall be rated for:
 - .1 Minimum 10 kA at 208Y/120V.
 - .2 Minimum 22 kA at 600Y/347V.
- .3 Copper bus with full size neutral.
- .4 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number.
- .5 Mains capacity, number of circuits and number and size of branch circuit breakers as indicated.

- .6 Provide all necessary connectors and mounting hardware in every space to facilitate installation of future breakers. Provide blank fillers for all spaces.
- .7 Concealed hinges and concealed trim mounting screws, hinged locking door with flush catch.
- .8 Panelboards to have flush doors. (Gasketed where required for damp locations).
- .9 Provide two keys for each panelboard and key similar voltage and system panelboards alike.
- .10 Panel tubs to be typically 600mm wide.
- .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 Panels to have integral Surge Protection Device (SPD) where indicated. See drawings for quantities and locations.

2.2 BREAKERS

- .1 All breakers to be:
 - .1 For Panelboards: Bolt on type molded case, non-adjustable and non-interchangeable trip, single, two and three pole, 120/208V 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.
- .3 Main breaker (where required) 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 or the Single Line Diagram.
- .5 Provide spare circuit breakers as indicated on panel schedules or single line diagram as applicable. Provide minimum 10% spare breakers.
- .6 Provide breaker type Ground Fault Interrupter(s) (GFI) as indicated.
- .7 Provide Lock-on devices for Exit sign circuits and Emergency Battery Equipment circuits.

2.3 PANELBOARD IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results - Electrical.
- .2 Nameplate for each panelboard size 5 (2 line) engraved as indicated and include panel designation and voltage/phase.
- .3 Complete updated 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 Mount panelboards to height given in Section 26 05 00 or as indicated.
- .4 Connect loads to circuits as indicated.
- .5 Connect neutral conductors to common neutral bus with respective neutral identified.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 This section specifies materials and installation for fused and non-fused disconnect switches.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CAN/CSA C22.2 No.4-M89 (R2000), Enclosed Switches.
 - .2 CSA C22.2 No.39-M89 (R2003), Fuseholder Assemblies.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 HEALTH AND SAFETY

- .1 Do construction occupational health and safety in accordance with Section 01 35 30 - Health and Safety Requirements.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Construction/Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper plastic polystyrene corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Separate for reuse and recycling and place in designated containers Steel Metal Plastic waste in accordance with Waste Management Plan.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 DISCONNECT SWITCHES

- .1 Fusible, horsepower rated, disconnect switch in CSA Enclosure to CAN/CSA C22.2 No.4 size as indicated.
- .2 Provision for padlocking in on-off switch position by three locks.
- .3 Mechanically interlocked door to prevent opening when handle in ON position.

- .4 Fuses: size as indicated.
- .5 Quick-make, quick-break action.
- .6 ON-OFF switch position indication on switch enclosure cover.

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Indicate name of load controlled on size 4 nameplate.

Part 3 Execution

3.1 INSTALLATION

- .1 Install disconnect switches complete with fuses if applicable.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 This section specifies materials and installation for self contained emergency lighting.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.141-M1985 (R1999), latest addition Unit Equipment for Emergency Lighting.

1.3 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Data to indicate system components, mounting method, source of power and special attachments.

Part 2 Products

2.1 EQUIPMENT

- .1 Emergency lighting equipment: to CSA C22.2 No.141.
- .2 Supply voltage: 120 ac.
- .3 Output voltage: 24 V dc.
- .4 Operating time: **60** min.
- .5 Battery: sealed, maintenance free.
- .6 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output of plus or minus 0.01V for plus or minus 10% input variations.
- .7 Solid state transfer circuit.
- .8 Low voltage disconnect: solid state, modular, operates at 80% battery output voltage.
- .9 Signal lights: solid state, for 'AC Power ON' and 'High Charge'.
- .10 Lamp heads: integral on unit, 345 degrees horizontal and 180 degrees vertical adjustment. Lamp type: LED, 4W.
- .11 Suitable for wall or ceiling mounted.
- .12 Finish: white.

Part 3 Execution

3.1 INSTALLATION

- .1 Install unit equipment.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 This section specifies materials and installation for exit signs complete with directional arrows.

1.2 TYPE OF EXIT SIGN

- .1 Install specification grade LED type exit signs in general public areas where indicated on drawings.

1.3 PRODUCT DATA

- .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data: submit manufacturer's product data sheets indicating dimensions, materials, and finishes, including classifications and certifications.

Part 2 Products

2.1 EXIT SIGN – PICTORIAL GREEN RUNNING MAN

- .1 Thin line, LED type with white finish thermoplastic housing 2 LED lights and battery back-up.
- .2 All exit signs shall comply with CAN/CSA C860.
- .3 Exit signs shall be complete with 10 year warranty.

2.2 MOUNTING TYPE

- .1 Exit signs to be suitable for universal mounting. Allow for exit signs to be mounted as to best suit ceiling/wall type and architectural features:
 - .1 Surface wall mounted
 - .2 End wall mounted double face
 - .3 Ceiling mounted single face
 - .4 Ceiling mounted double face
- .2 Exit signs to have direction arrows where indicated.
- .3 Provide steel rod pendant supports for exit signs to mount to +3.5m A.F.F. in high ceiling areas as required.

Part 3 Execution

3.1 INSTALLATION

- .1 Install exit signs as shown on plans complete with double face units where indicated.
- .2 Connect to life safety emergency power circuit as indicated on the plans.
- .3 Exit signs must be clear of all visual obstruction.
- .4 Contractor to confirm locations before final installation.

3.2 LOCATION

- .1 Review locations of exit signs with engineer and architect to ensure effectiveness and compatibility with decor before rough in. Failure to do so may result in relocation at no extra charge to the project.

3.3 MOUNTING HEIGHT

- .1 Wall mounted signs shall be clear above doors and, if space allows, 2.4 metres to centre, but with 25mm clearance of ceiling.
- .2 Ceiling mounted signs shall be mounted directly on ceiling, unless it is obstructed from view. Stem mount using two fixture rods (9.5mm white smooth type).

END OF SECTION

Part 1 General

1.1 SCOPE OF WORK

- .1 Supply and installation of new horizontal connectors and cover plates, racks and patch panels, BIX block, etc.

1.2 STANDARDS AND CODES

- .1 ANSI-J-STD-607-A
- .2 TIA/EIA -606-A
- .3 TIA/EIA-569-A
- .4 TIA/EIA -568-B.1 & all addenda
- .5 TIA/EIA -568-B.2 & all addenda
- .6 TIA/EIA -568-B.3
- .7 NBCC - 1995

1.3 CONTRACTOR QUALIFICATIONS

- .1 The cabling contractor must be a certified system vendor of the manufacturer's components and/or cable being bid. The technicians working on the projects must be fully trained and qualified, by the manufacturer, for the installation and testing of all cabling and components being used.
- .2 Upon request from the Departmental Representative, the Contractor shall provide certified documentation of the qualifications described above. Failure to meet or provide such documentation will be the basis for disqualification of the cabling Contractor.
- .3 All staff performing any type of work contained in this specification must be certified in the installation, termination and testing of all aspects of UTP cable systems by the manufacturer.

Part 2 PRODUCTS

2.1 HORIZONTAL CABLING

- .1 Four pair, Cat 6, unshielded, twisted, 22 AWG to 24 AWG, 100 ohm, solid copper, FT4 rated.
- .2 Transmission requirements shall meet or exceed all requirements of TIA/EIA-568-B.2 for Category 6 cabling and components.

- .3 Pinned in compliance with T568A standard.

2.2 CONNECTORS/COUPLERS/ ADAPTERS

- .1 Category 6 UTP cable connectors:
 - .1 8P/8W modular female connectors at both ends of horizontal cabling.
 - .2 8P/8W modular male connectors at both ends of patch cords.
 - .3 IDC connectors for installation in consolidation points.
 - .4 All connectors shall meet or exceed all requirements of TIA/EIA-568-B.1 & B.2
 - .5 Non-keyed, 4-pair, 8P/8W modular jacks, T568A wiring.
 - .6 Use snap-in type connectors at both ends of cables.
 - .7 Blue for data, pink for voice, white for auxiliary.
 - .8 Keystone format.

2.3 PATCH CORDS

- .1 Modular patch cords:
 - .1 Stranded conductors Cat 6 patch cords, 4 pair, 24 AWG, 8P/8W, T568A wired.
 - .2 Determine Required lengths and quantities:
- .2 Label each patch cord with sequential number and the cable length. e.g. 30-3 is patch cable 30 which is 2m long.
- .3 Provide patch cords for all horizontal cables.

2.4 Patch Panel

- .1 Modular patch panel.
- .2 24-port, high density, individual cut-outs for snap in type female 8P/8W.
- .3 Must not take up more than 1 unit of rack.
- .4 Keystone format.

2.5 FACEPLATES

- .1 Flush faceplates for wall mounted outlets
 - .1 For use on all flush mounted Voice/2 x Data/Aux
 - .2 Supply 4-port face plate. Install blanks on all unused
 - .3 Single gang, flush mounted - white.

2.6 HORIZONTAL CABLING

- .1 Supply and install 4 drops to each outlet (1V, 2D, 1A).
- .2 Cables to be used are unshielded, twisted, 4-pair, solid copper core, Category 6, 100 ohm, 22 AWG to 24 AWG, FT4 rated.

- .3 Each cable is to be hardwired directly to the IDC connector, T568A wired modular jack at both ends.
- .4 Leave 1m of cable slack in the communications cabinet end and 300mm at the outlet end.
- .5 To maintain the cable geometry, the cable sheath shall be removed only as much as necessary to terminate the cable pairs on the connecting hardware, regardless of the termination hardware type, i.e. 8P/8W jack or IDC. IDC mounting hardware has to be suitable to allow for proper bend radius of fully jacketed cables every 600mm.
- .6 Horizontal fields should be color coded as per TIA/EIA-606-A.

2.7 GROUNDING

- .1 Install a ground lug in communications panel.
- .2 Install #6 insulated copper ground wire.
- .3 Provide labeling as per TIA/EIA-606-A.
- .4 Bond communications panel with #6 insulated ground wire.
- .5 Provide labeling as per TIA/EIA-606-A.

2.8 WALL MOUNTABLE EQUIPMENT RACKS

- .1 The wall mountable equipment racks shall meet the following specifications:
 - .1 Be of fully welded steel construction;
 - .2 Unless otherwise specified, be made of 12 gauge steel;
 - .3 Be equipped with wall mounting plate;
 - .4 Provide 77 inch (44U) of usable rack mounting space;
 - .5 Provide aluminum of 19 inch of usable rack width;
 - .6 Be tapped with mounting holes (10-32) and in accordance with EIA-310C mounting hole spacing standard.
 - .7 Be equipped with ground lugs.

Part 3 EXECUTION

3.1 TESTING CAT 6 CABLE

- .1 The cabling Contractor must perform a permanent link to verify and ensure full functional capabilities.
- .2 Testing of each cable must be performed on a pair-to-pair basis.
- .3 Testing must be performed on all cables terminated at work-stations and in the consolidation points.

- .4 All testing must be implemented in both directions.
- .5 Tests are to be done using a Level II-E tester in accordance with TIA/EIA-568-B.1 and contain the following data:
 - .1 Wire map
 - .2 Insertion loss.
 - .3 Length.
 - .4 Near-end crosstalk (NEXT) loss.
 - .5 Power sum near-end crosstalk (PSNEXT) loss.
 - .6 Equal-level far-end crosstalk (ELFEXT).
 - .7 Powersum equal-level far-end crosstalk (PSELFEXT).
 - .8 Return loss.
 - .9 Propagation delay.
 - .10 Delay skew.
- .6 Marginal or conditional pass will not be acceptable.

3.2 LABELS

- .1 Labels:
 - .1 Boldface laser quality printed labels on patch panels and faceplates (black print on white background). Font shall be as large as possible.
 - .2 There shall be no handwritten labels of any kind.
- .2 Horizontal UTP cable labeling:
 - .1 Label format for the components is to follow the format below:
 - .2 Example
 - .3 VI indicates Port 1 on the voice patch panel
- .3 Both ends of each cable shall be labelled with the same designation and patch panel port ID to which it is connected. Labels should be placed 150 to 300 mm from each jack or connector.
- .4 Label each installed 8P/8W, T568A jack with ID and the patch panel port ID to which it is connected.
- .5 All IDC field labeling and patch panel labeling shall have background colours as per TIA/EIA-606-A.
 - .1 Inter-building cable labeling:
 - .2 Label as per TIA/EIA-606-A standards.

3.3 DOCUMENTATION

- .1 One copy of the floor plan, typically referred to as "as-built drawings" and detailing the items below, is to be provided upon completion.
 - .1 Produce the drawing using AutoCAD 2000. Provide 2 hard copies and an AutoCAD disk of as-built drawings.
 - .2 Required details: location and label of each installed 8P/8W, T568A jack.
- .2 Provide hard and soft copies of all test results.
- .3 Provide a Category 6 certificate document issued by the cable/component manufacturer, guaranteeing transmission capabilities of the cabling system to support 1000 Mbps devices for a period of 15 years.
- .4 Installation technicians must be certified through the manufacturer's certification program. Technicians must provide evidence of their training certification. Contractor must supply documentation verifying their current participation in the manufacturer's certification program.
- .5 Manufacturer's certification:
 - .1 The manufacturer's certification must guarantee that design or installation on the part of the certified Contractor will not negate or void any portion of the certified system.
 - .2 Manufacturer must guarantee that:
 - .1 All material and labour is covered in this circumstance for the full certification period, and
 - .2 In the event that the Contractor is no longer in business, the full certification remains valid.
- .6 The installed structured cabling system must be covered by a warranty which includes, as a minimum:
 - .1 15 year coverage.
 - .2 Warranty against defects in material and workmanship from the date of installation.
 - .3 Repair or replacement of a failed component, covering parts and labour, at no charge.
 - .4 Single point of contact for all warranty service.
- .7 Upon request and at no additional cost to PWGSC, provide a manufacturer's technical representative to conduct an on-site visit to ensure complete technical compliance.

END OF SECTION

Approved: 2006-09-30

Part 1 General

1.1 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM C117-[04], Standard Test Method for Material Finer than 0.075 mm (No.200) Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C136-[05], Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .3 ASTM D422-63[2002], 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 ;) (600 kN-m/m ;).
 - .5 ASTM D1557-[02e1], Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft ;) (2,700 kN-m/m ;).
 - .6 ASTM D4318-[05], Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- .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 Green Building Council (CaGBC)
 - .1 LEED Canada-NC Version 1.0-[December 2004], LEED (Leadership in Energy and Environmental Design): Green Building Rating System For New Construction and Major Renovations.
- .4 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-A3000-[03], 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-[04], Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

1.2 DEFINITIONS

- .1 Topsoil:
 - .1 Material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.
- .2 Waste material: excavated material unsuitable for use in Work or surplus to requirements.
- .3 Borrow material: material obtained from locations outside area to be graded, and required for construction of fill areas or for other portions of Work.
- .4 Recycled fill material: material, considered inert, obtained from alternate sources and engineered to meet requirements of fill areas.

- .5 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 Table:

Sieve Designation	% Passing
2.00 mm	[100]
0.10 mm	[45 - 100]
0.02 mm	[10 - 80]
0.005 mm	[0 - 45]
 - .3 Coarse grained soils containing more than 20 % by mass passing 0.075 mm sieve.

1.3 EXISTING CONDITIONS

- .1 Examine geotechnical report.
- .2 Buried services:
 - .1 Before commencing work verify location of buried services on and adjacent to site.
 - .2 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.
 - .3 Confirm locations of buried utilities by careful test excavations.
 - .4 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered .
 - .5 Where utility lines or structures exist in area of excavation, obtain direction of Departmental Representative before removing or re-routing. Costs for such Work to be paid by Departmental Representative.
 - .6 Record location of maintained, re-routed and abandoned underground lines.
- .3 Existing buildings and surface features:
 - .1 Conduct, with Departmental Representative, condition survey of existing buildings, trees and other plants, lawns, pavement 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

Part 2 Products

2.1 MATERIALS

- .1 Type 1 and Type 2 fill: properties to the following requirements:
 - .1 Crushed, pit run or screened stone, gravel or sand.

.2 Gradations to be within limits specified when tested to ASTM C136 and ASTM C117. Sieve sizes to CAN/CGSB-8.1.

.3 Table:

Sieve Designation	% Passing	
	Type 1	Type 2
75 mm	-	100
50 mm	-	-
37.5 mm	-	-
25 mm	100	-
19 mm	5-100]	-
12.5 mm	-	-
9.5 mm	50-100	-
4.75 mm	30-70	22-85
2.00 mm	20-45	-
0.425 mm	10-25	5-30
0.180 mm	-	-
0.075 mm	3-8	0-10

Part 3 Execution

3.1 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

3.2 PREPARATION/PROTECTION

- .1 Keep excavations clean, free of standing water, and loose soil.
- .2 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.
- .3 Protect buried services that are required to remain undisturbed.

3.3 STOCKPILING

- .1 Stockpile fill materials in areas designated by Departmental Representative.
 - .1 Stockpile granular materials in manner to prevent segregation.
- .2 Protect fill materials from contamination.
- .3 Implement sufficient erosion and sediment control measures to prevent sediment release off construction boundaries and into water bodies.

3.4 EXCAVATION

- .1 Excavate to lines, grades, elevations and dimensions as indicated.
- .2 Excavation must not interfere with bearing capacity of adjacent foundations.
- .3 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.
- .4 Keep excavated and stockpiled materials safe distance away from edge of trench
- .5 Restrict vehicle operations directly adjacent to open trenches.
- .6 Provide steel cover plates capable of supporting all traffic to maintain emergency access to site. Equipment required to place plates to be on site at all times trenches are open. Applicable to trenches in road only.
- .7 Dispose of surplus and unsuitable excavated material off site.
- .8 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.
- .9 Remove unsuitable material from trench bottom including those that extend below required elevations to extent and depth as directed by Departmental Representative.

3.5 FILL TYPES AND COMPACTION

- .1 Use types of fill as indicated or specified below. Compaction densities are percentages of maximum densities obtained from relevant ASTM specifications.
 - .1 Under pavement: As indicated on contract drawings. Compact base course to 98% SPD.
 - .2 Under foundations: As indicated on contract drawings and geotechnical report. Compact base course to 100% SPD.

3.6 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.

3.7 BACKFILLING

- .1 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.
- .2 Place backfill material in uniform layers not exceeding 150mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.

3.8 RESTORATION

- .1 Upon completion of Work, remove waste materials and debris Replace topsoil as directed by Departmental Representative.

- .2 Reinststate lawns to elevation which existed before excavation.
- .3 Reinststate pavements and sidewalks disturbed by excavation to thickness, structure and elevation which existed before excavation.
- .4 Clean and reinststate areas affected by Work as directed by Departmental Representative
- .5 Protect newly graded areas from traffic and erosion and maintain free of trash or debris.

END OF SECTION

New & Renovated Labs
Centre for Aquaculture and Environmental Research
4160 Marine Drive, West Vancouver, B.C.

Appendix A

APPENDIX A

Geotechnical Report,
Thurber Engineering Ltd.
DFO - West Vancouver Laboratory, Modular Buildings,
Geotechnical Report
December 11, 2017



THURBER ENGINEERING LTD.



December 11, 2017

File: 21575

Fisheries and Oceans Canada
4160 Marine Drive
West Vancouver, BC
V7V 1N6

Attention: Cher LaCoste, M.Sc., R.P.Bio

**DFO – WEST VANCOUVER LABORATORY, MODULAR BUILDINGS
GEOTECHNICAL REPORT**

Dear Cher:

Thurber Engineering Ltd. has conducted a geotechnical investigation for the above-mentioned project. This letter describes the results of the investigation and provides geotechnical engineering recommendations for design and construction of the proposed buildings.

It is a condition of this letter that Thurber's performance of its professional services is subject to the attached Statement of Limitations and Conditions.

1. BACKGROUND

We understand that DFO is proposing to install two modular buildings to facilitate immediate needs at the West Vancouver Laboratory located at 4160 Marine Drive. The proposed buildings are 24' by 24', constructed of foam board and proposed to be founded on lock blocks.

Assessment of soil and groundwater contamination was not in our scope of work.

2. SITE INVESTIGATION

Prior to conducting the field investigation, BC One Call was notified to identify utilities in the vicinity of the proposed investigation area. In addition, Western Utilities Services Ltd. was retained to scan for underground utilities at the proposed test pit locations.

The field investigation was scheduled for November 27, 2017, with a total of four test pits to be completed by an excavator. Due to the inability to locate a gas line during the utility scan, the investigation was delayed. A decision was made on site that three test holes would be completed using a hydrovac contractor due to the presence of utility lines in the area.

The field investigation comprised three test pits (TP17-1 to TP17-3) located within the proposed footprints of the modular buildings. TP17-1 and TP17-2 were completed in the footprint of the northern building, and TP17-3 in the footprint of southern building. The test pits were completed on December 1, 2017 using a hydrovac truck operated by First Call Energy. The test pits terminated at depths ranging from 1.4 m to 3.0 m.

The soils were logged in the field by a Thurber representative and disturbed samples were obtained at selected depths from the test pit walls for visual identification and moisture content determination. The test pits were backfilled with sand and gravel fill.

Test pit locations are shown on the attached Dwg. 21575-1.

3. SOIL AND GROUNDWATER CONDITIONS

The results of the field and laboratory testing are provided on the attached test pit logs. The logs provide a complete, detailed description of the conditions encountered and should be used in preference to the generalized summary provided below.

The ground conditions generally comprise compact sand and gravel to 0.6 m in depth over a matrix of boulders and cobbles with some compact gravel and sand. Construction debris and wood were encountered near the bottom of TPs 17-02 and 17-03.

Ground water was encountered at 2.1 m below existing grade in TP17-2.

4. GEOTECHNICAL ASSESSMENT & RECOMMENDATIONS

4.1 Limitations

The depth of our investigation was limited due to the ground conditions encountered. Our test pits did not encounter native material. However, based on the information collected and exposed bedrock nearby we provide following recommendations.

4.2 Base Preparation

In preparation for lock block placement, all organics, loose or wet, or any delirious material should be removed near surface. A 150 mm thick layer of well-graded 19 mm crushed sand and gravel should be placed on the subgrade. The sand and gravel pad should extend 200 mm beyond the edge of the lock block footing. The sand and gravel should be compacted to 100% Standard Proctor maximum dry density (SPMDD).

4.3 Bearing Resistances

We understand that the proposed structure will be bearing on lock blocks. Foundations can be designed using a bearing pressure of 50 kPa under SLS loading conditions and 70 kPa under ULS loading conditions.

Long-term settlement of footings should be expected due to the presence of decomposable material such as wood. The footings may require height adjustments in the future.

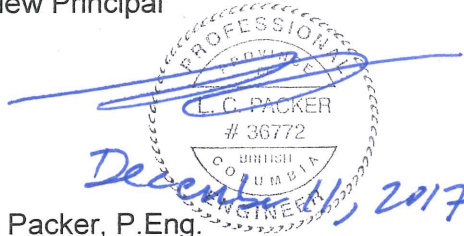
4.4 Seismic Design

Based on the results of our investigation, seismically induced soil liquefaction is not a concern for the two proposed modular buildings. In our opinion, Site Class D is appropriate for seismic design.

5. CLOSURE

We trust the above provides the information you require at this time. If you have any questions regarding this letter, please contact either of the undersigned.

Yours truly,
Thurber Engineering Ltd.
David Regehr, P.Eng.
Review Principal



December 11, 2017

Liza Packer, P.Eng.
Project Engineer

Attachment(s)	Statement of Limitations and Conditions (1 Page)
	Test Pit Location Plan (1 Page)
	Symbols and Terms (1 Page)
	Test Pit Logs (3 Pages)
	Photos (2 Pages)



STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

This Report has been prepared in accordance with generally accepted engineering or environmental consulting practices in the applicable jurisdiction. No other warranty, expressed or implied, is intended or made.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report, which is of a summary nature and is not intended to stand alone without reference to the instructions given to Thurber by the Client, communications between Thurber and the Client, and any other reports, proposals or documents prepared by Thurber for the Client relative to the specific site described herein, all of which together constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. THURBER IS NOT RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF REPORT

The Report has been prepared for the specific site, development, design objectives and purposes that were described to Thurber by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the Report, subject to the limitations provided herein, are only valid to the extent that the Report expressly addresses proposed development, design objectives and purposes, and then only to the extent that there has been no material alteration to or variation from any of the said descriptions provided to Thurber, unless Thurber is specifically requested by the Client to review and revise the Report in light of such alteration or variation.

4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT THURBER'S WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS THURBER MAY EXPRESSLY APPROVE. Ownership in and copyright for the contents of the Report belong to Thurber. Any use which a third party makes of the Report, is the sole responsibility of such third party. Thurber accepts no responsibility whatsoever for damages suffered by any third party resulting from use of the Report without Thurber's express written permission.

5. INTERPRETATION OF THE REPORT

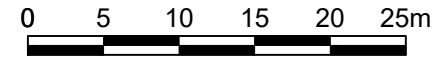
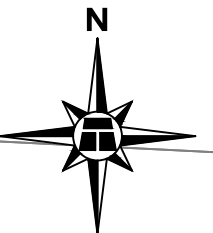
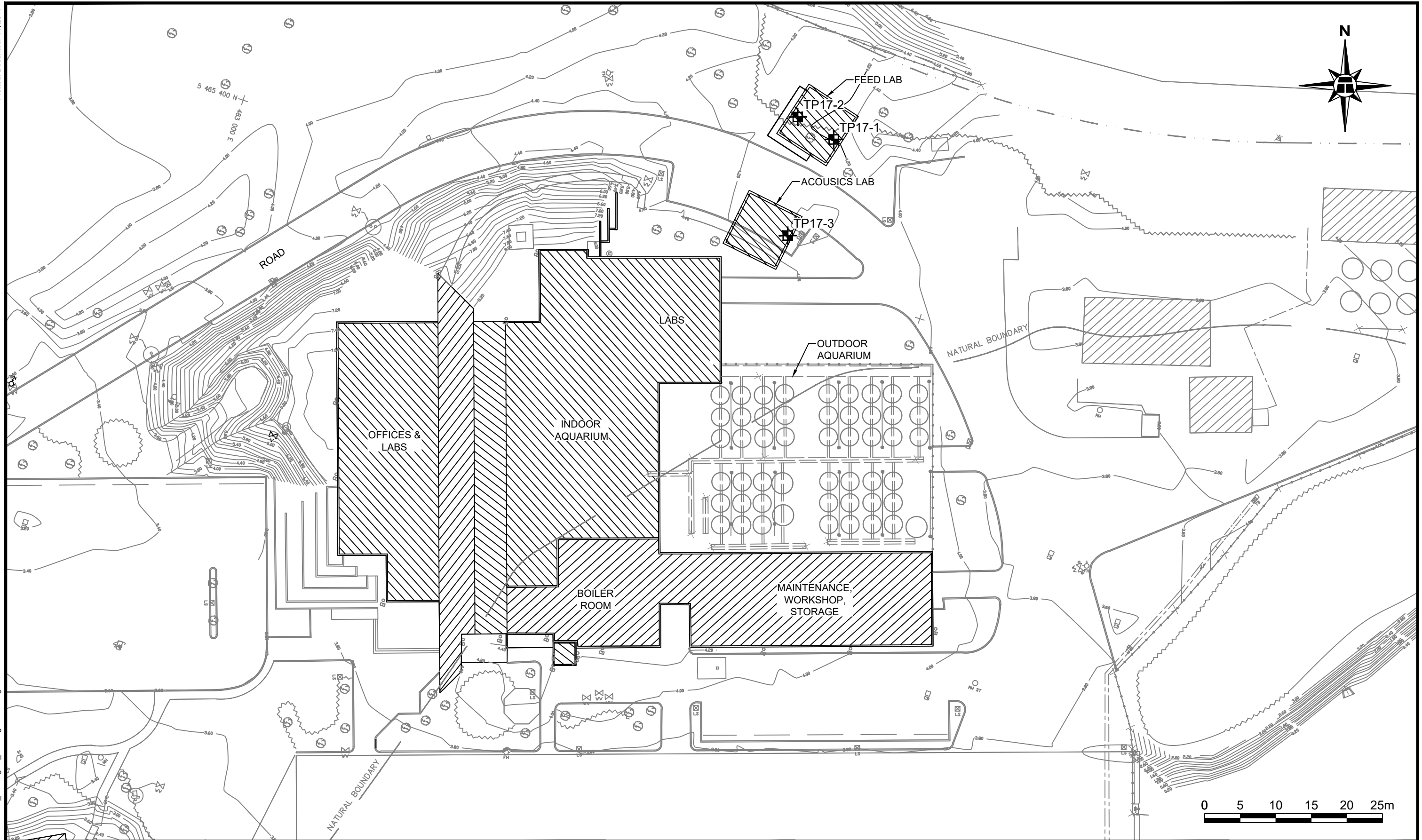
- a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will 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 the Client and all other persons making use of such documents or records with our express written consent should be aware of this risk and the Report is delivered subject to the express condition that such risk is accepted by the Client and such other persons. Some conditions are subject to change over time and those 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. If special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.
- b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to Thurber. Thurber has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, Thurber does not accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by Thurber. Thurber is entitled to rely on such representations, information and instructions and is not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.
- c) Design Services: The Report may form part of design and construction documents for information purposes even though it may have been issued prior to final design being completed. Thurber should be retained to review final design, project plans and related documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the Report's recommendations and the final design detailed in the contract documents should be reported to Thurber immediately so that Thurber can address potential conflicts.
- d) Construction Services: During construction Thurber should be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions in order to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.


6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause the escape, release or dispersal of those substances. Thurber shall have no liability to the Client under any circumstances, for the escape, release or dispersal of pollutants or hazardous substances, unless such pollutants or hazardous substances have been specifically and accurately identified to Thurber by the Client prior to the commencement of Thurber's professional services.

7. INDEPENDENT JUDGEMENTS OF CLIENT

The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.



LEGEND:
 TEST PIT

NOTES:
 1. BASE PLAN TAKEN FROM THE PUBLIC WORKS AND GOVERNMENT SERVICES OF CANADA SSO# 00314 DRAWINGS 1 TO 3.
 2. TEST PIT LOCATIONS ARE APPROXIMATE.



CLIENT
 FISHERIES AND OCEANS CANADA
TEST PIT LOCATION PLAN
 WEST VANCOUVER LABORATORY
 MODULAR BUILDINGS - 4160 MARINE DRIVE
 WEST VANCOUVER, BC

DESIGNED LP	DRAWN NAK	APPROVED DNR
DATE 11/12/17		SCALE 1:500
PROJECT No. 21575	DWG. No. 1	REV. 0

SYMBOLS AND TERMS

FOR SOIL DESCRIPTION AND TEST HOLE LOGS

BASIC SOIL SYMBOLS

	Predominant Material	Secondary Material
GRAVEL		gravelly to some gravel
SAND		sandy to some sand
SILT		silty to some silt
CLAY		clayey to some clay
PEAT / ORGANICS		some organics
Undifferentiated BEDROCK		
ORGANIC SILT		
FILL / DEBRIS		

SYMBOL VARIATIONS - EXAMPLES ⁽¹⁾

SAND and GRAVEL	
SAND, silty	
SILT with some clay	

DENSITY OF GRANULAR SOILS

Description	SPT N ⁽⁵⁾ ⁽⁶⁾
Very Loose	0 - 4
Loose	4 - 10
Compact	10 - 30
Dense	30 - 50
Very Dense	> 50

PROPORTION OF MINOR COMPONENTS BY WEIGHT ⁽²⁾

and	35 - 50%
y / ey	20 - 35%
some	10 - 20%
trace	0 - 10%

CONSISTENCY OF COHESIVE SOILS

Description	Undrained Shear Strength (kPa) ⁽⁶⁾
Very Soft	< 12
Soft	12 - 25
Firm	25 - 50
Stiff	50 - 100
Very Stiff	100 - 200
Hard	> 200

PENETRATION TESTS

Dynamic Cone Penetration	
Standard Penetration	
Becker Closed Casing	
Becker Open Casing	
Bounce Chamber Pressure	

CLASSIFICATION BY PARTICLE SIZE

Name	Size Range ⁽⁶⁾		
	(mm) ⁽³⁾	U.S. Standard Sieve Size	
		Retained	Passing
Boulders	> 200	8 inch	-
Cobbles	75 - 200	3 inch	8 inch
Gravel:	coarse 19 - 75	0.75 inch	3 inch
	fine 5 - 19	No. 4	0.75 inch
Sand:	coarse 2 - 5	No. 10	No. 4
	medium 0.4 - 2	No. 40	No. 10
	fine 0.075 - 0.4	No. 200	No. 40
Fines (Silt or Clay) ⁽⁴⁾	< 0.075	-	No. 200

- (1) Only selected examples of the possible variations or combinations of the basic symbols are illustrated.
- (2) Example: SAND, silty, trace of gravel = sand with 20 to 35% silt and up to 10% gravel, by dry weight. Percentages of secondary materials are estimates based on visual and tactile assessment of samples.
- (3) Approximate metric conversion.
- (4) Fines are classified as silt or clay on the basis of Atterberg limits.
- (5) SPT N values on test hole logs are uncorrected field values.
- (6) Reference Canadian Foundation Engineering Manual 4th Edition, 2006.

LOG OF TEST PIT

TEST PIT NO.
TP17-1

LOCATION: See Dwg. 21575-1



CLIENT: Fisheries and Oceans Canada
PROJECT: DFO West Vancouver Lab - Modular Buildings

TOP OF HOLE ELEV:

DATE: December 1, 2017

METHOD: Hydrovac

FILE NO.: 21575

DRILLING CO.: First Call Energy

REVIEWED BY: DNR

INSPECTOR: ANR

DEPTH (m)	PENETRATION (blows/300 mm)	WATER CONTENT (%) ○ Disturbed ● Undisturbed	WATER LEVEL ▼ Plastic Limit Liquid Limit	SAMPLES ■ Disturbed ■ Undisturbed ☒ No Recovery	UNDRAINED SHEAR STRENGTH (kPa) ◆ Peak ◇ Residual ◇ Remolded	GRAIN SIZE (%) ▲ Passing #200 sieve △ Passing #4 sieve	SOIL HEADSPACE READING (ppm) ■ GASTECH reading ∑ PID reading	DEPTH (m)	COMMENTS		SOILS DESCRIPTION	
0								0			Grey, moist SAND and GRAVEL with some silt and a trace of organics (Fill).	
0.5								0.5	GP-GM		Grey, moist COBBLES and BOULDERS with some gravel, sand and a trace of silt (Fill).	
1.5								1.5	GM/SM			
2.0								2.0			End of test pit due to refusal. Water level undetermined due to hydrovac method.	
3.0								3.0				
4.0								4.0				

LOG OF TEST PIT (NO EST.) 21575.GPJ PRACTICE MARLON.GDT 17-12-11- THURBER BC 2017.GLB

LOG OF TEST PIT

TEST PIT NO.
TP17-2

LOCATION: See Dwg. 21575-1



CLIENT: Fisheries and Oceans Canada
PROJECT: DFO West Vancouver Lab - Modular Buildings

TOP OF HOLE ELEV:

DATE: December 1, 2017

METHOD: Hydrovac

FILE NO.: 21575

DRILLING CO.: First Call Energy

REVIEWED BY: DNR

INSPECTOR: ANR

DEPTH (m)	PENETRATION (blows/300 mm)	WATER CONTENT (%) ○ Disturbed ● Undisturbed	WATER LEVEL ▼ Plastic Limit Liquid Limit	SAMPLES ■ Disturbed ■ Undisturbed ☒ No Recovery	UNDRAINED SHEAR STRENGTH (kPa) ◆ Peak ◇ Residual ◇ Remolded	GRAIN SIZE (%) ▲ Passing #200 sieve △ Passing #4 sieve	SOIL HEADSPACE READING (ppm) ■ GASTECH reading ⊗ PID reading	DEPTH (m)	COMMENTS	SOILS DESCRIPTION
0										TOPSOIL
									SM	Grey, moist SAND and GRAVEL with some silt (Fill).
										Grey, moist COBBLES and BOULDERS with some gravel and traces of sand and silt (Fill).
2									SP-SM/GP-GM	- bricks from 2.1 to 2.4 m depth
										- possible wood at bottom of test hole - cloth at 2.4 m depth
										End of test pit due to refusal. Water observed at 2.1 m depth upon completion of test pit.
4										

LOG OF TEST PIT (NO EST.) 21575.GPJ PRACTICE MARLON.GDT 17-12-11- THURBER BC 2017.GLB



TP17-1



TP17-2



TP17-2, Brick from test pit



TP17-3