

ARCHITECTURAL SPECIFICATIONS

Number of Pages

Specification Index 4

Division 1 – General Requirements

Section 01 11 55 – General Instructions 7
Section 01 14 00 – Work Restrictions 2
Section 01 29 83 – Payment Procedures for Testing Laboratory Services 2
Section 01 33 00 – Submittal Procedures 3
Section 01 35 33 – Health & Safety Requirements 9
Section 01 45 00 – Quality Control 3
Section 01 51 00 – Temporary Facilities 3
Section 01 61 10 – Product Requirements 3
Section 01 74 11 – Cleaning 2
Section 01 74 21 – Waste Management & Disposal 6
Section 01 91 13 – General Commissioning (CX) Req'ts 9
Section 01 91 31 – Commissioning (CX) Plan 4
Section 01 91 41 – Commissioning (CX) Training 3

Division 2 – Existing Conditions

Section 02 41 00 – Demolition 3

Division 3 – Concrete

Section 03 30 05 – Cast-In-Place Concrete 7

Division 4 – Masonry

Section 04 04 99 – Masonry for Minor Works 5

Division 5 – Metals

Section 05 12 23 - Structural Steel for Buildings 5
Section 05 50 00 – Metal Fabrications 7

Division 6 – Wood and Plastics

Section 06 10 00 – Rough Carpentry 2
Section 06 20 00 – Finish Carpentry and Millwork 4
Section 06 40 00 – Laminated Plastic 2

Division 7 – Thermal and Moisture Protection

Section 07 27 00 – Building Insulation 2
Section 07 90 00 – Sealants 3

Division 8 - Openings

Section 08 11 00 – Steel Doors and Frames	3
Section 08 31 00 – Access Doors and Panels	1
Section 08 41 00 – Aluminum Glazing Systems	3
Section 08 71 00 – Door Hardware	8
Section 08 72 00 – Automatic Door Operators	3
Section 08 80 00 – Glazing	3

Division 9 - Finishes

Section 09 22 00 – Non-Structural Metal Framing	2
Section 09 29 00 – Gypsum Board	4
Section 09 31 00 – Ceramic Tile	3
Section 09 51 00 – Acoustical Ceiling Tiles	3
Section 09 53 00 – Acoustical Ceiling Suspension	2
Section 09 65 00 – Resilient Flooring	5
Section 09 68 00 – Carpet Tile	7
Section 09 90 00 – Painting and Coatings	6

Division 10 – Specialties

Section 10 21 00 – Toilet Partitions	3
Section 10 22 39 – All Glass Folding Partition	5
Section 10 28 00 – Toilet & Bath Accessories	3
Section 10 51 00 – Metal Lockers	3

Architectural Appendices:

Appendix A

Lead Based Paint Survey - March 2004	15
Asbestos Containing Materials Survey - October 2003	8

Appendix B

Equipment Schedule	3
--------------------	---

Division 21 – Fire Protection

Section 21 05 01 - Common Work Results for Mechanical	23
Section 21 05 53 – Identification for Fire Suppression	1
Section 21 13 00 – Fire Suppression Sprinkler Systems	8

Division 22 – Plumbing

Section 22 05 53 – Identification for Plumbing Piping and Equipment	1
Section 22 05 76 – Facility Drainage Piping Cleanouts	4
Section 22 07 19 – Plumbing Piping Insulation	8
Section 22 11 00 – Facility Water Distribution	7
Section 22 13 00 – Facility Sanitary Sewerage	8
Section 22 14 00 – Facility Storm Sewerage	7

Section 22 14 10 – Subdrainage	4
Section 22 42 00 – Commercial Plumbing Fixtures	5

Division 23 – Heating, Ventilation & Air Conditioning (HVAC)

Section 23 01 31 – Air Duct Cleaning	6
Section 23 05 01 – Acceptable Manufacturers	4
Section 23 05 29 - Hangers and Supports for Mechanical Piping and Equipment	7
Section 23 05 48 - Vibration and Seismic Control for Mechanical	10
Section 23 05 53 – Identification for Mechanical Piping and Equipment	6
Section 23 05 93 – Testing Adjusting and Balancing for HVAC	6
Section 23 07 13 - Duct Insulation	8
Section 23 31 00 – HVAC Ducts and Casings	6
Section 23 33 00 - Duct Accessories	9
Section 23 34 00 – HVAC Fans	4
Section 23 37 00 - Diffusers, Registers and Grilles	4

Division 26 – Electrical

Section - 26 05 00 - Common Work Results for Electrical	13
Section - 26 05 02 - Seismic Restraints	4
Section - 26 05 04 - Existing Electrical Facilities	4
Section - 26 05 05 - Electrical Demolition	2
Section - 26 05 10 - Testing & Commissioning	4
Section - 26 05 11 - Operation and Maintenance Data	3
Section - 26 05 13 - Basic Electrical Materials and Methods	2
Section - 26 05 20 - Wire and Box Connectors (0-1000V)	2
Section - 26 05 21 - Wires and Cables (0-1000V)	3
Section - 26 05 22 - Connectors and Terminations	2
Section - 26 05 29 - Hangers & Supports for Electrical Systems	2
Section - 26 05 31 - Splitters, Junction, Pull Boxes & Cabinets	1
Section - 26 05 32 - Outlet Boxes, Conduit Boxes & Fittings	2
Section - 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings	4
Section - 26 09 24 - Lighting Control Devices - Low Voltage	2
Section - 26 27 26 - Wiring Devices	3
Section - 26 28 16.02 - Moulded Case Circuit Breakers	3
Section - 26 28 20 - Ground Fault Circuit Interrupters – Class “A”	2
Section - 26 50 00 - Lighting	3
Section - 26 53 00 - Exit Signs	2

Division 27 – Communications

Section - 27 05 28 - Pathways for Communications Systems	2
Section - 27 10 05 - Structured Cabling for Communications Systems	3

Division 28 – Electronic Safety and Security

Section - 28 13 00 - Access Control	4
Section - 28 23 00 - Video Surveillance	4

Section - 28 31 00.01 – Multiplex Fire Alarm System

4

Drawings (Bound Separately)

Architectural

A0.00	COVER SHEET
A0.01	GENERAL NOTES & LEGENDS
A1.10	SITE PLAN & ROOF PLANS
A2.10	DEMOLITION & CONSTRUCTION PLANS
A4.10	BUILDING SECTIONS
A6.10	EXTERIOR DETAILS
A7.00	DOOR & FRAME SCHEDULE
A8.00	ROOM FINISH SCHEDULE, ENLARGED PLAN & INTERIOR ELEVATIONS
A8.10	FINISHES PLANS & MILLWORK PLANS & ELEVATIONS
A8.20	MILLWORK SECTIONS & DETAILS

Mechanical

M0.01	SITE PLAN, GENERAL NOTES & SYMBOL SCHEDULES
M0.02	MECHANICAL SCHEDULE
M1.01	FOUNDATION PLAN
M1.02	PLUMBING PLAN
M2.01	FIRE PROTECTION PLAN
M3.01	HVAC PLAN

Electrical

E01	ELECTRICAL DRAWING LIST & SYMBOL LEGEND
E02	ELECTRICAL DEMOLITION DRAWING
E03	NEW ELECTRICAL PLAN
E10	ELECTRICAL DETAILS

Structural

S101	GENERAL NOTES
S201	PARTIAL MAIN FLOOR & FOUNDATION PLAN AND SECTIONS
S202	PARTIAL SECOND FLOOR PLAN AND SECTIONS

PART 1 GENERAL

1.1 Codes

- .1 Perform work in accordance with National Building Code for Canada 2015, Workers' Compensation Board of BC, and any other code of provincial or local application provided that in any case of conflict or discrepancy, the more stringent requirements shall apply.
- .2 Meet or exceed requirements of specified standards, codes and referenced documents.

1.2 Description of Work

- .1 Work under this Contract comprises, but is not limited to, the provision of all labour, materials, services and equipment necessary for the addition and renovation to the ground floor area of the Pacific Science Enterprise Centre in West Vancouver, BC. The work includes the addition of approximately 26m² and 13 m² respectively for classroom and drying room facilities and renovation of the remaining project area approximately facilities for Fisheries and Oceans Canada, including demolition and disposal of existing finishes and fixtures in the washrooms and locker rooms all as more fully described in the Tender Documents.

1.3 Contract Documents

- .1 The Contract documents, drawings and specifications are intended to complement each other.
- .2 Drawings are, in general, diagrammatic and are intended to indicate the scope and general arrangement of the work.
- .3 Cooperate with owner supplied pre-purchased furniture suppliers in carrying out their respective works and carry out instructions from Departmental Representative.
- .4 Coordinate work with that of owner supplied pre-purchased furniture suppliers. If any part of work under this Contract depends on its proper execution or result upon work of said suppliers, report promptly to Departmental Representative, in writing, any defects which may interfere with proper execution of this Work.

1.4 Time of Completion

- .1 Commence work immediately upon official notification of acceptance of offer and complete the work, including testing, adjusting and commissioning of all systems and equipment prior to March 29, 2019.

1.5 Hours of Work

- .1 All work which generates excessive noise, including cutting and coring, hammer drills and power activated fastening shall be executed outside of the normal operating hours for Pacific Science Enterprise Centre.
- .2 All other work, except for that noted in Clause 1.5.1 shall be executed during the normal operating hours for the Pacific Science Enterprise Centre:
Monday through Wednesday – 07:30 to 17:30 hours.
Thursday and Friday – 07:30 to 17:30 hours.
Saturday – Closed
Sunday – Closed.

- .3 All work conducted during and outside of normal operating hours will be subject to restrictions outlined in sections 01 14 00 and 01 51 00, including security arrangements.

1.6 Work Schedule

- .1 Carry out work as follows:
 - .1 Within 10 working days after Contract award, provide a project phasing gantt chart (in MS Project format) and a schedule showing anticipated key milestones and progress of all stages and trades work and final completion of the work within the time period required by the Contract documents. Indicate the following:
 - .1 Submission of shop drawings, product data, MSDS sheets and samples.
 - .2 Commencement and completion of work of each section of the specifications or trades for each phase as outlined.
 - .3 Final completion date within the time period required by the Contract documents.
 - .2 Do not change approved Schedule without notifying Departmental Representative.
 - .3 Interim reviews of work progress based on work schedule will be conducted as decided by Departmental Representative and schedule updated by Contractor in conjunction with and to approval of Departmental Representative.
 - .4 Regardless of submitted schedules by the contractor, The owner as represented by the Departmental Representative shall, at all times retain ownership of the schedule float.

1.7 Cost Breakdowns

- .1 Before submitting the first progress claim, submit a breakdown of the Contract price in detail as directed by the Departmental Representative and aggregating Contract price. After approval, the cost breakdown will form the basis of progress payments.

1.8 Codes, Bylaws, Standards

- .1 Perform work in accordance with the National Building Code of Canada (NBC) 2015, and other indicated Codes, Construction Standards and/or any other Code or Bylaw of local application.
- .2 Comply with applicable local bylaws, rules and regulations enforced at the location concerned.
- .3 Meet or exceed requirements of Contract documents, specified standards, codes and referenced documents.
- .4 In any case of conflict or discrepancy, the most stringent requirements shall apply.

1.9 Documents Required

- .1 Maintain one copy each of the following at the job site:
 - .1 Contract drawings.
 - .2 Contract specifications.
 - .3 Addenda to Contract documents.
 - .4 Copy of work schedule.
 - .5 Reviewed shop drawings.
 - .6 Change orders.
 - .7 Other modifications to Contract.

- .8 Field test reports.
- .9 Reviewed samples.
- .10 Manufacturer's installation and application instructions.
- .11 One set of record drawings and specifications for "as-built" purposes.
- .12 National Building Code of Canada 2015.
- .13 Current construction standards of workmanship listed in technical Sections.
- .14 Building Safety Plan.

1.10 Regulatory Requirements

- .1 Obtain and pay for all Permit, Certificates, Licenses and other approvals required by regulatory municipal, provincial or federal authorities to complete the work.
- .2 Provide inspection authorities with plans and information required for issue of acceptance certificates.
- .3 Furnish inspection certificates in evidence that the work installed conforms with the requirements of the authority having jurisdiction.

1.11 Contractor's Use of Site

- .1 Use of site:
 - .1 Exclusive and complete for execution of work.
 - .2 Assume responsibility for assigned premises for performance of this work.
 - .3 Be responsible for coordination of all work activities on site, including the work of other contractors engaged by the Departmental Representative.
 - .4 Cooperate with and coordinate construction/demolition activities with Pacific Science Enterprise Centre Property Manager
 - .5 Obtain and pay for use of additional storage or work areas needed for operations under this Contract.
- .2 Perform work in accordance with Contract documents. Ensure work is carried out in accordance with approved schedules.
- .3 Do not unreasonably encumber site with material or equipment

1.12 Examination

- .1 Examine site and be familiar and conversant with existing conditions likely to affect work.

1.13 Existing Services

- .1 Where work involves breaking into or connecting to existing services, carry out work as directed in Section 011400.

1.14 Location of Equipment and Fixtures

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

specified.

1.15 Cutting and Patching

- .1 Cut existing surfaces as required to accommodate new work.
- .2 Remove items so shown or specified.
- .3 Do not cut, bore, or sleeve load-bearing members.
 - .1 For large cuts in existing concrete scan slabs and / or walls for embedded services prior to cutting
- .4 Make cuts with clean, true, smooth edges. Make patches inconspicuous in final assembly.
- .5 Fit work airtight to pipes, sleeves, ducts and conduits.
- .6 Conceal pipes, ducts and wiring in raised floors, wall and ceiling construction of finished areas except where indicated otherwise.
- .7 Patch and make good surfaces cut, damaged or disturbed, to Departmental Representative's approval. Match existing material, colour, finish and texture.
- .8 Making good is defined as matching construction and finishing materials and the adjacent surfaces such that there is no visible difference between existing and new surfaces when viewed from 1.5 metres in ambient light, and includes painting the whole surface to the next change in plane.

1.16 Setting Out of Work

- .1 Assume full responsibility for and execute complete layout of work to locations, lines and elevations indicated.
- .2 Provide devices needed to lay out and construct work.
- .3 Supply such devices as templates required to facilitate Departmental Representative's inspection of work.

1.17 Acceptance of Substrates

- .1 Each trade shall examine surfaces prepared by others and job conditions which may affect his work, and shall report defects to the Departmental Representative. Commencement of work shall imply acceptance of prepared work or substrate surfaces.

1.18 Quality of Work

- .1 Ensure that quality workmanship is performed through use of skilled tradesmen, under supervision of qualified journeyman.
- .2 The workmanship, erection methods and procedures to meet minimum standards set out in the National Building Code of Canada 2015 and Construction Standards as specified herein.
- .3 In cases of dispute, decisions as to standard or quality of work rest solely with the Departmental Representative, whose decision is final.

1.19 Works Coordination

- .1 Coordinate work of sub-trades:
 - .1 Designate one person to be responsible for review of contract documents and shop drawings and managing coordination of Work.
- .2 Convene meetings between subcontractors whose work interfaces and ensure awareness

of areas and extent of interface required.

- .1 Provide each subcontractor with complete plans and specifications for Contract, to assist them in planning and carrying out their respective work.
- .2 Develop coordination drawings when required, illustrating potential interference between work of various trades and distribute to affected parties.
 - .1 Pay particularly close attention to overhead work above ceilings and within or near to building structural elements.
 - .2 Identify on coordination drawings, building elements, services lines, rough-in points and indicate location services entrance to site.
- .3 Facilitate meeting and review coordination drawings. Ensure subcontractors agree and sign off on drawings.
- .4 Publish minutes of each meeting.
- .5 Plan and coordinate work in such a way to minimize quantity of service line offsets.
- .6 Submit copy of coordination drawings and meeting minutes to Departmental Representative for information purposes.
- .3 Submit shop drawings and order of prefabricated equipment or rebuilt components only after coordination meeting for such items has taken place.
- .4 Work cooperation:
 - .1 Ensure cooperation between trades in order to facilitate general progress of Work and avoid situations of spatial interference.
 - .2 Ensure that each trade provides all other trades reasonable opportunity for completion of Work and in such a way as to prevent unnecessary delays, cutting, patching and removal or replacement of completed work.
 - .3 Ensure disputes between subcontractors are resolved.
- .5 Departmental Representative is not responsible for, or accountable for extra costs incurred as a result of Contractor's failure to coordinate Work.
- .6 Maintain efficient and continuous supervision.

1.20 Approval of Shop Drawings, Product Data and Samples

- .1 In accordance with Section 01 33 00, submit the requested shop drawings, product data, MSDS sheets and samples indicated in each of the technical Sections.
- .2 Allow sufficient time for the following:
 - .1 Review of product data.
 - .2 Approval of shop drawings.
 - .3 Review of re-submission.
 - .4 Ordering of approved material and/or products. Refer to individual technical sections of specifications.

1.21 Project Meetings

- .1 Contractor shall arrange project meetings and assume responsibility for setting times and distributing minutes.
- .2 The contractor shall provide the meeting facilities, record the meeting minutes and issue a meeting agenda 3 days prior to the meeting to Departmental Representative for review.

1.22 Testing and Inspections

- .1 Particular requirements for inspection and testing to be carried out by testing service or laboratory approved by the Departmental Representative are specified in Sections 01 45 00.
- .2 The Contractor will appoint and pay for the services of testing agency or testing laboratory as specified, and where required for the following:
 - .1 Inspection and testing required by laws, ordinances, rules, regulations or orders of public authorities.
 - .2 Inspection and testing performed exclusively for Contractor's convenience.
 - .3 Testing, adjustment and balancing of conveying systems, mechanical and electrical equipment and systems.
 - .4 Mill tests and certificates of compliance.
 - .5 Tests specified to be carried out by Contractor under the Departmental Representative's supervision.
 - .6 All concrete testing
- .3 Within 15 working days after Contract award provide a list of proposed testing services or testing laboratories for Departmental Representative's approval.
- .4 The Departmental Representative may require, and pay for, additional inspection and testing services not included in paragraph 1.22.2.
- .5 Where tests or inspections by designated testing laboratory reveal work is not in accordance with the Contract requirements, Contractor shall pay costs for additional tests or inspections as the Departmental Representative may require to verify acceptability of corrected work.
- .6 Contractor shall furnish labour and facilities to:
 - .1 Notify Departmental Representative in advance of planned testing.
- .7 Where materials are specified to be tested, deliver representative samples in required quantity to testing laboratory.
- .8 Pay costs for uncovering and making good work that is covered before required inspection or testing is completed and approved by Departmental Representative.
- .9 Provide Departmental Representative with 2 copies of testing laboratory reports as soon as they are available.

1.23 Record Documents

- .1 The Departmental Representative will provide 2 sets of drawings and 2 sets of specifications for "record of construction" purposes.
- .2. 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.
- .3 Refer to Section 01 78 00.

1.24 Cleaning

- .1 Refer to Section 01 74 00.

1.25 Dust Control

- .1 Provide temporary dust tight screens or partitions to localize dust generating activities, and for protection of workers, finished areas of work and public.
- .2 Protect furnishings and equipment within work area with 0.102 mm thick polyethylene film during construction. Remove film during non- construction hours and leave premises in clean, unencumbered and safe manner for normal daytime function.
- .3 Maintain and relocate protection until such work is complete.

1.26 Environmental Protection

- .1 Prevent extraneous materials from contaminating air beyond construction area, by providing temporary enclosures during work.
- .2 Do not dispose of waste or volatile materials into water courses, storm or sanitary sewers.
- .3 Ensure proper disposal procedures in accordance with all applicable territorial regulations.

1.27 Maintenance Materials, Special Tools and Spare Parts

- .1 Specific requirements for maintenance materials, tools and spare parts are specified in individual technical sections of specifications.

1.28 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 drawings referred to in the Contract Documents.
- .2 Upon request, Departmental Representative may furnish up to a maximum of ten (10) sets of Contract Documents for use by the Contractor at no additional cost. Should more than ten (10) sets of documents be required the Departmental Representative will provide them at additional cost.

1.29 Building Smoking Environment

- .1 Smoking within the building is not permitted.

1.30 System of Measurement

- .1 The metric system of measurement (SI) will be employed on this Contract.

1.31 Familiarization with Site

- .1 Before submitting tender, visit site - as indicated in tender documents and become familiar with all conditions likely to affect the cost of the work.

1.32 Security Requirements

- .1 Refer to Section 01 14 00.

1.33 Submission of Tender

- .1 Submission of a tender is deemed to be confirmation of the fact that the Tenderer has analyzed the Contract documents and inspected the site and is fully conversant with all conditions.

END OF SECTION

PART 1 GENERAL

1.1 Facility Operations and Security Procedures

- .1 All construction staff shall become thoroughly familiar with and abide by all provisions and requirements of Pacific Science Enterprise Centre's Operations, Safety and Security Procedures and Restrictions.
- .2 Cooperate with and coordinate construction/demolition activities with PSEC facility management team.

1.2 Access and Egress

- .1 Design, construct and maintain temporary staff and construction worker "access to" and "egress from" existing building, including hoarding and scaffolding.
- .2 Provide hoarding & scaffolding plan for Departmental Representative to review 5 business days prior to installation.

1.3 Use of Site and Facilities

- .1 Execute work with least possible interference or disturbance to normal use of premises. Make arrangements with Departmental Representative to facilitate work as stated.
- .2 Maintain existing services and provide for personnel & material access.
- .3 Where security is reduced by work, provide temporary means to maintain security as per Departmental Representative's direction and as specified.
- .4 Closures: protect work temporarily until project is completed.
- .5 Portions of the existing complex will be occupied by the public and government staff during entire construction period.
- .6 Coordinate with Departmental Representative in scheduling operations to minimize conflict and to facilitate use of space.

1.4 Alterations, Additions or Repairs to Existing Building

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

1.5 Existing Services

- .1 Where work involves interrupting, breaking into or connecting to existing mechanical or electrical services: give Departmental Representative 72 hours notice for permission. All shut-downs shall occur outside of normal facility operational hours. The maximum number of shut-down periods, which affect areas of building outside of work zones, is limited to four for duration of project.

- .2 Optimize and plan shut-downs so that services are restored in time for normal facility operation hours. Coordinate all shut-downs with utility providers, facility users and the property management firm.
- .3 Contractor shall be held responsible for damages to facility equipment as the result of service shut-downs.
- .4 Contractor shall be held responsible for any and all unscheduled shut-downs of building utilities and services.
- .5 Contractor will not be allowed to connect to Departmental Representative's existing data and communication services.
- .6 Submit a "Fire Alarm Bypass" request to Departmental Representative 72 hours in advance for approval.
- .7 Obtain permission from Departmental Representative for access to restricted areas outside the construction zones 24 hours in advance.

1.6 Building Smoking Environment

- .1 Comply with smoking restrictions. Smoking is NOT permitted within the existing buildings.

1.7 Noise Generation

- .1 Refer to section 01 11 55, clause 1.5 for policy on excessive noise and vibration generation.
- .2 Means and procedures of controlling and isolating other construction noise affecting occupied areas shall be responsibility of the Contractor and approved by the Departmental Representative.

1.8 After Hours Security

- .1 All work scheduled outside normal Pacific Science Enterprise Centre hours will require full-attendance security guard or guards. The Contractor shall make minimum 24 hours advance arrangements with the Pacific Science Enterprise Centre building management and commissionaire services for access and security. All security services shall be paid for by the Contractor.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Inspecting and testing by inspecting firms or testing laboratories designated by the Departmental Representative.

1.2 RELATED REQUIREMENTS SPECIFIED ELSEWHERE

- .1 Particular requirements for inspection and testing to be carried out by testing laboratory designated by Departmental Representative are specified under various sections.

1.3 APPOINTMENT AND PAYMENT

- .1 The contractor will engage and pay for services of testing and laboratory services.
- .2 The contractor shall submit to the Departmental Representative for approval a list of testing services and laboratories the contractor intends to engage.
- .3 The following is, but not limited to, the required inspection and testing required by the specifications:
 - .1 Inspection and testing required by laws, ordinances, rules, regulations or orders of public authorities.
 - .2 Inspection and testing performed exclusively for Contractor's convenience.
 - .3 Testing, adjustment and balancing of conveying systems, mechanical and electrical equipment and systems.
 - .4 Mill tests and certificates of compliance.
 - .5 Concrete Testing
 - .6 Tests specified to be carried out by Contractor under the supervision of Departmental Representative.
 - .7 Geotechnical inspection during excavation and testing by the Geotechnical Design Consultant.
 - .1 Nominated Geotechnical Consultant having already conducted work on site for DFO: Thurber Engineering, 900 – 1281 West Georgia Street, Vancouver, BC V6E 3G7 604-684-4384
 - .8 Additional tests specified in the following paragraph.
- .4 Where tests or inspections by designated testing laboratory reveal Work not in accordance with contract requirements, pay costs for additional tests or inspections as required by Departmental Representative to verify acceptability of corrected work.

1.4 CONTRACTOR'S RESPONSIBILITIES

- .1 Provide labour, equipment and facilities to:
 - .1 Provide access to Work for inspection and testing.
 - .2 Facilitate inspections and tests.
 - .3 Make good Work disturbed by inspection and test.
 - .4 Provide storage on site for laboratory's exclusive use to store equipment and cure test samples.

- .5 Arrange and pay for required testing.
- .2 Allow sufficient time in advance of operations to allow for assignment of laboratory personnel and scheduling of test.
- .3 Where materials are specified to be tested, deliver representative samples in required quantity to testing laboratory.
- .4 Pay costs for uncovering and making good Work that is covered before required inspection or testing is completed and approved by Departmental Representative.

END OF SECTION

PART 1 GENERAL

1.1 Approvals

- .1 Approval of shop drawings and samples: refer to Section 01 11 55.

1.2 General

- .1 This Section specifies general requirements and procedures for the Contractor's submissions of shop drawings, product data, samples and other requested submittals to Departmental Representative for review. Additional specific requirements for submissions are specified in individual technical sections.
- .2 Present shop drawings, product data and samples in SI Metric units.
- .3 Where items or information is not produced in SI Metric units, converted values are acceptable.
- .4 Contractor's responsibility for errors and omissions in submission is not relieved by Departmental Representative's review of submissions.
- .5 Notify Departmental Representative in writing at time of submission, identifying deviations from requirements of Contract documents and stating reasons for deviations.
- .6 Contractor's responsibility for deviations in submission from requirements of Contract documents is not relieved by Departmental Representative's review of submission unless Departmental Representative gives written acceptance of specific deviations.
- .7 Make any changes in submissions which Departmental Representative may require consistent with Contract documents and resubmit as directed by Departmental Representative
- .8 Notify Departmental Representative in writing, when resubmitting, of any revisions other than those requested by Departmental Representative.
- .9 **Do not proceed with work until relevant submissions are reviewed and approved by the Departmental Representative.**

1.3 Submission Requirements

- .1 Coordinate each submission with the requirements of the work and the Contract documents. Individual submissions will not be reviewed until all related information is available.
- .2 Allow (5) five days for Departmental Representative's review of each submission, unless noted otherwise.
- .3 Accompany submissions with transmittal letter, in duplicate, containing:
 - .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Identification and quantity of each shop drawing, product data and sample.
 - .5 Other pertinent data.
- .4 Submissions shall include:
 - .1 Date and revision dates.
 - .2 Project title and number.
 - .3 Name and address of:
 - .1 Subcontractor.
 - .2 Supplier
 - .3 Manufacturer.

- .4 Contractor's stamp, signed by Contractor's authorized representative, certifying approval of submissions, verification of field measurements and compliance with Contract documents.
- .5 Details of appropriate portions of work as applicable:
 - .1 Fabrication.
 - .2 Layout, showing dimensions (including identified field dimensions) and clearances.
 - .3 Setting or erection details.
 - .4 Capacities.
 - .5 Performance characteristics.
 - .6 Standards.
 - .7 Operating weight.
 - .8 Wiring diagrams.
 - .9 Single line and schematic diagrams.
 - .10 Relationship to adjacent work.
- .5 After Departmental Representative's review, distribute copies.

1.4 Shop Drawings

- .1 Shop drawings: original drawings or modified standard drawings provided by Contractor to illustrate details of portions of work which are specific to project requirements.
- .2 Electronic submission of shop drawings is allowed.
- .3 Maximum sheet size: 850 x 1050 mm.
- .4 Submit 6 prints of shop drawings for each requirement requested in the specification sections and/or as requested by the Departmental Representative.
- .5 Cross-reference shop drawing information to applicable portions of the Contract documents.

1.5 Shop Drawings Review

- .1 Review of shop drawings by Fisheries and Oceans Canada is for the sole purpose of ascertaining conformance with the general concept.
- .2 This review shall not mean that Fisheries and Oceans Canada approves the detail design inherent in the shop drawings, responsibility for which shall remain with Contractor submitting same.
- .3 This review shall not relieve the Contractor of responsibility for errors or omissions in the shop drawings or of responsibility for meeting all requirements of the construction and Contract documents.
- .4 Without restricting the generality of the foregoing, the Contractor is responsible for:
 - .1 Dimensions to be confirmed and correlated at the job site.
 - .2 Information that pertains solely to fabrication processes or to techniques of construction and installation.
 - .3 Coordination of the work of all sub-trades.

1.6 Product Data

- .1 Product data: manufacturers' catalogue sheets, MSDS sheets, brochures, literature, performance charts and diagrams, used to illustrate standard manufactured products or any other specified information.
- .2 Delete information not applicable to project.

- .3 Supplement standard information to provide details applicable to project.
- .4 Cross-reference product data information to applicable portions of Contract documents.
- .5 Submit 6 copies of product data.

1.7 Samples

- .1 Samples: examples of materials, equipment, quality, finishes and workmanship.
- .2 Where colour, pattern or texture is a criterion, submit a full range of samples.
- .3 Reviewed and accepted samples will become the standard of workmanship and material against which installed work will be verified.**

1.8 Submission Schedule

- .1 Coordinate Schedule of Submissions with Critical Path Construction Schedule. Identify all time sensitive items.

1.9 Test Results and Inspection Reports

- .1 Submit in duplicate test results and inspection reports required as noted in each Section of Specifications.

END OF SECTION

PART 1 GENERAL

1.0 References

- .1 Government of Canada.
 - .1 Canada Labour Code – Part II
 - .2 Canada Occupational Health and Safety Regulations
- .2 National Building Code of Canada (NBC)(2010):
 - .1 Part 8, Safety Measures at Construction and Demolition Sites.
- .3 Canadian Standards Association (CSA as amended):
 - .1 CSA Z797-2009 Code of Practice for Access Scaffold.
 - .2 CSA S269.1-1975 (R2003), Falsework for Construction Purpose.
 - .3 CSA-S350-M1980 (R2003) Code of Practice for Safety in Demolition of Structures.
- .4 Fire Protection Engineering Services (HRSDC):
 - .1 FCC No. 301, Standard for Construction Operations.
 - .2 FCC No. 302, Standard for Welding and Cutting.
- .5 American National Standards Institute (ANSI):
 - .1 ANSI A10.3, Operations – Safety Requirements for Powder-Actuated Fastening Systems.
- .6 Province of British Columbia:
 - .1 Workers Compensation Act Part 3 Occupational Health & Safety.
 - .2 Occupational Health and Safety Regulation

2.0 Related Sections

- .1 Refer to the following current NMS sections as required:
 - .1 General Instructions: Section 01 11 55
 - .2 Work Restrictions: Section 01 14 00
 - .3 Submittal Procedures: Section 01 33 00
 - .4 Temporary Facilities: Section 01 51 00
 - .5 Waste Management and Disposal: Section 01 74 19
 - .6 Demolition: Section 02 41 00
 - .7 Sealants: Section 07 90 00
 - .8 Painting and Coating: Section 09 90 00
 - .9 Hazardous Building Materials Survey Reports – Appendix ‘A’

3.0 Workers' Compensation Board Coverage

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

4.0 Compliance with Regulations

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

5.0 Submittals

- .1 Submit to Departmental Representative submittals listed for review in accordance with Section 01 33 00.
- .2 Work affected by submittal shall not proceed until review is complete.
- .3 Submit the following:
 - .1 Health and Safety Plan.
 - .2 Copies of reports or directions issued by federal and provincial health and safety inspectors.
 - .3 Copies of incident and accident reports.
 - .4 Complete set of Material Safety Data Sheets (MSDS), and all other documentation required by Workplace Hazardous Materials Information System (WHMIS) requirements.
 - .5 Emergency Procedures.
- .4 The Departmental Representative will review the Contractor's site-specific project Health and Safety Plan and emergency procedures, and provide comments to the Contractor within 2 days after receipt of the plan. Revise the plan as appropriate and resubmit to Departmental Representative for review.
- .5 Medical surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of work, and submit additional certifications for any new site personnel to Departmental Representative.

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

6.0 Responsibility

- .1 Assume responsibility as the Prime Contractor for work under this project
- .2 Be responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.
- .3 Comply with and enforce compliance by employees with safety requirements of Contract documents, applicable federal, provincial, territorial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

7.0 Health and Safety Coordinator

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

8.0 General Conditions

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

9.0 Regulatory Requirements

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

10.0 Work Permits

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

11.0 Filing Notice

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

12.0 Health and Safety Plan

- .1 Conduct a site-specific hazard assessment based on review of Contract documents, required work, and project site. Identify any known and potential health risks and safety hazards.
- .2 Prepare and comply with a site-specific project Health and Safety Plan based on hazard assessment, including, but not limited to, the following:
 - .1 Primary requirements:
 - .1 Contractor's safety policy.
 - .2 Identification of applicable compliance obligations.
 - .3 Definition of responsibilities for project safety/organization chart for project.
 - .4 General safety rules for project.
 - .5 Job-specific safe work, procedures.
 - .6 Inspection policy and procedures.
 - .7 Incident reporting and investigation policy and procedures.
 - .8 Occupational Health and Safety Committee/Representative procedures.
 - .9 Occupational Health and Safety meetings.
 - .10 Occupational Health and Safety communications and record keeping procedures.

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

13.0 Emergency Procedures

- .1 List standard operating procedures and measures to be taken in emergency situations. Include an evacuation plan and emergency contacts (i.e. names/telephone numbers) of:
 - .1 Designated personnel from own company.
 - .2 Regulatory agencies applicable to work and as per legislated regulations.
 - .3 Local emergency resources.
 - .4 Departmental Representative and site staff.
- .2 Include the following provisions in the emergency procedures:
 - .1 Notify workers and the first-aid attendant, of the nature and location of the emergency.
 - .2 Evacuate all workers safely.
 - .3 Check and confirm the safe evacuation of all workers.
 - .4 Notify the fire department or other emergency responders.
 - .5 Notify adjacent workplaces or residences that may be affected if the risk extends beyond the workplace.
 - .6 Notify Departmental Representative and site staff.
- .3 Provide written rescue/evacuation procedures as required for, but not limited to:
 - .1 Work at high angles.

- .2 Work in confined spaces or where there is risk of entrapment.
- .3 Work with hazardous substances.
- .4 Underground work.
- .5 Work on, over, under and adjacent to water.
- .6 Workplaces where there are persons who require physical assistance to be moved.
- .4 Design and mark emergency exit routes to provide quick and unimpeded exit.
- .5 Revise and update emergency procedures as required, and re-submit to the Departmental Representative.

14.0 Hazardous Products

- .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage and disposal of hazardous materials, and regarding labeling and provision of Material Safety Data Sheets (MSDS) acceptable to the Departmental Representative and in accordance with the Canada Labour Code.
- .2 Where use of hazardous and toxic products cannot be avoided:
 - .1 Advise Departmental Representative beforehand of the product(s) intended for use. Submit applicable MSDS and WHMIS documents as per Section 01 33 00.
 - .2 In conjunction with Departmental Representative, schedule to carry out work during "off hours" when tenants have left the building.
- .3 Provide adequate means of ventilation in accordance with Section 01 51 00.

15.0 Electrical Safety Requirements

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

16.0 Electrical Lockout

- .1 Develop, implement and enforce use of established procedures to provide electrical, mechanical, pneumatic, hydraulic, chemical, thermal, or potential energy isolation and lockout and to ensure the health and safety of workers for every event where work must be done on any electrical circuit or facility.

- .2 Prepare the lockout procedures in writing, listing step-by-step processes to be followed by workers, including how to prepare and issue the request/ authorization form. Have procedures available for review upon request by the Departmental Representative.
- .3 Keep the documents and lockout tags at the site and list in a log book for the full duration of the Contract. Upon request, make such data available for viewing by Departmental Representative or by any authorized safety representative.

17.0 Overloading

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

18.0 Falsework

- .1 Design and construct falsework in accordance with CSA S269.1-2016.

19.0 Scaffolding

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

20.0 Confined Spaces

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

21.0 Powder-Actuated Devices

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

22.0 Fire Safety and Hot Work

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

23.0 Fire Safety Requirements

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

24.0 Fire Protection and Alarm System

- .1 Fire protection and alarm systems shall not be:
 - .1 Obstructed.
 - .2 Shut off.
 - .3 Left inactive at the end of a working day or shift.
- .2 Contractor shall be responsible/liable for costs incurred from the fire department, the building owner and the tenants, resulting from false alarms.

25.0 Unforeseen Hazards

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

26.0 Posted Documents

- .1 Post legible versions of the following documents on site:
 - .1 Health and Safety Plan.
 - .2 Sequence of work.
 - .3 Emergency procedures.
 - .4 Site drawing showing project layout, locations of the first-aid station, evacuation route and marshalling station, and the emergency transportation provisions.
 - .5 Notice of Project.
 - .6 Floor plans or site plans.
 - .7 Notice as to where a copy of the Workers' Compensation Act and Regulations are available on the work site for review by employees and workers.
 - .8 Workplace Hazardous Materials Information System (WHMIS) documents.
 - .9 Material Safety Data Sheets (MSDS).
 - .10 List of names of Joint Health and Safety Committee members, or Health and Safety Representative, as applicable.

- .2 Post all Material Safety Data Sheets (MSDS) on site, in a common area, visible to all workers and in locations accessible to tenants when work of this Contract includes construction activities adjacent to occupied areas.
- .3 Postings should be protected from the weather and visible from the street or the exterior of the principal construction site shelter provided for workers and equipment, or as approved by the Departmental Representative.

27.0 Meetings

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

28.0 Correction of Non-Compliance

- .1 Immediately address health and safety non-compliance issues identified by the Departmental Representative.
- .2 Provide Departmental Representative with written report of action taken to correct non-compliance with health and safety issues identified.
- .3 The Departmental Representative may issue a “stop work order” if non-compliance of health and safety regulations is not corrected immediately or within posted time. The General Contractor/subcontractors will be responsible for any costs arising from such a “stop work order”.

END OF SECTION

PART 1 GENERAL

1.1 Inspection

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

1.2 Independent Inspection Agencies

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

1.3 Access to Work

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

1.4 Procedures

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

1.5 Rejected Work

- .1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by Departmental Representative as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.

- .2 Make good other Contractor's work damaged by such removals or replacements promptly.
- .3 If in opinion of Departmental Representative it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, Departmental Representative will deduct from Contract Price difference in value between Work performed and that called for by Contract Documents, amount of which will be determined by Departmental Representative.

1.6 Reports

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

1.7 Tests and Mix Designs

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

1.8 Mock-Ups

- .1 Prepare mock-ups for Work specifically requested in specifications. Include for Work of Sections required to provide mock-ups.
- .2 Construct in locations acceptable to Departmental Representative as specified in specific Section.
- .3 Prepare mock-ups for Departmental Representative review with reasonable promptness and in orderly sequence, to not cause delays in Work.
- .4 Failure to prepare mock-ups in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .5 If requested, Departmental Representative will assist in preparing schedule fixing dates for preparation.
- .6 Remove mock-up at conclusion of Work or when acceptable to Departmental Representative.
- .7 Mock-ups may remain as part of Work.
- .8 Specification section identifies whether mock-up may remain as part of Work or if it is to be removed and when.

1.9 Mill Tests

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

1.10 Equipment and Systems

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

- .2 Refer to Divisions 21, 22, 23, 26, 27, and 28 for definitive requirements.

END OF SECTION

PART 1 GENERAL

1.1 Access and Delivery

- .1 Only the designated entrance may be used for access to building.
 - .1 Maintain for duration of Contract.
 - .2 Make good damage resulting from Contractor's use.
- .2 The Pacific Science Enterprise Centre (PSEC) loading area will be available for the delivery of materials provided that the Centre's property management firm has been given adequate notice.
- .3 There is space on the PSEC property for waste bins, Contractor's trailers, lay-down area or contractor's vehicle parking. Space for these facilities will be limited to the adjacent parking area south of the building. Contractor shall obtain and pay for permit from the District of West Vancouver as required.

1.2 Construction Parking

- .1 Parking will be limited to six (6) regular vehicle spaces at the immediate south of the building adjacent to the wharf as indicated on the drawings and as per clause 1.1.3.
- .2 Additional construction staff shall be responsible for own parking in nearby facilities.

1.3 Storage Facilities

- .1 Confine work and operations of employees to areas indicated on Contract Documents. Do not unreasonably encumber premises with products.
- .2 Do not load or permit to load any part of Work with weight or force that will endanger Work or existing structure or elements.
- .3 Provide and pay for all off-site storage as required. Note that storage space is limited on site. Refer to site plan for location of Contractor's site storage and lay-down area.
- .4 Provide one waste bin for general debris and one for gypsum wallboard and associated products.

1.4 Temporary Construction Power

- .1 Designated electrical power circuits and lighting in existing building may be used for construction purposes at no extra cost, provided that warranties are not affected thereby and electrical components used for temporary power are replaced when damaged. Do not use emergency power or UPS panels for this purpose. Refer to Division 26.

1.5 Water Supply

- .1 Water supply is available in existing building and may be used for construction purposes at no cost.

1.6 Sanitary Facilities

- .1 Contractor may not use existing washrooms within the construction area. Provide and maintain clean and safe temporary sanitary facilities on site for the duration of the project. Construction Staff will not be allowed to use other PSEC facility washrooms.
 - .1 Provide clearly signed temporary sanitary facilities for both male and female workforces on site throughout the project.

1.7 Heating and Ventilation

- .1 Do not begin work until arrangements have been made with the Departmental Representative for protection of on-floor heating, ventilating and air conditioning.
- .2 If there is any dirt in the heating and ventilation system, at the completion of work, it will be the Contractor's responsibility to return system to its original state in accordance with the Departmental Representative's directions.
- .3 Prevent dust and odour migration to other occupied areas.
 - .1 Do not deactivate HVAC system to occupied floors. Purge air from construction floors only when directed by Departmental Representative, where dust and fumes will be generated.
 - .2 Change filters in existing HVAC system frequently.

1.8 Scaffolding

- .1 Construct and maintain scaffolding in rigid, secure and safe manner.
- .2 Erect scaffolding independent of walls. Remove promptly when no longer required.

1.9 Hoisting

- .1 Provide, operate and maintain hoists required for moving of workers, materials and equipment. Make financial arrangements with Sub-contractors for their use of hoists.
- .2 Hoists shall be operated by qualified operator.

1.10 Elevators

- .1 Contractors are not permitted to use the elevator on site.

1.11 Hoarding

- .1 Prior to all demolition and construction, install special painted plywood hoarding, as detailed, in the atrium. Maintain in safe and clean condition throughout duration of project. Submit hoarding plan to Departmental Representative for approval.
- .2 Erect and maintain safety barricades around all openings and other danger areas as required by the National Building Code 2015 and WCB.

1.12 Removal of Temporary Facilities

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

1.13 Signs and Notices

- .1 Signs and notices for safety and instruction shall be in both official languages or graphic symbols conforming to CAN/CSA-Z321.
- .2 Maintain approved signs and notices in good condition for duration of Project and dispose of off site on completion of Project when directed by Departmental Representative.

1.14 Clean-Up

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

- .5 At completion of Project: Remove and dispose of all debris, thoroughly clean and restore site to condition found at commencement of Work. Repair and make good to all damage caused by construction activities.

END OF SECTION

PART 1 GENERAL

1.1 Products/Material and Equipment

- .1 Use NEW products/material and equipment unless otherwise specified. The term "products" is referred to throughout the specifications.
- .2 Use products of 1 manufacturer for material and equipment of the same type or classification unless otherwise specified.
- .3 Unless otherwise specified, comply with manufacturer's latest printed instructions for materials and installation methods.
- .4 Notify Departmental Representative in writing of any conflict between these specifications and manufacturer's instructions. Departmental Representative will designate which document is to be followed.
- .5 Provide metal fastenings and accessories in the same texture, colour and finish as base metal in which they occur.
 - .1 Prevent electrolytic action between dissimilar metals.
 - .2 Use non-corrosive fasteners, anchors and spacers for securing exterior work.
- .6 Fastenings which cause spalling or cracking are not acceptable.
- .7 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.
- .8 Use heavy hexagon heads, semi-finished unless otherwise specified.
- .9 Bolts may not project more than 1 diameter beyond nuts.
- .10 Types of washers as follows:
 - .1 Plain type washers: use on equipment and sheet metal.
 - .2 Soft gasket lock type washers: use where vibrations occur.
 - .3 Resilient washers: use with stainless steel.
- .11 Deliver, store and maintain packaged material and equipment with manufacturer's seals and labels intact.
- .12 Prevent damage, adulteration and soiling of products during delivery, handling and storage. Immediately remove rejected products from site.
- .13 Store products in accordance with suppliers' instructions.
- .14 Touch up damaged factory finished surfaces to Departmental Representative's satisfaction.
 - .1 Use primer or enamel to match original.
 - .2 Do not paint over nameplates.

1.2 Quality of Products

- .1 Products, materials and equipment (referred to as products) incorporated into work shall be new, not damaged or defective, and of the best quality (compatible with the specifications) for the purpose intended. If requested, furnish evidence as to type, source and quality of the products provided.
- .2 Defective products will be rejected regardless of previous inspections.
 - .1 Inspection does not relieve responsibility, but is precaution against oversight or error.

- .2 Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.
- .3 Retain purchase orders, invoices and other documents to prove that all products utilized in this Contract meet the requirements of the specifications. Produce documents when requested by the Departmental Representative.
- .4 Should any dispute arise as to quality or fitness of products, the decision rests strictly with the Departmental Representative based upon the requirements of the Contract documents.
- .5 Unless otherwise indicated in the specifications, maintain uniformity of manufacture for any particular or like item throughout the 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.

1.3 Availability of Products

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

1.4 Manufacturer's Instructions

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

1.5 Contractor's Options for Selection of Products for Tendering

- .1 Products are specified by "Prescriptive" specifications: select any product meeting or exceeding specifications.
- .2 Products specified under "Acceptable Products": select any one of the indicated manufacturers, or any other manufacturer meeting or exceeding the Prescriptive specifications and indicated Products.
- .3 Products specified by performance and referenced standard: select any product meeting or exceeding the referenced standard.
- .4 Products specified to meet particular design requirements or to match existing materials: use only material specified "Approved Product". Alternative products will not be

considered.

- .5 When products are specified by a referenced standard or by Performance specifications, upon request of Departmental Representative obtain from manufacturer an independent laboratory report showing that the product meets or exceeds the specified requirements.

1.6 Substitution After Contract Award

- .1 No substitutions are permitted without prior written approval of the Departmental Representative.
- .2 Proposals for substitution may only be submitted after Contract award. Such request must include statements of respective costs of items originally specified and the proposed substitution.
- .3 Proposals will be considered by the Departmental Representative if:
 - .1 products selected by tenderer from those specified are not available;
 - .2 delivery date of products selected from those specified would unduly delay completion of Contract, or
 - .3 alternative product to that specified, which is brought to the attention of and considered by Departmental Representative as equivalent to the product specified, and will result in a credit to the Contract amount.
- .4 Should the proposed substitution be accepted either in part or in whole, assume full responsibility and costs when substitution affects other work on the project. Pay for design or drawing changes required as result of substitution.
- .5 Amounts of all credits arising from approval of the substitutions will be determined by the Departmental Representative, and the Contract price will be reduced accordingly.

END OF SECTION

PART 1 GENERAL

1.1 Related Work

- .1 Public Works Government Services Canada (PWGSC) Standard Acquisition Clauses and Conditions (SACC)-ID: R0202D, Title: General Conditions "C", In Effect as Of: May 14, 2004.

1.2 Project Cleanliness

- .1 Maintain Work in tidy condition, free from accumulation of waste products and debris, other than that caused by User or other parties.
- .2 Remove waste materials from site at daily regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials on site.
- .3 Clear snow and ice from access to building, bank/pile snow in designated areas only.
- .4 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .5 Provide on-site containers for collection of waste materials and debris.
- .6 Provide and use marked separate bins for recycling. Refer to Section 01 74 19 - Waste Management and Disposal.
- .7 Dispose of waste materials and debris at designated dumping areas off site.
- .8 Clean interior areas prior to start of finishing work, and maintain areas free of dust and other contaminants during finishing operations.
- .9 Store volatile waste in covered metal containers, and remove from premises at end of each working day.
- .10 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.
- .11 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
- .12 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

1.3 Final Cleaning

- .1 When Work is Substantially Performed remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.
- .2 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.
- .3 Prior to final review remove surplus products, tools, construction machinery and equipment.
- .4 Remove waste products and debris other than that caused by User or other parties.
- .5 Remove waste materials from site at regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials on site.
- .6 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.

- .7 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, and mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.
- .8 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, and floors.
- .9 Clean lighting reflectors, lenses, and other lighting surfaces.
- .10 Vacuum clean and dust building interiors, behind grilles, louvres and screens.
- .11 Wax, seal, shampoo or prepare floor finishes, as recommended by manufacturer.
- .12 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.
- .13 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.
- .14 Remove dirt and other disfiguration from exterior surfaces.
- .15 Clean and sweep roofs, gutters, areaways, and sunken wells.
- .16 Sweep and wash clean paved areas.
- .17 Clean equipment and fixtures to sanitary condition; clean or replace filters of mechanical equipment.
- .18 Clean roofs, downspouts, and drainage systems.
- .19 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.
- .20 Remove snow and ice from access to building.

1.4 Waste Management and Disposal

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

PART 2 LOCATIONS

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 General

- .1 The work in this Section includes but is not limited to:
 - .1 Management and disposal of project waste.

1.2 Attachments

- .1 The following forms are attached to this Section.
 - .1 Waste Reduction Workplan Form.
 - .2 Final Diversion Report Form.
 - .3 Waste Material Tracking Form.

1.3 Quality Assurance

- .1 After award of Contract, a mandatory site examination will be held for this project for all Contractors and/or Subcontractors responsible for the Demolition and Construction Waste Management. Date, time and location will be arranged by Departmental Representative.
- .2 Waste Management at Project Meetings:
 - .1 Waste Management Coordinator shall provide an update on the status of waste diversion and management activities at each meeting. A written monthly summary report of this status shall also be provided by the WMC.

1.4 Waste Management Goals

- .1 Prior to the start of the Work, schedule and conduct kick-off meeting with Departmental Representative and Subcontractors to review and discuss FOC's waste management goals and the Contractor's proposed Waste Reduction Workplan for the Construction, Renovation and/or Demolition (CRD) waste to be generated by the Project.
- .2 FOC's Waste Management Goal by weight for this project is 90% to be diverted from landfill of the Project's total CRD waste. Prior to Project close-out, provide Departmental Representative with documentation, including weigh bills, completed tracking forms and a Final Diversion Report, certifying that waste management, recycling, reuse of recyclable and reusable materials have been extensively practiced.
- .3 The following represent the target percentages for reuse and/or recycling for specific materials:
 - .1 Masonry 95%.
 - .2 Metal 100%.
 - .3 Mechanical – Plumbing Piping 90%.
 - .4 Packaging 100%.
- .4 Accomplish maximum source reduction, reuse and recycling of solid waste.
- .5 Protect the environment and prevent environmental pollution and damage.

1.5 References

- .1 Canadian Green Building Council (CGBC), Green Building Rating System, for New Construction and Major Renovations, Commercial Interiors LEED V4
- .2 Environmental Protection Act, Ontario 3R's Regulations for Waste Management

Programs applicable to construction and demolition projects greater than 2000 square metres:

- .1 Reg. 102/94, Waste Audits and Waste Reduction Workplans.
- .2 Reg. 103/94, Source Separation Programs.

1.6 Related Sections

- .1 Section 02 41 00 - Demolition.

1.7 Definitions

- .1 Approved/Authorized recycling facility: Waste recycler approved by application provincial authority or other users of material for recycling approved by the Departmental Representative.
- .2 Construction, Renovation and/or Demolition (CRD) Waste: Solid, non-hazardous waste material generated during construction, demolition, and/or renovation projects.
- .3 Recyclable: Ability of product or material to be recovered at end of its life cycle and re-manufactured into new product for reuse by others.
- .4 Recycle: Process by which waste and recyclable materials are transformed or collected for purpose of being transferred into new products.
- .5 Recycling: Process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using in altered form. Does not include burning, incinerating, or thermally destroying.
- .6 Reuse: Repeated use of product in same form but not necessarily for same purpose. Reuse includes:
 - .1 Salvaging reusable materials from re-modeling projects, before demolition stage, for resale, reuse on current project, or storage for use on future projects.
 - .2 Returning reusable items including pallets or unused products to vendors.
- .7 Salvage: Removal of structural and non-structural materials from deconstruction/disassembly projects for purpose of reuse or recycling.
- .8 Source Separation: Acts of keeping different types of waste materials separate from the point at which they are deconstructed, disassembled or demolished.
- .9 Waste Audit: Detailed inventory of the estimated quantities of waste materials into categories of reuse, recycling or landfill. Requires quantifying by weight the estimated amounts of material and waste to be generated during construction, demolition, deconstruction, or renovation.
- .10 Waste Diversion Report: Detailed report of final results, quantifying cumulative weights and percentages of waste materials reused, recycled and land-filled over the course of the Project. Measures success against WRW goals and identifies lessons learned.
- .11 Waste Management Coordinator: Contractor representative responsible for supervising on-site waste management activities as well as coordinating required submittals and reports.
- .12 Waste Reduction Workplan: Report which outlines the strategy to optimize opportunities for reduction, reuse, and recycling of waste materials generated by the Project. Specifies diversion goals, implementation and reporting procedures, anticipated results and responsibilities.
- .13 Waste Source Separation Program: The implementation and coordination of ongoing

activities to ensure designated waste materials will be sorted in pre-defined categories sent for recycling and reuse, maximizing diversion and the potential to reduce disposal costs.

1.8 Documents

- .1 Maintain and post in a visible, accessible area at job site, one copy of following documents:
 - .1 Waste Reduction Workplan.
 - .2 Waste Source Separation Program.

1.9 Submittals

- .1 Submittals in accordance with Section 01 33 00.
- .2 Prepare and submit following prior to Project start-up:
 - .1 Waste Reduction Workplan.
 - .2 Waste Source Separation Program.
- .3 Prepare and submit the following weekly throughout the Project or at intervals agreed to by the Department Representative:
 - .1 Receipts, scale tickets, waybills, and/or waste disposal receipts that show quantities and types of materials reused, recycled, or disposed of.
 - .2 Updated Waste Material Tracking Form – Attached.
 - .3 A written **monthly** summary report detailing the cumulative amounts of waste materials reused, recycled and landfilled, and a brief status of the ongoing waste management activities. Refer to attached Diversion Report form to track waste amounts.
- .4 Submit the following documentation prior to final payment:
 - .1 The Final Waste Diversion Report – indicating the final quantities by material types (in tonnes) salvaged for reuse, recycling or disposal in landfill and the recycling centres, re-use depots, landfills and other waste processors that received these waste materials. Form Attached.
 - .2 Provide all remaining receipts, scale tickets, waybills, waste disposal receipts that confirm the quantities and types of materials reused, recycled, or disposed of and their destination.

1.10 Waste Reduction Workplan

- .1 Prior to the Project start-up and not less than 10 days before the kick-off meeting, prepare and submit a written Waste Reduction Workplan report.
- .2 Structure Waste Reduction Workplan to prioritize actions and follow 3R's hierarchy, with Reduction as first priority, followed by Reuse, then Recycle.
- .3 The Waste Reduction Workplan report should include but is not limited to:
 - .1 Realistic goals for waste reduction, recognize existing barriers and develop strategies to overcome these barriers.
 - .2 Destination of materials listed.
 - .3 Deconstruction/disassembly techniques and sequencing.
 - .4 Recycler or reclaimer requirements.
 - .5 Schedule for deconstruction/disassembly.

- .6 Location.
- .7 Security.
- .8 Protection.
- .9 Materials handling and removal procedures.
- .10 Clear labeling of storage areas.
- .11 Details on materials handling and removal procedures.
- .12 Quantities for materials to be salvaged for reuse or recycled and materials sent to landfill. Detailed and Summary Waste Reduction Workplan forms are attached to this section.
- .4 Post Waste Reduction Workplan or summary where workers at site are able to review content.
- .5 Monitor and report on waste reduction by documenting total volume and cost of actual waste removed from project.

1.11 Material Source Preparation

- .1 As a part of the Waste Reduction Workplan, prepare and submit for review a Waste Source Separation Program prior to project start-up.
- .2 The Waste Source Separation Program shall detail the Contractor's methodology and planned on-site activities for separation of reusable and recyclable waste material from the other waste intended for landfill.
- .3 Provide all on-site facilities and containers for separation and storage of materials.
- .4 Provide training for employees/trades in the handling and separation of materials for reuse and/or recycling.
- .5 Clearly and securely label all containers to identify types/conditions of materials accepted and assist employees/trades in separating materials accordingly.
- .6 On-site sale of salvaged materials is not permitted unless authorized in writing by the Departmental Representative and provided that all site safety regulations and security requirements are adhered to.

1.12 Use of Site and Facilities

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

1.13 Scheduling

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

1.14 Waste Diversion Resources

- .1 The Contractor is responsible for researching and locating waste diversion resources and service providers.

PART 2 PRODUCTS

2.1 Not used.

PART 3 EXECUTION

3.1 Processing of Waste Materials

- .1 Implement the Waste Reduction Workplan and Waste Source Separation Program generated for the project in compliance with approved methods and as reviewed by the Departmental Representative.
- .2 Provide on-site facilities and containers for collection and storage of reusable and recyclable materials.
- .3 Locate containers in designed locations or areas approved by the Departmental Representative.
- .4 Keep separation areas clean and neatly organized. Separation activities shall not interfere with the daily operations of the building or areas of use.
- .5 Collect, handle, and store separated materials using methods which minimize material damage.
- .6 Store materials to be reused or recycled on-site in locations indicated or as directed by Departmental Representative.
- .7 Transport Salvaged materials off-site to approved and/or authorized recycling facility or to users of material for recycling.
- .8 Separate non-salvageable materials from salvaged items. Transport and deliver non-salvageable items to licensed disposal facility.
- .9 Protect, stockpile, store and catalogue salvaged items.

3.2 Weighing Materials

- .1 Unless otherwise agreed to by the Departmental Representative, all materials are to be weighed, whether designated for reuse, recycling, other diversion, or landfill.
- .2 Where agreed by the Departmental Representative, weights of material not weighed directly, will be obtained using measure values and unit weights.

3.3 Scheduling

- .1 Coordinate work with other activities at the site to ensure the timely and orderly progress of the work.

3.4 Protection

- .1 Unless specified otherwise, materials removed and salvaged become the property of the Contractor.
- .2 Protect salvaged materials intended for reuse on the site from damage. Catalogue and/or inventory all materials salvaged for reuse on-site.
- .3 Protect structural components not for removal or demolition from movement or damage.
- .4 Support affected structures. If safety of building is endangered, cease operations and immediately notify Departmental Representative.
- .5 Prevent contamination of materials to be salvaged and recycled and handle materials in accordance with requirements for acceptance by designated facilities.
- .6 Avoid co-mingling of materials intended for reuse or recycling. If required, remove co-mingled materials to off-site processing facility for separation.

3.5 Disposal of Wastes

- .1 Handle waste materials not reused, salvaged, or recycled in accordance with appropriate regulations and codes.
- .2 Do not bury rubbish or waste materials, and do not dispose of waste into waterways, storm, or sanitary sewers.

3.6 Documentation and Records

- .1 Keep accurate records of all construction waste generated and sent off-site during the Project using the sample Waste Material Tracking Form attached of this section. The information tracked should include:
 - .1 Number and size bins.
 - .2 Waste type (s) of each bin.
 - .3 Total tonnage generated of specific material.
 - .4 Tonnage reused or recycled of specific material.
 - .5 Reused or recycled waste destination.
- .2 Obtain receipts, scale tickets, and/or waybills for all waste materials removed from site. Where the receiver cannot provide the noted proof of delivery, provide copy of Waste Material Tracking Form signed by the receiver.
- .3 Prepare monthly Summary Waste Diversion Reports summarizing waste removal activities and quantities from site.
- .4 Materials reused on-site are considered to be diverted from landfill and as such are to be included in all reporting.
- .5 At the completion of the project, prepare a written Final Waste Diversion Report and summary indicating all final quantities of materials reused, recycled or disposed of as well as the following:
 - .1 Identify final diversion results and measure success against goals from the WRW.
 - .2 Compare final quantities/percentages diverted with initial projections in Waste Reduction Workplan, explaining variances.
 - .3 Supporting documentation (eg waybills and tracking forms).
 - .4 Description of issues, resolutions and lessons learned.

END OF SECTION

PART 1 GENERAL

1.1 Summary

- .1 Section Includes:
 - .1 General requirements relating to commissioning of project's components and systems, specifying general requirements to PV of components, equipment, sub-systems, systems, and integrated systems.
- .2 Related Sections:
 - .1 Section 01 33 00 Submittal Procedures
 - .2 Section 01 78 30 Closeout Submittals
 - .3 Section 01 91 31 Commissioning (CX) Plan
 - .4 Section 01 91 41 Commissioning Training
 - .5 Section 08 71 00 Door Hardware
 - .6 Division 21 Plumbing
 - .7 Division 23 Heating, Ventilating and Air Conditioning
 - .8 Division 26 Electrical
 - .10 Division 28 Electronic Safety and Security
- .3 Acronyms:
 - .1 AFD - Alternate Forms of Delivery, service provider.
 - .2 BMM - Building Management Manual.
 - .3 Cx - Commissioning.
 - .4 EMCS - Energy Monitoring and Control Systems.
 - .5 O&M - Operation and Maintenance.
 - .6 PI - Product Information.
 - .7 PV - Performance Verification.
 - .8 TAB - Testing, Adjusting and Balancing

1.2 General

- .1 Cx is a planned program of tests, procedures and checks carried out systematically on systems and integrated systems of the finished Project. Cx is performed after systems and integrated systems are completely installed, functional and Contractor's Performance Verification responsibilities have been completed and approved. Objectives:
 - .1 Verify installed equipment, systems and integrated systems operate in accordance with contract documents and design criteria and intent.
 - .2 Ensure appropriate documentation is compiled into the BMM.
 - .3 Effectively train O&M staff.
- .2 Contractor assists in Cx process, operating equipment and systems, troubleshooting and making adjustments as required.
 - .1 Systems to be operated at full capacity under various modes to determine if they function correctly and consistently at peak efficiency. Systems to be interactively with each other as intended in accordance with Contract Documents and design criteria.

- .2 During these checks, adjustments to be made to enhance performance to meet environmental or user requirements.
- .3 Design Criteria: as per client's requirements or determined by designer. To meet Project functional and operational requirements.

1.3 Commissioning Overview

- .1 The Construction Contractor shall engage and pay for a 3rd party Commissioning Authority. The Commissioning Authority develops and updates the commissioning plan, prepares commissioning forms, training plan and other commissioning documentation. Witnesses and certifies performance of all commissioning activities, organizes and monitors all activities as per the contract agreement, and is responsible for its contractual design, construction, and warranty related commitments. The Commissioning Authority represents the Owner's and User's interests, and is responsible for overseeing all commissioning activities during the development, implementation and post construction stages of the project.
- .2 Cx to be a line item of Contractor's cost breakdown.
- .3 Cx activities supplement field quality and testing procedures described in relevant technical sections.
- .4 Cx is conducted in concert with activities performed during stage of project delivery. Cx identifies issues in Planning and Design stages which are addressed during Construction and Cx stages to ensure the built of M15 addition is constructed and proven to operate satisfactorily under weather, environmental and occupancy conditions to meet functional and operational requirements. Cx activities includes transfer of critical knowledge to facility operational personnel.
- .5 Departmental Representative will issue Interim Acceptance Certificate when:
 - .1 Completed Cx documentation has been received, reviewed for suitability and approved by Commissioning Authority.
 - .2 Equipment, components and systems have been commissioned.
 - .3 O&M training has been completed.

1.4 Non-Conformance to Performance Verification Requirements

- .1 Should equipment, system components, and associated controls be incorrectly installed or malfunction during Cx, correct deficiencies, re-verify equipment and components within the unfunctional system, including related systems as deemed required by Commissioning Authority to ensure effective performance.
- .2 Costs for corrective work, additional tests, inspections, to determine acceptability and proper performance of such items to be borne by Contractor. Above costs to be in form of progress payment reductions or hold-back assessments.

1.5 Pre-CX Review

- .1 Before Construction:
 - .1 Review contract documents, confirm by writing to Commissioning Authority.
 - .1 Adequacy of provisions for Cx.
 - .2 Aspects of design and installation pertinent to success of Cx.
- .2 During Construction:
 - .1 Co-ordinate provision, location and installation of provisions for Cx.

- .3 Before start of Cx:
 - .1 Ensure installation of related components, equipment, sub-systems, systems is complete.
 - .2 Fully understand requirements and procedures.
 - .3 Understand completely design criteria and intent and special features.
 - .4 Submit complete start-up documentation to Commissioning Authority.
 - .5 Have Construction schedules up-to-date.
 - .6 Ensure systems have been cleaned thoroughly.
 - .7 Complete TAB procedures on systems, submit TAB reports to Commissioning Authority for review and approval.
 - .8 Ensure "As-Built" system schematics are available.
- .4 Inform Commissioning Authority in writing of discrepancies and deficiencies on finished works.

1.6 Conflicts

- .1 Report conflicts between requirements of this section and other sections to Commissioning Authority before start-up and obtain clarification.
- .2 Failure to report conflict and obtain clarification will result in application of most stringent requirement.

1.7 Submittals

- .1 Submittals: in accordance with Section 01 33 00 – Submittal Procedures.
 - .1 Submit no later than 4 weeks after award of Contract:
 - .1 Name of Contractor's Cx agent.
 - .2 Draft Cx documentation.
 - .3 Preliminary Cx schedule.
 - .2 Request in writing to Commissioning Authority for changes to submittals and obtain written approval at least 8 weeks prior to start of Cx.
 - .3 Submit proposed Cx procedures to Commissioning Authority where not specified and obtain written approval at least 8 weeks prior to start of Cx.
 - .4 Provide additional documentation relating to Cx process required by Commissioning Authority.

1.8 Commissioning Documentation

- .1 Provide Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms for requirements and instructions for use.
- .2 Commissioning Authority to review and approve Cx documentation.
- .3 Provide completed and approved Cx documentation to Commissioning Authority.
- .4 Provide completed SNC-Lavalin CMMS Forms, included in Architectural Appendix 'D', for all new mechanical and electrical equipment.

1.9 Commissioning Schedule

- .1 Provide detailed Cx schedule as part of construction schedule
- .2 Provide adequate time for Cx activities prescribed in technical sections and

commissioning sections including:

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

1.10 Commissioning Meetings

- .1 Convene Cx meetings following project meetings:
- .2 Purpose: to resolve issues, monitor progress, identify deficiencies, relating to Cx.
- .3 Continue Cx meetings on regular basis until commissioning deliverables have been addressed.
- .4 At 60% construction completion stage. Construction Progress Schedule Commissioning Authority to call a separate Cx scope meeting to review progress, discuss schedule of equipment start-up activities and prepare for Cx. Issues at meeting to include:
 - .1 Review duties and responsibilities of Contractor and subcontractors, addressing delays and potential problems.
 - .2 Determine the degree of involvement of trades and manufacturer's representatives in the commissioning process.
- .5 Thereafter Cx meetings to be held until project completion and as required during equipment start-up and functional testing period.
- .6 Meeting will be chaired by Commissioning Authority, who will record and distribute minutes.
- .7 Ensure subcontractors and relevant manufacturer representatives are present at 60% and subsequent Cx meetings and as required.

1.11 Starting and Testing

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

1.12 Witnessing of Starting and Testing

- .1 Provide 7 days notice prior to commencement.
- .2 Commissioning Authority to witness of start-up and testing.
- .3 Contractor's Cx Agent to be present at tests performed and documented by sub-trades, suppliers and equipment manufacturers.

1.13 Manufacturer's Involvement

- .1 Factory testing: manufacturer to:
 - .1 Coordinate time and location of testing.
 - .2 Provide testing documentation for approval by Commissioning Authority.
 - .3 Arrange for Departmental Representative to witness tests.
 - .4 Obtain written approval of test results and documentation from Commissioning Authority before delivery to site.
- .2 Obtain manufacturers installation, start-up and operations instructions prior to start-up of

components, equipment and systems and review with Commissioning Authority

- .1 Compare completed installation with manufacturer's published data, record discrepancies, and review with manufacturer.
- .2 Modify procedures detrimental to equipment performance and review same with manufacturer before start-up.
- .3 Integrity of warranties:
 - .1 Use manufacturer's trained start-up personnel where specified elsewhere in other divisions or required to maintain integrity of warranty.
 - .2 Verify with manufacturer that testing as specified will not void warranties.
- .4 Qualifications of manufacturer's personnel:
 - .1 Experienced in design, installation and operation of equipment and systems.
 - .2 Ability to interpret test results accurately.
 - .3 To report results in clear, concise, logical manner.

1.14 Procedures

- .1 Verify that equipment and systems are complete, clean, and operating in normal and safe manner prior to conducting start-up, testing and Cx.
- .2 Conduct start-up and testing in following distinct phases:
 - .1 Included in delivery and installation:
 - .1 Verification of conformity to specification, approved shop drawings and completion of PI report forms.
 - .2 Visual inspection of quality of installation.
 - .2 Start-up: follow accepted start-up procedures.
 - .3 Operational testing: document equipment performance.
 - .4 System PV: include repetition of tests after correcting deficiencies.
 - .5 Post-substantial performance verification: to include fine-tuning.
- .3 Correct deficiencies and obtain approval from Commissioning Authority after distinct phases have been completed and before commencing next phase.
- .4 Document require tests on approved PV forms.
- .5 Failure to follow accepted start-up procedures will result in re-evaluation of equipment by an independent testing agency selected by Commissioning Authority. If results reveal that equipment start-up was not in accordance with requirements, and resulted in damage to equipment, implement following:
 - .1 Minor equipment/systems: implement corrective measures approved by Commissioning Authority.
 - .2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures approved by Commissioning Authority.
 - .3 If evaluation report concludes that major damage has occurred, Commissioning Authority shall reject equipment.
 - .1 Rejected equipment to be remove from site and replace with new.
 - .2 Subject new equipment/systems to specified start-up procedures.

1.15 Start-up Documentation

- .1 Assemble start-up documentation and submit to Commissioning Authority for approval before commencement of commissioning.
- .2 Start-up documentation to include:
 - .1 Factory and on-site test certificates for specified equipment.
 - .2 Pre-start-up inspection reports.
 - .3 Signed installation/start-up check lists.
 - .4 Start-up reports,
 - .5 Step-by-step description of complete start-up procedures, to permit Commissioning Authority to repeat start-up at any time.

1.16 Operation and Maintenance of Equipment and Systems

- .1 After start-up, operate and maintain equipment and systems as directed by equipment/system manufacturer.
- .2 With assistance of manufacturer develop written maintenance program and submit Commissioning Authority for approval before implementation.
- .3 Operate and maintain systems for length of time required for commissioning to be completed.
- .4 After completion of commissioning, operate and maintain systems until issuance of certificate of interim acceptance.

1.17 Test Results

- .1 If start-up, testing and/or PV produce unacceptable results, repair, replace or repeat specified starting and/or PV procedures until acceptable results are achieved.
- .2 Provide manpower and materials, assume costs for re-commissioning.

1.18 Start of Commissioning

- .1 Notify Commissioning Authority at least 20 days prior to start of Cx.
- .2 Start Cx after elements of building affecting start-up and performance verification of systems have been completed.

1.19 Instruments/Equipment

- .1 Submit to Commissioning Authority for review and approval:
 - .1 Complete list of instruments proposed to be used.
 - .2 Listed data including, serial number, current calibration certificate, calibration date, calibration expiry date and calibration accuracy.
- .2 Provide the following equipment as required:
 - .1 2-way radios.
 - .2 Ladders.
 - .3 Equipment as required to complete work.

1.20 Commissioning Performance Verification

- .1 Carry out Cx:
 - .1 Under actual operating conditions, over entire operating range, in all modes.

- .2 On independent systems and interacting systems.
- .2 Cx procedures to be repeatable and reported results are to be verifiable.
- .3 Follow equipment manufacturer's operating instructions.
- .4 EMCS trending to be available as supporting documentation for performance verification.

1.21 Witnessing Commissioning

- .1 Commissioning Authority to witness activities and verify results.

1.22 Authorities Having Jurisdiction

- .1 Where specified start-up, testing or commissioning procedures duplicate verification requirements of authority having jurisdiction, arrange for authority to witness procedures so as to avoid duplication of tests and to facilitate expedient acceptance of facility.
- .2 Obtain certificates of approval, acceptance and compliance with rules and regulation of authority having jurisdiction.
- .3 Provide copies to Commissioning Authority within 5 days of test and with Cx report.

1.23 Commissioning Constraints

- .1 Since access into secure or sensitive areas will be very difficult after occupancy it is necessary to complete Cx of occupancy, weather, and seasonal sensitive equipment and systems in these areas before issuance of the Interim Certificate, using, if necessary, simulated thermal loads.

1.24 Extrapolation of Results

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

1.25 Extent of Verification

- .1 Provide manpower and instrumentation to verify up to 30 % of reported results, unless specified otherwise in other sections.
- .2 Number and location to be at discretion of Commissioning Authority.
- .3 Conduct tests repeated during verification under same conditions as original tests, using same test equipment, instrumentation.
- .4 Review and repeat commissioning of systems if inconsistencies found in more than 20% of reported results.
- .5 Perform additional commissioning until results are acceptable to Commissioning Authority.

1.26 Repeat Verification

- .1 Assume costs incurred by Commissioning Authority for third and subsequent verifications where:
 - .1 Verification of reported results fail to receive Commissioning Authority's approval.
 - .2 Repetition of second verification again fails to receive approval.

- .3 Commissioning Authority deems Contractor's request for second verification was premature.

1.27 Sundry Checks and Adjustments

- .1 Make adjustments and changes which become apparent as Cx proceeds.
- .2 Perform static and operational checks as applicable and as required.

1.28 Deficiencies, Faults, Defects

- .1 Correct deficiencies found during start-up and Cx to satisfaction of Commissioning Authority.
- .2 Report problems, faults or defects affecting Cx to Commissioning Authority in writing. Stop Cx until problems are rectified. Proceed with written approval from Commissioning Authority.

1.29 Completion of Commissioning

- .1 Upon completion of Cx leave systems in normal operating mode.
- .2 Except for warranty and seasonal verification activities specified in Cx specifications, complete Cx prior to issuance of Interim Certificate of Completion.
- .3 Cx to be considered complete when contract Cx deliverables have been submitted and accepted by Commissioning Authority.

1.30 Activities Upon Completion of Commissioning

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

1.31 Training

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

1.32 Maintenance Materials, Spare Parts, Special Tools

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

1.33 Occupancy

- .1 Cooperate fully with Commissioning Authority during stages of acceptance and occupancy of facility.

1.34 Installed Instrumentation

- .1 Use instruments installed under Contract for TAB and PV if:
 - .1 Accuracy complies with these specifications.
 - .2 Calibration certificates have been deposited with Commissioning Authority.
- .2 Calibrated EMCS sensors may be used to obtain performance data provided that sensor calibration has been completed and accepted.

1.35 Performance Verification Tolerances

- .1 Application tolerances:
 - .1 Specified range of acceptable deviations of measured values from specified values or

specified design criteria. Except for special areas, to be within +/- 10% of specified values.

- .2 Instrument accuracy tolerances:
 - .1 To be of higher order of magnitude than equipment or system being tested.
- .3 Measurement tolerances during verification:
 - .1 Unless otherwise specified actual values to be within +/- 2 % of recorded values.

1.36 Owner's Performance Testing

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

1.37 Deliverables

- .1 Deliverables required by the PWGSC Commissioning Manager from the Commissioning Authority:
 - .1 CX Plan and Schedule.
 - .2 Accepted Shop Drawings.
 - .3 Accepted PI Forms.
 - .4 Accepted TAB Report.
 - .5 Accepted PV Forms.
 - .6 Accepted O&M Manual.
 - .7 Accepted System and Integrated System Test Report.
 - .8 Accepted Training and Attendance Form.
 - .9 Accepted "As Built" Plans and Specifications.
 - .10 Accepted SNC-Lavalin CMMS Forms.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1	Section 01 11 55	General Instructions
.2	Section 01 91 13	General Commissioning (CX) Requirements
.3	Section 01 91 41	Commissioning: Training
.4	Division 22	Plumbing
.5	Division 23	Heating, Ventilating and Air Conditioning
.6	Division 26	Electrical
.7	Division 28	Electronic Safety and Security

1.2 Definitions

- .1 Acronyms:
 - .1 BMM – Building Management Manual.
 - .2 Cx – Commissioning.
 - .3 EMCS – Energy Monitoring and Control.
 - .4 O&M – Operation and Maintenance.
 - .5 PI – Product Information.
 - .6 PV – Performance Verification
 - .7 TAB – Testing, Adjusting and Balancing.
- .2 Cx – a required program of tests, procedures and checks carried out systematically on systems and integrated systems of the finished Project. Cx is performed after systems and integrated systems are completely installed, functional and Contractor’s Performance Verification responsibilities have been completed and approved.
- .3 Commissioning Roles and Responsibilities
 - .1 PWGSC QA Commissioning Manager: Undertakes a quality assurance role on behalf of the PWGSC project team and is responsible for fulfilling the PWGSC Commissioning Quality Management System requirements. Provides technical advice on O&M matters. Reviews commissioning documentation from the Commissioning Authority at all stages of project delivery and provides support to the Project Manager in matters related to commissioning.
 - .2 The Construction Contractor shall engage and pay for a 3rd party Commissioning Authority. The Commissioning Authority develops and updates the commissioning plan, prepares commissioning forms, training plan and other commissioning documentation. Witnesses and certifies performance of all commissioning activities, organizes and monitors all activities as per the contract agreement, and is responsible for its contractual design, construction, and warranty related commitments. The Commissioning Authority represents the Owner’s and User’s interests, and is responsible for overseeing all commissioning activities during the development, implementation and post construction stages of the project.

1.3 Quality Assurance

- .1 Testing organization: current member in good standing of AABC certified to perform specified services.

- .2 Comply with applicable procedures and standards of the certification sponsoring association.
- .3 Perform services under direction of supervisor qualified under certification requirements of sponsoring association.

1.4 References

- .1 Associated Air Balance Council (AABC): National Standards for Field Measurement and Instrumentation, Total systems Balance, Air Distribution-Hydrionics Systems.
- .2 Public Works and Government Services Canada (PWGSC)
 - .1 PWGSC – Commissioning Guidelines CP.4 3rd edition.
- .3 Underwriters’ Laboratories of Canada (ULC)
- .4 Standing Committee of Consulting Engineers and Mechanical Contractors in British Columbia.
 - .1 The Code of Practice for Commissioning Mechanical Systems in Buildings, 1986.

1.5 Submittals

- .1 Prior to start of Work, submit name of organization proposed to perform services. Designate who has managerial responsibilities for coordination of entire testing, adjusting and balancing. CX Authority as managerial responsibilities.
- .2 Submit documentation to confirm organization compliance with quality assurance provision.
- .3 Submit three (3) preliminary specimen copies of each or report forms proposed for use.
- .4 Ten (10) days prior to Substantial Performance, submit three (3) copies of final reports on applicable forms.
- .5 Submit reports of testing, adjusting and balancing postponed due to seasonal, climatic, occupancy, or other reasons beyond Contractor’s control, promptly after execution of those services.
- .6 CX schedule submittal.

1.6 Extent of Cx

- .1 Commission mechanical systems and associated equipment
 - .1 HVAC and exhaust systems
 - .2 Plumbing fixtures and piping
 - .3 EMCS Systems
- .2 Commission electrical systems and equipment
 - .1 Lighting system
 - .2 Fire alarm system
 - .3 Power distribution systems
 - .4 Communications cabling systems
 - .5 Grounding systems
- .3 Miscellaneous new and relocated equipment
 - .1 Communications equipment
 - .2 Computers and associated equipment

- .3 User's special equipment

1.7 Procedures – General

- .1 Comply with procedural standards of certifying association under whose standard services will be performed.
- .2 Notify Departmental Representative three (3) days prior to beginning of operations.
- .3 Accurately record data for each step.
- .4 Report to Departmental Representative any deficiencies or defects noted during performance of services.

1.8 Contractor's Responsibilities

- .1 Prepare each system for testing and balancing:
- .2 Cooperate with testing organization and provide access to equipment and systems.
- .3 Provide personnel and operate systems at designated times, and under conditions required for proper testing, adjusting, and balancing.
- .4 Notify testing organization seven (7) days prior to time project will be ready for testing, adjusting, and balancing.

1.9 Preparation

- .1 Provide instruments required for testing, adjusting, and balancing operations.
- .2 Make instruments available to Departmental Representative to facilitate spot checks during testing.
- .3 Retain possession of instruments and remove at completion of services.
- .4 Verify systems installation is complete and in continuous operation.
- .5 Verify lighting is turned on when lighting is included in cooling load.
- .6 Verify equipment such as computers and electronic equipment are in full operation.

1.10 Training

- .1 Refer to Section 01 91 41.

1.11 Deliverables

- .1 Deliverables required by the FOC Commissioning Manager from the Commissioning Authority:
 - .1 CX Plan and Schedule.
 - .2 Accepted Shop Drawings.
 - .3 Accepted PI Forms.
 - .4 Accepted TAB Report.
 - .5 Accepted PV Forms.
 - .6 Accepted O&M Manual.
 - .7 Accepted System and Integrated System Test Report.
 - .8 Accepted Training and Attendance Form.
 - .9 Accepted "As Built" Plans and Specifications.

1.12 Final Reports

- .1 Organization having managerial responsibility shall make reports.
- .2 Ensure each form bears signature of recorder, and that of supervisor of reporting organization.
- .3 Identify each instrument used, and latest date of calibration of each.

1.13 Completion of Commissioning

- .1 Upon completion of Cx leave systems in normal operating mode.
- .2 Except for warranty and seasonal verification activities specified in Cx specifications, complete Cx prior to issuance of Interim Certificate of Completion.
- .3 Cx deliverables have been submitted and accepted by Departmental Representative.

END OF SECTION

PART 1 GENERAL

1.1 Summary

- .1 Section Includes:
 - .1 This Section specifies roles and responsibilities of Commissioning Training.
- .2 Related Sections:
 - .1 Section 01 91 13 General Commissioning (CX) Requirements
 - .2 Section 01 91 31 Commissioning (CX) Plan

1.2 Trainees

- .1 Trainees: personnel selected for operating and maintaining this facility. Includes Facility Manager, building operators, maintenance staff, security staff, and technical specialists as required.
- .2 Trainees will be available for training during later stages of construction for purposes of familiarization with systems.

1.3 Instructors

- .1 Commissioning Authority will provide:
 - .1 Descriptions of systems.
 - .2 Instruction on design philosophy, design criteria, and design intent.
- .2 Contractor and certified factory-trained manufacturers' personnel: to provide instruction on the following:
 - .1 Start-Up, operation, shut-down of equipment, components and systems.
 - .2 Control features, reasons for, results of, implications on associated systems of, adjustment of set points of control and safety devices.
 - .3 Instructions on servicing, maintenance and adjustment of systems, equipment and components.
- .3 Contractor and equipment manufacturer to provide instruction on:
 - .1 Start-up, operation, maintenance and shut-down of equipment they have certified installation, started up and carried out PV tests.

1.4 Training Objectives

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

1.5 Training Materials

- .1 Instructors to be responsible for content and quality.
- .2 Training materials to include:
 - .1 "As-Built" Record Contract Documents.
 - .2 Operating Manual.
 - .3 Maintenance Manual.
 - .4 Management Manual.
 - .5 TAB and PV Reports.
- .3 Departmental Representative, Commissioning Authority and Facility Manager will review training manuals.
- .4 Training materials to be in a format that permits future training procedures to same degree of detail.
- .5 Supplement training materials:
 - .1 Transparencies for overhead projectors.
 - .2 Multimedia presentations.
 - .3 Manufacturer's training videos.
 - .4 Equipment models.

1.6 Scheduling

- .1 Include in Commissioning Schedule time for training.
- .2 Deliver training during regular working hours, training sessions to be 3 hours in length.
- .3 Training to be completed prior to acceptance of facility.

1.7 Responsibilities

- .1 Be responsible for:
 - .1 Implementation of training activities,
 - .2 Coordination among instructors,
 - .3 Quality of training, training materials,
- .2 Departmental Representative will evaluate training and materials.
- .3 Upon completion of training, provide written report, signed by Instructors, witnessed by Commissioning Authority and Departmental Representative.

1.8 Training Content

- .1 Training to include demonstrations by Instructors using the installed equipment and systems.
- .2 Content includes:
 - .1 Review of facility and occupancy profile.

- .2 Functional requirements.
 - .3 System philosophy, limitations of systems and emergency procedures.
 - .4 Review of system layout, equipment, components and controls.
 - .5 Equipment and system start-up, operation, monitoring, servicing, maintenance and shut-down procedures.
 - .6 System operating sequences, including step-by-step directions for starting up, shut-down, operation of valves, dampers, switches, adjustment of control settings and emergency procedures.
 - .7 Maintenance and servicing.
 - .8 Trouble-shooting diagnosis.
 - .9 Inter-Action among systems during integrated operation.
 - .10 Review of O&M documentation.
- .3 Provide specialized training as specified in relevant Technical Sections of the construction specifications.

1.9 Video-Based Training

- .1 Manufacturer's videotapes to be used as training tool with Commissioning Authority and Departmental Representative's review and written approval 3 months prior to commencement of scheduled training.
- .2 On-Site training videos:
 - .1 Videotape training sessions for use during future training.
 - .2 To be performed after systems are fully commissioned.
 - .3 Organize into several short modules to permit incorporation of changes.
- .3 Production methods to be high quality.

END OF SECTION

PART 1 GENERAL

1.1 Related Work

.1	Section 01 14 00	Work Restrictions
.2	Section 01 51 00	Temporary Facilities
.3	Section 01 74 21	Waste Management and Disposal
.4	Section 09 22 00	Non-Structural Metal Framing
.5	Section 09 31 00	Ceramic Tile
.6	Section 09 53 00	Acoustical Ceiling Suspension
.7	Section 09 65 00	Resilient Flooring
.8	Section 09 68 00	Carpeting
.9	Division 22	Plumbing Demolition
.10	Division 23	Heating, Ventilating & Air Conditioning Demolition
.11	Division 26	Electrical Demolition
.12	Architectural Appendix 'A'	Hazardous Building Materials Survey Report

1.2 Precautions

- .1 Should material resembling spray or trowel applied asbestos or any other designated substance be encountered in the course of demolition, stop work, take preventative measures and notify the Consultant immediately. Do not proceed until written instructions have been received.
- .2 All remediation of encountered hazardous substances shall be executed in accordance with Sections 02 82 00 and 02 83 00.

1.3 Protection

- .1 Prevent movement, settlement or damage to adjacent structures and paving. Provide bracing and shoring as required. Make good damage and be liable for injury caused by demolition.
- .2 Take precautions during demolition to support parts of structures not being demolished, and if safety of existing booth appears to be endangered, cease operations and notify Consultant.
- .3 Prevent debris from blocking drainage which must remain in operation.
- .4 Take precaution during demolition to protect all adjacent finished surfaces. Make good any damage to adjacent surfaces.
- .5 Except where otherwise noted, all exterior walls are to remain intact and provide a weathertight building envelope. Make good any damages due to demolition to exterior walls. Where exterior envelope elements are removed, provide temporary secure and weathertight closures.
- .6 Fire burning and selling of waste of materials is not permitted on site.
- .7 Do not bury waste or materials on site.
- .8 Do not dispose of waste or volatile materials such as: mineral spirits, oil, petroleum based lubricants, or toxic cleaning solutions into storm or sanitary sewers. Ensure proper disposal procedures are maintained throughout project.

1.4 Health and Safety

- .1 Do construction occupational health and safety in accordance with Section 01 35 33 – Health and Safety Requirements and the Workers' Compensation Board of BC latest regulations.

1.5 Waste Management and Disposal

- .1 Separate waste management materials for reuse and recycling in accordance with Section 01 74 21 – Waste Management and Disposal and the Waste Reduction Workplan, and the Waste Management Plan to the maximum extent economically possible.

PART 2 LOCATIONS

2.1

- .1 Site demolition: existing building areas as shown on drawings.
- .2 Refer to plumbing, Mechanical and Electrical drawings and specifications for material required for removal, capping and/or diversion.
- .3 Items to be removed and turned over to Departmental Representative are noted on drawing.
- .4 Elements for removal and re-use are noted on the drawings.

PART 3 EXECUTION

3.1 Work

- .1 Dispose of demolished materials off site except where noted otherwise. Refer to Section 01 74 21.
- .2 Carefully remove all noted material in areas of renovation. Qualified tradesmen shall be used for the removal of all material scheduled for re-use. Contractor shall be responsible for making good, to the satisfaction of the Consultant, all damage to materials and equipment to be reinstalled.
- .3 Site-examine and record locations, conditions, etc., of all elements which must be removed then re-installed and made good after re-installation work.
- .4 Where existing piping, conduits, wall assemblies, wiring, applied items and other elements are removed, patch and make good affected surfaces which are to remain. Patching and remedial materials shall match adjacent existing unless otherwise noted.
- .5 Carefully remove all wall assemblies and elements containing existing conduit, wiring, brackets, etc. Temporarily shore, protect and re-install said utilities in those areas where existing walls are being re-assembled by new components. Coordinate this work with electrical and mechanical trades and consultants.
- .6 Protect all existing elements and finishes not scheduled for replacement and store where directed as required. Make good where damaged.
- .7 Layout and execute all cutting and demolition such as to cause the least amount of disruption to remaining existing finishes, materials, elements and equipment.
- .8 Unless otherwise noted, all existing items noted as: "Remove and Dispose of" shall be considered as Contractor's salvage.
- .9 Cap and make safe all electrical wiring, plumbing, piping and ductwork where walls, ceilings, fixtures and millwork are being removed.

3.2 Cutting, Fitting and Patching

- .1 Execute cutting, fitting and patching required to make work fit properly together.
- .2 Fit work tight to pipes, ducts and conduits, with adequate provision for expansion and contraction.
- .3 Each specification section shall include cutting and patching for that trade section, unless otherwise specified, and as required.
- .4 Should existing concrete floor slab on grade require saw-cutting or drilling, provide approved ultrasound or sufficiently non-invasive scanning inspection prior to cutting or drilling operations.

3.3 Floor Finishes Demolition

- .1 Where new replacement floor and stair finishes are scheduled to be installed: Completely remove all existing finishes and coverings. Thoroughly clean and prepare substrate to accommodate new scheduled finishes. Mechanically abraise surfaces where required. Leave existing substrate ready for preparation by finished flooring sections. Refer to room finish schedule, floor finishes plans, and specification Sections 09 65 00, 09 31 00 and 09 68 00 for extent and type of new floor finishes.

3.4 Base Trim Demolition

- .1 Where existing walls are to remain in place and existing rubber or ceramic tile base is scheduled to be replaced by new rubber base, Section 09 65 00 will remove existing base and prepare/repair substrate to receive new scheduled base.
- .2 This Section shall carefully remove existing rubber or ceramic tile base from walls which are to remain in place but are scheduled to receive new plastic laminate and wood base.

3.5 Existing Drywall Ceiling Demolition

- .1 Where scheduled and noted: Remove and dispose of existing drywall ceilings including metal suspension system framing.
- .2 Leave existing suspension wires and inserts (which are in sound condition) in place by untying (not cutting) twist connections to metal framing in order to leave the new suspended ceiling installer the maximum length of wire for re-use.

3.6 Existing Tee-Bar Ceiling Demolition

- .1 Where scheduled and noted: remove and dispose of existing tee-bar ceilings including acoustical tile and metal tee-bar suspension system.
- .2 Leave existing suspension wires and inserts (which are in sound condition) in place by untying (not cutting) twist connections to metal tee-bar in order to leave the new suspended ceiling installer the maximum length of wire for re-use.

3.7 Door and Frame Demolition

- .1 Where scheduled and noted: remove existing doors and frames complete.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- | | | |
|----|------------------|--------------------------------|
| .1 | Section 05 12 00 | Structural Steel for Buildings |
| .2 | Section 07 92 00 | Joint Sealant |

1.2 References

- .1 CAN/CSA- A3000-13 Cementitious Material Compendium.
- .2 CSA-A23.1-14, Concrete Materials and Methods of Concrete Construction
- .3 CSA-A23.2-14, Methods of Test for Concrete
- .4 ASTM C260/C260M-10a(2016), Standard Specification for Air Entraining Admixtures for Concrete
- .5 ASTM C494/C494M-16, Chemical Admixtures for Concrete
- .6 ASTM D1751-04 (2013)e1. Standard Specification for Performed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)
- .7 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction
- .8 ANSI/ACI 315-99, Details and detailing of Concrete Reinforcement
- .9 CSA G30.3-M1998, Cold Drawn Steel wire for Concrete Reinforcement
- .10 CSA G30.5-M1983(R1998), Welded Steel Wire Fabric for Concrete Reinforcement
- .11 CSA G30.18-09, Billet Steel Bars for Concrete Reinforcement
- .12 CSA W186-M1990(R2016), Welding of Reinforcing Bars in Reinforced Concrete Construction
- .13 CSA 0121-08 (R2013), Douglas Fir Plywood
- .14 CSA 0151-09 (R2014) Canadian Softwood Plywood
- .15 CSA S269.1-16, Falsework and formwork

1.3 Substitutes

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

1.4 Waste Management and Disposal

- .1 Separate waste materials for recycling in accordance with Section 01 74 21 - Waste Management and Disposal.
- .2 Ensure emptied containers are sealed and stored safely.
- .3 Provide appropriate area on job site where concrete trucks and be safely washed.
- .4 Divert admixtures and additive materials from landfill to approved official hazardous material collections site as reviewed by Departmental Representative.
- .5 Unused admixtures and additive materials must not be disposed of into sewer systems, into lakes, streams, onto ground or in other location where it will pose health or environmental hazard.

PART 2 PRODUCTS

2.1 Concrete Materials

- .1 Proportion normal density concrete in accordance with CSA-A23.1, Alternative 1 to give the following properties:
 - .1 Cement: Type GU or GUb – General Use cement.
 - .2 Minimum compressive strength at 28 days: See General Notes
 - .3 Class of exposure: See General Notes
 - .4 Nominal size of coarse aggregate: See General Notes
 - .5 Slump at time and point of discharge: See General Notes
 - .6 Air content: See General Notes
 - .7 Chemical admixtures: following admixtures in accordance with CAN/CSA 3000. Admixtures shall contain no salts or acids.
- .2 Water, fine aggregates, normal density coarse aggregates: to CSA-A23.1
- .3 Air entraining admixture: to CSA-23.1
- .4 Chemical admixtures: to CAN3-A266.1 as approved by Departmental Representative.
- .5 Shrinkage compensating cementitious grout: consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agent
 - .1 Compressive strength: 50MPa at 28 days.
 - .2 Consistency:
 - .1 Fluid: to ASTM C827. Time of efflux through flow cone (ASTM C939), under 30 s.
 - .2 Flowable: to ASTM C827. Flow table, 5 drops in 3 s, (ASTM C109, applicable portion) 125 to 145%.

- .3 Plastic: to ASTM C827. Flow table, 5 drops in 3 s, (ASTM C109, applicable portions) 100 to 125%.
- .4 Dry pack to manufacturer's requirements.
- .6 Surface sealers:
 - .1 Exterior Pavement areas: to ASTM C309 Liquid Membrane-Forming Compounds for curing Concrete, Type 1
- .7 Patching compound: cementitious based premixed compound purpose made for patching concrete.

2.2 Formwork Materials

- .1 Formwork Lumber: plywood and wood formwork materials to CSA-A23.1.
- .2 Form release agent: chemically active release agents containing compounds that react with free lime present in concrete to provide water insoluble soaps, preventing set of film of concrete in contact with form
- .3 Form ties: removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25mm diameter in concrete surface

2.3 Reinforcing Materials

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

2.4 Concrete Accessories

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

2.5 Concrete Mixes

- .1 Proportion normal density concrete to CSA A23.1, Clause 4, Alternative 1 using Type GU or GUB General Use cement for concrete performance characteristics as indicated on the drawings

- .2 Provide certification that mix proportions selected will produce concrete of specified quality and yield and that strength will comply with CSA A23.1, Clause 4. Site mixing equipment, truck or stationary type to conform to CSA A23.1
- .3 Obtain Departmental Representative's approval before using chemical admixtures other than those specified
- .4 Use of Calcium chloride not permitted.

2.6 Reinforcing Steel Fabrication

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

PART 3 EXECUTION

3.1 Workmanship

- .1 Obtain Departmental Representative's approval before placing concrete. Provide forty-eight (48) hours notice to approved concrete testing agency prior to placing of concrete.
- .2 Place concrete in accordance with CSA A23.1, Clause 7.
- .3 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .4 Obtain Engineer's approval of proposed method for protection of concrete during placing and curing in adverse weather, prior to placing of concrete
- .5 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
- .6 Do not place load upon new concrete until authorized by Departmental Representative.
- .7 Pumping of concrete is permitted only after approval of equipment and mix.
- .8 Anchor bolts/dowels
 - .1 Use templates to place anchor bolts and dowels to tolerance associated with equipment or materials to be secured. Ensure anchor bolts and dowels remain vertical during concrete placing and finishing
 - .2 Protect anchor bolt holes from water accumulations
 - .3 Set bolts and fill holes with shrinkage compensating grout

- .4 Locate anchor bolts used in connection with expansion shoes, rollers and rockers with due regard to temperature at time of erection

3.2 Formwork Installation

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

3.3 Inserts

- .1 Set sleeves, ties anchor bolts and other inserts, openings and sleeves, in concrete floors and foundation walls, as required by other trades. Sleeves, openings, etc. greater than 100 x 100 mm not indicated on structural drawings must be approved by Departmental Representative.
- .2 Check locations and sizes of sleeves, openings, etc. shown on structural drawings with architectural, mechanical and electrical drawings.
- .3 If inserts cannot be located as specified, obtain approval of all modifications from Departmental Representative before placing of concrete

3.4 Joint Fillers

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

3.5 Damproof Membrane

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

3.6 Placing Reinforcement

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

3.7 Finishing

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

3.8 Defective Concrete

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

3.9 Plain Floor Finish

- .1 Roll or tamp concrete to force coarse aggregate into concrete mix and then screed.
- .2 Float surface with metal floats or with power finishing machine to bring surface to true grade.
- .3 Steel trowel to smooth and even surface.
- .4 Follow with second steel towelling to produce burnished surface to within 3 mm tolerance when measured in any direction using 3 m straight edge.

- .5 Sprinkling of dry cement or dry cement and sand mixture over concrete surfaces is not acceptable.
- .6 Saw cut crack-control joints to CSA A23.1, Clause 7.3.2 or use removable plastic insert strips.
- .7 After curing and when concrete floors are dry, seal control joints at junction with vertical surfaces with a self-levelling oil resistant sealing compound.

3.10 Inspection and Testing

- .1 Inspection and testing of concrete and concrete materials shall be carried out by testing laboratory.
- .2 Contractor shall pay costs for testing. Refer to Section 01 45 00 - Quality Control and 01 29 83 - Payment Procedures for Testing Laboratory Services.
- .3 Arrange with testing laboratory to do site testing from each batch of concrete placed or for each major day's pour.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- .1 Section 03 30 05 Cast-in-Place Concrete (Short Form)
- .2 Section 05 50 00 Metal Fabrications

1.2 References

- .1 Canadian Standards Association (CSA)
 - .1 CSA-A165 SERIES-14 (R2014), CSA Standards on Concrete Masonry Units.
 - .2 CAN/CSA-A179-14, Mortar and Grout for Unit Masonry.
 - .3 CAN/CSA-A370-14, Connectors for Masonry.
 - .4 CAN/CSA- A371-04 (R2014), Masonry Construction for Buildings.
 - .5 CSA G30.18-09 (R2014), Carbon Steel Bars for Concrete Reinforcement.
 - .6 CSA S304-14, Design of Masonry Structures.
- .2 American Society for Testing and Materials (ASTM)
 - .1 ASTM A496/A496M-07, Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
- .3 Green Seal Environmental Standards (GS)
 - .1 GS-11-Edition 3.2-October 26, 2015, Paints and Coatings.
- .4 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

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 masonry products and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit two (2) copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements.
 - .1 Indicate VOC's in g/L for epoxy coatings and galvanized protective coatings and touch-up products to be applied within building envelope.
- .3 Samples:
 - .1 Submit for review and acceptance of each unit.
 - .2 Samples will be returned for inclusion into work.
 - .3 Submit duplicate full size samples of each type of masonry units.

1.4 Delivery, Storage and Handling

- .1 Ensure that materials are delivered to the job site in dry condition.
- .2 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors], in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect masonry products from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

PART 2 PRODUCTS

2.1 Masonry Units

- .1 Standard concrete block units: to CAN/CSA-A165 Series (CAN/CSA-A165.1).
 - .1 Classification: H/15/A/M
 - .2 Size: modular.
 - .3 Special shapes: provide knock-out type blocks for lintels and bond beams

2.2 Reinforcement and Connectors

- .1 Bar reinforcement: to CSA G30.18, Grade 400.
- .2 Wire reinforcement: to 3.8mm Ladder Type, Conforming to CSA G30.5
- .3 Connectors shall be corrosion resistant: to CAN/CSA-A370.

2.3 Mortar and Grout

- .1 Mortar: to CAN/CSA-A179.
 - .1 Use aggregate passing 1.18 mm sieve where 6 mm thick joints are indicated.
 - .2 Colour: ground coloured natural aggregates or metallic oxide pigments.
- .2 Mortar Type: S based on property specifications,
- .3 Mortar for foundation walls, manholes, sewers, pavements, walks, patios and other exterior masonry at or below grade: type S based on property specifications.
- .4 Following applies regardless of mortar types and uses specified above:
 - .1 Mortar for stonework: type N based on property specifications.
 - .2 Mortar for grouted reinforced masonry: type S based on property specifications.
- .5 Grout: to CAN/CSA-A179, Table 3.
- .6 Parging mortar: type S to CAN/CSA-A179.

2.4 Accessories

- .1 Paints VOC limit 50 g/L maximum to SCAQMD Rule 1113.

PART 3 EXECUTION

3.1 Examination

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

3.2 Installation

- .1 Do masonry work in accordance with CAN/CSA-A371 except where specified otherwise.
 - .1 Bond: running stretcher bond with vertical joints in perpendicular alignment and centred on adjacent stretchers above and below.
 - .2 Coursing height: 200 mm for one block and one joint.
 - .3 Jointing: cut joints flush or where paint is specified to provide smooth surface.
- .2 Build masonry plumb, level, and true to line, with vertical joints in alignment.
- .2 Layout coursing and bond to achieve correct coursing heights, and continuity of bond above and below openings, with minimum of cutting.

3.3 Construction

- .1 Exposed masonry:
 - .1 Remove chipped, cracked, and otherwise damaged units, in exposed masonry and replace with undamaged units.
 - .2 Cut out for electrical switches, outlet boxes, and other recessed or built-in objects. Make cuts straight, clean, and free from uneven edges.
- .2 Building-in:
 - .1 Install masonry connectors and reinforcement where indicated on drawings.
 - .2 Build in items required to be built into masonry.
 - .3 Prevent displacement of built-in items during construction. Check plumb, location and alignment frequently, as work progresses.
 - .4 Brace door jambs to maintain plumb. Fill spaces between jambs and masonry with mortar.
 - .5 Install loose steel lintels over openings where indicated.
- .3 Support of loads:
 - .1 Use 20 MPa concrete to as per General Notes, where concrete fill is used in lieu of solid units.
 - .2 Use grout to CAN/CSA-A179 where grout is used in lieu of solid units.
 - .3 Install building paper below voids to be filled with concrete grout; keep paper 25 mm back from faces of units.

- .2 Provision for movement:
 - .1 Leave 25 mm space between top of non-load bearing walls and partitions and structural elements. Do not use wedges.
 - .2 Built masonry to tie in with stabilizers, with provision for vertical movement.

- .3 Interface with other work:
 - .1 Cut openings in existing work as indicated.
 - .2 Openings in walls: approved Departmental Representative
 - .3 Make good existing work. Use materials to match existing.

3.4 Reinforcing and Connecting

- .1 Install masonry connectors and reinforcement in accordance with CAN/CSA-A370, CAN/CSA-A371 and CSA S304 unless indicated otherwise.
- .2 Prior to placing grout, obtain Departmental Representative's approval of placement of reinforcement and connectors.

3.5 Reinforced Lintels and Bond Beams

- .1 Reinforce masonry lintels and bond beams as indicated.
- .2 Place and grout reinforcement in accordance with CAN/CSA-A179, CAN/CSA-A371 and CSA S304.

3.6 Grouting

- .1 Grout masonry in accordance with CAN/CSA-A179, CAN/CSA-A371 and CSA S304 and as indicated.

3.7 Anchors

- .1 Supply and install metal anchors as indicated.

3.8 Lateral Support and Anchorage

- .1 Supply and install lateral support and anchorage in accordance with CSA S304 and as indicated.

3.8 Site Tolerances

- .1 Tolerances of CAN/CSA-A371 apply.

3.9 Field Quality Control

- .1 Inspection and testing will be carried out by Testing Laboratory.
- .2 Contractor shall pay costs for testing. Refer to Section 01 45 00 Quality Control and 01 29 83 Payment Procedures for Testing Laboratory Services

3.10 Cleaning

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.

- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.11 Protection

- .1 Protect masonry and other work from marking and other damage. Protect completed work from mortar droppings. Use non-staining coverings.
- .2 Repair damage to adjacent materials caused by masonry products installation.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- | | | |
|----|------------------|-------------------------------------|
| .1 | Section 03 30 05 | Cast-in-Place Concrete (Short Form) |
| .2 | Section 05 50 00 | Metal Fabrications |
| .3 | Section 09 90 10 | Painting and Coatings |

1.2 References

- .1 Canadian Standards Association (CSA).
 - .1 CSA-G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/ Structural Quality Steels.
 - .2 CSA-S16-14, Design of Steel Structures.
 - .3 CSA W47.1-09 (R2014), Certification of Companies for Fusion Welding of Steel Structures.
 - .4 CSA W48-14 Filler Metals and Allied Materials for Metal Arc Welding.
 - .5 CSA W55.3-08 (R2013), Certification of Companies for Resistance Welding of Steel and Aluminum.
 - .6 CSA W59-13, Welded Steel Construction (Metal Arc Welding)
 - .7 CSA W178.1-14 Certification of Welding Inspection Organizations.
 - .8 CSA W178.2 Certification of Welding Inspectors.
- .2 Canadian General Standards Board (CGSB).
 - .1 CGSB 85.10-99, Protective Coatings for Metals.
- .3 American Society for Testing and Materials (ASTM)
 - .1 ASTM A36 / A36M-14, Standard Specification for Carbon Structural Steel.
 - .2 ASTM A193 / A193M-16, Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature or High Pressure Service.
 - .3 ASTM A123M-15, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .4 ASTM A307-14, Standard Specification for Carbon Steel Bolts, Studs and Threaded Rod, 60,000psi Tensile Strength.
 - .5 ASTM F3125/3125M Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120ksi (830MPa) and 150ksi (1040MPa) Minimum Tensile Strength, Inch and Metric Dimensions.

- .4 Canadian Institute of Steel Construction (CISC) / Canadian Paint Manufacturer's Association (CPMA).
 - .1 CISC/CPMA 1-73a, A Quick-Drying One-Coat Paint for Use on Structural Steel.
 - .2 CISC/CPMA 2 -75, A Quick-Drying Primer for use on Structural Steel.

1.3 Shop Drawings

- .1 Submit shop drawings including fabrication and erection documents and materials list in accordance with Section 01 33 00 – Submittals.
- .2 On erection drawings, indicate all details and information necessary for assembly and erection purposes such as, description of methods, sequence of erection, type of equipment used in erection and temporary bracings. Show detail of all non-standard connections such as bracing connections, truss connections, moment connections and hanger assemblies and other non-standard connections as requested by the Departmental Representative.
- .3 All fabricator designed assemblies, components and connections, and drawings to be stamped and signed by qualified Professional Engineer licensed in the province of British Columbia, Canada.
- .4 The Professional Engineer responsible for the shop drawings shall provide periodic field review during fabrication and erection of the work for conformance with the design and the shop drawings, and shall upon completion of the work submit to the Consultant a completed Schedule S-B: Assurance of Professional Design and Commitment for Field Review by Supporting Registered Professional, and Schedule S-C: Assurance of Professional Field Review and Compliance by Supporting Registered Professional.

1.4 DESIGN REQUIREMENTS

- .1 Design details and connections in accordance with requirements of CSA-S16 and CSA-S136 to resist forces, moments and shears and allow for movements indicated.
- .2 If shears are not indicated, select or design connections to support reaction from 120% maximum uniformly distributed load that can be safely supported by beam in bending (60% each end), provided no point loads act on beam.
- .3 At the Departmental Representative's request, submit sketches and design calculations for non standard connections, stamped and signed by qualified professional engineer registered in the Province of British Columbia, Canada.

1.5 QUALITY ASSURANCE

- .1 Submit 2 copies of mill test reports showing chemical and physical properties and other details of steel to be incorporated into work at least 4 weeks prior to fabrication of structural steel. Mill test reports shall be certified by metallurgists qualified to practice in province of British Columbia, Canada.

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

1.6 WASTE MANAGEMENT & DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Waste Management and Disposal.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene, wood and corrugated cardboard packaging material for recycling in accordance with Section 01 74 21 - Waste Management and Disposal.
- .4 Divert unused metal materials from landfill to metal recycling facility approved by the Departmental Representative.
- .5 Divert unused paint material from landfill to official municipal hazardous material collections site approved by Departmental Representative.
- .6 Do not dispose of unused paint materials into sewer systems, into lakes, streams, onto ground or in any location where it will pose health or environmental hazard.

PART 2 PRODUCTS

2.1 Materials

- .1 Structural steel: to CAN/CSA-G40.20/G40.21, Grade as indicated on drawings.
- .2 Anchor bolts: ASTM A307 unless noted otherwise on drawings.
- .3 High strength anchor bolts: to ASTM A193/a193M Grade as indicated on drawings.
- .4 Bolts, nuts and washers: to ASTM A325/ASTM A325M unless noted otherwise on the drawings.
- .5 Welding materials: to CSA W48 and CSA W59 and certified by the Canadian Welding Bureau.
- .6 Shop primer: to CAN/CGSB 2-75
- .7 Hot dip galvanizing: galvanize steel, where indicated, to ASTM A123, minimum zinc coating of 600 g/m².

2.2 Fabrication

- .1 Fabricate structural steel in accordance with CSA-S16 and/or CSA-S136 and in accordance with reviewed shop drawings.
- .2 Continuously seal members by continuous welds. Grind smooth.
- .3 Provide weep holes for all exposed HSS members.

2.3 Shop Painting

- .1 Clean, prepare surfaces and shop prime structural steel in accordance with CAN/CGSB-85.100 except where members to be encased in concrete.
- .2 Clean all members of loose mill scale, rust, oil, dirt and other foreign matter. Prepare surfaces in accordance to SSPC SP1 "Solvent Cleaning" and SP7 Brush Off Blast Cleaning for primer.
- .3 Apply one coat of, CISC/CPMA 2-75 Low VOC primer in shop to all steel surfaces to achieve minimum dry film thickness of 1.5 to 2.0 mils except:
 - .1 Surfaces to be encased in concrete.
 - .2 Surfaces and edges to be field welded.
- .4 Apply paint under cover on dry surfaces when surface and air temperatures are above 5°C.
- .5 Maintain dry condition and 5°C minimum temperature until paint is thoroughly dry.
- .6 Strip paint from bolts, nuts, sharp edges and corners before prime coat is dry.

PART 3 EXECUTION

3.1 General

- .1 Structural steel work: in accordance with CAN/CSA-S16, CAN/CSA-S136.
- .2 Welding: in accordance with CSA W59.
- .3 Companies to be certified under Division 1 or 2.1 of CSA W47.1 for fusion welding of steel structures and/or CSA W55.3 for resistance welding of structural components.

3.2 Schedule of Work

- .1 The following is a schedule of major items of work of this section:
- .2 The work includes, but is not necessarily limited to, the following items. Submit engineer-sealed shop drawings for items designated with an asterisk (*). Refer to the drawings.
 - .1 *New exterior Canopies at Main Entry and entry to Locker Rooms
 - .2 * New concealed steel support system for Sliding Glazed Partition in Classroom
 - .3 All anchorage and support clips and fasters associated with scheduled work

3.3 Connection to Existing Building

- .1 Verify dimensions and condition of existing building, report any discrepancy and potential problem areas to the Departmental Representative for direction before commencing fabrication.

3.4 Marking

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

3.5 Erection

- .1 Erect structural steel, as indicated and in accordance with CSA-S16, CISC Code of Standard Practice and its Appendices 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 The Owner and his Consultants will not be responsible for inspection of the Contractor's work as described in Clause 7.13 of the CISC Code of Standard Practice for Structural Steel. The Contractor is responsible for the accuracy and completeness of his own work and shall verify that the structural steel has been fabricated, erected and finished in accordance with the contract specifications, and that all connections designed by the fabricator have been inspected in the field by the Professional Engineer responsible for the design of those connections (or his/her representative) all in accordance with Paragraph 1.3 above.
- .2 Inspection and testing of materials and workmanship will be carried out by testing laboratory designated by the Departmental Representative.
- .3 Provide safe access and working areas for testing on site, as required by testing agency and as authorized by the Departmental Representative.
- .4 Submit test reports to the Departmental Representative within 1 week of completion of inspection.
- .5 Owner will pay costs of tests as specified in Section 01 45 00 – Quality Control.

3.7 Field Painting

- .1 Paint in accordance with Section – 09 90 00 – Painting and Coatings
- .2 Touch up all damaged surfaces and surfaces without shop coat with primer to SSPC SP7 except as specified otherwise. Apply in accordance with CGSB 85.10-99.

END OF SECTION

Part 1 GENERAL

1.1 Related Sections

- | | | |
|----|------------------|-------------------------------------|
| .1 | Section 01 33 00 | Submittal Procedures |
| .2 | Section 01 74 21 | Waste Management and Disposal |
| .3 | Section 01 61 10 | Product Requirements |
| .4 | Section 03 30 05 | Cast-in-Place Concrete (Short Form) |
| .5 | Section 05 12 23 | Structural Steel for Buildings |
| .6 | Section 06 20 00 | Finish Carpentry |
| .7 | Section 08 80 00 | Glazing |
| .8 | Section 09 90 00 | Painting |

1.2 References

- .1 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM A53/A53M-05, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - .2
 - .3 ASTM A307-04, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.40-97, Anti-corrosive Structural Steel Alkyd Primer.
 - .2 CAN/CGSB-1.181-99, Ready-Mixed, Organic Zinc-Rich Coating.
- .3 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-G40.20/G40.21-04, General Requirements for Rolled or Welded Structural Quality Steel.
 - .2
 - .3 CAN/CSA-G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .4
 - .5 CAN/CSA-S16.1-01, Limit States Design of Steel Structures.
 - .6 CSA W48-01, Filler Metals and Allied Materials for Metal Arc Welding
 - .7 CSA W59-03, Welded Steel Construction (Metal Arc Welding).
- .4 National Building Code of Canada (NBCC), 2010.

1.3 Submittals

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheet in accordance with Section 01 33 00 - Submittal Procedures.

- .2 Shop Drawings
 - .1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.
 - .2 Have shop drawings prepared under the supervision of a structural engineer registered in B.C. (specialty engineer) for items required to be designed in accordance with Part 4.0 of the National Building Code. Shop drawings shall be sealed by said specialty engineer.
 - .3 Indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.
 - .4 Where metal fabrication items interface with equipment and other building elements, this section shall be responsible for obtaining all measurements of said items prior to preparation of shop drawings.
 - .5 Referenced specialty engineer shall also be responsible for the engineered design and certification of the concrete-filled steel decking (Section 03 30 20) associated with the steel-framed access ramp of this Section. Said Engineer's responsibility shall also include field inspection for concrete placing and Letters of Assurance for Section 03 30 20.

1.4 Letters Of Assurance

- .1 The Engineer responsible for sealing the engineered shop drawings and duties covered in Clause 1.3.2.5 shall submit to the Departmental Representative, Schedule B Assurance of Professional Design and Commitment for Field Review.
- .2 Engineer shall provide field review of the installation and submit to the Departmental Representative Schedule CB Assurance of Professional Field Review and Compliance upon completion of the work.

1.5 Quality Assurance

- .1 Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.
- .2 Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .3 Foundry/fabricator of cast iron replicated stanchions/newel posts shall submit a list of similar projects completed within the last five years. Include project name, date, location and name and contact information of Owner. In addition, submit a brief outline of proposed methods of fabrication. Submit to Departmental Representative in accordance with Section 01 33 00.

1.6 Delivery, Storage, And Handling

- .1 Packing, Shipping, Handling and Unloading:
 - .1 Deliver, store, handle and protect materials in accordance with Section 01 61 10 - Product Requirements.
- .2 Storage and Protection:

- .1 Cover exposed stainless steel surfaces with pressure sensitive heavy protection paper or apply strippable plastic coating, before shipping to job site.
- .2 Leave protective covering in place until final cleaning of building. Provide instructions for removal of protective covering.

1.7 Waste Management And Disposal

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 – Waste Management and Disposal.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging material for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to metal recycling facility approved by Departmental Representative.

1.8 Coordination

- .1 Coordinate design, shop drawings, fabrication and installation of items of this Section with those of interfacing sections supplying components to metal fabrications including, but not limited to:
 - .1 Sliding Glass Partition Section 10 22 00
 - .2 Exterior Canopies

Part 2 PRODUCTS

2.1 Materials

- .1 Steel sections and plates: to CAN/CSA-G40.20/G40.21, Grade 350W.
- .2 Steel pipe: to ASTM A53/A53M standard weight, black finish.
- .3 Welding materials: to CSA W59.
- .4 Welding electrodes: to CSA W48 Series.
- .5 Bolts and anchor bolts: to ASTM A307.
- .6 Grout: non-shrink, non-metallic, flowable, 15 MPa at 24 hours.
- .7 Galvanizing: hot dipped galvanizing with minimum zinc coating of 610 g/m² to CSA G164-M92. All ferrous metal fabrications for exterior locations to be galvanized after fabrication.
- .8 Aluminum: Standard Alcan extruded shapes, tubular sections, bars and sheet. Alloy and temper to match use and finish.
- .9 Anodizing: All exposed surfaces shall be free of scratches and other blemishes, and shall receive an architectural Class 1 clear anodic coating conforming to Aluminum Association Standard AA-M12C22A41 (0.7 mils minimum).

- .10 Shop Coat Primer: to CGSB 1-GP-40M/CAN/CGSB-1.40. Special primer for epoxy-painted items. Refer to Section 09 90 00. Galvanized primer zinc rich, ready mix to CGSB 1-GP-198M/CAN/CGSB-1.181.
- .11 Stainless Steel Sheet: Type 304 (type 316 where noted) with No. 4 finish.

2.2 Fabrication

- .1 Fabricate work square, true, straight and accurate to required size, with joints closely fitted and properly secured.
- .2 Where possible, fit and shop assemble work, ready for erection.
- .3 Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush. Fabricate all miscellaneous metalwork shown and detailed in the drawings and listed in this section in the quantities required.
- .4 Assemble built-up work in the shop and match-mark for correct field erection. Execute work in accordance with reviewed shop drawings.
- .5 All copes, mitres and butt cuts in surfaces exposed to view shall be made with uniform gaps of 3.0 mm if detailed to be open joints or in uniform contact if detailed without gaps.
- .6 Weld in such a manner as to avoid distortion, discolouration or damage to the affected members.
- .7 Weld exposed exterior work continuously to provide a proper weathering seal to prevent leakage and other damage.
- .8 Weld interior work continuously along the entire line of contact except where spot welding is indicated or permitted.
- .9 Grind smooth welds where exposed to view. Use body filler on railings and sand smooth.
- .10 Provide all required holes in metalwork for attaching other materials.
- .11 Drill for countersunk screws if exposed to view unless otherwise shown or accepted by the Departmental Representative.
- .12 Locate holes in structural members for connections or for other purposes so as not to cause appreciable reduction in the strength of members.
- .13 Reinforce all work to suit the purpose for which it is intended and to withstand design loads.
- .14 Fabricate work square, true, straight and accurate to detail with sharply, defined profiles.
- .15 Fabricate curved work to smooth, uniform constant radii as detailed.
- .16 Joints in materials shall be cut to form fine hairline joints flush with adjacent surfaces.
- .17 Provide suitable temporary bracing as required to maintain alignment during shipment and erection.

2.3 Finishes

- .1 Galvanizing: hot dipped galvanizing with zinc coating 600 g/m² to CAN/CSA-G164. Locate galvanizing exterior drain/vent holes such that all holes will be to underside of installed item in final position.
- .2 All metal fabrications where noted, shall be hot dip galvanized after fabrication.
- .3 Shop coat primer for non-painted steel: to CAN/CGSB-1.40.
- .4 Zinc primer for non-painted steel: zinc rich, ready mix to CAN/CGSB-1.181.
- .5 For items to be finish painted conform to Section 09 90 00 for primer types.

2.4 Isolation Coating

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

2.5 Shop Preparation For Painting

- .1 Clean metal of all loose mill scale, rust, oil, dirt and all other foreign matter.
- .2 Clean interior metal to be painted in accordance with SSPC SPI Solvent Cleaning followed with SSPC SP.6 Commercial Blast Cleaning.
- .3 Clean exterior metal to be painted in accordance with SSPC SPI Solvent Cleaning followed with SSP C SP.10 Near White Metal Blast Cleaning.
- .4 Remove or repair sharp edges, burrs, weld spatter and other defects to steel members prior to application of primers.

2.6 Shop Painting

- .1 Apply one shop coat of primer to metal items, with exception of galvanized or concrete encased items. For items to be finish painted apply primers in accordance with Section 09 90 00. Apply primer as specified under Section 09 90 00 in accordance with manufacturer's directions. Ensure that primer is applied within 8 hours of completion of surface preparations.
- .2 Use primer unadulterated, as prepared by manufacturer. Paint on dry surfaces, free from rust, scale, grease. Do not paint when temperature is lower than 7 degrees C.
- .3 Clean surfaces to be field welded; do not paint.
- .4 All exterior metal in contact with masonry or concrete shall be back-primed before installation.
- .5 If the correct primer is not applied by this section of the Work, this section is responsible for removal of the incorrect primer, re-conditioning the surface and applying the correct primer as specified, including removal and re-installation of the affected work as required.

- .6 Primer applied to surfaces not properly prepared in accordance with specified SSPC preparations will be rejected by the Consultant and shall be removed, brought up to the specified requirements and re-installed by the Contractor at no additional cost to the Departmental Representative.

Part 3 EXECUTION

3.1 Erection

- .1 Do welding work in accordance with CSA W59 unless specified otherwise.
- .2 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.
- .3 Provide suitable means of anchorage acceptable to Departmental Representative such as dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.
- .4 Exposed fastening devices to match finish and be compatible with material through which they pass.
- .5 Provide components for building by other sections in accordance with shop drawings and schedule.
- .6 Make field connections with bolts to CAN/CSA-S16.1, or weld.
- .7 Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates.
- .8 Touch-up rivets, field welds, bolts and burnt or scratched surfaces after completion of erection with primer.
- .9 Touch-up galvanized surfaces with zinc rich primer where burned by field welding.

3.2 Schedules

- .1 The following is a schedule of major items of work of this section:
- .2 The work includes, but is not necessarily limited to, the following items. Submit engineer-sealed shop drawings for items designated with an asterisk (*). Refer to the drawings.
 - .1 *New exterior Canopies at Main Entry and entry to Locker Rooms
 - .2 * New concealed steel support system for Sliding Glazed Partition in Classroom
 - .3 Miscellaneous metal frames, brackets and supports.
 - .4 Anchorage sleeves, plates, bolts and anchors.

3.3 Cleaning

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

END OF SECTION

PART 1 GENERAL

1.1 Source Quality Control

- .1 Lumber Identification: by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.
- .2 Plywood identification: by grade mark in accordance with applicable CS standards.

1.2 Waste Management and Disposal

- .1 Separate waste management materials for reuse and recycling in accordance with Section 01 74 21 Waste Management and Disposal and the Waste Reduction Workplan, and the Waste Management Plan to the maximum extent economically possible.

PART 2 PRODUCTS

2.1 Lumber Material

- .1 Lumber: unless specified otherwise, softwood, S4S, moisture content 19% or less in accordance following standards:
 - .1 CAN/CSA-0141-91.
 - .2 NLGA Standard Grading Rules for Canadian Lumber, 1991.
- .2 Furring, blocking, nailing strips, grounds, rough bucks, SPF or Hemlock species:
 - .1 Board Sizes: "Standard" or better.
 - .2 Dimension sizes: "Standard" light framing or better grade.
 - .3 S4S Hem-Fir or S-P-F species, NLGA No. 2 or better Grade, all wood pressure preservative treated for exterior areas and lumber in contact with concrete, masonry, stucco, roofing and flashing.
- .3 Framing and board lumber: in accordance with NBCC, 2010; Section 9, except as follows:
 - .1 Blocking and framing concealed in final assembly"
 - .1 Hem-Fir species., NLGA No. 2 or better grade.

2.2 Panel Materials

- .1 Douglas Fir plywood (DFP): Thickness as indicated, shall comply with CSA 0121 standards.
- .2 Medium Density Overlaid Plywood (MDO): where noted and scheduled, Douglas Fir Plywood (DFP) shall have plastercized heavy kraft paper facing factory-bonded thereto.

2.3 Panel Materials End Uses

- .1 Plywood, DFP, GIS, square edge, thickness as indicated.
- .2 Electrical panelboards: DFP good one side grade, square edge, 19 mm thick.
- .3 Backing in walls: DFP solid one side grade, square edge, 19 mm thick.
- .4 Painted hoarding (with graphics): medium density overlaid, 19 mm.

2.4 Fasteners

- .1 Nails, spikes and staples: to CSA B111.
- .2 Bolts: ½" diameter unless indicated otherwise, complete with nuts and washers.
- .3 Proprietary fasteners: self-drilling threading screws, toggle bolts, expansion shields and lag bolts.

- .4 Galvanizing: to CSA G164, use galvanized fasteners for exterior work and where indicated. Screw fasteners with applied epoxy or polymer coating is also acceptable.

2.5 Fire Retardant Treatment

- .1 Treat wood material scheduled as “intumescent paint” by pressure impregnation with fire resistive chemicals in accordance with CAN/CSA-O80-M or ASTM D-2898 to provide a flame spread rating of less than 25.
- .2 Fire retardant treated wood shall bear underwriter’s label or be accompanied by a certificate in a form acceptable to the Departmental Representative showing compliance.
- .3 Conform strictly to the manufacturer’s directions for delivery, handling and storage of treated wood.
- .4 Use purpose-coated steel fasteners, as recommended by the manufacturer, which are unaffected by the fire retardant treatment for fastening fire retardant treated wood products. Fasteners shall not promote galvanic action with substrate supports to which they come in contact.

PART 3 EXECUTION

3.1 Construction

- .1 Comply with requirements of NBCC, 2015, Part 9.

3.2 Erection of Framing Members

- .1 Install members true to line and elevations. Install approved hardware and hangers to support loads.

3.3 Furring, Blocking and Rough Bucks

- .1 Install furring, strapping and solid backing as required to space-out and support casework, cabinets, applied finishes, facings, pipe chases, electrical and mechanical fixtures, washroom accessories, toilet partitions, door stops and other work as indicated.
- .2 Install blocking behind existing finishes to support the installation of new fixtures and equipment as necessary and indicated on the drawings.
 - .1 Coordinate solid wood blocking behind existing ceiling finish in washrooms and change rooms to support new ceiling mounted toilet partitions.
- .3 Align and plumb faces of furring and blocking to tolerance of 1:600.

3.4 Fastening

- .1 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity, in accordance with NBCC, 2015, Part 9.
- .2 Countersink bolts where necessary to provide clearance for other work.

3.5 Field Treatment of Pressure Preservative-Treated Products

- .1 Comply with American Wood-Preservers’ Association AWPA.M4-80, “Care of Preservative-Treated Wood Products”.
- .2 Re-treat surfaces exposed by cutting, trimming or boring, where in direct contact with air, roof membranes and vapour barrier, with liberal brush application of copper naphthenate preservative before installation.

END OF SECTION

PART 1 GENERAL

1.1 Related Work

.1	Section 05 50 00	Metal Fabrications
.2	Section 06 10 00	Rough Carpentry
.3	Section 06 24 00	Laminated Plastic
.4	Section 08 14 00	Wood Doors
.5	Section 08 71 00	Door Hardware
.6	Section 08 80 00	Glazing
.7	Section 09 90 00	Painting and Coating

1.2 Reference Standards

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

1.3 Samples

- .1 Submit duplicate 300 x 300 mm samples of each type of solid wood or veneer to receive stain or natural finish, in accordance with Section 01 33 00.
- .2 Submit duplicate 300 mm long samples of each type of trim and moulding, in accordance with Section 01 33 00.

1.4 Shop Drawings

- .1 Submit shop drawings in accordance with Section 01 33 00.
- .2 Clearly indicate details of construction, profiles, jointing, fastening and other related details.

1.5 Coordination & Verification

- .1 Verify all dimensions & existing conditions on job site prior to all shop fabrication and work on site. Where major discrepancies occur, alert Departmental Representative immediately.
- .2 Coordinate work of this section with that of wall, electrical and mechanical sections where millwork interfaces with drywall partitions, plumbing, electrical outlets, etc.
- .3 It shall be the responsibility of this section to verify the dimensions and installation details for all Departmental Representative supplied equipment and furnishings requiring cut-outs, adaptations and interfacing with millwork items.
- .4 Coordinate work of this Section with Section 05 50 00 where work of this Section is incorporated into Metal Fabrications.

1.6 Inspection

- .1 Architectural woodwork shall be manufactured and/or installed to AWMAC Quality Standards (Custom Grade) and shall be subject to an inspection at the plant and/or site, by an appointed inspector approved by the M.M.A.B.C. (the BC Chapter of AWMAC). Such inspection costs shall be included in the tender price for this project. Shop drawings shall be submitted for review or approval before any work is commenced. Where it is deemed necessary by the Departmental Representative, a sample cabinet (consisting of a minimum

of 1 drawer, 1 door, showing precisely the materials, hardware and the type of construction the manufacturer intends to use), shall be submitted for inspection.

- .2 Any work which does not meet AWMAC Quality Standards as specified, shall be replaced by this Section at no additional cost to the Department Representative and to the satisfaction of the Departmental Representative and the inspector.

1.7 Guarantee

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

1.8 Waste Management and Disposal

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 Waste Management and Disposal and the Waste Reduction Workplan, and the Waste Management Plan to the maximum extent economically possible.

PART 2 PRODUCTS

2.1 Materials

- .1 Softwood lumber: to C.S.A. 0141-1970 and National Lumber Grades Authority requirements, with maximum moisture content of 6% for interior work, lumber selected for paint finish, fir species, to A.W.M.A.C., custom grade.
- .2 Veneer and solid lumber for transparent finish: White oak species, to AWMAC custom grade.
- .3 Canadian softwood plywood: to C.S.A. 0151-M1978, solid two sides, select.
- .4 Douglas Fir plywood: to C.S.A. 0121-M1978, good one side, sanded grade.
- .5 Nails and staples: to C.S.A. B111-1974, galvanized for exterior work and interior highly humid areas, plain finish elsewhere.
- .6 Fiberboard: Standard of Acceptance: 'Ranger Premium MDF Board', 'Medite'. Medium Density (MDF) to ANSI/A208.2 and tested in accordance with ASTM D1037.
- .7 Hardboard: To CGSB11-GP-3M, tempered type, 3mm thick equal to 'Masonite'.

2.2 Cabinet Hardware

- .1 Hinges: High quality all metal concealed European (Blum) style for overlay door application.
- .2 Door & Drawer Locks (if required): to match Facility's standards.
- .3 Door & Drawer Pulls: Richelieu No. 33206, metal 4" C/C "D" pull, 26D finish.
- .4 Drawer Slides: Accuride, K & V, Roll-it or equal. Full extension type. Heavy duty for large drawers and where noted.
- .5 Adjustable shelving wall track and brackets: equal to Roll-it, K and V.

- .6 All shelf pins shall be metal.
- .7 Cord grommets (if required): round zinc-die-cast, black colour.

PART 3 EXECUTION

3.1 Cabinetwork

- .1 Fabricate wood and veneer for transparent finished millwork to A.W.M.A.C, custom grade.
- .2 Cabinet doors shall be A.W.M.A.C. type overlay 19 mm thick, flush.
- .3 Set nails and screws, apply stained plain wood filled to indentations, sand smooth and leave ready to receive finish.
- .4 Install and adjust cabinet hardware for shelves, doors, and drawers. Recess shelf standards unless noted otherwise. Shelving to be adjustable unless otherwise noted.
- .5 Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes and other fixtures. Make allowances for all wiring required within cabinet units, and conceal where possible. Refer to Mechanical and Electrical Drawings.
- .6 All shelving shall be plywood (no MDF shelving), birch veneer where painted.
- .7 Fit shelves with hardwood edging.
- .8 Provide solid matching wood strip on plywood edges, exposed in final assembly. Strips same width as plywood.
- .9 Details are shown on drawings for appearance purposes only and are not intended to supersede these specifications for fabrication methods or grades of material. Submit details with shop drawings.
- .10 Unless otherwise indicated, interiors of cabinets, all surfaces of concealed shelving and insides of drawers (except front panels) shall be melamine or shop-painted as scheduled.

3.2 Interior Trim

- .1 Standing and running trim for painting and transparent finish shall be A.W.M.A.C. custom grade construction..
- .2 Trim shall be as detailed.

3.3 Installation

- .1 Set and secure cabinetwork and finish carpentry items in place rigid, plumb and square.
- .2 Use purpose designed fixture attachments for wall mounted components.
- .3 Use threaded steel concealed joint fasteners to align and secure adjoining cabinet units, counter tops, and shelving.
- .4 When necessary to cut and fit on site, make material with ample allowance for cutting. Provide trim for scribing and site cutting.
- .5 Permanently fix cabinet and counter bases to floor using appropriate angles and anchorages.
- .6 Counter-sink all semi-concealed anchorage devices used to wall mount components and conceal with solid plugs of species to match surrounding wood. Place flush with surrounding surfaces.
- .7 Carefully scribe cabinetwork which is against other building materials, leaving gaps of

0.8 mm maximum. Do not use additional overlay trim for this purpose.

- .8 Install and adjust all cabinet hardware to ensure smooth and correct operation.

3.4 Transparent-Finished Veneer and Trim

- .1 Where detailed, trim, window stools, door and glazing frames, panels, railing caps and items as noted shall be of white oak species as scheduled, all to A.W.M.A.C. custom grade.

3.5 Wood Door and Glazing Frames

- .1 All door and glazing frames scheduled and noted as “wood for transparent finish” shall be white oak species veneered to either solid wood or MDF cores, generally in configurations as detailed.

3.6 Schedule of Finish Carpentry, Millwork Items

- .1 Supply and install the following carpentry and millwork items as shown and detailed or as specified, complete with all anchors and fastenings required for a complete installation.
- .2 Countertops, cabinets, railings, vanities, shelving, misc. trim, window/door jamb, headers, paneling, sills, built-up base moulding, window stools and installation of sill grilles and like items.
- .3 Millwork enclosures of new and existing equipment as scheduled and detailed.
- .4 Installation of cabinet hardware, door hardware and Division 10 items.

END OF SECTION

PART 1 GENERAL

1.1 Related Work

- .1 Section 06 20 00 Finish Carpentry

1.2 Samples

- .1 Submit duplicate samples of joints, edging, cut-outs and postformed profiles in accordance with Section 01 33 00.

1.3 Maintenance Data

- .1 Provide maintenance data for plastic laminate work for incorporation into maintenance manual specified in Section 01 78 30.

1.4 Product Handling

- .1 Cover finished laminated plastic surfaces with heavy kraft paper or put in cartons during shipment. Protect installed laminated surfaces by approved means. Do not remove until immediately before final inspection.
- .2 Do not store or install materials in areas where relative humidity is less than 25% or greater than 60% at 22 degrees C.

1.5 Waste Management

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal, the Waste Reduction Workplan, and the Waste Management Plan to the maximum extent economically possible.

PART 2 PRODUCTS

2.1 Materials

- .1 Laminated plastic for flatwork: to CAN3-A172, Type general purpose, 1.5mm thick based upon five solid colour or patterned material as selected by the Departmental Representative. Refer to Room Finish schedule, millwork elevations and Finishes Legend on the drawings.
- .2 Plywood core: to CSA 0151-1978, solid two (2) sides, 18mm thick unless otherwise noted on the drawings.
- .3 Laminated plastic adhesive: recorcinol resin to CSA 0112.7 as recommended by laminated plastic manufacturer's technical literature.
- .4 Draw bolts and splines: as recommended by fabricator.

2.2 Shop Fabrication

- .1 Comply with CAN3-A172, Appendix 'A'.
- .2 Obtain governing dimensions before fabricating items which are to accommodate or abut appliances, equipment and other materials.
- .3 Ensure adjacent parts of continuous laminate work match in colour and pattern.
- .4 Veneer laminated plastic to core material in accordance with adhesive manufacturer's instructions. Ensure core and laminate profiles coincide to provide continuous support and bond over entire surface. Use continuous lengths up to 2438 mm. Keep joints 200

- mm from sink cut-outs.
- .5 Use straight self-edging laminate strip for flatwork to cover exposed edge of core material. Chamfer exposed edges uniformly at approximately 20 degrees. Do not mitre laminate edges.

PART 3 EXECUTION

3.1 Installation

- .1 Install work, plumb, true and square, neatly scribed adjoining surfaces.
- .2 Make allowances around perimeter where fixed objects pass through or project into laminated plastic work to permit normal movement without restriction.
- .3 Use draw bolts and splines in countertop joints. Maximum spacing 450 mm o.c. 75 mm from edge. Make flush hairline joints.
- .4 Provide cutouts for inserts, grilles, appliances, outlet boxes and other penetrations. Round internal corners, chamfer edges and seal exposed core.
- .5 At junction of laminated plastic counter back splash and adjacent wall finish, apply small bead of sealant.
- .6 Site apply laminated plastic to units as indicated. Adhere laminated plastic over entire surface. Make corners with hairline joints. Use full sized laminate sheets. Make joints only where indicated or approved. Slightly bevel arises.
- .7 For site application, offset joints in plastic laminate facing from joints in core.

END OF SECTION

PART 1 GENERAL

1.1 Work Included

- .1 Batt insulation for acoustics.
- .2 Rigid Insulation under Slab

1.2 Related Work

- .1 Section 09 22 00 Non-Structural Metal Framing
- .2 Section 09 53 00 Acoustical Ceiling Suspension
- .3 Division 23 Thermal Insulation for Ducting

1.3 Waste Management and Disposal

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

PART 2 PRODUCTS

2.1 Acoustical Batt Insulation

- .1 Friction-fit mineral wool fibre noise attenuation blankets, made from basalt rock and slag, 76 mm thick, width-sized to fit metal studs at 400 mm o.c. and possessing the following acoustical characteristics:
 - .1 Noise reduction co-efficient: 1.05 (@ 76 mm)
 - .2 ASTM C423 co-efficients at following frequencies:
 - 125 HZ: 0.52
 - 500 HZ: 0.18
 - 1000 HZ: 1.07
 - 4000 HZ: 1.05
- .2 Sealant: to CGSB 19-GB-21M

2.2 Under slab / Foundation Wall Foam Plastic Board Insulation

- .1 Extruded Polystyrene Board Insulation: Comply with ASTM C 578, Type VII, 60 psi minimum compressive strength, 2.20 lb/cu. ft. (35 kg/cu. m)
 - .1 Thermal Resistance: (180 day real-time aging as mandated by ASTM C578, measured per ASTM C 518 at mean temperature of 75F): R-5.0 per inch of thickness, with 90% lifetime limited warranty on thermal resistance.
 - .2 Blowing Agent Formulation: Zero ozone depleting.
 - .3 Edge Condition: Ship-Lap.
 - .4 Surface Burning Characteristics (ASTM E 84): Flame spread less than 25, smoke developed less than 450, certified by independent third party such as Underwriters Laboratories (UL).

- .5 Indoor Air Quality: Compliance certified by independent third party such as GREENGUARD Indoor Air Quality Certified® and/or GREENGUARD Children and Schools CertifiedSM.
- .6 Recycled Content: Minimum 20%, certified by independent third party such as Scientific Certification Systems.
- .7 Warranty: Limited lifetime warranty covering all ASTM C578 physical properties.
- .8 Panel Size: Provide 2" thick (or required thickness to satisfy specified R value) by 4 ft. wide by 8 ft. long.

PART 3 EXECUTION

3.1 Batt Insulation Installation

- .1 Install insulation to maintain continuity of acoustical protection to building elements and spaces.
- .2 Fit insulation closely around electrical boxes, pipes, ducts, frames and other objects in or passing through insulation.
- .3 Do not compress insulation to fit into spaces.
- .4 Overlap insulation sufficiently to maintain continuity.

3.2 Acoustical Ceiling Insulation

- .1 Where Scheduled: lay a 1200 mm wide band of acoustical batt over ceiling suspension members around perimeter of room.

3.3 Rigid Insulation

- .1 Deliver materials in manufacturer's original packaging.
- .2 Store and protect products in accordance with manufacturer's instructions. Store in a dry area and protect from water, direct sunlight, flame, and ignition sources. Do not install insulation that has been damaged or wet.
- .3 In the event the board insulation becomes wet, wipe dry prior to installation.
- .4 Provide 10 mil poly vapour barrier over insulation prior to placement of concrete on under slab Application..
- .5 Tape and or seal all joints in vertical and horizontal applications.

END OF SECTION

PART 1 GENERAL

1.1 Reference Standards

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

1.2 Environmental and Safety Requirements

- .1 Comply with requirements of Workplace Hazardous materials Information System (WHIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and provision of material safety data sheets acceptable to Labour Canada.
- .2 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.
- .3 Sealant and substrate materials to be minimum 5° C.
- .4 Should it become necessary to apply sealants below 5° C, consult sealant manufacturer and follow their recommendations.

1.3 Waste Management and Disposal

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

PART 2 PRODUCTS

2.1 Sealant Materials

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

2.2 Sealant Material Designations

- .1 Urethanes One Part.
 - .1 Self-Levelling to CAN/CGSB-19.13, Type 1, colour as selected by Departmental Representative.
- .2 Urethane one Part.
 - .1 Non-Sag to CAN/CGSB-19.13, Type 2, MCG-2-40, colour as selected by Departmental Representative.
- .3 Silicones One Part.
 - .1 To CAN/CGSB-19.13.
 - .2 To CAN/CGSB-9.22 (Mildew resistant).

- .4 Acoustical Sealant
 - .1 To CAN/CGSB-19.21
- .5 Butyl.
 - .1 To CGSB 19-GP-14M
- .6 Acrylic Latex One Part.
 - .1 To CGSB 19-17.
- .7 Preformed Compressible and Non-Compressible back-up materials.
 - .1 Polyethylene, Urethane, Neoprene or Vinyl Foam.
 - .1 Extruded closed cell foam backer rod.
 - .2 Size: oversize 40 to 50%.
 - .2 Neoprene or Butyl Rubber.
 - .1 Round solid 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 Perimeters of exterior openings where frames meet exterior façade of building: Sealant type: one component urethane, non-sag.
- .2 Coping joints and coping-to-façade joints & flashing joints: Sealant type: butyl.
- .3 Interior control and expansion joints in floor surfaces: Sealant type: one component urethane self-levelling.
- .4 Countertops (e.g. sinks, urinals, basins, vanities): Sealant type: silicone, mildew resistant.
- .5 Exposed interior control joints in drywall: Sealant type: acrylic latex.
- .6 Concealed joints in sound attenuated walls and ceilings: Sealant type: acoustic.
- .7 Colour of sealants: selected by Departmental Representative from manufacturer's standard range to match adjacent surfaces.
- .8 Joint cleaner: xylol, methylethyleketon or non-corrosive type recommended by sealant manufacturer and compatible with joint forming materials.

2.4 Joint Cleaner

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

PART 3 EXECUTION

3.1 Preparation of Joint Surfaces

- .1 Examine joint sizes and conditions to establish correct depth to width relationship for installation of backup materials and sealants.
- .2 Clean bonding joint surfaces of harmful matter substances including dust, rust, oil, grease, and other matter which may impair work.
- .3 Do not apply sealants to joint surfaces treated with sealer, curing compound, water repellent, or other coatings unless tests have been performed to ensure compatibility in materials. Remove coatings as required.
- .4 Ensure joint surfaces are dry and frost free.
- .5 Prepare surfaces in accordance with manufacturer's directions.

3.2 Priming

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

3.3 Back Up Material

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

END OF SECTION

PART 1 GENERAL

1.1 Related Work

- .1 Section 07 90 00 Sealants
- .2 Section 08 71 00 Door Hardware
- .3 Section 08 80 00 Glazing
- .4 Section 09 22 00 Non-structural Metal Framing
- .5 Section 09 90 00 Painting and Coating

1.2 Reference Standards

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

1.3 Shop Drawings

- .1 Submit shop drawings in accordance with Section 01 33 00.
- .2 Clearly indicate each type of door and frame, material core thickness, mortises, reinforcements, anchorages, glazing, location of exposed fasteners and hardware arrangements.
- .3 Include schedule identifying each unit, with door marks and numbers relating to numbering on drawings and in door schedule.

PART 2 PRODUCTS

2.1 Materials

- .1 Sheet Steel (WGSC): tension leveled steel to STMA924M) galvanized to ASTMA653M, commercial steel (CS), type B, coating designation ZF120 (paintable Galvaneal).

- .2 Hot rolled Carbon Steel Sheet (HRCS): commercial quality to ASTM A1011, for concealed reinforcement for materials, 2.7 mm minimum thickness.
- .3 Cold rolled carbon steel sheet (CRCS) commercial quality to ASTM A1008, shop prime coated.
- .4 Bituminous paint: to CAN/CGSB-1/108.

2.2 Components

- .1 Frames: base thickness steel as follows:
 - .1 Interior: 1.6 mm steel having a strike bucket which will accept a 25 mm throw deadbolt. Wedge in the area of the strike bucket to prevent spreading; Exterior: 1.6 mm steel having a strike bucket which will accept a 25 mm throw deadbolt. Grout in the area of the strike bucket to prevent spreading.
- .2 Doors: base thickness steel as follows:
 - .1 Interior: Hollow-core, metal, 44 mm thick with 1.2 mm CRS; Exterior: Hollow-core, metal, 44 mm thick with 1.2 mm CRS.
- .3 Frame floor anchors and channel spreaders: minimum 1.6 mm thick base steel.
- .4 Guard boxes: minimum 0.8 mm thick base steel.
- .5 Steel frame anchors:
 - .1 Thickness and design listed by ULC for labeled door and frame assemblies.
 - .2 Stud walls: Twist in stud anchor with base anchor for commercial doors.
- .6 Hinge, lock, strike, flush bolt and surface applied hardware reinforcing: 3.5 mm minimum base metal thickness. Prepare doors and frames to accommodate hardware specified in Section 08 71 00.
- .7 Hinge, lock, strike, flush bolt and surface applied hardware reinforcing: 3.5 mm minimum base metal thickness.
- .8 Door bumpers: black neoprene single stud.
- .9 Reinforcing channel: to CAN/CSA G40.21-M, Type 300 W.
- .10 Primer: to CGSB 1-GP-181M, zinc rich.
- .11 Top caps: galvanized steel for all exterior doors, 0.9 mm base metal thickness.

2.3 Door Types

- .1 (HCM) Doors: flush steel with full honeycomb core of 25 mm size bonded resin – impregnated kraft reinforcement, with reinforcement for hardware.
- .2 (ICM) exterior flush doors: of same construction as HCM door except with bonded core of polyurethane or isocyanurate board insulation to CAN/ULC-S705.2, RSI 1.9 minimum, with all steel hardware reinforcements and complete with steel top cap.

2.4 Fabrication

- .1 Fabricate doors and frames as detailed: in accordance with Canadian Steel Door and Frame Manufacturer's Association (CSDFMA) "Canadian Manufacturing for Steel Doors and Frames", 1990; for hollow steel construction; ULC requirements and reviewed shop drawings except where specified otherwise. Fabricate frames for glazing, setup and welded in similar manner as for door frames.

- .2 Mortise, reinforce, drill and tap doors and frames and reinforcements to receive hardware using templates provided by finish hardware supplier. Refer to Section 08 71 00.
- .3 Touch up galvanized finish damaged during fabrication.

2.5 Frames

- .1 Cut mitres and joints accurately and weld continuously on inside of frame profile.
- .2 Grind welded corners to a flat plane, fill with metallic paste filler and sand to uniform smooth finish.
- .3 Protect strike and hinge reinforcements in grout filled frames in masonry walls using guard boxes welded to frames.
- .4 Weld in two channel spreaders per frame, to ensure proper frame alignment.
- .5 Provide Z type snap-in stud type anchors for fixing at floor. All frames in masonry walls with Tee wire type anchors.
- .6 Reinforce head of frames wider than 1200 mm; reinforce exterior frame assemblies to resist wind loading.
- .7 Install 3 bumpers on strike jamb for each single door and 2 bumpers at head for pairs of doors.

2.6 Doors

- .1 Assemble components using spot or arc welding.
- .2 Continuously weld longitudinal door edges, fill and grind smooth to conceal edge seams, Mechanical locked open seams no acceptable.
- .3 Equip exterior doors with flush steel top caps to prevent water accumulation.
- .4 Provide 3.6 mm thickness astragal for double doors predrilled and shipped loose.
- .5 Touch up doors with primer where galvanized finish damaged during fabrication.

PART 3 EXECUTION

3.1 Frame Installation

- .1 Set frames plumb, square, level and at correct elevation. Apply one coat of bituminous paint to interior surfaces of jambs/head being installed in exterior masonry walls.
- .2 Secure anchorages and connections to adjacent construction.
- .3 Brace frames rigidly in position while building-in. Install temporary horizontal wood spreaders at third points of door opening to maintain frame width. Remove temporary spreaders after frames are built-in.
- .4 Make allowance for deflection to ensure structural loads are not transmitted to frames.
- .5 Fill frames with fibreglass insulation for all exterior doors.

3.2 Door Installation

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

END OF SECTION

PART 1 GENERAL

1.1 Scope

- .1 All wall-mounted access doors and ceiling-mounted access panels.
- .2 Refer also to Divisions 22 and 23 for remainder of access doors & panels.

1.2 Related Work

- .1 Section 07 90 00 Sealants
- .2 Section 09 29 00 Gypsum Board
- .3 Section 09 90 00 Painting and Coating
- .4 Divisions 22 and 23 Mechanical Sections

PART 2 PRODUCTS

2.1 Wall-Mounted Access Doors

- .1 As detailed for installation in masonry and gypsum board finished walls, and supplied with sufficient anchors. Fire rating shall match that of wall.
- .2 Door frames shall be fabricated from 16 gauge steel, and panels from 14 gauge.
Size: as noted.
Finish: Baked prime coat for field painting.
- .3 Supply complete with 3 concealed spring hinges & 5 flush screwdriver operated spanner head cam locks per leaf.

2.2 Ceiling-Mounted Access Panels

- .1 As detailed for installation in suspended drywall ceiling. Fire rating shall match that of ceiling.
- .2 Panel frames shall be fabricated from 16-gauge steel, and panels from 18 gauge. Prime coat for field painting. Add reinforcing as required.
- .3 Supply complete with continuous type steel hinge with stainless steel pin. Provide 3 flush screwdriver operated Cam locks per leaf.

PART 3 EXECUTION

3.1 Installation

- .1 Set frame plumb, square, level and at correct elevation.
- .2 Secure anchorages and connections to adjacent construction.
- .3 Brace frames rigidly in position while building-in.
- .4 Install doors and panels in accordance with templates and manufacturer's instructions.
- .5 Adjust operable part for correct function.

END OF SECTION

PART 1 GENERAL

1.1 Scope of Work

- .1 New aluminum storefront doors and frames for interior partitions
- .2 New Aluminum Curtainwall frames for exterior glazed walls.
- .3 Exterior Skylight glazing systems and canopies

1.2 Related Work

- .1 Section 01 74 11 Cleaning
- .2 Section 05 12 23 Structural Steel for Buildings
- .3 Section 07 90 00 Sealant
- .4 Section 08 71 00 Door Hardware
- .5 Section 08 80 00 Glazing
- .6 Division 26 Electrical
- .7 Division 28 Electronic Safety and Security

1.3 Shop Drawings

- .1 Submit shop drawings in accordance with Section 01 33 00.
- .2 Indicate reinforcing, fastenings, method of glazing, jointing, finish and interface with other systems and materials.
- .3 The Departmental Representative's review shall be for conformity to the design concept and general arrangement only.

1.4 Protection

- .1 Components and frames shall be adequately wrapped to prevent damage during shipping and construction operations.

PART 2 PRODUCTS

2.1 Materials

- .1 Extruded Aluminum Storefront: Acceptable Products - Alcan 6063-T5, Aluminum Alloy to manufacturer's standard gauge of temper to suit finish. Finish shall match existing to the following standards: Submit finish samples for approval.
- .2 Fluoropolymer Paint: Recommended resin base finishes shall be two coat system consisting of an inhibitive primer and a colour topcoat factory applied by spray over properly pretreated aluminum panels or extrusions (all formed before coating) according to specifications supplied and in accordance to American Architectural Manufacturers Association publication #AAMA 605.2.

2.2 Aluminum Storefront Frames

- .1 Fabricate frames and rails of extruded aluminum rectangular sections of sizes and profiles to match existing single glazed frames. Non-thermally broken.
- .2 Framing members shall provide for flush glazing with no projecting stops. Glass shall be set in neoprene gaskets both sides of glass.
 - .1 Include all reinforcing, fastenings, screws and internal components in stainless steel or corrosion resistant metal.
 - .2 All joints shall be hairline joints with concealed fixing.

2.3 Aluminum Storefront Entrance Doors & Door Hardware

- .1 44mm thick by approximately 89mm wide stiles and 76 mm top rail. Welded and mechanically fastened. 152mm bottom rail. Verify dimensions with existing doors.
- .2 Snap-in glazing stops for neoprene bulb type glazing. Reinforcing as required to accommodate spans. Glazed as scheduled.
- .3 To match existing "Medium Style" type door.
- .4 Thresholds: Aluminum, 100mm wide, full width of doors (where scheduled).
- .5 Hinges: Manufacturer's standard NRP ball bearing butt hinges.
- .6 Closers: Concealed overhead, single acting, heavy-duty.
- .7 Locking: Manufacturer's standard heavy-duty locking mechanism. Cylinder by Section 08 71 00.
- .8 Weatherstripping: Manufacturer's standard pile type.
- .9 Lock protection: aluminum bolt protection plate to match door.
- .10 Push/pulls: brushed nickel "Double Cee" design to match existing.

2.4 Aluminum Curtainwall (Capless – 2SSG)

- .1 Four-sided toggle-glazed, screw spline system with 16mm exterior vertical and horizontal weather seal sightline that produces an uninterrupted all-glass appearance.
- .2 Framing shall be 64 mm X 184 mm and 64 mm x 258 mm - verify for spans as indicated.
- .3 Outside glazed with glass type as scheduled- refer to Section 08 80 00.
- .5 Accepted product: "Clearwall SSP" Curtainwall by Kawneer. Products having the same characteristics produced by Columbia Aluminum Products, Alumicor or Old Castle will not be excluded.

2.5 Aluminum Glazed Canopies

- .1 All materials shall be to CAN/CSA-A4490-98 CAN3-S157. Extrusions shall be 6063-T5 or T6 alloy and temper. Formed aluminum components shall be sheet or tube of alloy and temper suitable for their application and finish.
- .2 Fasteners shall be 300/400 Series Stainless Steel and of sufficient size and quantity to perform their intended function.
- .3 Anchorage to building: corrosion resistant masonry type appropriate to loads.
- .4 Weathering and glazing gaskets shall be extruded, black, closed cell or dense elastomer of durometer appropriate to the function.

- .5 Aluminum shall have isolation coating where required using Alkali-resistant Bituminous paint using dialectic separators where required.
- .6 Flashing, Gutters and downspouts shall be pre-formed to shapes and profiles shown or as required to insure a waterproof assembly. Material from aluminum alloy, clear anodized.
- .7 Glazing: Type "5" as per section 08 80 00.

2.6 Miscellaneous Aluminum Trim and Angles

- .1 Provide all miscellaneous aluminum closures, flashing trim and angles associated with aluminum entrances as detailed.

2.7 Aluminum Fixed Glazing Channels (Where Required)

- .1 44 x 19 x 6mm and 19 x 25 x 6mm wall thickness aluminum channels as shown on drawings.

PART 3 EXECUTION

3.1 Erection

- .1 All doors and frames shall be erected level, square plumb and at proper elevation and in line with adjoining work.
- .2 Adjust doors to operate smoothly with minimum clearance and with seals in close contact with frames.

3.2 Cleaning

- .1 Remove protective coating and clean all surfaces. Refer to Section 01 74 11.

3.3 Glass & Glazing

- .1 All entrance doors, sidelights and sliding entrances, shall be glazed as specified in Section 08 80 00.
- .2 Glazing as scheduled by type on drawings.
- .3 Safety glass where required by Building Code.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1	Section 01 33 00	Submittal Procedures
.2	Section 01 61 10	Product Requirements
.3	Section 01 74 21	Waste Management & Disposal
.4	Section 01 78 30	Closeout Submittals
.5	Section 08 11 00	Steel Doors and Frames
.6	Section 08 14 00	Wood Doors
.7	Section 08 40 00	Aluminum Storefront
.8	Section 08 72 00	Automatic Door Operators

1.2 References

- .1 Canadian Steel Door and Frame Manufacturers' Association (CSDFMA).
 - .1 CSDFMA Canadian Metric Guide for Steel Doors and Frames (Modular Construction): standard hardware location dimensions.
- .2 ANSI (American National Standards Institute) / BHMA (Builder Hardware Manufacturer Association).
 - .1 ANSI/BHMA A156.1, Butts and Hinges.
 - .2 ANSI/BHMA A156.2, Preassembled Locks and Latches.
 - .3 ANSI/BHMA A156.3, Exit Devices.
 - .4 ANSI/BHMA A156.4, Door Controls (Closers).
 - .5 ANSI/BHMA A156.5, Auxiliary Locks and Associated Products.
 - .6 ANSI/BHMA A156.6, Architectural Door Trim.
 - .7 ANSI/BHMA A156.13, Mortise Locks and Latches.
 - .8 ANSI/BHMA A156.16, Auxiliary Hardware.
 - .9 ANSI/BHMA A156.18, Materials and Finishes.
 - .10 UL 305, Panic Hardware
- .3 National Building Code of Canada (NBCC), 2010.

1.3 Hardware/Security Coordination

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

1.4 Submittals

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheet in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Hardware List:
 - .1 Submit contract hardware list in accordance with Section 01 33 00.
 - .2 Indicate specified hardware, including make, model, material, function, size, finish and other pertinent information.
- .3 Manufacturer's Instructions:
 - .1 Submit manufacturer's installation instructions.
- .4 Closeout Submittals
 - .1 Provide operation and maintenance data for door closers, locksets, and panic hardware for incorporation into manual specified in Section 01 78 30.

1.5 Quality Assurance

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

1.6 Delivery, Storage and Handling

- .1 Packing, Shipping, Handling and Unloading:
 - .1 Deliver, store, handle and protect materials in accordance with Section 01 61 10 - Product Requirements.
 - .2 Package each item of hardware including fastenings, separately or in like groups of hardware, label each package as to item definition and location.
- .2 Storage and Protection:
 - .1 Store finishing hardware in locked, clean and dry area.

1.7 Waste Disposal and Management

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Waste Management and Disposal.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

1.8 Maintenance

- .1 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 30 - Closeout Submittals.
 - .2 Supply two sets of wrenches for door closers.

1.9 Coordination with Other Sections

- .1 Coordinate certain door hardware items of this Section with interfacing sections including, but not limited to the following:
 - .1 Section 08 11 00 – Steel Doors and Frames
 - .2 Section 08 14 00 – Wood Doors
 - .3 Section 08 40 00 – Aluminum Storefront.
 - .5 Division 26 – Electrical.
 - .6 Division 28 – Electronic Safety and Security.

1.10 Redundant Locksets

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

PART 2 PRODUCTS

2.1 Hardware Items

- .1 Use one manufacturer's products only for similar items.
- .2 Interior hardware finish: BHMA625, satin chrome to match existing at facility (verify).
- .3 Exterior hardware finish: BHMA630, satin stainless steel to match existing (verify).

2.2 Door Hardware

- .1 Locksets
 - .1 Extra heavy-duty commercial/institutional grade one operational mortise locksets to ANSI/BHMA A156.13 Series 1000, grade one security, UL 10.C.
 - .2 6 pin (or 7) tumbler keying to facility's master system.
 - .3 Trim lever and rose to match existing.
 - .4 ANSI functions as scheduled.
- .2 Deadbolts
 - .1 Extra heavy-duty commercial/institutional grade mortise deadbolts with stainless steel armoured front to ANSI 115.1, adjustable.
 - .2 Same features as mortised locksets (Item 2.2.1).
 - .3 Key outside in vandal-proof trim, thumbturn inside.
- .3 Butts and hinges

- .1 To CAN/CGSB-69.18 heavy weight, high frequency, five knuckle, ball bearing (4). NRP at outswing locations.
- .4 Door closers and accessories
 - .1 To CAN/CGSB-69.20 to match Facility's existing closers (verify) model and series. Arms and brackets to suit application.
- .5 Flush Bolts
 - .1 Heavy duty top and bottom mounted, finish to match locksets.
- .6 Door Stops
 - .1 Floor and wall mounted, cast type, heavy duty, finish to match locksets, complete with appropriate fixings.
- .7 Rain Diverters/Bottom Sweeps (Exterior doors)
 - .1 Extruded aluminum, out-swing type, full width of doors with aluminum door shoe containing neoprene draft insert and integral rain deflector.
- .8 Weatherstripping
 - .1 Bulbous neoprene type inserted into aluminum retainer including twin type to match at meeting stiles.
- .9 Automatic Door Bottoms (seals)
 - .1 Heavy duty, semi-mortised door seal of extruded aluminum housing and sponge neoprene recessed seal. Closed ends, adjustable and clear anodized finish. Automatic retract mechanism when door is open.
- .10 Thresholds
 - .1 Interior for auto door bottoms: 57.2 mm wide x full width of door opening, extruded aluminum mill finish smooth flat saddle type for use where automatic door bottoms are scheduled. Must fully engage automatic door bottom gasket full width in order to seal gap.
 - .2 Interlocking type aluminum at exterior doors. Drill and escutcheon at panic sets.
- .11 Interior Door Air Seals
 - .1 Silicone pressure sensitive door gasketing for adhesive application to head and jambs of door frame, dark bronze colour.
 - .2 Smoke tested in accordance with UL 1784-90 to meet NFPA 105-1983.
 - .3 Assembly shall meet FAR 25.853, ASTM E283-1984 and SDI 116.

- .12 Panic Hardware
 - .1 Minimum to ANSI A156.3, (latest), Grade 1, to match building's existing Manufacturer, type, trim design and finish.
- .13 Push/Pulls
 - .1 Combination type to match design, size and finish of facility's existing push/pulls. (75 x 300 mm, verify).
- .14 Kickplates
 - .1 250 mm high x 25 mm less than door width, 16 ga. anodized aluminum to match other hardware, secure with matching countersunk screws.
- .15 Electric Strikes
 - .1 Folger Adam "700 Series" (weatherproof) to match Facility's existing. Include all accessories, transformer and housing. Conduit by Division 26, connection by Division 28.

2.3 Fastenings

- .1 Use only fasteners provided by manufacturer. Failure to comply may void warranties and applicable licensed labels.
- .2 Supply screws, bolts, expansion shields and other fastening devices required for satisfactory installation and operation of hardware.
- .3 Exposed fastening devices to match finish of hardware.
- .4 Use fasteners compatible with materials through which they pass.
- .5 Use tamperproof fasteners in high security hardware.

2.4 Keying Schedule

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

2.5 Keys

- .1 Use standard construction cylinders for locks for Contractors' use during the construction period.
- .2 Issue instructions to employees and sub-trades, as necessary, to ensure safe custody of the construction set of keys.
- .3 Upon completion of each phase of the construction, the Departmental Representative will, in conjunction with the lock manufacturer:
 - .1 Prepare an operational keying schedule.
 - .2 Accept the operational keys and cylinders directly from the lock manufacturer.

- .3 Arrange for removal and return of the construction cores and install the operational core in all locks.

2.6 Additional Door Hardware Scheduled Elsewhere

- .1 Refer to Division 28 – Electronic Safety and Security, for additional door items including, but not limited to the following:
 - .1 Access and intrusion control panels.
 - .2 Card readers.
 - .3 Door Contacts.
 - .4 Intrusion detection.
- .2 Refer to Division 26 – Electrical for all wiring and conduit for above items.

PART 3 EXECUTION

3.1 Manufacturer's Instructions

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

3.2 Installation

- .1 Install hardware to standard hardware location dimensions in accordance with Canadian Metric Guide for Steel Doors and Frames (Modular Construction) prepared by Canadian Steel Door and Frame Manufacturers' Association.
- .2 Where door stop contacts door pulls, mount stop to strike bottom of pull.
- .3 Use only manufacturer's supplied fasteners. Failure to comply may void manufacturer's warranties and applicable licensed labels. Use of "quick" type fasteners, unless specifically supplied by manufacturer is unacceptable.
- .4 Remove construction cores when directed by Departmental Representative; install permanent cores and check operation of locks.

3.3 Adjusting

- .1 Adjust door hardware, operators, closures and controls for optimum, smooth operating condition, safety and for weather tight closure.

- .2 Lubricate hardware, operating equipment and other moving parts.
- .3 Adjust door hardware to provide tight fit at contact points with frames.

3.4 Cleaning

- .1 Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .2 Clean hardware with damp rag and approved non-abrasive cleaner, and polish hardware in accordance with manufacturer's instructions.
- .3 Remove protective material from hardware items where present.
- .4 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

3.5 Demonstration

- .1 Keying System Setup:
 - .1 Set up key control system with file key tags, duplicate key tags, numerical index, alphabetical index and key change index, label shields, control book and key receipt cards.
 - .2 Place file keys and duplicate keys in existing key cabinet on their respective hooks.
 - .3 Lock key cabinet and turn over key to Departmental Representative.
- .2 Maintenance Staff Briefing:
 - .1 Brief maintenance staff regarding:
 - .1 Proper care, cleaning, and general maintenance of project's complete hardware.
 - .2 Description, use, handling, and storage of keys.
 - .3 Use, application and storage of wrenches for door closers.
 - .3 Demonstrate operation, operating components, adjustment features, and lubrication requirements. Refer to Section 01 91 41 – Commissioning Training.

3.6 Hardware Schedule

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

Group No. 1 – Sliding Glazed Partition Wall

Cylinder only, all other hardware by door supplier including locking mechanism.

Group No. 2 – Classroom Door in Storefront

ANSI F05 mortised lockset, electric strike, closer, threshold, bottom sweeps, Card reader power supply by Division 28. Remainder of hardware by Storefront supplier (Section 08 41 00)

Group No. 3 – Stairwell Entry Door

ANSI F02 mortised lockset, electric strike, closer, Card reader power supply by Division 28. Remainder of hardware by Storefront supplier (Section 08 41 00)

Group No. 4 – Exterior Door to Drying Room

NRP butts, ANSI F04 mortised lockset, electric strike, closer, threshold, bottom sweeps with rain diverter, weatherstripping. Card reader, power supply by Division 28

Group No. 5 – Interior HM Door

NRP butts, ANSI F07 mortised lockset, electric strike, closer, threshold. Door Release Switch to Security Desk, Card reader, power supply by Division 28

END OF SECTION

PART 1 GENERAL

1.1 Scope of Work

- | | | |
|----|------------------|--------------------------|
| .1 | Section 05 50 00 | Metal Fabrications |
| .2 | Section 08 11 00 | Steel Doors and Frames |
| .3 | Section 08 43 00 | Aluminum Glazing Systems |
| .4 | Section 08 71 00 | Door Hardware |
| .5 | Division 26 | Electrical |

1.2 Submittals

- .1 All submittals shall be in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Shop Drawings:
 - .1 Indicate equipment layout, mounting bolt locations, electric power requirements, lead-in wire, installation details wiring diagrams.

1.3 Maintenance Data and Instructions

- .1 Provide operation and maintenance data in accordance with Section 01 33 00.
- .2 Conduct comprehensive demonstration for accommodation of maintenance staff on operation and care of systems in accordance with Section 01 91 31.

1.4 Power Supply

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

1.5 Quality Assurance

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

1.6 Coordination with Door Hardware

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

1.7 Sub-Trade Document Submission

- .1 Sub-trades of this Section are reminded that, in addition to the customary Sections associated with their trades, they must become familiar with, and abide by all Sections of Division 1 including the contents of Appendices 'A' 'B' and 'D' of these Specifications.

- .2 In addition to the normal required sub-trade forms and agreements, each sub-trade of this Section shall complete and sign each of the following documents and submit to the Construction Manager or the General Contractor:
 - .1 CMMS information sheet for all new or replacement equipment being provided.
 - .2 Confidentiality Agreements for drawing control.
 - .3 All security requirements and forms covered in Section 01 14 00 and included in Appendices of these Specifications.

PART 2 PRODUCTS

2.1 Description of Systems

- .1 New automatic door operators for installation in aluminum entrance and vestibule doors and frames:
 - .1 New automatic operator: surface mounted on door heads.
 - .2 Wiring between operator and control switches shall be routed through aluminum frames, walls and ceilings.
 - .3 System must allow for normal manual operation of doors at all times.
 - .4 System must be lockable. interface required with FOB access control system
 - .5 Run concealed wiring between operators and entry wall Refer to Division 26.

2.2 System Operation

- .1 Interior Door:
 - .1 Activation of Push button switching either from exterior or interior shall open the active door leaf after FOB swipe
 - .2 Operator on outer door shall have key activated on-off switch for deactivation and security after hours.

2.3 System Equipment

- .1 Automatic door operating mechanism shall be a low-energy, self-contained, electromechanical design. The operator shall be powered open with a DC motor working through six reduction gears. Closing shall be by spring force. The motor is to be off when the door is in the closing mode. The door may be manually operated with power on or off without damage to the operator.
- .2 Motor shall be sized to accommodate size and material of doors.
- .3 The control shall be furnished with a selection switch that provides for two methods of actuating the automatic door. The selection switch will enable the building users to select the desire operation and adapt to changing conditions.
- .4 The operator shall include the following variable adjustments to enable it to comply with Standard ANSI A156.19:
 - .1 Opening speed: 4 to 6 seconds
 - .2 Closing speed: 4 to 6 seconds
 - .3 Time delay before closing: 2 to 30 seconds (ANSI requirement is 5 second minimum time delay).
- .5 Opening and closing force, measured 50.8mm out from the lock stile of the door, not to exceed 67N of force to stop the door when operating in either direction.
- .6 The operator shall include "time out" feature. This feature will turn off the opening force

when the door is stopped for one second. The door then begins to close. The operator immediately resets and will accept another opening signal.

- .7 The operator shall be mounted and concealed in an extruded aluminum cover not less than 3mm thickness in clear anodize. Cover shall run width of door.
- .8 Interior and exterior push button switches mounted where shown. Exterior shall be lockable and tamper-proof. Handicapped marking not required. Coordinate supply of cylinders with Section 08 71 00.
- .9 Division 26 shall furnish and install 120 VAC, 60 cycle, 1 phase, 15 amp service to the operator. Two low-voltage wires shall be furnished to connect push-plate switch to the operator.
- .10 Approved Manufacturer: Subject to compliance with requirements, provide products by one of the following:
 - .1 Ditec Entrematic (DI) – HA-8 Series (1/4 HP Motor).

PART 3 EXECUTION

3.1 Inspection

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

3.2 Installation

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

3.3 Adjustment and Cleaning

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

END OF SECTION

PART 1 GENERAL

1.1 Related Work

- | | | |
|----|------------------|-------------------------------|
| .1 | Section 06 20 00 | Finish Carpentry and Millwork |
| .2 | Section 08 11 00 | Steel Doors and Frames |
| .3 | Section 08 14 00 | Wood Doors |
| .4 | Section 08 41 00 | Aluminum Glazing Systems |
| .5 | Section 10 28 00 | Toilet and Bath Accessories |

1.2 Glazing Design

- .1 This section shall be responsible for providing engineered design necessary to supply glass thicknesses required to safely span openings indicated.
- .2 A professional Engineer (Specialty Engineer), registered in British Columbia, shall seal all shop drawing.

PART 2 PRODUCTS

2.1 Glass Materials

- .1 Type "1"
Float glass – Clear glazing quality to CAN/CGSB-12.3-M91. Of thicknesses shown in following table and as indicated.
 - 3 mm – up to 2135 united mm
 - 4 mm – up to 3300 united mm
 - 5 mm – up to 3555 united mm
 - 6 mm – over 3555 united mm
- .2 Type "2"
 - .1 Single glazed, clear tempered safety glass, (Engineer-verified thicknesses for spans indicated) transparent tempered float glass to CAN2-12.1-M79, Type 2, Class B. Minimum 6 mm thick at silicone butt-jointed installations.
- .3 Type "3"
 - .1 Sealed Double Glass Vision Units ("IGU-1"): IGMAC Certified, hermetically sealed, to CAN/CGSB 12.8 (latest) minimum 12 mm air space, 90% argon/10% air filled, double sealed edges (primary: polyisobutylene, secondary: polysulphide), desiccant filled stainless steel spacer bar.
 - .1 There shall be no voids or skips in the primary seal or the secondary seal.
 - .2 Minimum performance requirements: for glass units; based on above description:
 - .3 Glazing u-values shall be designed such that they meet or exceed the overall U-value of their particular glazing system including the frame.

- .4 Transmittance: Visible (VLT): 66%, Solar: 27%, U-V: 7%
- .5 Reflectance: Exterior: 11%, Interior: 11%, Solar: 55%
- .6 U-Values: Winter: 0.29, Summer: 0.26, Shading Coefficient: 0.33, Reflective Heat Gain: 70, SHGC: 0.29, LSG: 2.28.
- .4 Type "4"
 - .1 6 mm thick polished Georgian wired glass with square stainless steel mesh approx. 12 mm o.c. imbedded therein conforming to CAN2-12.11 latest edition.
- .5 Type "5" (Canopy Glazing)
 - .1 Laminated heat strengthened clear safety glass, to CAN.CGSB-12.1 composed of two sheets of glass (thickness as determined by Specialty Engineer) with a minimum 0.76 mm (0.030") thick fully bonded, high impact, UV resistant clear polyvinyl butyral (PVB) inter layer for exterior canopy (Section 08 40 00). Prepare and ensure suitability for structural silicone glazing.
- .6 Type "6" (Shower Stalls)
 - .1 Single glazed, clear tempered safety glass, with translucent mylar interlayer. (Engineer-verified thicknesses for spans indicated) transparent tempered float glass to CAN2-12.1-M79, Type 2, Class B. Minimum 6 mm thick at silicone butt-jointed installations.
- .7 Mirrors
 - .1 To CGSB CAN12.5-M76 + Amdt-Dec-76, silvered, type A1.2B, 2, 5 mm thick unframed of size indicated.

2.2 Glazing and Sealing Compound Materials

- .1 Only compounds listed on the CGSB Qualified List are acceptable for use on this project.
- .2 Sealant Compound: One component silicone rubber to CAN/CGSB-19.18, gun grade.
- .3 Glazing tape: Performed butyl tape, 10 – 15 durometer hardness, paper release, 3 mm thick x "X" width to suit stash.
- .4 Setting Blocks: Neoprene, Shore "A" durometer hardness, 60, 75 mm long x 2.4 mm thick x 9 mm high.
- .5 Glazing Splines: Neoprene polyvinyl chloride manufacturer's standard dry glazing splines to suit aluminum extrusions or window system.
- .6 Glazing points and wire spring clips: Corrosion resistant, manufacturer's standards.
- .7 Primer-sealer and cleaners: To glass manufacturer's standard.

PART 3 EXECUTION

3.1 Workmanship

- .1 Remove protective coatings and clean contact surfaces with solvent and wipe dry.
- .2 Apply primer-sealer to contact surfaces.
- .3 Place setting blocks as per manufacturer's instructions.

- .4 Insert spacer shims to centre glass in space. Place shims at 600 mm o.c. and keep 600 mm below sight line.
- .5 Install glass, backbedded in glazing compound or tape, rest on setting blocks, ensure full contact and adhesion at perimeter.
- .6 Install removal stops, over glazing compound or tape without displacing tape or compound.
- .7 Provide edge clearance of 3 mm minimum.
- .8 Apply cap bead of sealant at exterior void.
- .9 At Glazed Canopies coordinate with Section 05 23 13 Structural Steel for Buildings. Review and coordinate design between structural steel fabricator and aluminum Glazing System supplier.
- .10 At glazed doors: coordinate with Door Suppliers, Section 08 11 00 and 08 41 00.

3.2 Interior Glazing

- .1 Dry Method – tape/tape:
 - Cut glazing tape to length and install against permanent stop.
 - .1 Place glazing tape on free per-meter of glass in same manner described above.
- .2 Wet Method
 - .1 Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
 - .2 Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
 - .3 Tool exposed surfaces of sealants to provide a substantial wash away from glass.
- .2 Spline Method:
 - .1 Install spline to permanent stop and install glass.
 - .2 Apply removable stops and spline and secure in place.
- .3 Reference: Hollow Metal Doors and Frames Section 08 11 00
- .4 Reference: Wood Doors Section 08 14 00

3.3 Finishing

- .1 Immediately remove sealant and compound droppings from finished surfaces. Remove labels after work is completed.

END OF SECTION

PART 1 GENERAL

1.1 Work Included

- .1 Interior steel studs, metal furring channels, including floor and ceiling track and associated accessories.
- .2 Suspended metal and drywall ceilings including inserts, wire suspension, wire ties, etc.
- .3 Installation of hollow metal door frames in steel stud partitions.
- .4 Employ 0.84 mm (20 gauge) metal studs in walls which have wall-hung casework attached or have the potential for future casework attachment.
- .5 Installation of access panels in steel stud partitions.

1.2 Related Work

- | | | |
|----|------------------|-------------------------------|
| .1 | Section 07 90 00 | Sealants & Caulking |
| .2 | Section 08 11 00 | Steel Door Frames |
| .3 | Section 09 29 00 | Gypsum Board |
| .4 | Section 09 51 00 | Acoustical Ceiling Tile |
| .5 | Section 09 53 00 | Acoustical Ceiling Suspension |

1.3 Standard Specifications

- .1 Unless otherwise shown or specified, materials and workmanship shall meet the standards detailed in the Specification Standards Manual of the British Columbia Wall and Ceiling Industry.
- .2 Where standards are outlined herein, it will not preclude the use of other standards included in the Specification Standards Manual where such standards are approved in writing by the Departmental Representative.
- .3 Reference in these project specifications to Section numbers, Parts, and Item numbers, means those within Section 9.7 & 9.8 of the Specification Standards Manual.

1.4 Design of Steel Studs Systems

- .1 This section shall be responsible for the engineering design of the steel stud systems.
- .2 Steel stud systems and connections shall be designed in strict accordance with CAN/CSA S136-01.
- .3 The stud wall system shall be designed to support lateral & gravity loadings as prescribed in the NBC 2015.

1.5 Shop Drawings

- .1 Submit shop details and erection drawings showing stud gauges, sizes, fastening, configuration, etc.
- .2 Each drawing submission shall bear the signature and stamp of qualified professional engineer registered in Province of British Columbia.
- .3 Submit sealed NBC Schedules B, and C-B.

PART 2 PRODUCTS

2.1 Interior Steel Studs

- .1 As specified in BCWC Section 9.7, Part 2, Items 1 & 2 to ASTM C645.
- .2 25 gauge galvanized steel studs, generally 92 mm wide, and as detailed.
- .3 Use 20 gauge galvanized steel studs (doubled) at door jambs.
- .4 Supply special extended leg head track on walls subjected to deflection of the structure above.

2.2 Furring Channels

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

2.3 Ceiling Suspension Members

- .1 Hangers, inserts and tie wires, shall be as specified in Section 9.7, Part 2, Item 4, i.e. hangers 9 ga., tie wire not less than 16 ga.

PART 3 EXECUTION

3.1 Installation Interior Steel Studs

- .1 Install steel and stud partitions in accordance with Section 9.7, Part 3, Item 2. Studs 400 mm o.c.
- .2 Use doubled 20 Ga. thick studs each side of door frames.
- .3 Erect new hollow metal door frames in steel stud partitions.
- .4 Use double walls where required to accommodate piping, ducts, exist. wall thicknesses, etc.
- .5 Install access panels for other trades where directed.
- .6 On acoustically treated partitions, track shall be secured over a continuous length of acoustical tape.
- .7 Use extended leg ceiling track in areas where deflection of structure will be present.
- .8 Employ 0.84 mm (20 gauge) metal studs in walls which have wall-hung casework attached or have the potential for future casework attachment.
- .9 Install 1.5 mm (14 ga.) sheetmetal backing strips where scheduled and detailed. Secure to stud flanges with sheetmetal screws as prescribed in specifications manual.

3.2 Installation Vertical & Horizontal Furring

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

END OF SECTION

PART 1 GENERAL

1.1 Related Work

- .1 Section 07 21 00 Building Insulation
- .2 Section 07 90 00 Sealants
- .3 Section 09 22 00 Non-structural Metal Framing

1.2 Reference Standards

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

1.3 Quality Assurance

- .1 Provide gypsum board materials that comply with the following limits for surface burning characteristics when tested as per ASTM E 84:
 - 1. Flame spread: 25, maximum.
 - 2. Smoke developed: 450, maximum.

1.4 Waste Management and Disposal

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 Waste Management and Disposal.
- .2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

PART 2 PRODUCTS

2.1 Standard Gypsum Board

- .1 Standard: non combustible core of not less than 65% gypsum as determined by CAN/CSA-A82.20.1, 16mm and 12mm thickness and as indicated and scheduled, 1219mm wide x maximum practical length, ends square cut, edges tapered.
- .2 Fire-Resistant: To CAN/ULCS 101 or ASTM E119, 16mm thick x 1219mm wide x maximum practical length, ends square cut, edges tapered.
- .3 Moisture Resistant: Board shall have a water resistant core such that when tested in accordance with CAN/CSA-A82.20.3, the average absorption shall not exceed 5% by mass after 2 hours of immersion; and shall have a surfacing such that when tested in accordance with CAN/CSA-A82.20.3, the average absorption shall not exceed 1.6g on either the face or back surface. Face papers shall have a green-tinted colour. Board shall be suitable for taping, filling, finishing and painting. Thickness as indicated and scheduled. Provide fire-resistant (Type 'X') where indicated and scheduled.
- .4 Soundproof: thickness: 16mm, weight: 2.7 psf, STC rating: 51-72 (ASTM E90), Fire rating: 1 hour, Surface flamespread: Class A (ASTM E84), R-Value: 0.5, UL-rated assemblies U386 and W317. An example of the product is "Quietrock 525". Other products having the same characteristics will not be excluded..

2.2 Metal Furring & Suspension Systems

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

2.3 Rated Shaft Wall Assemblies (If Required)

- .1 Shaft Wall Assemblies: proprietary system with stud type and framing system and gypsum board panel thicknesses to suit manufacturer's system requirements to meet rating requirements in accordance with construction assembly, if required by site conditions encountered and as noted on drawings. Provide the following components:
 - .1 Shaft Wall Framing System: to ASTM C645, "J" tracks and slotted discontinuous "I" or "C-T" studs to manufacturer's specifications and appropriate ULC/WHI tested design assembly requirements.
 - .2 Shaft Wall Liner: to ASTM C442/442M and C36/36M and AWCC Section 9.10 – Part 2, Items 2.1 and 2.2, 19 mm or 25 mm thick liner board or factory or field laminated layers of Type X or Type C gypsum coreboard of thickness and widths to suit shaft wall assembly requirements and specified design test assembly number.

2.4 Adhesives

- .1 Laminating compound: to CSA A82.31.

2.5 Accessories

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

2.6 Fastening and Finishing

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

2.7 Fastening

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

PART 3 EXECUTION

3.1 Gypsum Wallboard Application

- .1 Apply drywall in accordance with ASTM C 840, Section 9.6, Part 3, Item 6 of the Specification Standards Manual and printed instructions issued by the board manufacturer.
- .2 Gypsum wallboard shall be attached to metal studs, furring or ceiling channels by screw application.
- .3 Gypsum wallboard shall be attached to concrete or masonry by adhesive.
- .4 Use fire resistant gypsum wallboard (Type X) for fire rated walls and ceilings applied in accordance with U.L.C. design for fire rating required.
- .5 Use paperless gypsum board, where scheduled, in moist areas and as backer board for ceramic tile.

3.2 Corner Beads & Casing Beads

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

3.3 Finishing and Joint Treatment

- .1 Finish field joints, internal angles, screw heads, beads and trim in accordance with Section 9.6, Part 3, Item 4.1 of the Specification Standards Manual for a Level 5 finish.

3.4 Sound Retardant Application

- .1 Where scheduled and detailed:
 - .1 Install foam gasket tape in joint between ceiling track and ceiling soffit.

- .2 Install sound insulation blankets between studs full height of partition, tightly fitted to studs, electrical boxes, ducts and other penetrations.
- .3 Install a 10mm" continuous bead of acoustical sealant between joint of gypsum wallboard and floors or abutting vertical surfaces.

3.5 Grouting of Metal Door Frames

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

3.6 Patching and Pointing

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

3.7 Accessories

- .1 Erect accessories straight, plumb or level, rigid and at proper plane. Use full length pieces where practical. Make joints tight, accurately aligned and rigidly secured. Mitre and fit corners accurately, free from rough edges. Secure at 150 mm o.c. using contact adhesive for full length.
- .2 Install casing beads where gypsum board butts against surfaces having no trim concealing junction and where indicated. Seal joints with sealant.

3.8 Trim

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

3.9 Access Doors

- .1 Install access doors to electrical and mechanical fixtures specified in respective sections, and where noted.
- .2 Rigidly secure frames to furring or framing systems.

3.10 Clean-up

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

END OF SECTION

PART 1 GENERAL

1.1 Related Work

- .1 Section 06 20 00 Finish Carpentry
- .2 Section 07 90 00 Sealants
- .3 Section 10 28 00 Toilet and Bath Accessories

1.2 Reference Standards

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

1.3 Samples

- .1 Submit duplicate 200 x 800 mm sample panels of each colour, texture, size and pattern of tile in accordance with Section 01 33 00.
- .2 Adhere tile samples to 12 mm thick plywood and grout joints to represent project installation.

1.4 Maintenance Materials

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

1.5 Environmental Conditions

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

PART 2 PRODUCTS

2.1 INTERIOR FINISH MATERIAL AND COLOUR SCHEDULE

- .1 This schedule will be issued as a part of the drawings and may list specific manufacturers related to patterns and colours upon which the colour scheme for the project is based.
- .2 The following material specifications, which are prescriptive in nature, are presented in order to establish a quality of product upon which a price can be tendered.
- .3 The Departmental Representative will consider substitute Products which meet or exceed the properties of the specified Product and are similar in material, construction, thickness,

colour, texture, and overall quality, provided that proposals are submitted to the Departmental Representative complete with samples and whatever other data the Departmental Representative may require in order to evaluate the proposed substitute Product. If the Departmental Representative approves the proposed substitute Product, the Contractor will have the option of providing Product listed in the Finish schedule or an approved alternative.

2.2 Porcelain Floor Tile

- .1 300 x 600 mm non-skid commercial grade porcelain floor tile in colours as selected by Departmental Representative from standard range. Natural Finish. Refer to Interior Finish Material and Colour Schedule.
- .2 Use Similar porcelain Floor tile on single wall as indicated on drawings.

2.3 Porcelain Wall Tile

- .1 100 x 300 mm porcelain commercial grade wall tile in colours as selected by Departmental Representative from standard range. Matte finish. Refer to Interior Finish Material and Colour Schedule.
- .2 Provide matching self-coved base and bull nosed edge tile as required.

2.6 Mortar and Adhesive Materials

- .1 Cement: white to CAN3-A5-M93, type 10.
- .2 Sand: to CSA A82.57.
- .3 Lime: to CSA A82.43-M1950 (R1971).
- .4 Latex: formulated for use in cement mortar.
- .5 Water: potable and free of minerals which may discolour mortar.
- .6 Colour pigment: non-fading mineral oxides, unaffected by lime or cement and which will not stain tile.
- .7 Organic adhesive: to CGSB 71-GP-22M.
- .8 Thin set bond cast.

2.7 Grout

- .1 All grouts: Colour as selected by Departmental Representative (premium grades).

2.8 Mortar and Adhesive Mixes

- .1 Slurry coat: cement and water mixed to creamy paste. Latex additive may be included.
- .2 Bond or setting coat: one (1) part cement, 1/3 part lime, one (1) part water, latex additive.
- .3 Measure mortar ingredients by volume.
- .4 Dry set Mortar: mix to manufacturer's instructions.
- .5 Organic adhesives: pre-mixed.

2.9 Metal Protection Trim

- .1 4.5 mm clear anodized aluminum edge protection for ceramic wall tile an example of the product is Schluter® – Jolly No. A45. Other products having the same characteristics will not be excluded.

2.10 Uncoupling Underlayment

- .1 Polyethylene membrane with a grid structure of square cavities, each cut back in a dovetail configuration, and an anchoring fleece laminated to the underside.
- .2 Employ where condition of substrate warrants use.
- .3 An example of the product is “Ditra” membrane by Schluter. Other products having the same characteristics will not be excluded.

2.11 Crack Isolation Membrane

- .1 Underlayment membrane employed to dissipate effects of minor cracks in concrete slab substrates.
- .2 Employ where condition of substrate warrants use.
- .3 An example of the product is “Flexolastic 1000” by Flex Tile. Other products having the same characteristics will not be excluded.

PART 3 EXECUTION

3.1 Workmanship

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

3.2 Wall Tile

- .1 Install tiles on gypsum board walls in accordance with TTMAC detail 304W-98, wall tile installed over wall board on interior dry surfaces only using thin set bond coat and dry curing wall grout.

3.3 Floor Tile

- .1 Install tiles on floor substrate in accordance with TTMAC detail 200-14A. Ceramic floor tile installed in cement mortar bonded to existing and new concrete structural and topping slabs using thin set bond coat and thin set system grout.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- .1 Section 01 33 00 Submittal Procedures
- .2 Section 01 74 21 Waste Management and Disposal
- .3 Section 01 45 00 Quality Control
- .4 Section 01 78 00 Closeout Submittals
- .5 Section 02 41 00 Demolition
- .6 Section 09 53 00 Acoustical Ceiling Suspension

1.2 References

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM E1264-98, Classification for Acoustical Ceiling Products.
- .2 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-88(R2000), Surface Burning Characteristics of Building Materials.

1.3 Samples

- .1 Submit samples in accordance with Section 01 33 00 - Shop Drawings, Product Data and Samples.
- .2 Submit duplicate full size samples of each type of ceiling unit.

1.4 Waste Management and Disposal

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 – Waste Management and Disposal.
- .2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan

1.5 Environmental Requirements

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

1.6 Extra Materials

- .1 Provide extra materials of acoustic units in accordance with Section 01 78 30 – Closeout Submittals.
- .2 Provide acoustical units amounting to 2% of gross ceiling area for each pattern and type required for project.
- .3 Extra materials to be from same production run as installed materials.

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

PART 2 PRODUCTS

2.1 INTERIOR FINISH MATERIAL AND COLOUR SCHEDULE

- .1 This schedule will be issued as part of the drawings and may list specific manufacturers related to patterns and colours upon which the colour scheme for the project is based.
- .2 The following material specifications, which are prescriptive in nature, are presented in order to establish a quality of product upon which a price can be tendered.
- .3 The Departmental Representative will consider substitute Products which meet or exceed the properties of the specified Product and are similar in material, construction, thickness, colour, texture, and overall quality, provided that proposals are submitted to the Departmental Representative complete with samples and whatever other data the Departmental Representative may require in order to evaluate the proposed substitute Product. If the Departmental Representative approves the proposed substitute Product, the Contractor will have the option of providing Product listed in the Finish schedule or an approved alternative.

2.2 Acoustic Ceiling Tiles

- .1 New square-edged (for metric grid) wet-formed mineral fibre acoustical tile units, non-directional, white, and possessing the following characteristics:
 - .1 Matching existing tiles where necessary
 - .2 CAC Rating: 35
 - .3 Light Reflectance: 0.85
 - .4 ASTM E1264 Classification: Type III, Form 2, Fire Class A.
 - .5 30-year system performance guarantee against visible sag.
 - .6 Flame Spread: 25 or under (UL labelled) per ASTM E84, smoke developed: 50.
 - .7 NRC Rating: 0.55
 - .8 Sizes: 600 mm x 1200 mm x 19 mm (for metric grid).
 - .9 Surface texture and appearance shall be as selected by Departmental Representative.
 - .10 Refer to Interior Finish Material and Colour Schedule.

PART 3 EXECUTION

3.1 Examination

- .1 Do not install acoustical tiles and linear panels until work above ceiling has been inspected by Departmental Representative.

3.2 Installation

- .1 As scheduled, install new lay-in panels in new 24mm t-bar ceiling suspension system.
- .2 Commence installation when all work in ceiling space has been completed, inspected and tested.

- .3 Coordinate with mechanical and electrical trades for cut-outs, fixture and equipment penetrations, etc.
- .4 Install linear panels in strict accordance with manufacturer's written instructions and 2010 NBCC.

3.3 Application

- .1 Install linear panels and acoustical units in accordance with reflected ceiling plan.
- .2 Scribe acoustic units to fit adjacent work. Butt joints tight, terminate edges with moulding.

3.4 Interface with Other Work

- .1 Co-ordinate ceiling work to accommodate components of other sections, such as light fixtures, diffusers, speakers, sprinkler heads, to be built into acoustical ceiling components.

END OF SECTION

PART 1 GENERAL

1.1 Related Word

- | | | |
|----|------------------|---|
| .1 | Section 02 41 00 | Demolition |
| .2 | Section 09 22 00 | Suspension System for Gypsum Board Ceilings |
| .3 | Section 09 51 00 | Acoustical Ceiling Tiles |
| .4 | Division 23 | Trim to Recessed Mechanical Fixtures |
| .5 | Division 26 | Trim for Recessed Light Fixtures |

1.2 Reference Standards

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

1.3 Design Criteria

- .1 Maximum deflection" 1/360th of span to ASTM C635 deflection test.
- .2 Hanger inserts in structure shall be capable of developing full strength of hangers they support.
- .3 Design suspension system to conform to seismic restraint requirements of NBCC 2010 and as specified herein. Include Engineering fees in Contract Price.
- .4 Submit Human Resource Development Canada Fire Protection Engineering Services Schedules B-1, B-2 and C-B sealed by a qualified professional Engineer registered in the Province of British Columbia.

1.4 Waste Management and Disposal

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 – Waste Management and Disposal.
- .2 Divert unused metal materials from landfill to metal recycling facility approved by Departmental Representative.
- .3 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .4 Dispose of corrugated cardboard, polystyrene, plastic packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

PART 2 PRODUCTS

2.1 Materials

- .1 Heavy duty system to ASTM C635-07.
- .2 Basic materials for suspension system: commercial quality cold rolled steel.
- .3 Suspension system: non fire rated, two directional exposed tee bar grid.

- .4 Exposed tee bar grid components for Acoustical Tile: 24 mm rolled cap on exposed face. Cross tee with rectangular bulb; web extended to form positive interlock with main tee webs; lower flange extended and offset to provide flush intersection. Grid sizes: 600 mm x 1200 mm metric.
- .5 Hangers: galvanized soft annealed steel wire, 2.6mm thick for all ceilings.
- .6 Carrying channels: of size, thickness and weight to carry spans; painted galvanized steel. Where spans exceed 1200mm use channels of adequate strength.
- .7 Accessories: splices, clips, wire ties, retainers, shadow moulding and wall moulding to complement suspension system components, as recommended by system manufacturer.
- .8 ULC – approved hold-down clips where noted and required.

PART 3 EXECUTION

3.1 Installation

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

3.2 Cleaning

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

END OF SECTION

- .2 Submit duplicate 300 x 300 mm sample pieces of sheet material and 300 mm long base.

1.5 Submittals

- .1 Provide maintenance data for resilient flooring for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Submit copies of moisture and alkalinity test reports to the Departmental Representative for review.

1.6 Extra Materials

- .1 Provide extra materials of resilient sheet flooring and adhesives in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Provide 10% extra of each colour, pattern and type flooring material required for project for maintenance use.
- .3 Extra materials to be in same container and from same production run as installed materials.
- .4 Clearly identify each container of tile flooring and each container of adhesive.
- .5 Deliver to Departmental Representative, upon completion of the work of this section.
- .6 Store where directed by Departmental Representative.

1.7 Environmental Requirements

- .1 Maintain air temperature and structural base temperature at flooring installation area above 20° for 48 hours before, during and 48 hours after installation.

1.8 Waste Management and Disposal

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 – Waste Management and Disposal.
- .2 Do not dispose of unused sealant and adhesive materials into landfill.
- .3 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .4 Collect and separate for disposal paper, plastic, polystyrene, and corrugated cardboard packaging material for recycling.

Part 2 Products

2.1 INTERIOR FINISH MATERIAL AND COLOUR SCHEDULE

- .1 This schedule will be issued as part of the drawings and may list specific manufacturers related to patterns and colours upon which the colour scheme for the project is based.
- .2 The following material specifications, which are prescriptive in nature, are presented in order to establish a quality of product upon which a price can be tendered.
- .3 The Departmental Representative will consider substitute Products which meet or exceed the properties of the specified Product and are similar in material, construction, thickness, colour, texture, and overall quality, provided that proposals are submitted to the Departmental Representative complete with samples and whatever other data the Departmental Representative may require in order to evaluate the proposed substitute Product. If the

Departmental Representative approves the proposed substitute Product, the Contractor will have the option of providing Product listed in the Finish schedule or an approved alternative.

2.2 Sheet Linoleum Flooring

- .1 Where shown and scheduled: 2.5 mm thick homogenous sheet linoleum flooring composed of natural ingredients which are mixed and calendered into a jute backing.
- .2 Marbelized pattern of colours as selected by Departmental Representative from Manufacturer's standard range. Allow for two (2) colour patterns.
- .3 Refer to Interior finish material and colour schedule.

2.3 Rubber Base

- .1 Continuous, top set, complete with premoulded end stops and external corners:
 - .1 Type: rubber, to ASTM F1861
 - .2 Style: cove, B.
 - .3 Thickness: 3.17 mm
 - .4 Height: 101.6 mm
 - .5 Lengths: cut lengths minimum 2400 mm
 - .6 Colour: as selected by Departmental Representative.
 - .7 Include end stops and external corners, premoulded.
 - .8 Refer to interior finish material and clour schedule.

2.4 Anti-Slip Safety Tape

- .1 For use as tactile warning strip at stairs and ramps and where otherwise indicated, 50 mm wide self-adhesive strips applied to floor surface spaced 100 mm o.c. (50 mm spaces between strips). Colours as selected by Departmental Representative from manufacturer's standard range. Provide all cleaners and primers as required for installation.
- .2 An example of the product is "Flex-Tred" instant self-adhesive anti-slip safety tape manufactured by Wooster Products Inc. Other products having the same characteristics will not be excluded.

2.5 Accessories

- .1 Primers and adhesives: waterproof as recommended by flooring manufacturer for specific material on applicable substrate, above, at or below grade.
- .2 Sub-floor filler: white premix latex requiring water only to produce cementitious paste.
- .3 Sealer: to CGSB 25-GP-20, type 2, recommended by flooring manufacturer.
- .4 Wax: to CGSB 25-GP-16M type recommended by flooring manufacturer.
- .5 Polyethylene sheet: to CAN2-51.33-M77, Type 2.

2.6 Edge Strips

- .1 Provide transition aluminum satin anodized mouldings at exposed resilient flooring edges. An example of the product is: "Schluter Floor 1.8 Reno-Ramp AERP 30 B9". Other products having the same characteristics will not be excluded.

Part 3 Execution

3.1 Manufacturer's Instructions

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

3.2 Examination

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

3.3 Preparation

- .1 Section 02 41 00 – Demolition, will remove and dispose of all existing carpet, ceramic tile, and resilient flooring, which is scheduled to be replaced, including the final removal of all residual glues and mastics leaving the substrate ready for preparation/priming by this section for new flooring. Commencement of new flooring work shall signify acceptance of substrate.
- .2 This section shall carefully remove all existing resilient base and residual mastic from existing walls scheduled to receive new resilient base. Make good to walls where condition will affect appearance and proper installation of new rubber base. Installation of new material will imply acceptance of substrate.
- .3 Comply with ASTM F710-92 and manufacturer's recommendations for surface preparation. Remove substances incompatible with resilient flooring adhesive by method acceptable to manufacturer.
 - .1 Concrete floors with steel troweled (slick) finish shall be properly roughened-up (sanded) to ensure suitable adhesion.
 - .2 Concrete floors with curing, hardening and breaking compounds, shall be abraded with mechanical methods only to remove compounds.
- .4 Fill voids, cracks and depressions with trowel-applied levelling compounds acceptable to manufacturer and architect. Remove projections and repair other defects to tolerances acceptable to manufacturer.
- .5 Vacuum sub-floors immediately prior to installation to remove loose particles.

3.4 Installation: Resilient Flooring

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

3.5 Application: Rubber Base

- .1 Lay out base to keep number of joints at minimum.
- .2 Clean substrate and prime with one coat of adhesive.
- .3 Apply adhesive to back of base.
- .4 Set base against wall and floor surfaces tightly by using 3 kg hand roller.
- .5 Install straight and level to variation of 1:1000.
- .6 Scribe and fit to door frames and other obstructions. Use premoulded end pieces at flush door frames.
- .7 Cope internal corners. Use premoulded corner units for right angle external corners. Use formed straight base material for external corners of other angles.

3.6 Maintenance

- .1 Cleaning & Waxing
 - .1 Remove excess adhesive from floor, base and wall surfaces without damage. Clean, seal and wax floor and base surface to flooring manufacturer's recommendations.
 - .2 Clean, seal and wax floor and base surface to flooring manufacturer's recommendations.
- .2 Protection of Finished Work
 - .1 Protect new floors with 0.15 mm thick polyethylene cover from time of final set of adhesive after initial waxing until just before final inspections.
 - .2 Prohibit traffic on floor for forty-eight (48) hours after installation.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- | | | |
|----|------------------|-------------------------------|
| .1 | Section 01 33 00 | Submittal Procedures |
| .2 | Section 01 74 21 | Waste Management and Disposal |
| .3 | Section 01 78 00 | Closeout Submittals |
| .4 | Section 02 41 00 | Demolition |
| .5 | Section 09 31 00 | Ceramic Tile |
| .6 | Section 09 65 00 | Resilient Flooring |

1.2 REFERENCES

- .1 American Association of Textile Chemists and Colorists (AATCC)
 - .1 AATCC 16-1998, Color Fastness to Light.
 - .2 AATCC 23-1999, Color Fastness to Burn Gas Fumes.
 - .3 AATCC 118-1997, Oil Repellency: Hydrocarbon Resistance Test.
 - .4 AATCC 129-2001, Colour Fastness to Ozone in the Atmosphere Under High Humidities.
 - .5 AATCC 134-2001, Electrostatic Propensity of Carpet.
 - .6 AATCC 171-2000, Carpets: Cleaning of; Hot Water Extraction Method.
 - .7 AATCC 174-1998, Antimicrobial Activity Assessment of Carpets.
 - .8 AATCC 175-1998, Stain Resistance: Pile Floor Coverings.
 - .9 AATCC 189-2001, Fluorine Content of Carpet Fibers.
- .2 American Society for Testing and Materials (ASTM International)
 - .1 ASTM D1055-97, Specification for Flexible Cellular Materials - Latex Foam.
 - .2 ASTM D1335-98, Tuft Bind of Pile Floor Coverings.
 - .3 ASTM D1667-97, Standard Specification for Flexible Cellular Materials-Vinyl Chloride Polymers and Copolymers (Closed-Cell Foam). ASTM D3936-00 Standard Test Method for Resistance to Delamination of the Secondary Backing of Pile Yarn Floor Covering.
 - .5 ASTM D5252-98a, Standard Practice for the Operation of the Hexapod Drum Tester.
 - .6 ASTM D5417-99, Standard Practice for Operation of the Vettermann Drum Tester.
 - .7 ASTM E84-01, Test Method for Surface Burning Characteristics of Building Materials.
 - .8 ASTM E648-00, Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.
 - .9 ASTM E662-01, Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials.
 - .10
- .3 Canadian General Standards Board (CGSB)

- .1 CAN/CGSB-4.2 No.27.6-M91, Textile Test Methods - Flame Resistance - Methemine Tablet Test for Textile Floor Coverings.
 - .2 CAN/CGSB-4.2 No.77.1-94/ISO 4919:1978, Textile Test Methods - Carpets - Determination of Tuft Withdrawal Force.
 - .3 CGSB 4-GP-36M-78, Carpet Underlay, Fiber Type.
 - .4 CAN/CGSB-4.129-93(R1997), Carpets for Commercial Use.
 - .5 CGSB 20-GP-23M-78, Cushion, Carpet, Flexible Polymeric Material.
 - .6 CAN/CGSB-25.20-95, Surface Sealer Floors.
- .4 Carpet and Rug Institute (CRI)
 - .1 CRI-104-96, Standard Installation of Commercial Carpet.
 - .2 IAQ Carpet Testing Program.
 - .5 National Floor Covering Association (NFCA)
 - .1 Floor Covering Specification Manual 1998.
 - .6 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-88(R2000), Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S102.2-88(R2000), Surface Burning Characteristics of Flooring, Floor Covering and Miscellaneous Materials and Assemblies.

1.3 SUBMITTALS

- .1 Submit control submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit verification to demonstrate compliance with CAN/ULCS102 and CAN/ULCS102.2.
- .3 Submit proof that carpet has been tested and passed the Indoor Air Quality (IAQ) Carpet Testing Program requirements of the Carpet and Rug Institute (CRI) and the Canadian Carpet Institute (CCI).
- .4 Submit report verifying that tuft bind meets requirements of CAN/CGSB-4.129 when tested to CAN/CGSB-4.2 No.77.1.
- .5 Submit report outlining proposed dust control measures.
- .6 Submit carpet schedule using same room designations indicated on drawings.
- .7 Submit carpet manufacturer's installation instructions: Indicate special procedures and perimeter conditions requiring special attention.

1.4 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00.
- .2 Submit product data sheet for each carpet, undercushion, adhesive, carpet protection and subfloor patching compound.
- .3 Submit WHMIS MSDS - Material Safety Data Sheets acceptable to Labour Canada and Health Canada for carpet adhesive and seam adhesive. Indicate VOC content.

- .4 Submit data on specified products, describing physical and performance characteristics, sizes, patterns, colours, and methods of installation.

1.5 SAMPLES

- .1 Submit samples in accordance with Section 01 33 00.
- .2 Submit duplicate 610 x 610 mm pieces of each type carpet specified.

1.6 CLOSEOUT SUBMITTALS

- .1 Submit operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Submit maintenance data: Include maintenance procedures, recommendations for maintenance materials and equipment, and suggested schedule for cleaning.

1.7 QUALIFICATIONS

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

1.8 DELIVERY, STORAGE AND HANDLING

- .1 Label packaged materials. For carpet tile products indicate nominal dimensions of tile and indicate installation direction.
- .2 Packaging, labelling, packing and marking details.
- .3 Store packaged materials in original containers or wrapping with manufacturer's seals and labels intact.
- .4 Store carpeting and accessories in location as directed by Departmental Representative. Store carpet and adhesive at minimum temperature of 18oC and relative humidity of maximum 65% for minimum of 48 hours before installation.
- .5 Prevent damage to materials during handling and storage. Keep materials under cover and free from dampness.
- .6 Store materials in area of installation for minimum period of 48 hours prior to installation.
- .7 Modular carpet: store on pallet form as supplied by Manufacturer. Do not stack pallets.

1.9 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 – Waste Management and Disposal, and with Waste Reduction Workplan.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging material for recycling in accordance with Waste Management Plan.

1.10 ENVIRONMENTAL REQUIREMENTS

- .1 Moisture: Ensure substrate is within moisture limits and alkalinity limits prescribed by manufacturer. Prepare moisture testing and provide report to Departmental Representative.
- .2 Temperature: Maintain ambient temperature of not less than 18 oC from 48 hours before installation to at least 48 hours after completion of work.
- .3 Relative humidity: Maintain relative humidity between 10 and 65% RH for 48 hours before, during and 48 hours after installation.
- .4 Safety: Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials.
- .5 Ventilation:
 - .1 Provide continuous ventilation during and after carpet application. Run ventilation system 24 hours per day during installation; provide continuous ventilation for 7 days after completion of carpet installation.
- .6 Do not install carpet until space is enclosed and weatherproof, wet-work in space is completed and nominally dry, work above ceilings is complete.

1.11 EXTRA MATERIALS

- .1 Provide extra materials of carpet, carpet base, and adhesives in accordance with Section 01 78 30 - Closeout Submittals.
- .2 Provide 5% of each colour, pattern and type of carpeting. Provide in one continuous full width roll.
- .3 Extra materials to be from same production run as installed materials.
- .4 Identify each package of carpet and each container of adhesive.
- .5 Deliver to Departmental Representative and store where directed by Departmental Representative.

Part 2 Products

2.1 INTERIOR FINISH MATERIAL AND COLOUR SCHEDULE

- .1 This schedule will be issued as part of the drawings and may list specific manufacturers related to patterns and colours upon which the colour scheme for the project is based.
- .2 The following material specifications, which are prescriptive in nature, are presented in order to establish a quality of product upon which a price can be tendered.
- .3 The Departmental Representative will consider substitute Products which meet or exceed the properties of the specified Product and are similar in material, construction, thickness, colour, texture, and overall quality, provided that proposals are submitted to the Departmental Representative complete with samples and whatever other data the Departmental Representative may require in order to evaluate the proposed substitute Product. If the Departmental Representative approves the proposed substitute Product, the Contractor will have the option of providing Product listed in the Finish schedule or an approved alternative.

2.2 CARPET TILE

- .1 All carpet tile shall meet or exceed the following standards:
 - .1 Radiant Panel: ASTM E648, Class 1.
 - .2 Smoke Density: ASTM E662, less than 450.
 - .3 Electrostatic Propensity: AATCC 134, less than 3.5 kv.
- .2 Carpets, required by NBC 2010, shall have flame spread rating or smoke developed classification accordance with CAN/ULC S102.2 for floor surface covering.
- .3 Approximately 600 x 600 mm, 475/576 g/m² yarn weight, 47.2 ends/10 cm machine gauge, tufted/textured or pattern loop solution dyed nylon carpet tile in one field colour/pattern as selected by the Departmental Representative.
- .4 Refer to interior finish material and colour schedule.
- .5 The following are examples of accepted products. Other products having the same characteristics will not be excluded:
 - .1 “Diffuse” and “Disperse” by Shaw.
 - .2 “Furrows II/Fescue” by Interface Flor.
 - .3 “Platform/Aztec” by Interface Flor.
 - .4 “Travel Time”, “Paved Freedom” and “Speed Limit” by Bigelow.

2.3 ACCESSORIES

- .1 Adhesive:
 - .1 Multi-purpose adhesive type: recommended by carpet manufacturer for direct glue down installation.
 - .2 Pressure sensitive type: recommended by carpet manufacturer for direct glue down installation of modular carpet or speciality backed carpets.
- .2 Carpet protection: non-staining heavy duty kraft paper.
- .3 Concrete floor sealer: to CAN/CGSB-25.20, Type 1.
- .4 Subfloor patching compound: Portland cement base filler, mix with latex to form a cementitious paste.

Part 3 Execution

3.1 SUB-FLOOR TREATMENT

- .1 Concrete shall be inspected to determine special care required to make it a suitable foundation for carpet. Cracks 3 mm wide or protrusions over 0.8 mm will be filled and levelled with appropriate and compatible latex patching compound.
- .2 Do not exceed manufacturer's recommendations for patch thickness.
- .3 Large patch areas are to primed with a compatible primer.
- .4 Concrete substrates shall be cured, clean and dry.

- .5 Concrete substrates shall be free of paint, dirt, grease, oil, curing or parting agents, and other contaminants, including sealers, that may interfere with the bonding of the adhesive.
- .6 Wherever a powdery or porous concrete surface is encountered, a primer compatible with the adhesive shall be used to provide a suitable surface for glue-down installation.

3.2 PREPARATION

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

3.3 INSTALLATION

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

3.4 DIRECT GLUE DOWN CARPET

- .1 Apply adhesive and install carpeting in accordance with manufacturer's written instructions, by direct glue-down method.

3.5 SEAMS

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

3.6 BASE INSTALLATION

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

3.7 PROTECTION OF FINISHED WORK

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

END OF SECTION

PART 1 GENERAL

1.1 Work Included

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

1.2 Work Excluded

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

1.3 Requirements of Regulatory Agencies

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

1.4 Qualifications

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

1.5 Submittals

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

1.6 Product Handling

- .1 Paint materials shall be delivered to the job site in sealed original labeled containers bearing manufacturer's name, type of paint, brand name, designation and instruction for mixing and/or reducing.
- .2 The Contractor shall provide adequate storage facilities. Paint materials shall be stored at a minimum ambient temperature of 7°C in a well ventilated and heated single designated area.

- .3 Take all necessary precautionary measures to prevent fire hazards and spontaneous combustion.
- .4 Where toxic materials and both toxic and flammable solvents are used, appropriate precautions shall be taken and no smoking allowed as a regular procedure.

1.7 Environmental Conditions

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

1.8 Protection

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

1.9 Quality Control

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

1.10 Finishing of Cabinets and Shelving

- .1 With the exception of touch-up, scheduled new wood cabinets and shelving shall be shop finished.

1.11 Guarantee

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

PART 2 PRODUCTS

2.1 Materials

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

PART 3 EXECUTION

3.1 General

- .1 Method of paint application shall be generally by the accepted trade method. Painting coats specified are intended to cover surfaces satisfactorily when applied in strict accordance with recommendations.
- .2 Apply each coat at the proper consistency. Each coat of paint shall be slightly darker than preceding coat unless otherwise approved.
- .3 Sand lightly between coats to achieve the required finish. Each coat of finish should be dry and hard before a following coat is applied unless the manufacturer's directions state otherwise (4 hours for latex; 8 hours for alkyd).
- .4 Tint filler to match wood when clear finished are specified; work filler well into the grain and before it has set wipe the excess from the surface.

- .5 Application of paint shall be in strict accordance with MPI Maintenance Repainting and Architectural Painting Specification Manuals requirements.
- .6 Complete hiding is required on all finishes, including deep tone colours.
- .7 Contractor shall employ sufficient tradesmen to carry out the job with no interruption, slow down or inconvenience to the owners.

3.2 Condition of the Surfaces

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

3.3 Preparation of Surfaces

- .1 Prior to commencement of work of this section, thoroughly examine all surfaces scheduled to be painted. Report to Departmental Representative any conditions adversely affecting this work. Prepare all interior surfaces for repainting in accordance with MPI Manual requirements.
- .2 No painting work shall proceed until all defects have been corrected and surfaces are acceptable for painting. All preparation work shall be the responsibility of the Painting Contractor.
- .3 Prepare all surfaces in accordance with the requirements in Chapter 3 of the MPI Maintenance Repainting and Architectural Painting Specification Manuals (latest edition) and as herein specified.
- .4 Remove and securely store all miscellaneous surface fittings/fastenings (eg: electrical places and frame stops), removable rating/hazard/instruction labels, prior to painting and replace upon completion. Carefully clean and replace all such items upon completion of repainting work in each area. Do not use solvent or reactive cleaning agents on items that will mar or remove finishes (eg: lacquer finishes).
- .5 All surfaces shall be sanded prior to the application of any coatings.
- .6 Allow full drying between coats, as per manufacturer's recommendations. Sand in between coats.
- .7 Remove all loose and peeling paint from walls and woodwork to a sound surface.
- .8 Loose and peeling paint not meeting ASTM Designation D3359-87 Test Method A-X cut scale 2A shall have the entire surface(s) removed to a sound surface.
- .9 Repair all water damaged drywall and spot prime with a stain blocking primer.
- .10 Surface defects, such as nail/screw popping, paper tears, nicks and scratches, line gauges caused by chair back seat rests, tables, etc., shall be filled, sanded and spot primed with an approved primer and shall be considered normal surface preparation.
- .11 Units severely contaminated with grease, smoke and tar – hand wash with detergent and rinse thoroughly prior to any surface preparation.

- .12 All surfaces: applications shall be by brush/roller, including smooth ceilings.
- .13 Allow full drying between coats, as per manufacturer's recommendations. Sand in between coats.
- .14 Surface defects such as old paint runs on walls and wood works must be sanded smooth prior to the applications of any coating(s).
- .15 Tape fill, sand and spot prime all structural cracks.
- .16 Remove clear tape from walls, ceilings, doors, etc. Remove felt pen graffiti from doors, walls, etc. before priming. Prepare and paint all mechanical and electrical services with the appropriate primers, as per MPI Architectural Specification Manual latest edition.
- .17 Ensure that a transition primer is applied over alkyd surfaces where waterborne systems have been specified.

3.4 Mechanical and Electrical Equipment

- .1 Paint exposed conduits, pipes, hangers and other mechanical and electrical equipment occurring in finished areas. Colour and texture to match adjacent surfaces, except as noted otherwise.
- .2 Keep sprinkler heads free of paint.
- .3 Paint inside of ductwork where visible with primer and one coat of matt black paint.
- .4 Paint both sides and edges of plywood back-boards for equipment in original finish except for touch-up as required, and paint conduits, mounting accessories and other unfinished items.

3.5 Field Quality Control

- .1 In strict accordance with the MPI Maintenance Repainting and Architectural Painting Specifications Manuals requirements.

3.6 Painting Schedule

- .1 The following titles, grades and code numbers refer to those listed in the Master Painters Institute (MPI) Architectural Painting Specifications Manual and the Maintenance Repainting Manual, latest edition.
- .2 Existing Interior Surfaces:
 - .1 Concrete and Plaster Ceilings: (Premium Grade) RIN 3.1A, G2, DSD2.
 - .2 Gypsum Board Ceilings: (Premium Grade) RIN 9.2B, G1, DSD2.
 - .3 Plaster and Gypsum Board, Walls: (Premium Grade) RIN 9.2B, G3, DSD2.
 - .4 Miscellaneous Metal: (Premium Grade) RIN 5.1R, G6, DSD2.
 - .5 Wood: (Premium Grade) RIN 6.4C, G5.
 - .6 Existing H.M. Doors, Frames and Other Galvanized Metal Items: (Premium Grade) RIN 5.3J, G5, DSD3.
- .3 New Interior Surfaces:
 - .1 Gypsum Board Ceilings: (Premium Grade) INT, 9.2B, G1
 - .2 Gypsum Board Walls: (Premium Grade) INT 9.2B, G3
 - .3 Hollow Metal Doors and Frames: (Premium Grade) INT 5.3C, G5
 - .4 Metal Fabrications: (Premium Grade) INT 5.1E, G5.

- .5 Metal Fabrications Associated with Stairs, Ramps and Guardrails: (Premium Grade) INT 5.1L, G5.
 - .6 Wood, Trim: (Premium Grade) INT 6.3B, G5
 - .7 Concrete: (Premium Grade) INT 3.1C, G3
 - .8 Transparent Finished Hardwood: (Premium Grade) INT 6.3E polyurethane varnish (semi-gloss) over stain (to match existing) to samples as selected by Departmental Representative.
- .4 New Exterior Surfaces:
- .1 Metal Fabrications: (Premium Grade) EXT 5.1E, G5.
 - .2 Galvanized Steel (H.M. Doors and Frames): (Premium Grade) EXT 5.3C, G5.

3.7 Existing Surfaces

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

3.8 Paint Colour Schedule

- .1 To be issued as part of the drawings at a later date.

3.9 Cleaning

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

END OF SECTION

PART 1 GENERAL

1.1 Section Includes

- .1 Ceiling-hung embossed stainless steel toilet partitions and urinal screens scheduled including all overhead framing and supports.

1.2 Quality Assurance

- .1 Obtain all components of toilet partitions and urinal screens from one single source manufacturer who certifies that materials meet or exceed specifications.
- .2 Installation work of this section shall be performed by a Contractor who is regularly engaged in the assembly and installation of toilet partition systems. Contractor shall demonstrate to the acceptance of the Consultant, that they have successfully performed on comparable projects over the previous 5 years.

1.3 Submittals

- .1 Shop Drawings:
 - .1 Show the proposed system of anchorage and materials being supplied on shop drawings submitted for review.
 - .2 Show all hardware items, anchorage devices, dimensions, description of materials and finishes, and all other pertinent information.
- .2 Samples:
 - .1 Submit sample of panel finish and samples of all hardware items. If requested.
- .3 Maintenance:
 - .1 Submit maintenance data for maintenance of work of this section for incorporation into maintenance manual in accordance with Section 01 78 00.

1.4 Deliver, Storage and Handling

- .1 Deliver pre-finished materials to the project site in original, unopened cartons or other packaging materials necessary to protect structure and finishes.
 - .1 Label packages clearly with manufacturer's name and item description.
 - .2 Store materials in such packaging until installation.

1.5 Project Conditions

- .1 Building shall be enclosed and provide complete protection from outside weather. Temperature within building shall be above a minimum of 60°F.

1.6 Sub-Trade Document Submission

- .1 Sub-trades of this Section are reminded that, in addition to the customary Sections associated with their trades, they must become familiar with, and abide by all Sections of Division 1 including the contents of Appendices 'A' and 'B' of these Specifications.
- .2 In addition to the normal required sub-trade forms and agreements, each sub-trade of this Section shall complete and sign each of the following documents and submit to the Construction Manager and the General Contractor.
 - .1 CMMS information sheet for all new or replacement equipment being provided.
 - .2 Confidentiality Agreements for drawing control.
 - .3 All security requirements and forms covered in Section 01 14 00 and included in Appendices of these Specifications.

PART 2 PRODUCTS

2.1 Description

- .1 Ceiling-hung partitions with 1473 mm high doors and panels mounted 305 mm above the floor.
- .2 Panels constructed of embossed stainless steel factory-bonded to 25 mm honeycomb core.
- .3 #4 Stainless steel wall brackets and tamperproof 6-lobe security head stainless steel fasteners.
- .4 #4 brushed stainless steel wrap-around hinges with “No-Sightline Solution” privacy feature at door joints.
- .5 Barrier-free door latches and door-mounted coat hooks of #4 brushed stainless steel.

2.2 Accepted Product

- .1 Hadrian Ceiling-Hung embossed stainless steel “Standard Series”.
- .2 Other products having the same characteristics will not be excluded.

PART 3 EXECUTION

3.1 Installation

- .1 General: Comply with manufacturer’s written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer’s recommended anchoring devices.
 - .1 Maximum Clearances:
 - .1 Pilasters and Panels: 12.7 mm.
 - .2 Panels and Walls: 25.4 mm.
- .2 Stirrup brackets: Secure panels to walls and to pilasters with no fewer than two brackets attached near top and bottom of panel.
 - .1 Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
 - .2 Align brackets at pilasters with brackets at walls.
- .3 Coordinate overhead suspension with Division 5 for bracing, brackets and sub-supports and with Division 09 for ceiling finishes.
- .4 Urinal screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.
- .5 Install hardware components and partitions with tamperproof fastenings and screws to manufacturer’s written specification. Attach panel and pilasters to brackets with through type sleeve bolt and nut. Completed assembly shall be free of vibrations and rattles.
- .6 Secure wall brackets to blocking in steel stud walls.
- .7 Erect enclosure panels accurately to dimensions, and set plumb and level. Hang doors, adjust hinges to perform as specified. Re-check doors for emergency feature. Install latch and hooks.
- .8 Install system to be free of rattles and reverberations during normal usage.

3.2 Adjustment and Cleaning

- .1 Hardware adjustment:
 - .1 Adjust hardware so that latches operate smoothly and without binding. Lubricate hardware if required by manufacturer's instructions.
 - .2 Set hinges on out-swinging doors to return doors to fully closed position. Set hinges on doors to fully closed position.
- .2 Clean exposed surfaces using materials and methods recommended by manufacturer. Provide protection during remainder of construction period.

END OF SECTION

PART 1 GENERAL

.1 Summary of Work

- .1 Section includes furnishing and installing a top-hung, hinged-panel, aluminum and glass door system that includes:
 - .1 Aluminum rails
 - .2 Top track
 - .3 Folding panels
 - .4 Paired panels
 - .5 Single action door panels attached to chain of folding panels
 - .6 Single/double action end panels
 - .7 Folding/swinging hardware
 - .8 Locking hardware
 - .9 Sealing brushes
 - .10 Glass and glazing
 - .11 Accessories as required for a complete working installation.

.2 Related Documents and Sections

- .1 Contractor to examine Contract Documents for requirements that directly affect or are affected by Work of this Section. A list of those Documents and Sections include, but is not limited to, the following:
- .2 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 General Requirements, Specification Sections, apply to this Section.
 - .1 Section 06 10 00 Rough Carpentry
 - .2 Section 08 41 00 Aluminum Glazed Systems
 - .3 Section 09 22 00 Non-Structural Metal Framing

.3 References

- .1 Reference Standards in accordance with Division 01 and current editions from the following:
 - .1 AAMA. American Architectural Manufacturers Association; www.aamanet.org
 - .1 AAMA 611, Voluntary Specification for Anodized Architectural Aluminum
 - .2 AAMA 2603, Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels
 - .3 AAMA 2604, Voluntary Specifications, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels
 - .2 ANSI. American National Standards Institute; www.ansi.org
 - .1 ANSI Z97.1, Safety Performance Specifications and Methods of Test for Safety Glazing Material Used In Buildings

- .2 ASTM. ASTM International; www.astm.org
 - .1 ASTM C1036, Standard Specification for Flat Glass
 - .2 ASTM C1048, Standard Specification for Heat-Strengthened and Fully
- .3 Tempered Float Glass
 - .1 ASTM D1003, Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics
 - .2 ASTM E330, Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
 - .3 CPSC 16CFR-1201, Safety Standard for Architectural Glazing Materials.

.4 Coordination:

- .1 Coordinate top-hung head track support with structural drawings. See Section 05 12 23 Structural Metal for Buildings and 05 55 00 Metal Fabrications..
- .2 Coordinate All Glass Folding Partition system and framing R.O.
- .3 Hold on site preinstallation meeting.

.5 Submittals

- .1 For Contractor submittal procedures see Section 01 30 00.
- .2 Product Data: Submit manufacturer's printed product literature for each All Glass Folding Partition system to be incorporated into the Work. Show performance test results and details of construction relative to materials, dimensions of individual components, profiles and colors.
- .3 Shop Drawings: Indicate All Glass Folding Partition system component sizes, dimensions and framing R.O., configuration, pivot and swing panels, direction of swing, stacking layout, typical head jamb, side jambs and sill details, type of glazing material, handle height and field measurements.
- .4 Manufacturers' Instructions: Submit manufacturer's installation instructions.
- .5 Operation and Maintenance Data: Submit Owner's Manual from manufacturer. Identify with project name, location and completion date, and type and size of unit installed.

.6 Quality Assurance

- .1 Manufacturer Qualifications: Manufacturer capable of providing complete, precision built, engineered, pre-fitted units with a minimum twenty-five (25) years' experience in the sale of folding door systems for large openings in the North American market.
 - .1 Manufacturer to have ISO 9001: 2008 quality management system registration.
 - .2 Manufacturer to have ISO 14001: 2005 environmental management system registration.
- .2 Installer Qualifications: Installer experienced in the installation of manufacturer's products or other similar products for large openings. Installer to provide reference list of at least three (3) projects of similar scale and complexity successfully completed in the last three (3) years.
- .3 Installer to be trained and certified by manufacturer.

.4 Single Source Responsibility: Furnish All Glass Folding Partition system materials from one manufacturer for entire Project.

.7 Delivery, Storage, And Handling

.1 Comply with manufacturer's instructions and recommendations, Section 01 60 00 requirements, and as follows:

.1 Deliver materials to job site in sealed, unopened cartons or crates.

.1 Upon receipt, inspect the shipment to ensure it is complete, in good condition and meets project requirements.

.2 Store material under cover in a clean and dry location, protecting units against weather and defacement or damage from construction activities, especially to the edges of panels.

.8 Field Conditions

.1 Field Measurements: Contractor to field verify dimensions of:

.1 rough openings (R.O.)

.2 threshold cut to receive floor track.

.2 Mark field measurements on shop drawing submittal.

.9 Warranty

.1 Manufacturer Warranty: Provide All Glass Folding Partition system manufacturer's standard limited warranty as per manufacturer's published warranty document in force at time of purchase, subject to change, against defects in materials and workmanship.

.2 Warranty Period beginning with the earliest of 120 days from Date of Delivery or Date of Substantial Completion:

.1 Rollers: Ten (10) years

.2 All Other Components Except Screens: Ten (10) years

PART 2 PRODUCTS

.1 Manufacturers

.1 Basis-of-Design Product by Manufacturer: NanaWall FSW75 (www.nanawall.com)

.1 As supplied by Nanawall Systems Inc. 100 Meadow Creek Drive, Corte Madera, CA 94925 Toll Free (800) 873-5673, Telephone: (415) 383-3148, Fax: (415) 383-0312 Email: info@nanawall.com

.2 Proprietary products and system (single source manufactured and supplied with approved site installers) having similar characteristics will not be excluded.

.2 Materials

.1 All Glass Folding Partition Description: All glass, top-hung, single track folding system with no vertical profiles. Manufacturer's standard top and bottom channel frame and panel profiles, with head track, floor track, side jams, folding-swing panels with dimensions as shown on Drawings.

.2 Panel Size (W x H): As indicated on drawings

.3 Provide aluminum head track, hinges/pivot points and face and edges of top and bottom rails.

- .4 Panels with Push/Pull Handles, Knobs, Rosettes, or Panic Devices: Provide handle height centered at 41-3/8 inch (105 cm) from bottom of the panel or as indicated otherwise.
- .5 Other Components: Bumpers: Provide recessed polyamide bumpers on one end of sliding panel end caps, at the top and bottom.
- .6 Transparent Vertical Edge Seals: Between panels, provide UV resistant edge mounted gaskets.

.2 Fabrication

- .1 Extruded aluminum frame and rail profiles, folding hardware, locking hardware and handles, and glass used to fabricate a center pivot folding glass wall.
- .2 Each unit factory pre-assembled and shipped with all components and installation instructions.
- .3 Exposed work to be carefully matched to produce continuity of line and design with all joints.
- .4 No raw edges visible at joints.

PART 3 EXECUTION

.1 Examination

- .1 Examination and Acceptance of Conditions per Section 01 70 00 and as follows:
- .2 Carefully examine rough openings with Installer present, for compliance with requirements affecting Work performance.
 - .1 Verify that field measurements, substrates, cleanliness, tolerances, level, plumb, square, with no unevenness, bowing, or bumps on floor, not only in the rough opening area but also in the single action panel swing areas, and other conditions are as required by the manufacturer, and ready to receive Work.
 - .2 Verify the structural integrity of the header for deflection with live and dead loads limited to the lesser of L/720 of the span or 1/4 inch (6 mm). Provide structural support for lateral loads, and eccentric load when the panels are stacked open.
- .3 Proceed with installation only after unsatisfactory conditions have been corrected.

.2 Installation

- .1 General: Install All Glass Folding Partition system in accordance with the Drawings, approved submittals, manufacturers' recommendations and installation instructions, and as follows:
- .2 Properly seal around opening perimeter.
- .3 Securely attach anchorage devices to rigidly fit top head track and stacking bay in place, level, straight, plumb and square. Install frame in proper elevation, plane and location, and in proper alignment with other work
- .4 Install panels, handles, lockset and other accessories in accordance with manufacturer's recommendations and instructions.

.3 Field Quality Control

- .1 Field Tests and Inspections per Section 01 45 00 of the following:
 - .1 Verify the All Glass Folding Partition system operates and functions properly. Adjust hardware for proper operation.

.2 Non-Conforming Work: Repair or replace non-conforming work as directed by the

.4 Cleaning and Protection

- .1 Keep units closed and protect All Glass Folding Partition installation against damage from construction activities.
- .2 Remove protective coatings and use manufacturer recommended methods to clean exposed surfaces.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- .1 Section 06 20 00 Finish Carpentry and Millwork
- .2 Section 08 80 00 Glazing

1.2 References

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

1.3 Shop Drawings

- .1 Submit shop drawings in accordance with Section 01 33 00.
- .2 Indicate size and description of components, base material, surface finish inside and out, hardware and locks, attachment devices, description of rough-in frame, building-in details of anchors for grab bars.

1.4 Closeout Submittals

- .1 Provide maintenance data for toilet and bath accessories for incorporation into manual specified in Section 01 78 30 – Closeout Submittals.

1.5 Waste Management and Disposal

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 – Waste Management and Disposal.
- .2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

1.6 Extra Materials

- .1 Provide special tools required for accessing, assembly/disassembly or removal for toilet and bath accessories in accordance with requirements specified in Section 01 78 30 – Closeout Submittals.
- .2 Deliver special tools to Departmental Representative.

PART 2 PRODUCTS

2.1 Materials

- .1 Sheet steel: to ASTM A653/A653M with ZF001 designation zinc coating.
- .2 Stainless steel sheet metal: to ASTM A167, Type 302 with No. 4 finish.
- .3 Stainless steel tubing: Type 304 commercial grade, seamless welded, 1.2 mm wall thickness.
- .4 Fasteners: concealed screws and bolts hot dip galvanized, exposed fasteners to match face of unit. Expansion shields, fibre, lead or rubber as recommended by accessory manufacturer for component and its intended use.
- .5 All washroom accessories shall be the same design line of the same manufacturer. Component schedule is based upon Bobrick "Classic Line" for purposes of establishing quality and appearance. Other products having the same characteristics will not be excluded.

2.2 Components

- .1 Paper towel dispenser (at all stainless steel counter sinks): universal type for both folded and roll towels. Approx. 310 x 185 x 155 mm. Stainless steel surface-mounted. (B-263).
- .2 Vanity-mounted soap dispensers: liquid/lather push-in valve 102 mm spout, self contained translucent polyethylene 1.0 L tank, stainless steel piston and valve assembly, tamper proof filler lock, under counter mounted, exposed metal components chrome plated. (B-822).
- .3 Wall-mounted soap dispensers (at all stainless steel counter sinks): horizontal tank, satin stainless steel, 1.2L capacity liquid soap, 205 x 120 mm. (B-2112).
- .4 Wall-mounted toilet tissue dispenser: stainless steel for 2-rolls, surface-mounted 320 x 125mm (B-2740).
- .5 Sanitary napkin disposal bin: stainless steel, surface-mounted, 270 x 385 x 105mm. (B-254).
- .6 Mirror: 6mm No. 1 quality glass mirror in stainless steel beveled frame, 460 x 760mm. (B-290-1830).
- .7 Coat hooks: Heavy-duty single-cast, satin nickel finish, concealed mounting. (B-2116).
- .8 Grab bars: 30/32 mm dia x 1.6 mm wall tubing of stainless steel, 38 mm diameter wall flanges, concealed screw attachment, flanges welded to tubular bar, provided with steel back plates and all accessories. Knurl bar at area of hand grips. Grab bar material and anchorage to withstand downward pull of 2.2 kN. Configurations and sizes as indicated.

2.3 Fabrication

- .1 Weld and grind joints of fabricated components flush and smooth. Use mechanical fasteners only where approved.
- .2 Wherever possible form exposed surfaces from one sheet of stock, free of joints.
- .3 Brake form sheet metal work with 1.5 mm radius bends.
- .4 Form surfaces flat without distortion. Maintain flat surfaces without scratches or dents.
- .5 Back paint components where contact is made with building finishes to prevent

- electrolysis.
- .6 Hot dip galvanize concealed ferrous metal anchors and fastening devices to CSA G164.
- .7 Shop assemble components and package complete with anchors and fittings.
- .8 Deliver inserts and rough-in frames to job site at appropriate time for building-in. Provide templates, details and instructions for building in anchors and inserts.
- .9 Provide steel anchor plates and components for installation on studding and building framing.

PART 3 EXECUTION

3.1 Installation

- .1 Install and secure accessories rigidly in place as follows:
 - .1 Stud walls: install steel back-plate to stud prior to plaster or drywall finish. Provide plate with threaded studs or plugs.
 - .2 Hollow masonry units: use toggle bolts drilled into cell/wall cavity.
 - .3 Solid masonry, marble, stone or concrete: use bolt with lead expansion sleeve set into drilled hole.
- .2 Install grab bars on built-in anchors provided by bar manufacturer.
- .3 Use tamper proof screws/bolts for fasteners.
- .4 Fill units with necessary supplies shortly before final acceptance of building.

3.2 Schedule

- .1 Locate accessories where indicated. Exact locations determined by Departmental Representative.
- .2 Toilet tissue dispenser: one at each toilet.
- .3 Combination towel dispenser/waste receptacles: one in each washroom where indicated. Maximum height of dispenser and operable part from floor 1200 mm.
- .4 Soap dispenser: one at each wash basin and s.s. sink.
- .5 Grab bar: set at each toilet as indicated. Height of grab bar from floor 750 mm. Side grab bar: maximum distance from rear wall 300 mm, minimum distance passed front edge of toilet 450 mm.
- .6 Sanitary napkin disposal: one in each female washroom.
- .7 Mirror: one above each washroom lavatory
- .8 Coat hooks: where indicated on drawings.
- .9 Paper towel dispenser and wall-mounted soap dispenser: one of each above each stainless steel counter-mounted sink.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- .1 Section 10 28 00 Toilet and Bath Specialties

1.2 Reference Standards

- .1 CAN/CGSB-44.40-92, Steel Clothing Locker.

1.3 Shop Drawings

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate type and class of locker, thicknesses of metal, fabricating and assembly methods, assembled banks of lockers, tops, hooks, shelves, bases, trim, numbering, filler panels, end/back panels, doors, handles, locking method, finishes.

1.4 Samples

- .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit duplicate 50 x 50 mm samples of colour and finish on actual base metal.

1.5 Waste Management and Disposal

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 – Waste Management and Disposal.
- .2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.
- .3 Fold up metal banding, flatten and place in designated area for recycling.

PART 2 PRODUCTS

2.1 Metal Locker Description

- .1 Size:
 - .1 305mm W x 457mm D x 1525mm H. Single Tier
 - .2 305mm W x 457mm D x 762mm H Double Tier
- .2 Tier Arrangement: Single Tier and Double Tier
- .3 Sheet Metal: 16 gauge mild cold rolled sheet steel. Doors: Closed box construction, 16 gauge outer panel and 18 gauge inner panel, flush with frame, with recessed handle and recessed number plate. 25mm cell honeycomb core bonded to the inner surfaces at 102mm above and 102mm below recessed handle. 13mm wide x 25mm high oval staggered perforations at upper and lower sections. 16 gauge continuous piano hinge securely welded to frame and riveted to door. Hinge shall maximize security and enhance resistance to vandalism.
- .4 Door Frames: 16 gauge formed steel channel with 18 gauge formed steel channel high top and bottom cross members.

- .5 Door Stops: Continuous, full height of locker door.
- .6 Body: 16 gauge steel sides ventilated with 13mm wide x 25mm high oval staggered perforations. 18 gauge steel backs with right angle flanges on vertical sides for strength and rigidity.
- .7 Tops: 16 gauge formed steel pan flanged on all sides. Provide sloping tops.
- .8 Base: Mount to base bench storage lift per drawings
- .9 Lockers shall be assembled by riveting. Bolted construction not acceptable.
- .10 Locks: 11 gauge padlock hasp welded to door frame, metal lock pocket recessed into door, black laminated plastic number plate recessed flush with door surface.
- .11 Interior equipment: one hat shelf and three single prong coat hooks.
- .12 Finish: Manufacturer's cleaning, degreasing and pre-treatment followed by a baked high-performance epoxy powder coating. Colour as selected by Consultant from manufacturer's standard range.

2.2 Gear Locker Description

- .1 Size:
 - .1 600mm x 600 mm x 2200mm Single Tier
- .2 Pre-engineered wire mesh gear locker system consisting of framed wire mesh panels, framed doors, framed shelves, roof panels, wire mesh back panels and hardware.
- .3 Wire mesh side panels shall be framed. Panel frames shall be made of 1¼"x1¼"x12ga structural steel angle and shall have two vertical framing elements that extend 6-inches beyond the lower edge of the framed fabric. Corners shall be notched and seam welded. The fabric shall be welded to the frame at every 6-inches. The following metal fabrics are acceptable for side panels:
 - .1 The panel shall be welded of 10-gauge wire creating a fabric of wire spaced 2"x2" (50 x 50)
- .4 Swing doors shall be made of the same material and in the same method as the side panels (two vertical framing elements that extend 6-inches beyond the lower edge of the framed fabric excluded). In addition, two ½" round diagonal stay bars shall be included on the door panel. Doors shall be equipped with a set of padlocking hasps, a welded handle, and door stopper. Doors shall be of single swing type. The following fabrics are acceptable for side panels:
 - .1 The panel shall be welded of 10-gauge wire creating a fabric of wire spaced 2"x1" (50 x 25)
- .5 Roof panels shall be designed for security purposes only. Roof panels are not designed to resist loads.
 - .1 The panel shall be welded of 6-gauge and 8-gauge wire creating a fabric of wire spaced 2"x2" and include:
 - .1 1¼"x1¼"x12ga structural steel transom angle;

- .6 Back panels shall be made of the same material and in the same method as the roof panels. Back panels shall be unframed. The fabric shall be galvanized. The following fabrics are available for roof panels:
 - .1 The panel shall be welded of 6-gauge and 8-gauge wire creating a fabric of wire spaced 2"x2" (50 x 50)
- .7 Top and Bottom Shelf: Shelf panels shall be framed. Shelf panel frames shall be made of 1¼"x1¼"x12ga structural steel angle. Corners shall be notched and seam welded. The fabric shall be welded to the frame at every 6-inches. The following fabrics are available for side panels:
 - .1 The panel shall be welded of 10-gauge wire creating a fabric of wire spaced 2"x2" (50x50)
- .8 A steel coat rod, with four hooks, shall be an provided as part for the Gear locker.
- .9 Provide lockable hasps and latches for personal locking de ices supplied by occupants.
- .10 Provide all anchors, supports and fasteners for proper installation.

2.3 Standard of Acceptance

- .1 Metal Lockers: "Gladiator Athletic Lockers" by Hadrian. Colour: 621 Slate.
- .2 Gear Lockers: "TA-50 Gear Lockers" by Cogan Wire and Metal Products QC, Canada Tel.: [800]-567-2642: Colour Grey
- .3 Other proprietary products having similar characteristics will not be excluded.

PART 3 EXECUTION

3.1 Installation

- .1 Assemble and install lockers in accordance with manufacturer's written instructions.
- .2 Securely fasten lockers to grounds and nailing strips.
- .3 Install filler panels where obstructions occur.
- .4 Install finished end panels to exposed ends of locker banks.
- .5 Install locker numbers.

END OF SECTION

APPENDIX A
LEAD BASED PAINT SURVEY – MARCH 2004
ASBESTOS CONTAINING MATERIALS SURVEY – OCTOBER 2003

Lead-Based Paint Survey Report

**CULTUS LAKE LABORATORY
AND
WEST VANCOUVER LABORATORY**

March 2004

Prepared By:

Canadian Coast Guard
Environmental Services
Victoria, BC

Table of Contents

Introduction 1

Methods 1

 Equipment 1

 Procedure 1

Results 3

 Cultus Lake Laboratory 3

 West Vancouver Laboratory 3

Occurrence Descriptions 4

 Cultus Lake Laboratory 4

 East Crew House 4

 Main Office 4

 Wet Laboratory 4

 Generator Shed 4

 Workshop 5

 West Vancouver Laboratory 5

 Main Office 5

 Boat Shed 5

Conclusion 5

Appendices

A: Cultus Lake Laboratory Data

B: West Vancouver Laboratory Data

Introduction

This document presents the findings of the lead-based paint survey of two Department of Fisheries and Oceans laboratory facilities: Cultus Lake and West Vancouver. The surveys were completed over two days in February, 2004, and provide an overview of lead-based paint occurrences at the facilities. The intention is provide information on the location of lead-based paint on the sites to assist in safe work practice planning. Worker protection measures have been developed for the staffed lightstations and could easily apply to the laboratory sites. These measures are contained in the CCG Risk Management Plan for Addressing Environmental Contamination at Staffed Lightstations which can be made available when the document has reached final draft.

Results of the survey are presented in this report in both descriptive and tabular format. Site managers at both sites were provided with a tabular printout of the results of their respective sites upon completion of the survey.

Methods

Equipment

Surveys were completed using the following equipment:

- Niton XL300 Lead Analyzer
- Laptop Computer
- 2-way radios
- Portable printer

Procedure

User safety measures were followed as outlined in the standard operating procedures created for the Niton XL300.

A dedicated log was created for each site to assist in the tracking of lead-based paint (LBP) occurrences. The log consists of columns to record building characteristics and sample specific details. Start-up and calibration of the analyzer was completed as outlined in the user manual and values for the calibration testing were entered into the site log.

Materials, in this case, paint, can be assayed in-situ; paint samples are not removed from surfaces. This is accomplished by measuring the fluorescence emitted by lead atoms when exposed to gamma radiation. The process is referred to as x-ray fluorescence (XRF). Lead-based paint surveying consists of systematic movement from structure to structure. Within structures, changes in paint colour, paint texture, feature, application area, and result patterns must be observed and survey methods adapted. Short descriptions of these aspects follow:

1. Paint Colour Paint colour is the most obvious change in paint application. Different paint colours can have varying potential for lead.
2. Paint Texture Textures of surfaces indicate potential for items being painted different colours in their lifetime. For example, similar colour walls with different textures in one room have, on occasion, been found to have different lead levels.
3. Feature Similarly coloured features may have different types of paint depending on their usage. High-wear areas such as siding, cupboards, baseboard and door trim, and doors were often painted with LBP due to its durability.
4. Application Area Paint type often changes with area usage. Areas with high humidity (kitchen or bathroom) or exposure (interior vs. exterior) are more likely to have been painted with LBP.
5. Result Patterns Similar features throughout a building often have similar histories. As a building is surveyed, patterns can be established concerning LBP in order to reduce, or increase, the amount of sampling required.

Relative depth of the lead-based paint is provided along with the lead reading. Depth index (DI) produces a number between one and ten that signifies the location of the lead-based paint within a profile of paint. Literature associated with the Niton XL300 suggests that following ranges be used to describe depth:

- 0 – 1.5 Shallow
- 1.5 – 4 Medium
- 4 – 10 Deep

These numbers do not represent paint layers. Through experiment, it has been found that a single layer of paint can fall anywhere within the shallow range. Returns with a DI in the medium or deep ranges have been found to have the lead layer covered by at least one layer of paint.

Results

Cultus Lake Laboratory

A total of 128 points were surveyed at Cultus Lake Laboratory, 15 of which resulted in lead-based paint identification. The 15 confirmed locations are categorized into five buildings:

East Crew House	Exterior – South Soffit – White Exterior – North Soffit – White Exterior – North Door Trim – White Exterior – North Door Jamb – White Interior – Laundry Room – North Door – White Interior – Laundry Room – East Wall – White Interior – Laundry Room – West Wall – White
Main Office	Interior – North Lab – Bathroom Cupboard – Brown Interior – North Lab – Bathroom Cupboard – Cream (x2)
Wet Lab	Interior – South (Large) Room – Ceiling – White Interior – South (Large) Room – Support Posts - White
Generator Shed	Interior – Main Room – Engine Surface - Yellow
Workshop	Exterior – North Door – Beige Interior – Wood Shop – North Door – Cream

All of the above painted surfaces were in good condition; there was no visible bubbling or chipping. The depth index (DI) given by the analyzer suggested that all lead-based paints were under at least one layer of non-lead paint with exception of the yellow painted generator. Complete data tables are included in Appendix A.

West Vancouver Laboratory

A total of 57 points were surveyed at West Vancouver Laboratory, two of which resulted in lead-based paint identification. The two confirmed locations are categorized into two buildings:

Main Office	Interior – 3 rd Floor – Steel Stairway – Grey
Boat Shed	Exterior – South Wall – Siding - Yellow

Paint on the stairway was in good condition. Paint on the Boat Shed was in poor condition; bubbling and chipping were noted. The depth index (DI) given by the analyzer suggested that all lead-containing paints were at or near the surface. Complete data tables are included in Appendix B.

Occurrence Descriptions

The results of both surveys show that lead-based paint was used sparingly on both sites. The locations where LBP was found coincided with usage identified in previous for staffed and destaffed lightstations. Site specific discussions on the findings are presented below by location.

Cultus Lake Laboratory

East Crew House

The north and south soffits were found to contain LBP. Visual inspection identified similar white paint on the east and west soffits and should be assumed to be lead-containing.

White painted areas around the north door were also found to contain lead. The door jamb, door trim, and door interior showed positive results while the door exterior and the porch post showed negative. The south door exterior paint does not contain lead. This combination shows a typical mix of LBP and non-LBP surfaces. These inconsistencies can often be explained through varying maintenance timing and procedures.

Along with the north door interior, the east and west walls in the adjoining laundry room were found to contain lead. These surfaces were delineated with the testing of the north and south walls, and the ceiling (all negative). The reason for these two LBP containing walls was not apparent at the time of survey. The depth index indicates that the lead containing paint is well covered (DI of 2.94 to 4.34).

Main Office

Lead-based paint in the main office building was limited to the cupboards in the north laboratory bathroom. These surfaces, painted cream and brown, produced depth indexes around 1.75, suggesting cover of one or two layers of paint.

Wet Laboratory

The ceiling and the support posts in the interior of the main room of the wet laboratory contained lead. No lead was identified in the walls, doors, or worktables in the building. LBP was likely used in this application due to the room's high humidity. The surfaces were in good condition.

Generator Shed

The yellow paint covering the surface generator was found to contain lead. This application was not unexpected as many paints for covering metal historically contained

lead. Although the depth index (DI = 1.12) indicated the paint was sampled, the readings may have been affected by the metal surface under the paint.

Workshop

The main door on the north side of the workshop showed lead-based paint on both surfaces; each being covered with at least one coat of non-LBP (DI ranges 1.93 to 3.28). The door jamb did not contain lead. Visual inspection of the door suggests that it was likely a salvaged door from a previous building on site and the occurrence of lead is not related to the current building.

West Vancouver Laboratory

Main Office

The metal stairway leading to the third floor returned a positive lead reading at shallow depth. It is apparent that there are two thin layers of paint on the stairs, grey over red. Given the medium depth (DI = 1.52), it is expected that the red paint is a primer that contains lead. Primer containing lead is not unexpected and has been found in other surveys. The paint was in good condition with little wear.

Boat Shed

One location on the south wall of the yellow boat storage shed contained lead. No lead was located on the three remaining walls. When the south wall was sampled a second time, no lead was found. These readings suggest that the yellow paint on the building is not lead based. The reason for the lead reading could not be deduced.

Conclusion

With one exception, all painted surfaces surveyed were in good condition with no bubbling or chipping present. The exception to this is the yellow paint on the boat shed which is in poor condition. The yellow paint produced one lead reading that could not be duplicated on any other area of the building. It is likely that the lead reading shows a localized anomaly in an otherwise lead-free coating. Features containing lead-based paint are unlikely to present a hazard to occupants of the facilities in their current state and usage. Worker protection measures may be required if significant surface refinishing is planned. Examples of these measures can be found in the Coast Guard's Risk Management Plan for Staffed Lightstations.

Appendix A - Cultus Lake Laboratory Data

XRF#	Building	Floor	Interior/Exterior	Room	Direction	Feature	Colour	Reading (mg/cm2)	Depth	Calibration (mg/cm2)	Standard	Time
1	calibrate							-99	null	0.29	0.3	11:10:00
2	calibrate							-99	null	0.24	0.3	11:11:00
3	calibrate							-99	null	2.7	3.56	11:12:00
4	calibrate							-99	null	1	1.05	11:13:00
5	west crew house	upper	interior	living room	south	wall	cream	0.02				
6	west crew house	upper	interior	living room	east	wall	cream	0.04				
7	west crew house	upper	interior	dining room	north	window frame	cream	0.07				
8	west crew house	upper	interior	kitchen	west	wall	cream	0.06				
9	west crew house	upper	interior	kitchen	north	window frame	cream	0.02				
10	west crew house	upper	interior	stairway	east	wall	cream	0.02				
11	west crew house	upper	interior	stairway	east	baseboard	white	0.06				
12	west crew house	upper	interior	hallway	south	wall	cream	0.1				
13	west crew house	upper	interior	hallway	south	closet inner	cream	0.08				
14	west crew house	upper	interior	south room	north	wall	cream	0				
15	west crew house	upper	interior	south room	north	closet inner	cream	0.03				
16	west crew house	upper	interior	north room	west	wall	cream	0.02				
17	west crew house	upper	interior	north room	south	closet inner	cream	0.02				
18	west crew house	upper	interior	north room	north	window frame	cream	0.02				
19	west crew house	lower	interior	bathroom	west	wall	cream	0				
20	west crew house	lower	interior	boardroom	south	wall	white	0				
21	west crew house	lower	interior	boardroom	south	window trim	white	0				
22	west crew house	lower	interior	boardroom	east	door inner	white	0.04				
23	west crew house	lower	interior	boardroom	east	threshold	grey	0.07				
24	west crew house	lower	interior	storage room	surface	floor	grey	0.03				
25	west crew house	lower	interior	storage room	east	door jamb	white	0				
26	west crew house	lower	interior	west room	surface	floor	grey	0.3				

XRF#	Building	Floor	Interior/Exterior	Room	Direction	Feature	Colour	Reading (mg/cm2)	Depth	Calibration (mg/cm2)	Standard	Time
27	west crew house	n/a	exterior	n/a	south	door	white	0.04				
28	west crew house	n/a	exterior	n/a	south	wall	brown	0				
29	east crew house	n/a	exterior	n/a	south	wall	brown	0.03				
30	east crew house	n/a	exterior	n/a	south	door	white	0.03				
31	east crew house	n/a	exterior	n/a	south	soffet	white	1.5	2.2			
32	east crew house	main	interior	living room	south	wall	white	0.01				
33	east crew house	main	interior	living room	south	baseboard	white	-99	null			
34	east crew house	main	interior	living room	south	baseboard	white	0				
35	east crew house	main	interior	kitchen	north	wall	white	0.01				
36	east crew house	main	interior	kitchen	north	window frame	white	0.05				
37	east crew house	main	interior	hallway	north	wall	white	0.21				
38	east crew house	main	interior	se bedroom	north	door jamb	white	0.05				
39	east crew house	main	interior	se bedroom	north	wall	white	0.18				
40	east crew house	main	interior	se bedroom	east	closet inner	white	0.02				
41	east crew house	main	interior	sw bedroom	west	wall	white	0				
42	east crew house	main	interior	sw bedroom	north	closet inner	peach	0.01				
43	east crew house	main	interior	n bedroom	north	wall	white	0.18				
44	east crew house	main	interior	n bedroom	north	window frame	white	0.02				
45	east crew house	main	interior	n bedroom	south	closet inner	peach	0.02				
46	east crew house	main	interior	bathroom	west	wall	cream	0				
47	east crew house	main	interior	laundry	east	wall	white	1.8	2.94			
48	east crew house	main	interior	laundry	north	door	white	1.6	3.06			
49	east crew house	main	interior	laundry	north	door frame	white	0.46				
50	east crew house	main	interior	laundry	south	wall	white	0.2				
51	east crew house	main	interior	laundry	west	wall	white	1.5	4.34			
52	east crew house	main	interior	laundry	west	shelf	grey	0.04				
53	east crew house	main	interior	laundry	north	wall	white	0.04				
54	east crew house	n/a	exterior	n/a	north	door	white	0.5				
55	east crew house	main	interior	laundry	surface	ceiling	white	0				
56	east crew house	main	exterior	n/a	north	door jamb	white	1	2.44			

XRF#	Building	Floor	Interior/Exterior	Room	Direction	Feature	Colour	Reading (mg/cm2)	Depth	Calibration (mg/cm2)	Standard	Time
57	east crew house	main	exterior	n/a	north	door trim	white	2.3	1.67			
58	east crew house	main	exterior	n/a	north	porch post	white	0.1				
59	east crew house	main	exterior	n/a	north	soffet	white	1.2	2.82			
60	east crew house	main	interior	garage	west	upper wall	light blue	0.02				
61	east crew house	main	interior	garage	west	lower wall	light green	0.01				
62	west crew house	n/a	exterior	n/a	north	soffet	white	0.03				
63	west crew house	n/a	exterior	n/a	north	roof trim	white	0.02				
64	main office	n/a	exterior	n/a	north	wall	brown	0.03				
65	main office	n/a	exterior	n/a	north	door	beige	0.7				
66	main office	main	interior	boiler	north	door	aqua	0.49				
67	main office	main	interior	boiler	north	wall	white	0.04				
68	main office	main	interior	boiler	west	door	brown	0.07				
69	main office	main	interior	north lab	east	lower wall	grey	0				
70	main office	main	interior	north lab	east	upper wall	white	0.04				
71	main office	main	interior	north lab	south	bathroom door	cream	0.04				
72	main office	main	interior	lab bathroom	east	wall	cream	0.05				
73	main office	main	interior	lab bathroom	south	cupboard outer	brown	1.3	1.77			
74	main office	main	interior	lab bathroom	south	cupboard inner	cream	1.3	1.86			
75	main office	main	interior	lab bathroom	south	cupboard inner	cream	1.6	1.67			
76	main office	main	interior	north lab	south	wall	white	0.19				
77	main office	main	interior	main entrance	south	wall	light green	0				
78	main office	main	interior	main entrance	south	baseboard	grey	0				
79	main office	main	interior	office #2	south	door jamb	white	0.4				
80	main office	main	interior	entrance bathroom	east	wall	white	0				
81	main office	main	interior	chemistry lab	east	wall	light blue	0.14				
82	main office	main	interior	chemistry lab	north	freezer door	blue	0.05				
83	main office	main	interior	chem lab office	south	wall	light green	0.27				

XRF#	Building	Floor	Interior/Exterior	Room	Direction	Feature	Colour	Reading (mg/cm2)	Depth	Calibration (mg/cm2)	Standard	Time
84	main office	main	interior	chem lab office	south	door jamb	white	0.04				
85	main office	main	interior	chem lab office	south	door jamb	cream	-99	null			
86	main office	main	interior	chem lab office	south	door jamb	cream	0.03				
87	main office	main	interior	chemistry lab	south	cupboard outer	grey	0.01				
88	main office	main	interior	north lab	west	wall	white	0.03				
89	main office	main	interior	north lab	north	cupboard outer	light blue	0				
90	main office	main	interior	north lab	south	door jamb	light blue	0.25				
91	main office	main	interior	south lab	north	cupboard outer	green	0.17				
92	main office	main	interior	south lab	north	wall	white	0.02				
93	main office	main	interior	south lab	south	wall	white	0.01				
94	main office	main	interior	office #8	east	door jamb	grey	0.15				
95	main office	main	interior	office #6	east	door jamb	white	0.05				
96	main office	main	interior	office #3	south	upper support beam - exterior	cream	0.5				
97	main office	main	interior	office #4	east	window sill	grey	0				
98	main office	main	interior	lunchroom	south	window sill	white	0.03				
99	main office	main	interior	office #4	west	exterior wall	cream	0				
100	main office	main	interior	office #9	north	door jamb	white	0.06				
101	main office	main	interior	east hallway	east	door	cream	0.05				
102	main office	main	exterior	entrance	east	door	cream	0.07				
103	wet lab	main	exterior	warehouse	north	wall	brown	0.03				
104	wet lab	main	interior	warehouse	surface	worktable	grey	0.05				
105	wet lab	main	interior	warehouse	east	upper wall	pale yellow	0.08				
106	wet lab	main	interior	warehouse	east	lower wall	grey	0.08				
107	wet lab	main	interior	warehouse	north	cabinet exterior	orange	0.6				
108	wet lab	main	interior	warehouse	south	door	white	0.1				
109	wet lab	main	interior	warehouse	east	window trim	white	0.02				
110	wet lab	main	interior	warehouse	south	door jamb	white	0.05				

XRF#	Building	Floor	Interior/Exterior	Room	Direction	Feature	Colour	Reading (mg/cm2)	Depth	Calibration (mg/cm2)	Standard	Time
111	wet lab	main	interior	wet lab	south	wall	white	0				
112	wet lab	main	interior	wet lab	surface	central support post	white	1.2	1.43			
113	wet lab	main	interior	wet lab	west	wall	cream	0.04				
114	wet lab	main	interior	wet lab	surface	ceiling	white	1.5	1.67			
115	wet lab	main	interior	wet lab	east	door	cream	0				
116	generator shed	main	interior	main	east	wall panel	aquamarine	0				
117	generator shed	main	interior	main	west	wall	grey	0				
118	generator shed	main	interior	main	surface	engine	yellow	2.2	1.12			
119	generator shed	main	exterior	main	north	wall	brown	0.09				
120	workshop	main	interior	main	north	door	cream	1.9	1.93			
121	workshop	main	exterior	main	north	door	beige	4.5	3.28			
122	workshop	main	interior	main	north	door jamb	beige	0.8				
123	workshop	main	exterior	main	north	wall	brown	0.05				
124	workshop	main	interior	main	north	wall	white	0				
125	workshop	main	interior	main	east	window trim	green	0				
126	workshop	main	interior	office	east	wall	white	0				
127	workshop	main	interior	main	surface	central support post	white	0				
128	workshop	main	interior	main	south	door	cream	0.02				
129	workshop	main	interior	shop/storage	south	workbench	white	0				
130	workshop	main	interior	shop/storage	surface	shelves	grey	0.03				
131	workshop	main	interior	shop/storage	west	door	white	0.08				
132	workshop	main	interior	shop/storage	east	flammable lockers	blue	0.8				
133	soils lab	n/a	interior	main	north	wall	white	0				
134	soils lab	n/a	interior	main	surface	brown	brown	0.09				
135	calibrate							-99	null	1.1	1.05	14:08:00
136	calibrate							-99	null	3.5	3.56	14:09:00

Appendix B - West Vancouver Laboratory Data

XRF#	Building	Floor	Interior/Exterior	Room	Direction	Feature	Colour	Reading (mg/cm ²)	Depth	Calibration (mg/cm ²)	Standard	Time
1	start-up							-99	null			
2	calibration							-99	null	0	0	09:39:00
3	calibration							-99	null	0.3	0.29	09:40:00
4	main	main	interior	old foyer	east	wall	cream	0.02				
5	main	main	interior	new foyer	west	wall	brown	0				
6	main	main	interior	new foyer	east	wall	beige	0.02				
7	main	main	interior	hall	south	wall	cream	0				
8	main	main	interior	lunchroom (105)	north	wall	cream	0.04				
9	main	main	interior	lunchroom (105)	east	wall	cream	0.01				
10	main	main	interior	lunchroom (105)	west	door trim	black	0.1				
11	main	main	interior	lunchroom (105)	west	door exterior	cream	0.21				
12	main	main	interior	lunchroom (105)	west	door jamb	blue/green	0.3				
13	main	main	interior	outside lunchroom	west	safety centre	red	0.04				
14	main	main	interior	microscopy (1007D)	south	cupboard outer	blue	0.2				
15	main	main	interior	room 107A	east	wall	cream	0.02				
16	main	main	interior	room 107C	south	door exterior	pale blue	0.01				
17	main	main	interior	room 107A	surface	cupboard door	aqua	0.01				
18	main	main	interior	room 117	north	wall	cream	0				
19	main	main	interior	north exit stairwell	surface	stair foundation	brown	0				
20	main	main	interior	north stairwell	surface	ceiling	cream	0.01				
21	main	main	interior	room 132A	surface	floor	cream	0				
22	main	main	interior	room 132A	west	wall	rust stripe	0				
23	main	main	interior	room 116B	surface	threshold	gold	0				
24	main	main	interior	wet lab	south	wall	grey	0				
25	main	n/a	exterior	outdoor aquarium	surface	barrier posts	yellow	0.6				

XRF#	Building	Floor	Interior/Exterior	Room	Direction	Feature	Colour	Reading (mg/cm2)	Depth	Calibration (mg/cm2)	Standard	Time
26	warehouse	main	interior	workshop 136A	surface	floor	rust	0.01				
27	warehouse	main	interior	storeroom	surface	floor	grey	0				
28	warehouse	main	exterior	storeroom	east	door	rust	0.37				
29	warehouse	main	interior	boiler room	surface	floor	rust	0.01				
30	main	main	interior	boiler room	surface	boier	light green	0.2				
31	main	main	interior	boiler room	west	wall	cream	0				
32	main	main	interior	south stairwell	west	wall	cream	0				
33	main	2nd	interior	hall	west	wall	cream	0				
34	main	2nd	interior	office 209	south	wall	cream	0.03				
35	main	2nd	interior	office 209	east	wall	brown	0.03				
36	main	2nd	interior	boardroom 201	north	wall	cream	0.04				
37	main	3rd	interior	south room	south	wall	cream	0.01				
38	main	3rd	interior	south room	south	door exterior	beige	0.2				
39	main	3rd	interior	central room	surface	floor	grey	0				
40	main	3rd	interior	stairwell	surface	stairs	grey	1	1.52			
41	pump house	n/a	interior	main	surface	door	red	0.03				
42	pump house	n/a	interior	main	surface	floor	red	0.7				
43	pump house	n/a	interior	main	north	wall	cream	0				
44	boat shed	n/a	exterior	main	south	door	brown	0.8				
45	boat shed	n/a	interior	main	surface	central support post	white	0.04				
46	boat shed	n/a	interior	northeast room	west	wall	white	0				
47	boat shed	n/a	exterior	n/a	south	wall	yellow	1.2	1.41			
48	boat shed	n/a	exterior	n/a	west	wall	yellow	0.5				
49	boat shed	n/a	exterior	n/a	east	wall	yellow	0.11				
50	boat shed	n/a	exterior	n/a	south	wall	yellow	0.9				
51	boat shed	n/a	exterior	n/a	south	wall	yellow	0.7				
52	vertical tank shed	n/a	exterior	n/a	west	door	brown	0				
53	vertical tank shed	n/a	exterior	n/a	west	wall	yellow	0.11				
54	vertical tank shed	n/a	exterior	n/a	south	wall	yellow	0.07				

<i>XRF#</i>	<i>Building</i>	<i>Floor</i>	<i>Interior/Exterior</i>	<i>Room</i>	<i>Direction</i>	<i>Feature</i>	<i>Colour</i>	<i>Reading (mg/cm2)</i>	<i>Depth</i>	<i>Calibration (mg/cm2)</i>	<i>Standard</i>	<i>Time</i>
55	solvent stores	main	interior	main	surface	floor	grey	0				
56	solvent stores	n/a	exterior	n/a	west	door	rust	0.07				
57	doughnut tank lab	n/a	interior	east upper room	south	wall	pale blue	0.06				
58	doughnut tank lab	n/a	interior	east upper room	south	window sill	blue	0.03				
59	doughnut tank lab	n/a	interior	tank room	west	wall	pale blue	0.17				
60	doughnut tank lab	n/a	interior	storage room	surface	shelving	white	0.03				
61	calibration							-99	null	0.45	0.3	13:02:00
62	calibration							-99	null	0	0	13:03:00

ASBESTOS-CONTAINING MATERIALS SURVEY

**Department of Fisheries & Oceans
West Vancouver Laboratory,
4160 Marine Drive, West Vancouver, BC**

October 27, 2003

For

Department of Fisheries & Oceans

By

**Megan Shannon
Environmental Services
Public Works & Government Services Canada
Pacific Region**

Reviewed by

**Amanda James
Environmental Services
Public Works & Government Services Canada
Pacific Region**

This document has been formatted for double-sided printing

Table of Contents

Executive Summary	3
Introduction	4
Background	4
Construction of Facility	4
Scope of work	5
Asbestos-Containing Materials Survey Results	5
Background	5
Findings.....	5
Conclusions/Recommendations	6
References.....	7

Executive Summary

The Asbestos-containing materials survey was conducted on October 9, 2003 at the Department of Fisheries & Oceans West Vancouver Laboratory, 4160 Marine Drive, BC. The presence of asbestos-containing materials (ACMs) was assessed in the following buildings: UBC Laboratory, Feed Storage Shed, Vertical Tank (simulation tank), Solvent Storage Shed and the Salt Water Pump House. These buildings were constructed between 1971 and 1984. The main laboratory building and the warehouse were excluded from this survey as they were constructed in 1987, at which time the use of asbestos in building materials was banned (since 1983).

The survey inspected for the following suspect ACMs:

- Vinyl floor tiles
- Sheet flooring
- Mechanical insulation
- Drywall taping compound
- Asbestos cement board
- Ceiling tiles
- Duct mastic
- Window putty
- Textured coat

Of these materials, none were identified in the buildings surveyed. Therefore, no samples were taken and it is concluded that the subject buildings are free of asbestos-containing materials.

Introduction

Background

The Department of Fisheries and Oceans (DFO) has requested assistance from Public Works and Government Services Canada (PWGSC) in the timely acquisition of Asbestos-Containing Materials (ACMs) surveys at a number of DFO sites where the presence of ACMs is uncertain. The West Vancouver Laboratory (WVL) in West Vancouver, British Columbia had been identified for such attention. Megan Shannon of PWGSC, accompanied by Karl Skold of DFO, conducted the survey on October 9, 2003.

All structures on the property, barring the main Laboratory and warehouse buildings, which were constructed in 1987, were assessed for the presence of suspect ACMs.

Construction of Facility

There are seven significant structures in total found at the West Vancouver Laboratory. The ages of the buildings vary considerably, from the Salt Water Pump House, which was built in 1971 and underwent a retrofit in 1990, to the main laboratory and warehouse buildings, which were constructed in 1987. The main laboratory and warehouse buildings were excluded from this survey as their construction occurred four years after the use of ACMs in building construction had been discontinued.

The following table summarizes the buildings included in the survey at the WVL:

Building Name	Year Constructed	Floors	Approx. Gross Area (m ²)	Description of Construction
UBC Laboratory	1986	1	178	-wood frame -wood and concrete floors -plywood walls and ceilings -fibreglass insulation -plastic mechanical insulation
Feed Stock Shed	1984	1	63	-wood frame -concrete floor -plywood walls and ceilings -fibreglass insulation
Vertical Tank (simulation tank)	1984	1	160	-wood frame -concrete floor -plywood walls and ceilings -fibreglass insulation -foam and plastic mechanical insulation
Salt Water Pump House	1971 (retrofitted in 1990)	1	22	-cinder block construction -concrete floor -plywood ceiling -plastic mechanical insulation -metal clad roof
Solvent Storage	1983	1	51	-cinder block construction -concrete floor -corrugated aluminum ceiling

Scope of work

The Asbestos-Containing Materials survey included visual inspection of the seven structures listed above, and if required, the collection of representative samples of suspect asbestos-containing materials.

The survey inspected for the following suspect asbestos-containing materials:

- Vinyl floor tiles
- Sheet flooring
- Mechanical insulation
- Drywall taping compound
- Asbestos cement board
- Ceiling tiles
- Duct mastic
- Window putty
- Textured coat

Asbestos-Containing Materials Survey Results

Background

"Asbestos" is a generic name given to a fibrous variety of six naturally occurring minerals that have been used for decades in the development of thousands of commercial products. The term "asbestos" is not a mineralogical definition but a commercial name given to a group of minerals that possess high tensile strength, flexibility, resistance to chemical and thermal degradation, and electrical resistance. These minerals have been used in many products, including insulation and fireproofing materials, automotive brakes and textile products, and cement and wallboard materials.

The asbestos minerals have a tendency to separate into microscopic-size particles that can remain in the air and are easily inhaled. Persons occupationally exposed to asbestos have developed several types of life-threatening diseases, including lung cancer. Although the use of asbestos and asbestos products has dramatically decreased, they are still found in many older residential and commercial settings and continue to pose a health risk to workers and others.

Findings

No suspect asbestos-containing materials were identified within the structures surveyed. Therefore, no samples were collected and it is concluded that due to the building ages and construction types, these buildings are free of suspect asbestos-containing materials.

Conclusions/Recommendations

- 1) The buildings surveyed for the presence of asbestos-containing materials include the following: UBC Laboratory, Feed Storage Shed, Vertical Tank (simulation tank), Solvent Storage Shed and the Salt Water Pump House. Within these structures, no suspect asbestos-containing materials were identified.

References

- **Safe Work Practices for Handling Asbestos.** Workers' Compensation Board of British Columbia, January 2001.
- **Public Works and Government Services Canada Asbestos Management Plan,** Property and Facilities Management Services, Real Property Services Branch, Revised April 2002.
- **Compliance Audit – West Vancouver,** Dillon Consulting Limited, March 30, 2001.
- **Fisheries and Oceans Laboratory As-built Drawings,** Eng & Wright Partners, Architects, August 31, 1984.

Statutory Requirements

- [*Canada Labour Code Part, Occupational Health and Safety Regulation,*](#)
- [*BC Waste Management Act, Special Waste Regulations*](#)
- [*BC Workers Compensation Act, Occupational Health And Safety Regulation*](#)

APPENDIX B
Equipment Schedule

APPLIANCE SPECIFICATIONS

CATEGORY: APPLIANCE (Equipment)
CLIENT: Fisheries and Oceans Canada
PROJECT: PSEC Classroom Addition
PROJECT #: F1700-170019

CODE

E-1

NOTES

Item: **Gear Dryer**

Manufacturer: **Williams Direct Dryers**

Model: **WS4 – PPE Direct Dryer Station**

Description: 110V 12A 1550 W (74 kg) Personal Effects Dryer, Fixed Floor Mounted,

Size: 1219mm Width / 533mm Depth / 2159mm Height

Quantity: **2**

Location: RM.

Include wall timers or each unit and all anchoring clips, fasteners and mounts to securely fasten to structure.

IMAGES & DRAWINGS



*Quantity survey of the floor plans is the responsibility of the contractor; floor plans take precedence over specification sheets for unit counts.

APPLIANCE SPECIFICATIONS

CATEGORY: APPLIANCE (Equipment)
CLIENT: Fisheries and Oceans Canada
PROJECT: PSEC Classroom Addition
PROJECT #: F1700-170019

CODE

E-2

NOTES

Item:	Refrigerator
Manufacturer:	GE Appliances
Model:	GDE21DSKSS
Description:	Full height refrigerator
Size:	756mm Width / 918mm Depth / 1775mm Height
Quantity:	1
Location:	RM.101

IMAGES & DRAWINGS



*Quantity survey of the floor plans is the responsibility of the furniture contractor; floor plans take precedence over specification sheets for unit counts.

APPLIANCE SPECIFICATIONS

CATEGORY: APPLIANCE (Equipment)
CLIENT: Fisheries and Oceans Canada
PROJECT: PSEC Classroom Addition
PROJECT #: F1700-170019

CODE

E-3

NOTES

Item: **Microwave**
Manufacturer: **Panasonic**
Model: **NN-ST681S**
Description: 1.2 Cu. Ft. Microwave – STAINLESS STEEL
Size: 52.5 cm Width / 40.1 cm Depth / 31 cm Height
Quantity: **1**
Location: RM. 101

IMAGES & DRAWINGS



*Quantity survey of the floor plans is the responsibility of the contractor; floor plans take precedence over specification sheets for unit counts.

1. GENERAL

1.1 This Section specifies general conditions for Divisions 21, 22, 23 and 25 and is to be read, interpreted and coordinated with all other sections.

1.2 Related Requirements

- .1 This section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
- .2 Drawings and General Provisions of the Contract, including General and Supplementary Conditions, Division 00 and Division 01 Specification Sections apply to work specified in this section.

1.3 References

- .1 The latest revisions of the following standards shall apply unless noted otherwise.
- .2 British Columbia Codes:
 - .1 British Columbia Building Code 2012 (BCBC).
 - .2 British Columbia Fire Code 2012.
 - .3 British Columbia Plumbing Code 2012.
- .3 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE):
 - .1 ASHRAE 90.1-10, Energy Standard for Buildings Except Low-Rise Residential Buildings.
 - .2 ASHRAE 62.1, Ventilation for Acceptable Indoor Air Quality.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS):
 - .1 Material Safety Data Sheets (MSDS).
- .5 Electrical Equipment Manufacturers' Association Council (EEMAC):

1.4 Definitions

- .1 "concealed" – means hidden from normal sight in furred spaces, shafts, ceiling spaces, walls and partitions.
- .2 "exposed" – means work normally visible, including work in equipment rooms, service tunnels, and similar spaces.
- .3 "finished" - means when in description of any area or part of an area or a product which receives a finish such as paint, or in case of a product may be factory finished.
- .4 "provision" or "provide" (and tenses of "provide") – means supply and install complete.
- .5 "install" (and tenses of "install") – means secure in position, connect complete, test, adjust, verify and certify.
- .6 "supply" – means to procure, arrange for delivery to site, inspect, accept delivery and administer supply of products; distribute to areas; and include manufacturer's supply of any special materials, standard on site testing, initial start-up, programming, basic commissioning, warranties and manufacturers' assistance to Contractor.
- .7 "delete" or "remove" (and tenses of "delete" or "remove") – means to disconnect, make safe, and remove obsolete materials; patch and repair/finish surfaces to match adjoining similar construction; include for associated re-programming of systems and/or change of documentation identifications to suit deletions, and properly dispose of deleted products off site unless otherwise instructed by Owner and reviewed with Consultant.

- .8 "BAS" – means building automation system; "BMS" – means building management system; "FMS" – means facility management system; and "DDC" means direct digital controls; references to "BAS", "BMS", "FMS" and "DDC" generally mean same.
- .9 "governing authority" and/or "authority having jurisdiction" and/or "regulatory authority" and/or "Municipal authority" – means government departments, agencies, standards, rules and regulations that apply to and govern work and to which work must adhere.
- .10 "OSHA" and "OHSA" – stands for Occupational Safety and Health Administration and Occupational Health and Safety Act, and wherever either one is used, they are to be read to mean local governing occupational health and safety regulations that apply to and govern work and to which work must adhere, regardless if Project falls within either authority's jurisdiction.
- .11 "Mechanical Divisions" – refers to Divisions 20, 21, 22, 23, 25 and other Divisions as specifically noted, and which work as defined in Specifications and/or on drawings is responsibility of Mechanical Contractor, unless otherwise noted.
- .12 "Electrical Divisions" – refers to Divisions 26, 27, 28 and other Divisions as specifically noted, and which work as defined in Specifications and/or on drawings is responsibility of Electrical Contractor, unless otherwise noted.
- .13 "Consultant" – means person, firm or corporation identified as such in Agreement or Documents, and is licensed to practice in Place of the Work, and has been appointed by Owner to act for Owner in a professional capacity in relation to the Work.
- .14 Wherever words "indicated", "shown", "noted", "listed", or similar words or phrases are used in Contract Documents they are understood, unless otherwise defined, to mean product referred to is "indicated", "shown", "listed", or "noted" on Contract Documents.
- .15 Wherever words "reviewed", "satisfactory", "as directed", "submit", or similar words or phrases are used in Contract Documents they are understood, unless otherwise defined, to mean that work or product referred to is "reviewed by", "to the satisfaction of", "submitted to", etc., Consultant.

1.5 General Scope

- .1 The scope of Section 21 Fire Suppression, Section 22 Plumbing, Section 23 HVAC and Section 25 Control is for building services within the project structure and 1m from the building.
- .2 Provide complete, fully tested and operational systems to meet the requirements described herein and in complete accord with applicable codes and ordinances.
- .3 Contract documents and drawings of this Division are diagrammatic and approximately to scale unless detailed otherwise. They establish scope, material and installation quality but are not detailed installation instructions.
- .4 Follow manufacturers' recommended installation instructions, details and procedures for equipment, supplemented by requirements of the Contract Documents.
- .5 Install equipment generally in locations and routes indicated. Run piping and ductwork close to building structure, parallel to building lines, maximize head room and maintain minimum interference with other services and free space. Remove and replace improperly installed equipment to satisfaction of the Consultant at no extra cost.
- .6 Install equipment to provide: service access, maintain service clearances and for ease of maintenance.
- .7 Connect to equipment specified in other Sections and to equipment supplied and installed by other Contractors or by the Owner. Uncrate equipment, move in place and install complete; start up and test.
- .8 Install control valves, control dampers, thermal wells, and other devices on piping and ductwork, furnished by Division 25.

1.6 Coordination of Work

- .1 Cooperate and coordinate with other trades on the project.
- .2 Make reference to electrical, mechanical, structural and architectural drawings when setting out work. Consult with respective Divisions in setting out locations for ductwork, equipment, and piping, so that conflicts are avoided and symmetrical even spacing is maintained. Jointly work out all conflicts on site before fabricating or installing any materials or equipment.
- .3 Where dimensional details are required, work with the applicable architectural and structural drawings.
- .4 Full size and detailed drawings shall take precedence over scale measurements from drawings. Specifications shall take precedence over drawings.
- .5 Any areas indicated as space for future materials or equipment shall be left clear.

1.7 Permits and Fees

- .1 All work shall comply with provincial, municipal, bylaws and authorities having jurisdiction.
- .2 Obtain all permits and pay all fees applicable to the scope of work.
- .3 Contractor shall arrange for inspections of the work by the authorities having jurisdiction and shall provide certificates indicating Final Approval.

1.8 Examination of Site

- .1 Before submitting tender, visit and examine the site and note all characteristics and features affecting the work. No allowances will be made for any difficulties encountered or any expenses incurred because of any conditions of the site or item existing thereon, which is visible or known to exist at the time of tender.

1.9 Tender Price Breakdown

- .1 Submit a tender price breakdown within thirty (30) days of tender closing and before first progress claim, in a format agreed to with the Consultant.
- .2 As a minimum, include the following in the tender price breakdown:
 - .1 Site Services: Materials, labour
 - .2 Mechanical: Equipment, materials, labour
 - .3 Plumbing: Equipment, materials, labour
 - .4 Sheet Metal: Equipment, materials, labour
 - .5 Fire protection: Equipment, materials, labour
 - .6 Controls: Equipment, materials, labour

1.10 Submittals

- .1 Submittals shall be in accordance with Division 01 - Submittal Procedures, Division 01 – Closeout Procedures, Division 01 – Closeout Submittals and the following:
- .2 No work may begin on any segment of this project until submittals have been successfully reviewed for conformity with the design intent.
- .3 Contractor shall provide and submit to the Consultant Assurance of Professional Design and Commitment for Field Review Schedule B and Assurance of Professional Field Review and Compliance Schedule C-B for seismic engineering.
- .4 Contractor shall provide and submit to the Consultant Assurance of Professional Design and Commitment for Field Review Schedule B and Assurance of Professional Field Review and Compliance Schedule C-B for fire protection engineering.

- .5 Contractor shall provide and submit to the Consultant Assurance of Professional Design and Commitment for Field Review Schedule B and Assurance of Professional Field Review and Compliance Schedule C-B for fire stopping.
- .6 Contractor shall provide and submit to the Consultant Schedule B-1: Letter of Commitment by the Registered Professional of Record; Schedule B-2: Summary of Design and Field Review Requirements; and Schedule C-2: Assurance of Professional Field Review and Compliance for seismic engineering.
- .7 Contractor shall provide and submit to the Consultant Schedule B-1: Letter of Commitment by the Registered Professional of Record; Schedule B-2: Summary of Design and Field Review Requirements; and Schedule C-2: Assurance of Professional Field Review and Compliance for fire protection engineering.
- .8 Contractor shall provide and submit to the Consultant Schedule B-1: Letter of Commitment by the Registered Professional of Record; Schedule B-2: Summary of Design and Field Review Requirements; and Schedule C-2: Assurance of Professional Field Review and Compliance for fire stopping.
- .9 Submit shop drawings for all products identified in the relevant specification sections of Divisions 21, 22, 23 and 25. Provide drawings as electronic files (file format: .dwg, .dxf, pdf, or comparable). When manufacturer's cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Each submitted piece of literature and drawings shall clearly reference the specification and/or drawing that the submittal is to cover. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Submittals shall include a complete bill of materials of equipment to be used indicating quantity, manufacturer, model number, and other relevant technical data
- .10 Submit the following shop drawings stamped and signed by professional engineer registered or licensed in Province of British Columbia.
 - .1 Fastening details for Seismic restraints.
 - .2 Mounting details for spring isolation of equipment.
 - .3 Sprinkler drawings including hydraulic calculations as per NFPA.
- .11 Shop drawings and product data shall be accompanied by:
 - .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 Acoustical sound power data, where applicable.
 - .3 Points of operation on performance curves.
 - .4 Manufacturer to certify current model production.
 - .5 Certification for compliance to applicable codes.
- .12 Shop drawings to indicate:
 - .1 Material Specification including CSA or ULC reference numbers.
 - .2 Installation details to suit the applications on this project.
 - .3 Operating and maintenance requirements.
- .13 Material Safety Data Sheets (MSDS):
 - .1 Submit Material Safety Data Sheets (MSDS) in accordance with Division 01 - Submittal Procedures for the following products. Indicate VOC emissions, prior to installation or use:
 - .1 Adhesives.
 - .2 Caulking compounds.
 - .3 Sealants.

- .4 Insulating materials.
- .5 Fireproofing or fire stopping materials.
- .14 Closeout Submittals:
 - .1 Provide mechanical operation and maintenance data in compliance with Division 01 - Closeout Submittals and the following:
 - .1 The Contractor shall furnish and pay for three (3) complete sets of operating and maintenance manuals for the complete mechanical installation plus two (2) copies of the digital version of the manuals on USB type flash drive.
 - .2 Supply indexed copies of equipment manufacturers' operating and maintenance (O&M) instruction data manuals. Consolidate each copy of data in an identified hard cover three "D" ring binder. Each binder to include:
 - .1 Front cover: project name; wording – "Mechanical Systems Operating and Maintenance Manual"; and date;
 - .2 Introduction sheet listing Consultant, Contractor, and Subcontractor names, street addresses, telephone and fax numbers, and e-mail addresses;
 - .3 Equipment manufacturer's authorized contact person name, telephone number and company website;
 - .4 Table of Contents sheet, and corresponding index tab sheets;
 - .5 Copy of each "REVIEWED" or clean, updated "REVIEWED AS NOTED" shop drawing or product data sheet, with manufacturer's/supplier's name, telephone and fax numbers, email address, company website address, and email address for local source of parts and service; when shop drawings are returned marked "Reviewed As Noted" with revisions marked on shop drawing copies, they are to be revised by equipment supplier to incorporate comments marked on "Reviewed" shop drawings and a clean updated copy is to be included in operating and maintenance manuals;
 - .3 Operation and maintenance manual approved by, and final copies deposited with the Consultant a minimum of 7-days before final inspection.
 - .4 Operation data to include but not limited to:
 - .1 Pressure test reports, and certificates issued by governing authorities
 - .2 Control schematics for systems including environmental controls.
 - .3 Wiring and connection diagrams.
 - .4 A description of the systems and associated controls.
 - .5 Description of operation of systems at various loads together with reset schedules and seasonal variances.
 - .6 Operational instructions for systems and associated components.
 - .7 A description of actions to be taken in the event of equipment failure.
 - .8 Valves schedule and flow diagrams.
 - .9 Colour coding chart.
 - .5 Maintenance data to include:
 - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.

- .2 Data to include schedules of tasks, frequency, tools required and task time.
- .3 Recommended maintenance practices and precautions.
- .4 Complete parts lists with numbers.
- .6 Performance data to include:
 - .1 Equipment manufacturer's performance datasheets indicating point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results and final commissioning report.
 - .3 Special performance data as specified.
 - .4 Testing, adjusting and balancing.
- .7 Digital Version of Manuals
 - .1 The digital version of the manuals and the hard copy version shall be prepared by the same company.
 - .2 Utilize latest version of Adobe Acrobat, Portable Document Format (pdf).
 - .3 The digital manual shall be enhanced with the following features: Bookmarks, Internet Links and Internal Documents Links.
 - .4 All shop drawings shall be scanned to a minimum 8.5" x 11" size. If the original page is 11" x 17", the digital copy shall also be 11" x 17"
 - .5 Digital manual shall be organized in the same manner as the hard copy manual. Bookmark all major tabs and sub-sections and each set of shop drawings. Link the Table of Contents to the referenced section. Insert Internet Links to the Mechanical Equipment Manufacturers/Suppliers/Contractors official websites
- .8 Approvals:
 - .1 Submit 1 copy of draft Operation and Maintenance Manual to Consultant for approval. Submission of individual data will not be accepted unless directed by Consultant.
 - .2 Make changes as required and re-submit as directed by Consultant.
- .9 Warranties
 - .1 Include copy of all equipment warranty and extended warranty certificates into the Operation and Maintenance Manual.
- .10 Additional data:
 - .1 Prepare and insert into operation and maintenance manual additional data when need as it becomes apparent during demonstrations and instructions.
 - .2 Chemical treatment reports.
 - .3 Back-flow preventer test certificates.
 - .4 Results of Owner's Orientation (demonstrations).
 - .5 List of spare parts turned over to owner's forces.
- .2 Site records:
 - .1 Contractor shall maintain 1 set of white prints at contractors cost to mark changes as work progresses and as changes occur.

- .2 Use different colour waterproof ink for each service. Do not use pencil or black ink.
 - .3 Transfer information weekly to show work as actually installed.
 - .4 Make available for reference purposes and inspection.
 - .5 Before applying for a Certificate of Substantial Performance of the Work, update a clean copy of Contract Drawing set in accordance with marked up set of "as-built" white prints including deviations from original Contract Drawings, thus forming an "as-built" drawing set. Submit "as-built" site drawing prints to Consultant for review. Make necessary revisions to drawings as per Consultant's comments, to satisfaction of Consultant.
- .3 Record drawings:
- .1 Prior to start of Testing, Adjusting and Balancing for Mechanical, finalize production of record drawings.
 - .2 Use final reviewed "as-built" drawing set to provide CAD files of drawings thus forming true "as-built" set of Contract Drawings. Identify set as "Project Record Copy". Load digital copies of final reviewed by Consultant as-built drawings onto USB type flash drive. Provide 2 complete sets of "as-built" drawings on separate USBs. Submit "as-built" sets of white prints and USBs to Consultant
 - .3 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (date).
 - .4 Submit to Consultant for approval and make corrections as directed.
 - .5 Perform testing, adjusting and balancing for HVAC using record drawings.
 - .6 Submit completed reproducible record drawings with Operating and Maintenance Manuals.
 - .7 The transfer of record information onto reproducible media & Auto-CAD is the contractor's responsibility. Consultant will release drawings to contractor after signing a copyright form.
 - .8 Submit copies of record drawings for inclusion in final testing and balancing report
 - .9 Submitted drawings are to be of same quality as original Contract Drawings. CAD drawing files are to be compatible with AutoCAD software release version confirmed with Consultant.

1.11 Quality of Work

- .1 All work shall be by qualified tradesmen with valid Provincial Trade Qualification Certificates. Spot checks will be made by the Consultant.
- .2 Work which does not conform to standards accepted by the Consultant and the trade may be rejected by the Consultant. The Contractor shall redo rejected work to the accepted standard at no cost to the Owner.

1.12 Metric Conversion

- .1 All units in this division are expressed in SI units.
- .2 Submit all shop drawings and maintenance manuals in SI units.

- .3 On all submittals (shop drawings etc.) use the same SI units as stated in the specification.
- .4 Equivalent Nominal Diameters of Pipes - Metric and Imperial:
 - .1 Where pipes are specified with metric dimensions and Imperial sized pipes are available, provide equivalent nominal Imperial sized pipe as indicated in the table, and provide at no extra cost adapters to ensure compatible connections to all metric sized fittings, equipment and piping.
 - .2 When CSA approved SI Metric pipes are provided, the Contractor shall provide at no extra cost adapters to ensure compatible connections between the SI Metric pipes and all new and existing pipes, fittings, and equipment.

EQUIVALENT NOMINAL DIAMETER OF PIPES					
mm	inches (NPS)	mm	inches (NPS)	mm	inches (NPS)
3	1/8	40	1-1/2	200	8
6	1/4	50	2	250	10
10	3/8	65	2-1/2	300	12
15	1/2	75	3	375	15
20	3/4	100	4	450	18
25	1	125	5	500	20
30	1-1/4	150	6	600	24

- .5 Metric Duct Sizes:
 - .1 The Metric duct sizes are expressed as 25 mm = 1 inch.

1.13 Drawings and Specifications

- .1 Drawings and specifications are complementary to each other, and what is called for by one shall be binding as if called for by both.
- .2 Should any discrepancy appear between drawings and specifications which leaves the Contractor in doubt as to the true intent and meaning of the plans and specifications, obtain written clarification from the Consultant during the tender period. Without a written clarification, the better quality and/or greater quantity of work or materials shall be estimated, performed and furnished within the tendered price.
- .3 Examine all contract documents, including all drawings and specifications, and work of other trades to ensure that work is satisfactorily carried out without changes to building.

1.14 Cutting, Patching and Coring

- .1 Provide holes and sleeves, cutting and fitting required for mechanical work. Relocate improperly located holes and sleeves.
- .2 Drill for expansion bolts, hanger rods, brackets, and supports.
- .3 Perform x-rays and obtain written approval from the Structural Consultant before cutting or burning structural members.
- .4 Provide openings and holes required in precast members for mechanical work. Cast holes 100 mm or larger in diameter. Field cut smaller than 100 mm.
- .5 Patch building where damaged from equipment installation, improperly located holes etc. Use matching materials as specified in the respective section.

- .6 Removal of any existing pipe, conduit, or ductwork within a slab core hole or slab opening must be removed completely, including any associated sleeving, in a safe manner. Provisions are to be made during the removal process to protect any occupants and/or fabric of the space below. The Consultant is to be advised of all existing mechanical service penetration locations, such that site visits and field reviews can be fully coordinated and undertaken before and after the opening is closed in and filled.
- .7 Filling of any existing slab core or opening is to be with an engineered design of concrete fill complete with doweling for adhesion and/or fire stopping system as appropriate.

1.15 Excavation and Backfill

- .1 Refer to the requirements of Division 31.
- .2 Provide all excavating to facilitate installation of the mechanical work, including shoring, pumping, 150 mm compacted sand bedding under and first 300 mm of compacted sand over piping and ducting.
- .3 Refer to drawing details as applicable.

1.16 Installation of Equipment

- .1 Pipe all equipment drains to building drains except systems containing glycol.
- .2 Unions and flanges shall be provided in piping or ductwork to permit easy removal of equipment.
- .3 Maintain permanent access to equipment for maintenance.

1.17 Connections to Existing Services

- .1 Maintain liaison with the Owner and provide a mutually acceptable schedule to interrupt, reroute or connect to existing building services with the minimum of interruption of those services.
- .2 Major services shall not be interrupted before all preparatory work is completed and all required materials are on site. Provide a minimum of 48 hours notice for all service shutdowns. Allow for major service interruptions outside of normal operating hours of the facility.
- .3 Interruptions and shutdowns of existing services shall be by the building/plant maintenance staff.

1.18 Selective Demolition

- .1 Reference Standards
 - .1 Unless otherwise specified, carry out demolition work in accordance to CSA S350-M1980 Code of Practice for Safety in Demolition of Structures.
- .2 Remove from site all equipment, ducting or piping which is no longer required because of work under this Contract.
- .3 Existing Conditions
 - .1 Visit and examine the site and note all characteristics and irregularities affecting the work of this Section.
- .4 Protection
 - .1 Prevent movement or settlement of adjacent work. Provide and place bracing or shoring and be responsible for safety of such work. Be liable for any such movement or settlement and any damage or injury caused.

- .2 Cease operations and notify the Prime Consultant immediately for special protective and disposal instructions when any asbestos materials are uncovered during the work in this Section.
- .3 Prevent debris from blocking surface drainage inlets and all types of drainage piping systems which remain in operation

1.19 Equipment and Materials

- .1 Materials and equipment installed shall be new, CSA approved and of quality specified.
- .2 Each major component of equipment shall bear manufacturer's name, address, catalog and serial number in a conspicuous place.
- .3 Where two or more products of the same type are required, products shall be of the same manufacturer.
- .4 Notify the Consultant in writing ten (10) days prior to the tender close, any materials or equipment specified which is not currently available or will not be available for use as called for herein. Failing this, the contract will assume that the most expensive alternate has been included in the tender price.
- .5 All equipment supplied to the project will meet efficiencies as defined in ASHRAE Standard 90.1 and NECB (current versions)

1.20 Cleaning

- .1 During construction, keep site reasonably clear of rubbish and waste material resulting from work on a daily basis to the satisfaction of Owner and Consultant. Before applying for a Certificate of Substantial Performance of the Work, remove rubbish and debris, and be responsible for repair of any damage caused as a result of work.
- .2 Clean equipment and devices installed as part of this project

1.21 Delivery, Storage and Handling

- .1 Deliver, store and handle materials in accordance with Division 01 - Common Product Requirements, the manufacturer's written instructions and the following:
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials and equipment in accordance with the manufacturer's recommendations; in a clean, dry, well-ventilated area.
 - .2 Store and protect equipment from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Protect equipment and materials in storage on site during and after installation until final acceptance. Leave factory covers in place. Take special precautions to prevent entry of foreign material into working parts of piping, equipment and duct systems.
- .5 Protect equipment and open end duct with polyethylene covers and maintain equipment on crates until installation.
- .6 Operate, drain and flush out unsealed bearings and refill with fresh oil before final acceptance.
- .7 Thoroughly clean piping, ducts and equipment of dirt, cuttings and other foreign substances.
- .8 Protect bearings and shafts during installation. Grease shafts and sheaves to prevent corrosion. Supply and install necessary extended nipples for lubrication purposes.

- .9 Ensure that existing equipment is carefully dismantled and not damaged or lost. Do not reuse existing materials and equipment unless specifically indicated.

1.22 Firestopping and Smoke Seals

- .1 Provide firestopping and smoke seals in accordance with Division 01 - Firestopping and as follows:
 - .2 Submittals:
 - .1 Submit shop drawings for all firestop systems anticipated on this project. Shop drawings shall be complete with a systems directory for system details.
 - .3 Scope:
 - .1 Provide firestopping for all mechanical work in Divisions 21, 22, 23 and 25
 - .2 For renovation projects, in addition to the necessary new penetrations, provide the firestopping for all existing mechanical assemblies where firestopping is damaged, discontinued or absent.
 - .4 Definition:
 - .1 Firestopping: Material or combination of materials used to retain integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke, and hot gases through penetrations in fire rated wall and floor assemblies.
 - .5 Co-ordination Requirements
 - .1 Coordinate location and proper selection of cast-in-place Firestop Devices with trade responsible for the work. Ensure device is installed before placement of concrete.
 - .2 Responsible trade to provide adequate spacing of field run pipes to allow for installation of cast-in-place firestop devices without interferences.
 - .3 Obtain fire resistance ratings and classifications for all wall and floor assemblies from the Architectural contract documents.
 - .6 Performance Standards:
 - .1 Test Requirements:
 - .1 ULC-S115-M or CAN4-S115-M, "Standard Method of Fire Tests of Through Penetration Fire Stops".
 - .2 CAN4-S115-M under their designation of ULC-S115-M publishes test results in their "FIRE RESISTANCE RATINGS DIRECTORY" that is updated annually. All firestop system installations must meet the requirements of CAN4-S115-M or ULC S-115-M tested assemblies that provide a fire rating
 - .3 Underwriters Laboratories (UL) of Northbrook, IL runs ASTM E-814 under their designation of UL 1479 and publishes the results in their "FIRE RESISTANCE DIRECTORY" that is updated annually. UL tests that meet the requirements of ULC-S115-M are given a cUL listing and are published by UL in their "Products Certified for Canada (cUL) Directory
 - .4 International Firestop Council Guidelines for Evaluating Firestop Systems Engineering Judgments
 - .2 Inspection Requirements:
 - .1 ASTM E 2174 – 01, "Standard Practice for On-site Inspection of Installed Fire Stops.
 - .2 CAN/ULC-S102-M, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - .3 NFPA 101 - Life Safety Code

.7 Quality Assurance

- .1 Engage an experienced installer who is certified, licensed, or otherwise qualified by the firestop manufacturer as having been provided the necessary training to install manufacturer's products per specified requirements. On request the certified installer shall provide documented proof of certification from the firestop system manufacturer. A manufacturer's willingness to sell its firestop products to the Contractor or to an Installer engaged by the Contractor does not in itself confer qualification on the buyer.
- .2 Retain and pay for the service of a Professional Engineer registered in the Province of British Columbia to inspect each and every mechanical fire stopping installation, and as required by the Authority having jurisdiction, and provide a report on all installations. The fire stopping engineer shall provide letters of assurance to the Owner's Consultant, in accordance with the BC Building Code.
- .3 A manufacturer's direct representative (not distributor or agent) shall be on-site during the initial installation of firestop systems to train appropriate contractor personnel in correct selection and installation procedures. This will be done per manufacturer's written recommendations published in their literature and drawing details.
- .4 Proposed firestop materials and methods shall conform to applicable governing codes having local jurisdiction.
- .5 For those firestop applications that exist for which no ULC or cUL tested system is available through a manufacturer, a manufacturer's engineering judgment derived from similar ULC or cUL system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineer judgment drawings must follow requirements set forth by the International Firestop Council (September 7, 1994) and the Authorities having jurisdiction and be sealed by a Professional Engineer registered in the Province of British Columbia.

1.23 Access Doors

.1 General

- .1 Provide access doors for maintenance or adjustment of all parts of the mechanical system. This shall apply but not be limited to valves, dampers, cleanouts and controls.
- .2 Where equipment is concealed by a T.bar ceiling, the location of equipment shall be indicated by coloured markings. Refer to Section 23 05 53 Identification for Mechanical Piping and Equipment.
- .3 Where equipment is concealed by a continuous structural or architectural surface, supply access doors of design to suit and match the surface in which they will be installed.
- .4 Provide stainless steel doors in walls of washrooms, kitchen, janitor rooms and laundry rooms.
- .5 Provide Drywall type access doors in all public drywall spaces requiring access to equipment.
- .6 All fasteners on access panels shall be tamper proof, contractor shall provide three (3) sets of keys.
- .7 Locate all access doors outside of secure areas where possible. Where not possible, review the locations of panels with the Owner's Consultant prior to installation. All access panels within secure areas are to be of penal quality, lockable, vandal-proof and ligature resistant.
- .8 Provide 300 mm x 300 mm minimum size for inspection and hand access.

- .9 600 mm x 600 mm minimum size, larger if indicated on drawings, where entry is required and access is difficult.
 - .10 Size to suit masonry modules when located in a masonry wall.
 - .11 When located in a finished floor with tile, stonework, terrazzo, etc., a recessed bearing type access door is required. The door surface shall have a recess to take the particular surface material and pattern if this is available at the time the units are ordered.
- .2 Submittals:
- .1 Submit shop drawings for all access doors anticipated on this project.

1.24 Electrical Motors

- .1 Supply mechanical equipment complete with electrical motors.
- .2 Quality Assurance
 - .1 Provide motors designed, manufactured, and tested in accordance with the latest edition of the following codes and standards: NEMA, EEMAC, CSA, CEC Part 1, IEEE and ANSI. All motors to be UL listed and CSA labelled.
 - .2 All motors to be approved for use in the designated area classification by the Provincial Electrical Protection Branch.
 - .3 All motors intended for use with a [variable speed drive] [variable frequency drive] (VFD) shall be inverter duty rated.
 - .4 Motors connected to VFD(s) shall be wound using inverter spike resistant magnet wire capable of 1600V.
 - .5 The noise level of each motor shall comply with NEMA standards, less than 80 dBA at 1 meter.
 - .6 Minimum certified motor efficiency shall be as outlined in current version of ASHRAE 90.1 and NECB.
- .3 Unless specified otherwise, provide motors designed for full voltage starting, EEMAC Design B. Motors driving high torque or high inertia loads may be EEMAC Design C or D.
- .4 Provide motors rated for continuous duty with 1.15 service factor unless specified otherwise in the driven equipment specifications. Provide all motors with thermal overload protection.
- .5 Motors less than 3/4-hp shall be 120 V, 60 Hz, 1 phase. Motors 3/4-hp and larger shall be 3 phase at the indicated voltage.
- .6 All motors shall be 1800 rpm unless otherwise noted.
- .7 Provide motors complete with equipment except where indicated.
- .8 Provide motors with grease or oil lubricated anti-friction type ball or roller bearings.
- .9 Provide motors designed with Class B insulation; Class F insulation for totally enclosed motors.
- .10 Motors exposed to outdoor temperature to be lubricated with lubricants suitable for operation at 6 deg. C. below the lowest temperature recorded by ASHRAE or the Climatic Information (Supplement to the National Building Code), for the location in which they are installed.
- .11 All motors 10 hp and larger that are controlled by a VFD are to use a dielectric grease bearings and a grounding kit with a system of brass or stainless steel brushings.
- .12 Refer to electrical specifications, Section 26 05 81 - Motors, for voltage, frequency, and phase data. This shall take precedence over any reference in Divisions 21, 22, 23 and 25.

- .13 Where motor power is stated in watts or kilowatts, nominal motor horsepower multiplied by 746 or 0.746 respectively, has been used as the conversion factor.
- .14 Submittals
 - .1 Submit data of test method used and motor efficiencies with shop drawings.

1.25 Miscellaneous Metals

- .1 Provide all necessary miscellaneous to hang or support materials, equipment and provide access for work under this contract.
- .2 All miscellaneous metals shall be prime painted.
- .3 Miscellaneous metals shall include but not limited to:
 - .1 Hangers for equipment, piping and ductwork.
 - .2 Support for equipment.
 - .3 Access platforms and catwalks.

1.26 Scaffolding, Hoisting and Rigging

- .1 Unless otherwise specified or directed, supply, erect and operate scaffolding, rigging, hoisting equipment and associated hardware required for work, and subject to approval from Owner.
- .2 Immediately remove from site scaffolding, rigging and hoisting equipment when no longer required.
- .3 Do not place major scaffolding/hoisting equipment loads on any portion of structure without approval from Owner.

1.27 Pipe Sleeves

- .1 Pipe sleeves shall be provided for piping passing through walls and floors. Minimum schedule 40 steel pipes or factory fabricated, flanged, high density polyethylene sleeves with reinforced nail bosses. Sleeves shall extend 25 mm on either side of the wall.
- .2 Schedule 40 steel pipes shall be used as floor pipe sleeves in wet areas with a 50 mm up-stand.
- .3 Review and coordinate sleeve diameters with fire stop installation details as applicable.
- .4 Pipe sleeves are not required where pipes pass through cored concrete walls or floors.

1.28 Water Proofing Materials

- .1 Modular, mechanical seal assemblies consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and pipe sleeve or wall opening, assembled with stainless steel bolts and pressure plates and designed so when bolts are tightened the links expand to seal the opening watertight. Select seal assemblies to suit pipe size and sleeve size or wall opening size.
- .2 Acceptable products are (or equivalent to):
 - .1 Thunderline Corp. (Power Plant Supply Co.) "LINK SEAL" Model S-316;
 - .2 The Metraflex Co. "MetraSeal" type ES

1.29 Escutcheons and Plates

- .1 Provide escutcheons and plates on all piping and ductwork passing through finished walls, floors and ceilings.
- .2 Escutcheons shall be one piece, stainless or chrome plated steel.

1.30 Temporary Heat

- .1 Do not use the permanent system for temporary heating purposes without written permission from the Consultant.
- .2 If approved, permanent mechanical systems in building may be used for temporary heating during construction subject the following conditions:
 - .1 Each entire system is complete, pressure tested, cleaned, and flushed out.
 - .2 Specified water treatment system has been commissioned, and treatment is being continuously monitored.
 - .3 Thoroughly clean and overhaul permanent equipment used during the construction period, replace worn or damaged worn or damaged parts before final inspection.
 - .4 Use of permanent systems for temporary heat shall not modify terms of warranty.
 - .5 Operate heating systems under conditions which ensure no temporary or permanent damage. Operate with proper safety devices and controls installed and fully operational. Operate systems only with treated water as specified.
 - .6 Air systems shall not be used for temporary heating.
 - .7 When permanent systems are used for temporary heat, provide alarm indicating system failure. Connect alarm to independent alarm company system.
 - .8 Where pumps are used for temporary heating, replace mechanical seals, regardless of condition, with new mechanical seals.
 - .9 Energy costs are to be paid by Contractor.
 - .10 During this period of construction, such systems/equipment to not become property of Owner or be Owner's responsibility for maintenance or service. Systems/equipment are to remain property of respective manufacturers/suppliers or Contractor, who are responsible for full maintenance and servicing of systems/equipment in order to maintain validity of warranties after turn over to Owner.
 - .11 Prior to application for a Certificate of Substantial Performance of the Work and turn over to Owner, such systems/equipment to be cleaned, restored to "new" condition, paint finishes "touched-up", filters cleaned or replaced, etc.

1.31 Progress Claim Breakdown

- .1 Prior to submittal of first progress payment draw, submit a detailed breakdown of work cost to assist Consultant in reviewing and approving progress payment claims.
- .2 Payment breakdown is subject to Owner's approval and Consultant's review. Progress payments will not be processed until an approved breakdown is in place. Breakdown is to include one-time claim items such as mobilization and demobilization, insurance, bonds (if applicable), shop drawings and product data sheets, commissioning including testing, adjusting and balancing, system testing and verification, and project closeout submittals.
- .3 Indicate equipment, material and labour costs for site services (if applicable) and indicate work of each trade in same manner as indicated on progress draw

1.32 Notice for Required Field Reviews

- .1 Whenever there is a requirement for Consultant to perform a field review prior to concealment of any work, to inspect/re-inspect work for deficiencies prior to Substantial Performance of the Work, for commissioning demonstrations, and any other such field review, give minimum 5 working days' notice in writing to Consultant.
- .2 If Consultant is unable to attend a field review when requested, arrange an alternative date and time.

- .3 Do not conceal work until Consultant advises that it may be concealed.
- .4 When Consultant is requested to perform a field review and work is not ready to be reviewed, reimburse Consultant for time and travel expenses

1.33 Changes in the Work

- .1 Whenever Consultant proposes in writing to make a change or revision to design, arrangement, quantity or type of work from that required by Contract Documents, prepare and submit to Consultant for review, a quotation being proposed cost for executing change or revision.
- .2 Quotation is to be a detailed and itemized estimate of product, labour, and equipment costs associated with change or revision, plus overhead and profit percentages and applicable taxes and duties.
- .3 Make requests for changes or revisions to work to Consultant in writing and, if Consultant agrees, will issue Notice of Change.
- .4 Do not execute any change or revision until written authorization for the change or revision has been obtained from Consultant.

1.34 Temporary or Trial Usage

- .1 Temporary or trial usage by the Owner or Consultant of mechanical equipment supplied under contract shall not represent acceptance.
- .2 Repair or replace permanent equipment used temporarily.
- .3 Repair or otherwise rectify damage caused by defective materials or workmanship during temporary or trial usage.
- .4 Avoid thermal shock to heating system by coordination with the Owner during planning, construction and operation of temporary heating system.

1.35 Instruction to Owner

- .1 Refer to equipment and system operational and maintenance training requirements specified in Division 01.
- .2 Train Owner's designated personnel in aspects of operation and maintenance of equipment and systems as specified. Demonstrations and training are to be performed by qualified technicians employed by equipment/system manufacturer/supplier. Supply hard copies of training materials to each attendee.
- .3 Unless where specified otherwise in trade Sections, minimum requirements are for manufacturer/suppliers of each system and major equipment, to provide minimum two separate sessions each consisting of minimum 4 hours on site or in factory training (at Owner's choice), of Owner's designated personnel, on operation and maintenance procedures of system.
- .4 For each item of equipment and for each system for which training is specified, prepare training modules as specified below. Use Operating and Maintenance Manuals during training sessions. Training modules include but are not limited to:
 - .1 Operational Requirements and Criteria – equipment function, stopping and starting, safeties, operating standards, operating characteristics, performance curves, and limitations;
 - .2 Troubleshooting – diagnostic instructions, test and inspection procedures;
 - .3 Documentation – equipment/system warranties, and manufacturer's/supplier's parts and service facilities, telephone numbers, email addresses, and the like;

- .4 Maintenance – inspection instructions, types of cleaning agents to be used as well as cleaning methods, preventive maintenance procedures, and use of any special tools;
- .5 Repairs – diagnostic instructions, disassembly, component removal and repair instructions, instructions for identifying parts and components, and review of any spare parts inventory.
- .5 Before instructing Owner's designated personnel, submit to Consultant for review preliminary copy of training manual and proposed schedule of demonstration and training dates and times. Incorporate Consultant's comments in final copy.
- .6 Obtain in writing from Owner a list of Owner's representatives to receive instructions. Submit to Consultant prior to application for Certificate of Substantial Performance of the Work, complete list of systems for which instructions were given, stating for each system:
 - .1 Date instructions were given to Owner's staff;
 - .2 Duration of instruction;
 - .3 Names of persons instructed;
 - .4 Other parties present (manufacturer's representative, consultants, etc.).
- .7 Obtain signatures of Owner's staff to verify they properly understood system installation, operation and maintenance requirements, and have received operating and maintenance instruction manuals and "as-built" record drawings

1.36 Guarantee / Warranty

- .1 Furnish a written guarantee stating that all work executed in this contract will be free from defective workmanship and materials for a period of one (1) year from the date of Substantial Performance. The Contractor shall, at his own expense, repair and replace any work which fails or becomes defective during the term of the guarantee/warranty, providing such work is not due to improper usage. The period of guarantee specified shall not in any way supplant any other guarantees of a longer period but shall be binding on work not otherwise covered.
- .2 Use of permanent systems for temporary heat shall not modify terms of the manufacturers' warranty or the guarantee.
- .3 If the equipment is used during construction, the warranty or guarantee period shall not be shortened or altered.

1.37 Substantial and Total Performance

- .1 Prior to requesting an inspection for Substantial Performance, provide a complete list of items which are deficient.
- .2 A certificate of Substantial Performance will not be granted unless the following items are completed and available to the Owner's Consultant:
 - .1 Final Plumbing Inspection Certificate from the Authority having Jurisdiction.
 - .2 Schedule C-B for seismic engineering.
 - .3 Draft Operating/Maintenance Manuals have been submitted for review.
 - .4 All mechanical systems have been commissioned and are capable of operation with alarm controls functional and automatic controls in operation.
 - .5 Air and water systems have been balanced with draft report submitted to the Consultant.
 - .6 Mechanical identification is complete.

- .7 Warranty forms have been mailed to the manufacturer. Provide copy of the original warranty for equipment which has a warranty period longer than one year.
- .8 Operating and Maintenance demonstrations have been provided to the Owner.
- .9 Written inspection report by manufacturer's representative has been submitted for noise and vibration control devices and flexible connections.
- .10 Record drawings have been submitted.
- .11 Fan plenums have been cleaned, and temporary filters have been replaced with permanent filters.
- .12 All previously identified deficiencies have been corrected and accepted.
- .3 Prior to a Total Performance Inspection provide declaration in writing that deficiencies noted at time of substantial performance inspection have been corrected and the following items completed prior to the total performance inspection:
 - .1 Submit final air and water balance reports.
 - .2 Submit final operating and maintenance manuals.
 - .3 Complete final calibration.
- .4 The Consultant shall provide one (1) visitation for the purpose of total performance inspection. Subsequent visitations if required shall be at the expense of the Contractor.
- .5 The Contractor shall provide qualified personnel in appropriate numbers to operate the facility until substantial performance is declared.

1.38 Alternate Materials and Equipment

- .1 The price submitted for this contract shall be based on the use of materials and equipment as specified or as contained within the Acceptable Manufacturers List.
- .2 Requests for alternate equivalent materials or equipment must be submitted to the Consultant no later than seven (7) working days prior to the Mechanical trades' closing tender date. Submit all applicable technical data, including performance curves and physical details for review. Approval of requests shall only be given by addendum.
- .3 Approved equivalents and/or alternatives to specified products shall be equal to the specified product in every respect, operate as intended, and meet the space, capacity, and noise requirements outlined.
- .4 The Contractor shall be fully responsible for any additional labour and materials required by any trades or other Contractors to accommodate the use of other than specified materials or equipment. The Contractor shall bear any and all costs for design/system modifications to accommodate the "alternate" equipment. Extras will not be approved to cover such work.

2. PRODUCTS

2.1 Acceptable Manufacturers

- .1 Refer to Section 23 05 01 Acceptable Manufacturers.

2.2 Existing Services

- .1 Disconnect and cap all mechanical services in accordance with requirements of the authority having jurisdiction. Natural gas supply lines shall be removed by the local gas company or by a qualified tradesman in accordance with gas company instructions.
- .2 Building Mechanical Services: Maintain activity of all building services during demolition/removal of existing services required of this contract.

- .3 Maintain all trap seals and cap open end pipe to ensure no sewer gas enters the building during renovations or demolition work. Maintain all existing sewer piping in a wet condition daily.

2.3 Demolition

- .1 Completely demolish the items scheduled and remove all materials from the premises.
- .2 Carry out demolition in a manner to cause as little inconvenience to the occupied building area as building area as possible. Co-ordinate this activity with the Owner and/or the Consultant.
- .3 Carry out demolition in an orderly and careful manner
- .4 All coring, patching and removal of existing equipment, pipes, and ductwork which may affect the operation of occupied areas of the building shall be carried out outside of regular office hours or as scheduled with the Owner.

2.4 Asbestos

- .1 The intent is for a Haz-Mat Contractor to remove all asbestos containing material prior to the proposed project work taking place. Notify the Consultant if asbestos containing material is suspected to remain on site.
- .2 When new work is required to be connected to existing plumbing, piping, ductwork or equipment which contains asbestos insulation or products the following shall apply:
 - .1 Keep disruption to existing piping and equipment to a minimum
 - .2 Protect the site and all Contractors from the work
 - .3 Remove the asbestos at piping and equipment for new connections and carry out work in accordance with Work Safe BC requirements for asbestos removal.

2.5 Core Drilling

- .1 Clearly identify all proposed piping penetrations through existing slabs, walls etc and advise the General Contractor. Obtain x-rays of the locations to ensure penetration will avoid any existing post tension cables or reinforced steel. Advise the Structural Consultant of any conflicts as a result of the x-rays and obtain the Structural Consultant approval before any coring take place.

2.6 Firestopping and Smoke Seals

- .1 Use the same product for all like applications.
- .2 Use the same manufacturer throughout the project and compatible materials for restoration work.
- .3 Provide fill material components for each firestopping system as needed. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.
- .4 Firestopping Materials are either "cast-in-place" (integral with concrete placement) or "post installed." Co-ordinate cast-in-place firestop devices prior to concrete placement.
- .5 For penetrations through a Fire Separation wall provide a firestop system with a "F" Rating as determined by ULC or cUL as indicated below:

Fire Resistance Rating of Separation	Required ULC or cUL "F" Rating of Firestopping Assembly
30 minutes	20 minutes
45 minutes	45 minutes
1 hour	45 minutes
1.5 hours	1 hour
2 hours	1.5 hours
3 hours	2 hours
4 hours	3 hours

- .6 For combustible pipe penetrations through a Fire Separation provide a firestop system with a "F" Rating as determined by ULC or cUL which is equal to the fire resistance rating of the construction being penetrated.

2.7 Access Doors

- .1 Drywall Surface: Extruded aluminum frame with gypsum board inlay and structural corner elements. Hinge to be concealed 2-point hinge, non-corroding with screwdriver operated cam latch.
- .2 Masonry Surface: Universal design, steel door (16ga) and steel frame (18ga), door flush to frame, rounded safety corners, continuous concealed hinge, screwdriver operated cam latch, prime coat grey painted finish.
- .3 Tile Surface: Universal design, stainless steel door (16ga) and stainless steel frame (18ga), door flush to frame, rounded safety corners, continuous concealed hinge, screwdriver operated cam latch, #4 satin stainless steel finish.
- .4 Plaster Walls and Ceiling: steel door (14ga) and steel frame (14ga), door flush to frame edge, expansion casing bead and 75 mm wide galvanized lath surround recessed 18 mm to receive plaster, continuous concealed hinge, screwdriver operated cam latch, prime coat grey painted finish.
- .5 Acoustic Plaster: Steel door (16ga) and steel frame (14ga), door recessed 12 mm lined with self-furring lath, 75 mm wide galvanized lath surround recessed 18 mm to receive plaster flush to frame edge, concealed pivoting rod type hinge, screwdriver operated cam latch, prime coat grey painted finish.
- .6 Acoustical Tile Ceilings: Steel door (16ga) and steel frame (14ga), door recessed 25 mm to receive acoustic tile, concealed pivoting rod type hinge, screwdriver operated cam latch, prime coat grey painted finish.
- .7 Fire Rated Walls:
 - .1 Non-combustible construction: Uninsulated steel door (16ga) and steel frame (16ga), door flush to frame edge, 25mm mounting frame with masonry anchor straps, concealed self-closing hinge, flush key latch, prime coat grey painted finish, ULC rated 2 hour 'B' label.
 - .2 Combustible construction: Insulated steel door (20ga) for maximum 250°C rise after 30 minutes and steel frame (16ga), door flush to frame edge, 25mm mounting frame with masonry anchor straps, concealed self-closing hinge, flush key latch, prime coat grey painted finish, ULC rated 1-1/2 hour 'B' label.
- .8 Fire Rated Ceilings: 50mm Insulated steel door (16ga) and steel frame (16ga), door flush to frame edge, 25mm mounting frame with masonry anchor straps, concealed upswing self-closing hinge, L handle latch, white baked enamel finish, size 600mm x 600mm (24" x 24") ULC rated 2 hour 'B' label.

- .9 Ductwork: Ultra low leakage type, flat oval design, galvanized steel frame (22ga), double skin galvanized steel door (22 ga) with 25mm insulation fully enclosed in panel, bulb type seal integrally fastened to door, lever cam locks. Provide stainless steel in lieu of galvanized steel in stainless steel ductwork.

3. EXECUTION

3.1 Painting Repairs and Restoration

- .1 Do painting in accordance with Division 09 - Interior Painting.
- .2 Prime and touch up marred finished paintwork to match original.
- .3 Restore to new condition, finishes which have been damaged.
- .4 Clean exposed bare metal surfaces supplied under Divisions 21, 22, 23 and 25. Apply at least one coat of corrosion resistant primer paint to all supports and equipment fabricated from ferrous metal.
- .5 Paint all pipe hangers and exposed sleeves, in exposed areas, with a rust inhibiting primer.

3.2 System Cleaning

- .1 Clean interior and exterior of all systems including strainers. Commercially vacuum interior of ductwork and air handling units.

3.3 Field Quality Control

- .1 Manufacturer's Field Services:
 - .1 Obtain written reports from manufacturers' verifying compliance of the work, in handling, installing, applying, protecting, cleaning and start-up of a product.
 - .2 Submit Manufacturer's Field Reports as described in PART 1 - Submittals.
 - .3 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.4 Demonstration

- .1 Consultant and/or Owners representative may use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Supply tools, equipment and personnel to demonstrate and instruct the operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .3 Where specified elsewhere in Division 21, 22, 23 or 25 manufacturers to provide demonstrations and instructions.
- .4 Use operation and maintenance manual, record drawings, and audio visual aids as part of instruction materials.
- .5 Instruction duration requirements shall be as specified in the appropriate sections.
- .6 Contractor will record these demonstrations on digital video for future reference.

3.5 Firestopping and Smoke Seals

- .1 The Owner's Consultant shall conduct mandatory destructive reviews for each type of installation. Destructive testing shall be at the discretion of the Owner's Consultant and Authority having jurisdiction

- .2 Allow for destructive testing of 5% of fire stopping applications. Should installations not conform to manufacturer's listed assembly, an additional 25% of installations may be destructively tested and should there be more failures, the contractor will be responsible to remove all fire stopping products and reinstall products correctly, at no additional cost to the project..
- .3 Preparation:
 - .1 Verification of Conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.
 - .1 Verify penetrations are properly sized and in suitable condition for application of materials.
 - .2 Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, rust, laitance, release agents, water repellents, and any other substances that may affect proper adhesion.
 - .3 Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestop materials.
 - .4 Comply with manufacturer's recommendations for temperature and humidity conditions before, during and after installation of firestopping.
 - .5 Clean all surfaces adjacent to sealed holes and joints to be free of excess firestop materials and soiling as work progresses.
 - .4 Tag all penetrations and every 3 meters of joint seal with printed tags
 - .1 Tags shall indicate:
 - .1 Product.
 - .2 System #.
 - .3 Date installed.
 - .4 Installed by: (name and phone number of subcontractor).
 - .5 Re-penetrated by & Date.
 - .2 Tags shall state:
 - .1 CAUTION! FIRESTOP - DO NOT REMOVE, PUNCTURE OR DISCONTINUE UNLESS PREPARED TO RE-SEAL IMMEDIATELY WITH SPECIFIED PRODUCT
 - .5 Installation:
 - .1 Regulatory Requirements: Install firestop materials in accordance with ULC Fire Resistance Directory or UL Products Certified for Canada (cUL) Directory.
 - .2 Manufacturer's Instructions: Comply with manufacturer's instructions for installation of through-penetration joint materials.
 - .1 Seal all holes or voids made by penetrations to ensure an air and water resistant seal.
 - .2 Consult with mechanical engineer, project manager, and damper manufacturer prior to installation of ULC or cUL firestop systems that might hamper the performance of fire dampers as it pertains to duct work.
 - .3 Protect materials from damage on surfaces subjected to traffic.
 - .4 Where possible, use metal sleeves for floor penetrations to prevent/mitigate the consequences of leakage or flooding.
 - .6 Field quality control:

- .1 Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas.
- .2 Keep areas of work accessible until inspection by applicable code authorities.
- .3 Inspection of through-penetration firestop shall be performed in accordance with ASTM E 2174, "Standard Practice for On-Site Inspection of Installed Fire Stops" or other recognized standard.
- .4 Use primers whenever recommended by manufacturer.
- .5 Perform under this section patching and repairing of firestop caused by cutting or penetrating of existing firestop systems already installed by other trades.

3.6 Access Doors

- .1 Installation:
 - .1 Provide all access doors required to access work installed by Divisions 21, 22, 23 and 25. Be responsible for coordinating locations, cutting opening and installing panels. Any secondary supports, blocking etc. will be by the ceiling or wall contractor.
 - .2 Access doors in mechanical equipment to be provided by this Division.
 - .3 Access panel requirements and locations shall be fully coordinated with all involved contractors prior to the installation of any mechanical systems or equipment.
- .2 Location:
 - .1 Ensure that equipment is within view and accessible for operating, inspecting, adjusting, servicing without using special tools.
 - .3 Provide 3 sets of each type of access door key to the Owner at substantial completion. Obtain a signed receipt indicating date, quantity of keys and person receiving keys. Submit receipt to the Owner's Consultant.

3.7 Electrical Motors

- .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.

3.8 Protection

- .1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

END OF SECTION

1. GENERAL

1.1 Section Scope

- .1 This Section shall be read in conjunction with and as a supplement to Section 22 05 53 – Identification for Plumbing Piping and Equipment. Comply with all requirements of that Section of work as related to general requirements, products and execution. This Section indicates additional scope for identification of fire suppression systems.
- .2 This Section shall be read in conjunction with and as a supplement to Section 23 05 53 – Identification for Mechanical Piping and Equipment. Comply with all requirements of that Section of work as related to general requirements, products and execution. This Section indicates additional scope for identification of fire suppression systems.

1.2 General Requirements

- .1 Provide identification on all fire suppression piping, valves and equipment including the following:
 - .1 Wet-pipe sprinkler systems.
 - .2 Dry-pipe sprinkler systems.
 - .3 Pre-action (wet) sprinkler systems.
 - .4 Pre-action (dry clean agent) fire suppression system.
 - .5 Wet-pipe Standpipe systems.
 - .6 Dry-pipe Standpipe system.
 - .7 Fire Pumper lines.
 - .8 Fire pumps and jockey pumps.
 - .9 Piping with heat tracing cables.

2. PRODUCTS

2.1 Not Used.

3. EXECUTION

3.1 Not Used.

END OF SECTION

1. GENERAL

1.1 Section Scope

- .1 This is a performance specification for the provision of all labour and materials necessary to install complete and ready for continuous operation, fire suppression systems and associated underground piping for this project. The systems shall be as indicated in the contract documents and as required by the referenced codes and the Authority having jurisdiction.
- .2 This project is required to follow the Insurer's Advisory Organization (IAO) Interpretive Guides.

1.2 Related Requirements

- .1 This section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
- .2 Section 21 05 01 – Common Work Results for Mechanical
- .3 Section 23 05 01 – Acceptable Manufacturers

1.3 References

- .1 British Columbia Codes
 - .1 British Columbia Building Code 2012 (BCBC)
 - .2 British Columbia Fire Code 2012
 - .3 British Columbia Plumbing Code 2012
- .2 The latest revisions of the following standards shall apply unless noted otherwise.
 - .1 Fire Commissioner of Canada standards
 - .2 Factory Mutual (FM) approval guides
 - .3 Insurer's Advisory Organization (IAO) Interpretive Guides.
- .3 The following standards shall be the latest revision unless an earlier revision is referred to in the relevant Building Code
 - .1 National Fire Protection Association (NFPA)
 - .1 NFPA 13 - Standard for the Installation of Sprinkler Systems.
 - .2 NFPA 13D - Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes
 - .3 NFPA 13R - Standard for the Installation of Sprinkler Systems in Low-Rise Residential Occupancies
 - .4 NFPA 24, Installation of Private Fire Service Mains and Their Appurtenances.
 - .5 NFPA 25, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems

1.4 Submittals

- .1 Comply with Division 1 – Submission and Closeout Procedures, Section 21 05 01 Common Work Results for Mechanical – Submittals and in addition the following:

- .2 Provide Consultant Assurance of Professional Design and Commitment for Field Review Schedule B and Assurance of Professional Field Review and Compliance Schedule C-B for Seismic Restraint of fire suppression systems.
- .3 Shop drawings:
 - .1 Prior to preparing shop drawings, sprinkler contractor shall review contract drawings of all disciplines and site conditions to ensure the piping systems do not conflict with other building systems and clearance zones. Report any serious interferences to Owner's Consultant prior to commencement of work.
 - .2 Manufacturer's Catalog Data, including specific model, type, and size for:
 - .1 Pipe and fittings.
 - .2 Alarm valves (including dry and pre-action etc.)
 - .3 Valves, all types.
 - .4 Water motor alarms.
 - .5 Sprinkler heads, all types.
 - .6 Pipe hangers and supports (including earthquake bracing).
 - .7 Pressure, flow and supervisory switches.
 - .8 Pre-action releasing panel
 - .9 Fire department connections.
 - .10 Excess pressure pump.
 - .11 Air compressor
 - .12 Mechanical couplings.
 - .13 Test and drain assemblies
 - .14 Backflow prevention stations
 - .15 Sprinklers shall be referred to on drawings and shall be specifically identified by the listed manufacturer's style or series designation. Trade names and abbreviations are not permitted.
- .4 Samples:
 - .1 Submit two (2) samples for all sprinkler types with escutcheons and other samples as required in other Sections of the specifications.
- .5 Closeout submittals: submit all maintenance and scheduled test schedules, Schedule C's, reviewed shop drawings, materials and test certificate and any re-certification requirements for incorporation into manual specified in Section 21 05 01 – Common Work Results - Mechanical

1.5 General Requirements

- .1 The fire suppression system information shown on the drawings is diagrammatic. The information is for general scope of work and coordination during building design. The Sprinkler Contractor shall prepare fabrication/working drawings for all the sprinkler work and obtain all approvals from the Authorities having jurisdiction prior to installation. Where sprinkler head locations are shown, this is to indicate general intent only. It is the responsibility of the contractor to allow in his bid and to install all heads and piping required to satisfy the code. No extra cost will be considered based on failure of the contractor to allow for sprinklers as required during construction to conform to all NFPA requirements and the Authority Having Jurisdiction, whether shown on the drawings or not.

- .2 Provide all fire suppression and fire extinguishing systems throughout the buildings including:
 - .1 Wet sprinkler systems in all heated areas
 - .2 All other systems noted on the drawings, but not listed above.
- .3 Refer to the Code Consultant's or equivalency reports, obtain copies through the Architect or Project Manager and provide all fire suppression systems outlined therein including water curtains, window and glazing sprinkler suppression systems.
- .4 Submit all documentation to the Authorities Having Jurisdiction, arrange for, pay for and obtain trade permits prior to commencing installation work on site.
- .5 Fire suppression equipment:
 - .1 Install equipment generally in locations and routes shown. Run piping close to building structure, parallel to building lines to maximize head room, and with minimum interference with other services and free space. Remove and replace improperly-installed equipment to the satisfaction of the Consultant at no extra cost.
 - .2 Install equipment to provide access and ease of maintenance.
- .6 Provide additional fire suppression sprinkler system protection per NFPA for high piled storage and in-rack sprinklers in warehouses and storage areas.
- .7 Connect to the combined fire suppression / potable water supply main or dedicated fire suppression water main located on the drawings.
- .8 Refer to the Civil Consultant's drawings for work beyond 1m [3'] from the building.
- .9 Provide all Testing, Adjusting and Balancing; Commissioning; Identification; Insulation; and Heat Tracing for all fire suppression systems as described in the associated specification Sections.
- .10 Provide seismic restraints for all required equipment and piping in seismic zones.
- .11 All inspections and tests required by the Authorities shall be arranged and paid for by this contractor.

1.6 Contractor Drawings

- .1 When laying out sprinkler systems, the contractor shall review the contract documents and site conditions to ensure that piping systems do not conflict with other building elements and clearance zones.
- .2 Any serious interferences shall be reported to the Owner's Consultant prior to commencement of work.
- .3 Make reference to architectural, plumbing, mechanical, structural and electrical drawings when setting out work. Consult with respective trades in setting out locations for equipment, and piping, so that conflicts are avoided and symmetrical, even spacing is maintained. Jointly work out all conflicts on site before fabricating or installing any materials or equipment.

1.7 Seismic Protection

- .1 Refer to Section 23 05 48 – Vibration and Seismic Control for Mechanical.
- .2 Supply and install sway-bracing hangers on fire suppression piping systems in accordance with NFPA 13 requirements.
 - .1 Generally this shall apply to all cross mains 2NPS and larger, and shall apply to all feed mains including all standpipe risers.

- .2 Horizontal piping shall be provided with 2-way bracing and vertical piping shall include 4-way bracing at the tops of all risers.
- .3 On floor loops, sway-braces are required at the corners of all loops.
- .3 Power-driven fasteners shall not be used to attach braces to the building structure, unless ULC listed for this service in the seismic zone in which the fire suppression systems are being installed.

1.8 Pipe, Fittings and Couplings

- .1 Provide for all pipe, fittings, couplings, valves, nipples, drains, test connections and all accessory pipe work for a complete installation within the base tender price.
- .2 No extra cost will be considered based on failure of the contractor to allow for pipe, fittings and pipe work as required during construction to provide offsets to avoid structural components, and to coordinate with other piping services, ductwork, cable trays, conduits or other obstacles whether indicated on the drawings or not.
- .3 All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
- .4 All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability

1.9 Substantial & Total Performance

- .1 Comply with Section 21 05 01 Common Work Results for Mechanical – Substantial and Total Performance.
- .2 A certificate of Substantial Performance will not be granted unless the Fire protection systems have been commissioned and are capable of operation with alarm controls functional and automatic controls in operation. Commissioning checklists must be submitted prior to the request by the Contractor to have a substantial completion inspection.

2. PRODUCTS

2.1 Acceptable Manufacturers

- .1 Refer to Section 23 05 01 – Acceptable Manufacturers

2.2 General

- .1 All materials shall be ULC Listed for the intended service and shall be supplied new in original factory packaging.

2.3 Pipe Hangers and Supports

- .1 Comply with Section 23 05 29 – Hangers and Supports for Mechanical Piping and Equipment.
- .2 All hangers and supports for fire suppression shall be ULC listed for fire protection services in accordance with NFPA

2.4 Miscellaneous Metal Related to Fire Protection System

- .1 All miscellaneous metal related to the fire suppression systems including all metal back up plates, stands, brackets and supports for all roof, floor or wall supported equipment and piping systems is part of this Section of the work.

- .2 Provide two coats of heavy red oxide primer to all steel components after fabrication, and touch up on site after installation.

2.5 Above Ground Pipe and Fittings

- .1 Steel Pipe
 - .1 Steel pipe, black or hot dipped galvanized, standard weight or lightwall, material and IPS dimensions conforming to NFPA 13 and referenced ASTM Standards.
 - .2 Utilize minimum Schedule 40 wall thickness steel pipe for threaded or cut grooved joining methods.
- .2 Fittings:
 - .1 Compatible with the piping material and suitable for the maximum pressures in the system but not less than 1210 kPa (175 psi) working pressure.
 - .2 Threaded Fittings:
 - .1 Threaded fittings conforming to NFPA 13 and referenced ASME and ASTM Standards. Fittings shall be minimum Class 150. Fittings shall have a ULC corrosion resistance ratio of 1.00 or greater.
 - .3 Grooved Fittings:
 - .1 Installation-Ready™ fittings for grooved end steel piping in fire protection applications sizes NPS 1-¼ thru 2½. Fittings shall consist of a ductile iron housing conforming to ASTM A-536, Grade 65-45-12, with Installation-Ready™ ends, enamel coated. Fittings complete with pre-lubricated Grade “E” EPDM Type ‘A’ gasket; and ASTM A449 electroplated steel bolts and nuts. System shall be UL listed for a working pressure of 2065 kPa (300 psi) and FM approved for working pressure 2517kPa (365 psi).
 - .2 Grooved end fittings shall be ductile iron conforming to NFPA 13 and referenced ASTM Standards. Fittings shall be full flow design, short-pattern with flow equal to standard pattern fittings. Fittings, couplings and gaskets and grooving tools shall be of one manufacturer. Installation-Ready, for direct stab installation without field disassembly.
 - .3 Rigid: Coupling housings with offsetting, angle-pattern bolt pads shall be used to provide system rigidity and support for hanging in accordance with NFPA-13. Couplings shall be fully installed at visual pad-to-pad offset contact. Couplings that require gapping of bolt pads or specific torque ratings for proper installation are not permitted.
 - .4 Flexible: Use in locations only where vibration attenuation and stress relief are required.
- .4 General:
 - .1 Branch connections may be provided by bolted, mechanical branch connections complete with synthetic rubber gaskets approved for line service. Outlet tees shall have cast upper and lower housings and may be used for up to NPS 1 branch outlets and individual sprinklers.
 - .2 Rigid Type: Housings shall be cast with offsetting angle-pattern bolt pads to provide rigidity and system support and hanging in accordance with NFPA-13. Couplings shall be fully installed at visual pad-to-pad offset contact. (Tongue and recess type couplings, or any coupling that requires exact gapping of bolt pads on each side of the coupling at specified torque ratings, are not allowed.)
 - .3 Flexible Type: For use in locations where vibration attenuation and stress relief are required, and for seismic applications.

- .4 For dry pipe systems, use a FlushSeal® coupling gasket in rigid and flexible couplings where required by NFPA 13.

2.6 Sprinkler Heads

- .1 All sprinklers shall be to ANSI/NFPA 13 and ULC listed for fire service.
- .2 Wrenches shall be provided by the sprinkler manufacturer that directly engage the hex-shaped wrench boss in the sprinkler body.
- .3 Sprinklers with rubber O-rings are not permitted.
- .4 All sprinklers in exposed areas subject to viewing by the building occupants shall match existing finish with matched escutcheons to existing building. All sprinklers in service spaces, mechanical and electrical rooms and other spaces subject to view by the maintenance staff of the building may be in natural plain brass finish.
- .5 Escutcheon plates shall allow accessible (T-bar) ceilings to be removed without removing sprinklers. The finished escutcheon shall not project more than 4 mm (1/4") below the finish ceiling surface. The escutcheons shall match the sprinkler finish, be of the same manufacturer as the sprinkler and shall coordinate with architectural features of the building.
- .6 Escutcheons and guards shall be listed, supplied, and approved for use with the sprinkler by the sprinkler manufacturer.
- .7 All sprinklers shall be quick response unless stated otherwise.
- .8 All sprinklers shall be for commercial applications unless stated otherwise. Residential sprinklers are only permitted in residential areas of residential buildings.
- .9 Sprinkler fusible link shall be glass bulb type, quick response, temperature rated for specific hazard area.
- .10 Types:
 - .1 Refer to the Architectural Drawings for ceiling types and finishes.
 - .2 Exposed pendant type.
 - .1 Finish: Brass
 - .3 Exposed in high moisture areas – including drying and gear storage
 - .1 To be corrosion resistance – epoxy coated
 - .2 Match finish of all existing heads within the area
 - .4 Concealed pendant type with matching cover plate.
 - .1 Finish: Chrome-plated.
 - .2 Cover Plate Finish: Enamel, white
 - .5 Upright type, unfinished areas
 - .1 Finish: Plain Brass
 - .6 Semi-Recessed Horizontal Sidewall
 - .1 Finish: Enamel, white.
 - .2 Escutcheon Plate Finish: Enamel, white.
 - .7 Sprinklers required as an equivalency or for glazing systems, shall be as per the Code Consultant's report. Provide a separate zone valve connection for such systems from the supply riser unless noted otherwise.

- .11 Flexible Stainless Steel Sprinkler Drop Systems may be used to locate sprinklers as required by final finished ceiling tiles and walls. The drop shall include a UL approved braided hose with a bend radius to 50mm (2") to allow for proper installation in confined spaces. Union joints shall be provided for ease of installation. The flexible drop shall attach to the ceiling grid using a one-piece open gate bracket. The bracket shall allow installation before the ceiling tile is in place. The braided drop system is UL listed and FM Approved for sprinkler services to 1206 kPa (175 psi).

3. EXECUTION

3.1 Installation

- .1 Install equipment in accordance with manufacturer's instructions.
- .2 Refer to code equivalency report for sprinkler protection across windows within rated fire separations and special installations.
- .3 Provide wall, floor or ceiling polished chrome escutcheon rings at all pipe penetrations in finished, visible areas.
- .4 Where sprinkler head spacing is less than 1830 mm (72") and requires baffles, provide samples and/or photos of proposed baffles for review prior to fabrication.

3.2 Pipe and Fittings

- .1 Install piping to maximize headroom in all areas, including exposed installations. Coordinate space requirements with other installation Contractors.
- .2 Arrange sprinkler piping and provide drain valves such that it is completely drainable. Extend drain lines to an accessible location above ceiling over housekeeping areas. Provide valved-hose connection and access panel.
- .3 Adjust sprinkler piping up or down if conflicts occur between structure, lighting, electrical, plumbing piping or ductwork.
- .4 All welding shall be done in the shop using welding fittings. Field welding is not permitted.
- .5 Flanged pattern fittings shall be used for piping NPS 8 and larger, and at valve stations and fire department connections.
- .6 Provide expansion joints or flexible couplings at building expansion joints, building earthquake joints, building firewalls and other locations as required. Refer to Section 23 05 16 – Expansion Fittings and Loops for Piping
- .7 All grooved end components including valves, fittings and couplings shall be of one manufacturer.
- .8 The grooved coupling manufacturer's factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools and installation of grooved joint products. The representative shall periodically visit the jobsite and review contractor is following best recommended practices in grooved product installation.
- .9 Tie rods shall only be used in conjunction with fittings possessing integral tie lugs.
- .10 Tie rods complete with their associated nuts and bolts shall be coated with two coats of asphaltic paint after installation.
- .11 All off site prefabrication of sprinkler piping shall be at the contractor's own risk.

3.3 Sprinkler Heads

- .1 Do not install any sprinkler heads until all piping systems have been flushed of all contaminants such as cutting oil.

- .2 Do not install sprinklers that have been dropped, damaged, or show a visible loss of fluid. Never install sprinklers with cracked bulbs.
- .3 Provide 1 NPS nipple and 25 mm x 15 mm (1" x 1/2") reducing fitting for each upright head.
- .4 All sprinkler head locations shall be coordinated with the lighting, audio equipment, and all other obstacles on the ceilings.
- .5 Allow for additional sprinkler heads in mechanical rooms to accommodate field conditions.
- .6 The Victaulic Vic-Flex multiple use stainless steel open-gate flexible drop system may be used to properly locate sprinkler heads. The drop system shall be supplied with required supporting members and bracing.
- .7 Sprinkler bulb protectors shall be removed by hand after installation. Do not use tools or any other device(s) to remove the protector that could damage the bulb in any way.
- .8 Provide wire sprinkler guards in areas such as mechanical rooms, service rooms, elevator shafts, below lower level stair landings, gymnasiums, exterior locations, etc. where sprinklers are susceptible to mechanical damage or vandalism.
- .9 Provide tight pipe drain connections from test valves to open discharge at floor drains, service sinks, or other discharge points acceptable to the Owner or the Owner's Consultant.

END OF SECTION

1. GENERAL

1.1 Section Scope

- .1 This Section shall be read in conjunction with and as a supplement to Section 23 05 53 – Identification for Mechanical Piping and Equipment. Comply with all requirements of that Section of work as related to general requirements, products and execution. This Section indicates additional scope for identification of plumbing piping and plumbing equipment.

1.2 General Requirements

- .1 Provide identification on all domestic water piping, valves and equipment including the following:
 - .1 Domestic cold water.
 - .2 Domestic hot water and recirculation.
 - .3 Domestic tempered water and recirculation.
 - .4 Non-potable water.
 - .5 Grey Water
 - .6 Irrigation water
 - .7 Sanitary waste and venting.
 - .8 Acid waste.
 - .9 Storm drainage.
 - .10 Natural gas.
 - .11 Propane gas.
 - .12 Compressed air.
 - .13 Medical gases and vacuum piping systems.
 - .14 Laboratory gases and vacuum piping systems.
 - .15 Pure water systems.
 - .16 Pool and fountain systems.
 - .17 Tanks, pumps, compressors, vacuum units and all other equipment.
 - .18 Piping with heat tracing cables.

2. PRODUCTS

2.1 Not Used.

3. EXECUTION

3.1 Not Used.

END OF SECTION

1. GENERAL

1.1 Section Scope

- .1 Sanitary and storm cleanouts for interior and exterior applications to within 1m from the building.

1.2 Related Requirements

- .1 This section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
- .2 Section 21 05 01 – Common Work Results for Mechanical
- .3 Section 23 05 01 – Acceptable Manufacturers

1.3 References

- .1 The latest revisions of the following standards shall apply unless noted otherwise.
- .2 Applicable Building Code - Refer to Section 21 05 01

1.4 Submittals

- .1 Comply with Division 1 – Submission and Closeout Procedures, Section 21 05 01 Common Work Results for Mechanical – Submittals and in addition the following:
 - .1 Shop drawings:
 - .1 Cleanouts
 - .2 Valve boxes
 - .2 Closeout submittals: submit all reviewed shop drawings for incorporation into manual specified in Section 21 05 01 – Common Work Results - Mechanical

1.5 General Requirements

- .1 Provide cleanouts on all sanitary and storm drainage piping at all changes in direction, at the ends of all horizontal runs, at the base of every stack, where drains leave the building; where shown on the drawings and in compliance with the local plumbing code, bylaws and ordinances.
- .2 Cleanout spacing on horizontal piping shall be as a maximum:
 - .1 7.6 m apart in horizontal drainage lines of less than 3 NPS
 - .2 15.2 m apart in horizontal lines of 3 NPS to 4 NPS
 - .3 30 m apart for 6 NPS and larger.
- .3 Provide caulked or threaded type cleanouts extended to finished floor wall surface.
- .4 Provide bolted cover plate clean-outs on vertical rainwater leaders only. Ensure ample clearance at clean-out for rodding of drainage system.
- .5 All cleanouts shall be full pipe size for pipes 4 NPS and smaller.
- .6 Cleanouts shall be 4 NPS for pipes 4 NPS and larger.
- .7 Drainage sewer cleanouts on piping 8 NPS and larger shall be manholes. Refer to Section 22 05 73 Facility Drainage Manholes

2. PRODUCTS

2.1 Acceptable Manufacturers

- .1 Refer to Section 23 05 01 – Acceptable Manufacturers

2.2 Flashing

- .1 Lead Flashing:
 - .1 Waterproofing: 5 lb/sq ft sheet lead
 - .2 Soundproofing: 1 lb/sq ft sheet lead.
- .2 CPE Flashing:
 - .1 40 mil thick chlorinated polyethylene (CPE), equivalent to Chloraloy.

2.3 Floor - Unfinished Area

- .1 Provide the following clean out in unfinished areas such as concrete floors in equipment rooms and flush type C.O. in outside areas.
- .2 Cast iron floor level cleanout assembly with extra heavy duty, round, adjustable, scoriated, secured cast iron top and no-hub outlet. Suitable for heavy traffic

2.4 Floor - Finished Area

- .1 Provide the following cleanout for general areas of a hospital, school, or an institutional building:
 - .1 Cast iron cleanout with extra heavy duty round, adjustable, scoriated, secured nickel bronze top, and no-hub outlet
- .2 Provide the following cleanout for foot traffic areas with sheet goods flooring:
 - .1 Cast iron floor level cleanout assembly with a square adjustable nickel bronze top with 6mm (1/8") tile recess, and no-hub outlet.
- .3 Provide the following for a cleanout in a carpeted floor area subject to foot traffic:
 - .1 Cast iron floor level cleanout assembly with round, adjustable, scoriated, nickel bronze top and carpet clamping frame.
- .4 Provide the following cleanout in a terrazzo or other poured floor with foot and medium load wheeled traffic:
 - .1 Cast iron floor level cleanout assembly with round adjustable nickel bronze top with 12mm (1/2") terrazzo recess and center lifting device, and no-hub outlet

2.5 Wall – Finished Area

- .1 Provide the following full calibre caulk ferrule cleanout for a hub opening in drainage piping in a finished wall:
 - .1 Cast iron full calibre caulk ferrule with cast bronze taper thread plug and stainless steel round cover and screw.
- .2 Provide the following cleanout in a concealed drainage line in a finished wall:
 - .1 Cast iron cleanout tee and cast iron countersunk plug with stainless steel round cover and screw.

2.6 Cleanout – Copper Pipe

- .1 Cast brass with raised shoulder on plug and gasket.

2.7 Cleanouts – Cast Iron Pipe

- .1 Steel plug type.

2.8 Landscaped Areas

- .1 Provide the following valve box cover for all cleanouts installed in landscaped areas:
 - .1 Rigid HDPE resin round irrigation valve box, UV resistant, corrugated sides, black body and lid
 - .2 175mm round valve box for cleanouts 4 NPS and smaller
 - .3 250 mm round valve box for cleanouts 6 NPS

3. EXECUTION

3.1 General

- .1 Cleanouts shall be extended to a finished wall or floor unless exposed in a basement area or similar. Cleanout piping may require to be extended beyond the room as required for cleanout installation.
- .2 All cleanouts passing through walls or floors with a waterproofing membrane shall have a clamping collar which shall be clamped to the membrane.
- .3 All barriers for cleanout plugs shall be securely anchored so that they do not rotate when plug is being removed.
- .4 Install cleanouts on vertical risers a minimum of 200mm (8") above finished floor.
- .5 Coordinate location of interior cleanouts with millwork and other obstructions such that clearance for access and rodding is maintained.

3.2 Flashing

- .1 All cleanouts passing through walls or floors subject to hydrostatic pressure and waterproofed by means other than a membrane shall be provided with clamping collars and flashings of 25 kg/m² (5 lb/ft²) lead or equivalent.

3.3 Floor – Unfinished Areas

- .1 All outside cleanouts in paved areas shall be extended to grade in cast iron. They shall be sufficiently anchored in a 300 mm x 300 mm x 100 mm thick concrete block of concrete to prevent rotation of the pipe. Concrete work shall be provided and installed by Division 03.

3.4 Floor - Finished Areas

- .1 Where cleanouts occur in carpeted areas, they shall be extended to the finished walls unless the Consultant gives special permission for them to terminate the carpeted floor.
- .2 In potentially wet areas such as washrooms, cleanouts shall be extended to the walls wherever possible. Where conditions do not permit wall cleanouts, the cleanout cover shall be waterproof type with nickel bronze frame and cover and integral waterproofing clamping collar.

- .3 No cleanouts shall terminate at the ceiling of a room, sanitary and storm shall be extended to the floor above. Cleanouts shall not terminate in the floor of any sterile rooms.

3.5 Landscaped Areas

- .1 All outside cleanouts in landscaped areas shall be extended to finished grade and terminate in an irrigation box. Top of the irrigation box shall be 25mm above grade.

3.6 Access Doors

- .1 Access doors shall be in compliance with Section 21 05 01 Common Work Results for Mechanical – Access Doors and the following:
- .2 Access doors shall have a minimum clear opening of 200 mm x 200 mm for cleanouts 2 NPS and smaller 300 mm x 300 mm for cleanouts 3 NPS and larger.
- .3 Painted walls: Provide prime coated covers as specified in Section 21 05 01 Common Work Results for Mechanical – Access Doors.
- .4 Feature walls: Avoid covers on feature walls; i.e.: wood panels. If unavoidable, the covers shall be for painted walls but with finish material secured to the cover to the satisfaction of the Architect and finished flush with wall.
- .5 Sterile areas: Provide stainless steel finish on all access doors in sterile areas and ceramic tiled walls.
- .6 Access doors in fire rated walls shall be fire rated to match the wall rating.

END OF SECTION

1. GENERAL

1.1 Section Scope

- .1 Thermal insulation and jacketing for plumbing piping and plumbing piping accessories.

1.2 Related Requirements

- .1 This section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
- .2 Section 21 05 01 – Common Work Results for Mechanical.

1.3 References

- .1 The latest revisions of the following standards shall apply unless noted otherwise.
- .2 Applicable Building Code - Refer to Section 21 05 01- Common Work Results for Mechanical.
- .3 ASHRAE 90.1 – 2010 Energy Standard for Buildings Except Low Rise Residential Buildings.
- .4 Thermal Insulation Association of Canada (TIAC) – National Insulation Standards.
- .5 CAN/ULC S102-M88 – Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .6 ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
- .7 ASTM C553 – Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

1.4 Submittals

- .1 Comply with Division 1 – Submission and Closeout Procedures, Section 21 05 01 Common Work Results for Mechanical – Submittals and in addition the following:
 - .1 Certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Manufacturer's installation instructions.

1.5 General Requirements

- .1 The Installation firm shall be a current member of the Thermal Insulation Association of Canada (TIAC).
- .2 Only Journeyman insulation applicators, with 3 years minimum successful experience in this size and type of project, shall perform the work.
- .3 Definitions:
 - .1 "CONCEALED" insulated mechanical services in trenches, chases, furred spaces, shafts and hung ceilings (services in tunnels are not considered to be concealed.)
 - .2 "EXPOSED" will mean not concealed.
 - .3 "K" value means Thermal Conductivity.

- .4 UL GREENGUARD: Provides independent third-party, Indoor Air Quality (IAQ) certification of products for emissions of respirable particles and Volatile Organic Compounds (VOC's) and other specific product-related pollutants. Certification is based upon criteria used by Environmental Protection Agency (EPA), Occupational Safety and Health Organization (OSHA) and World Health Organization (WHO).
- .5 ASJ: All Service Jacket composed of aluminum foil reinforced with glass scrim bonded to a kraft paper.
- .6 SSL: Self-Sealing Lap.
- .7 FSK: Foil Scrim Kraft; jacketing.
- .8 PSK: Poly Scrim Kraft; jacketing.
- .9 PVC: PolyVinyl Chloride.
- .4 Provide thermal insulation on all plumbing piping, valves and fittings and as follows:
 - .1 Domestic cold water.
 - .2 Domestic hot water and recirculation.
 - .3 Service hot water and recirculation 82°C (180°F).
 - .4 Domestic tempered water and recirculation.
 - .5 Non-potable water.
 - .6 Storm drainage piping for the full length of the systems located within the building and the underside of drain bodies.
 - .7 Sanitary waste p-traps, grey and black water systems in exterior and unheated areas.
 - .8 Pool and fountain piping in exterior and unheated areas.
 - .9 All piping provided with heat tracing cable for freeze protection, domestic hot water temperature maintenance, or grease waste lines in unheated areas.
 - .10 Offset waste piping, p-traps and supplies under all wheelchair accessible lavatories and sinks.
 - .11 Provide foil faced flexible insulation on components requiring adjustment or servicing including booster pumps, meter sets, pressure reducing valves, valve bodies, strainers etc.
 - .12 Sanitary vent stacks for the last 3m (10') prior to penetrating the roof or penetrating into a cold attic or similar space.
- .5 If the Contractor, during renovations, should discover asbestos (or material suspected to be asbestos) on piping, ductwork, etc., he shall immediately cease all work in that area and contact Owner's representative.
- .6 Make good all existing insulation disturbed or removed to facilitate alterations and additions to existing piping

2. PRODUCTS

2.1 Acceptable Manufacturers

- .1 Refer to Section 23 05 01 – Acceptable Manufacturers.

2.2 General

- .1 Products shall not contain asbestos, lead, mercury, mercury compounds or Polybrominated diphenyl ethers (PBDE).
- .2 Mineral fibre specified includes glass wool and rock wool.
- .3 Thermal conductivity ("k" factor) not to exceed specified values when tested in accordance with ASTM C547.
- .4 Insulation and jacketing materials shall not exceed 25 flame spread, 50 smoke developed rating when tested in accordance with CAN/ULC S102-M88 and NFPA 90A.
- .5 Insulation for PP-R piping shall be sized to fit the outer dimensions of the metric pipe sized piping system in lieu of standard NPS.
- .6 Glass mineral wool products shall have a recycled content of a minimum of 50 percent recycled glass content.
- .7 Low Emitting Materials: For all thermal and acoustical applications of glass mineral wool insulation, insulation shall be UL GREENGUARD Certified.
- .8 Products shall be either Declare LBC Red List free or LBC compliant.

2.3 Preformed Pipe Covering

- .1 Piping Thermal Insulation:
 - .1 Piping service temperature 0°C to 315°C (32°F to 599°F).
 - .2 Preformed insulation, formed glass mineral wool pipe insulation with all service jacket vapour retarder (ASJ). ASJ shall be re-enforced with glass fibre, factory applied with pressure sensitive lap closure.
 - .3 ASJ vapour transmission rate 0.02 perms maximum.
 - .4 "K" value at 24°C (75°F) = 0.033 W/m.°C (0.23 Btu.in/hr.ft2.°F).

2.4 Blanket Insulation

- .1 Piping Thermal Insulation:
 - .1 Piping service temperature 0°C to 315°C (32°F to 599°F).
 - .2 Flexible, glass mineral wool blanket insulation, all service aluminum foil vapour retarder (FSK). FSK shall be reinforced with glass fibre and factory applied.
 - .3 "K" value at 24°C (75°F) = 0.035 W/m.°C (0.24 Btu.in/hr.ft2.°F).

2.5 Fastenings, Adhesives and Coatings

- .1 Insulation Fastenings: min. 1.6 mm thick [16 ga.] galvanized wire, 0.6 mm thick aluminium wire, 0.6 mm thick type 304 stainless steel wire or 1.6 mm thick copper wire as commercially available.
- .2 Jacket Fastenings:
 - .1 Thermocanvas and All Service Jacket:
 - .1 Staples (flare type), compatible jacket finishing tape, contact adhesives recommended by the jacket manufacturer.
 - .2 Metal Jackets:
 - .1 Sheet metal screws, pop rivets, stainless steel bands.

- .3 PVC Jacket and Fitting Covers:
 - .1 PVC self-adhesive tape, plastic pop rivets, bonding cement.
- .3 Adhesives:
 - .1 Fabric adhesive to insulation pipe covering, water based, ultra white, washable, anti-microbial.
- .4 Coatings:
 - .1 Vapour barrier coating on reinforcing membrane or on insulating cement:

2.6 Finish Jackets

- .1 Jackets:
 - .1 Thermocanvas Jacket: fire rated, 170g (6 oz) fire retardant canvas jacket for covering mechanical insulation indoors, 25/50 fire class, plain wave cotton, no dyes.
 - .2 PVC Finishing Jacket: white, UV resistant, for indoor or outdoor applications, 25/50 fire class, minimum 0.50 mm (0.02") thick.
 - .3 Aluminum Jacket: 0.51 mm (22 ga.) thick stucco or smooth aluminum jacketing with longitudinal slip joints and 50mm (2") end laps with factory applied protective liner on interior surface.
- .2 Preformed Fitting Covers:
 - .1 PVC Fitting Covers pre-moulded one piece covers, white, UV resistant, for indoor or outdoor applications, 25/50 fire class, minimum 0.50 mm (0.02") thick.
 - .2 Aluminum Fitting Covers: Die shaped components with factory applied protective liner on interior surface, 0.51 mm (22 ga.) thick.

2.7 Under-Sink Piping Covers - Accessible Lavatories

- .1 ADA compliant waste and supply piping covers.
- .2 Suitable for all 1-1/4NPS or 1-1/2NPS cast brass or tubular P-trap assemblies and 3/8NPS or 1/2NPS angle stop assemblies.
- .3 Rigid high-impact, stain-resistant PVC.
- .4 Bacteria/Fungus Resistance of zero growth as per ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- .5 UV stable, will not fade or discolor.
- .6 Color: white.

3. EXECUTION

3.1 General

- .1 Install in accordance with Thermal Insulation Association of Canada (TIAC) National Standards.
- .2 Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.
- .3 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified prior to insulation installation.

- .4 Use two layers of preformed insulation with staggered joints when the required nominal wall thickness exceeds 75 mm.
- .5 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
- .6 Install hangers, supports outside vapour retarder jacket.
- .7 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.
- .8 Ensure insulation is continuous through inside walls. Pack around pipes with fire proof self-supporting insulation material, properly sealed.
- .9 Insulate piping, fittings and valves. Do not insulate unions, flanges (except on flanged valves), "victaulic" couplings, strainers, flexible connections and expansion joints. Terminate insulation neatly with plastic material trowelled on a bevel.
- .10 Locate insulation or cover seams in least visible locations. Locate seams on piping in ceiling spaces on the underside of the pipe.
- .11 Roof Drains and Vents: Adhere flexible blanket insulation with adhesive applied to all laps. Provide annealed tie wire at 400mm (16") centres for securing insulation. Butt insulation and seal joints and breaks with 50mm (2") wide foil adhered over joint.
- .12 Do not insulate exposed run-outs local to a plumbing fixture, chrome plated piping, valves, fittings. Do not insulate run-outs to individual units and equipment not exceeding 3600 mm long.
- .13 Where insulation is not specified:
 - .1 Hot Piping: Coat exposed hot pumps, pipe and fittings with Therma-Lite liquid insulation product to prevent skin burns
 - .2 Cold Piping: Coat exposed cold pumps, pipes, and fittings, connecting surfaces of thermometers, pressure gauges, flow switches, controllers, etc. with a No Sweat paint product to prevent condensation.

3.2 Installation Cold Application - (5°C to 15°C) 1501-C

- .1 Piping: Apply pipe insulation with integral vapor retarder jacket to piping and hold in place by securing the jacket flap. Seal all flaps and butt strips with vapor retarder adhesive. Pipe insulation with integral self-sealing vapor retarder jacket will not require additional fastening.
- .2 Screwed or welded fittings: Insulate fittings with section of the pipe insulation mitered to fit tightly. All seams shall be sealed using vapor retarder tape.
- .3 Valves, Strainers: Insulate valve bodies, bonnets and strainers with fitted pipe insulation or mitered blocks all to thickness of adjacent pipe insulation, then seal all seams of vapor retarder with vapor retarder tape.
- .4 Flanged and grooved fittings: Insulate with oversized pipe insulation or mitered blocks to the thickness of the adjacent pipe insulation, then seal all seams of vapor retarder jacket with vapor retarder tape.

3.3 Installation Hot Application - Intermediate Temperature (15°C - 315°C) 1501-H

- .1 Piping: Pipe covering without integral jacket shall be held in place with insulation fastening at not less than 300 mm centres. Pipe insulation with integral jacket shall be held in place by stapling the flap on 75 mm centres. Pipe insulation with integral self-sealing jacket will not require additional fastening.

- .2 Screwed or welded fittings: Insulate fittings with sections of the pipe insulation mitered to fit tightly, or with tightly placed flexible insulation covered with reinforcing membrane stapled in place. Alternately insulate fittings with tightly placed flexible insulation and apply PVC fitting covers.
- .3 Valves, Strainers: Insulate valve bodies and strainers with fitted pipe insulation segments, or mitered blocks all to thickness of the adjacent pipe insulation. Drains, blow off plugs and caps shall be left uncovered. Alternately insulate with tightly placed flexible insulation and apply PVC fitting covers.
- .4 Flanged and grooved fittings: Insulate with oversized pipe covering or mitered blocks to the thickness of the adjacent pipe covering. Alternately insulate with tightly placed flexible insulation and apply PVC fitting covers.
- .5 Insulation Termination Points: Terminate insulation 75mm from fittings to provide working clearance and bevel insulation at 45° angle.

3.4 Finishes

- .1 Concealed piping shall be left as factory finished, TIAC standard CPF/2.
- .2 Exposed Piping Indoor (Canvas) CPF/1:
 - .1 The factory applied integral all service jacket shall be neatly applied to receive the fabric jacket. Apply a jacket with a fire resistive lagging coating. Apply a finishing coat of fire resistive lagging coating.
- .3 Exposed Piping Indoor (PVC Jacket) CPF/4:
 - .1 Apply PVC jacketing using necessary fastenings on approximately 300mm centers, or bond using an adhesive recommended by the manufacturer to provide continuous seal. Overlap each section a minimum 75mm (3"). Cover longitudinal and circumferential joints with finishing tape neatly applied. On hot piping tacks may be used to secure jacket laps. Tacks are to be applied on 100mm (4") centres.
 - .2 Over insulated fittings, valve bodies, valve bonnets, strainers and flanges apply PVC jacket or preformed PVC fitting covers to provide a complete jacket system. Secure with appropriate fastenings and jacket finishing tape.
- .4 Exposed Piping Outdoor (Metal Jacket) CPF/3:
 - .1 Apply a coat (minimum 1 litre per 1.5 m) of weather coating over the insulated surfaces. While still wet, embed a layer of reinforcing membrane and finish with a final coat (minimum 1 liter per 1.5 m) of weather coating.
 - .2 Apply metal jacketing with a 60mm overlap at 3 o'clock using necessary fastenings on approximately 150mm centers.
 - .3 Over insulated fittings, valve bodies, valve bonnets, strainers and flanges apply metal jacket or preformed metal fitting covers to provide a complete jacket system. Secure with necessary fastenings.

3.5 Under-Sink Piping Covers

- .1 Install on all exposed p-traps, offset p-traps and angle stop assemblies serving accessible lavatories.

3.6 Application Design Operating Temperatures

- | | | |
|----|--------------------------------|-------------|
| .1 | Continuous Cold Water Drainage | 10°C (50°F) |
| .2 | Domestic Cold Water | 10°C (50°F) |

- .3 Domestic Hot & Tempered Water 60 - 80°C (140 - 180°F)
- .4 Interior Storm Drainage 10°C (50°F)
- .5 Exterior Storm Drainage Insulation Not Required

3.7 Application Thickness Table

Type of System	Design Operating Temperature Range °C (°F)	Thermal Conductivity of Insulation		Nominal Pipe Diameter NPS				
		Conductivity Range W/m.°C	Mean Rating Temperature °C (°F)	Runouts ≤ 1	1 to 1.25	1.5 to 3	4 to 6	≥ 8
				Minimum Thickness of Piping Insulation (mm)				
Above Grade Exterior	All	0.046-0.049	38 (100)	40	65	65	75	90
Hot Water Systems	61-93 (142-200)	0.036-0.042	52 (126)	40	40	50	50	50
	41-60 (106-141)	0.032-0.040	38 (100)	25	25	40	40	40
Cold Water Systems	5-13 (41-55)	0.033-0.039	24 (75)	25	25	25	25	25
	<5 (41)	0.029-0.037	10 (50)	25	25	40	40	40

Note: Where the thermal conductivity of a proposed insulation is greater than the range specified above, the thickness will be increased by the ratio of U2/U1.

U2 = proposed insulation “k” value at the table mean rating temperature.

U1 = upper range limit “k” value from the table above.

Note: Where thermal conductivity of proposed insulation is less than the range specified above, the thickness may be decreased by the ratio of U2/U1.

U2 = proposed insulation “k” value at the table mean rating temperature.

U1 = lower range limit “k” value from the table above.

Above grade exterior or outside the building insulation for all pipe sizes shall be:

Climatic Zone 4 100mm (4”) thickness

Climatic Zones 5,6 & 7A 112mm (4 ½”) thickness

Hot water 61°C to 93°C (142-200°F): Pipe dia. up to NPS 1-1/4 = 40mm (1-1/2”) min. thickness

Pipe dia. NPS 1-1/2 and larger = 50mm (2”) min. thickness

Hot water 41°C to 60°C (106-141°F): Pipe dia up to NPS 1 = 12mm (1/2”) min thickness for all piping forming part of a continuously recirculated system and for 2m from a hot water heater.

Pipe dia. NPS 1-1/4 = 25mm (1”) min. thickness

Pipe dia. NPS 1-1/2 and larger = 40mm (1-1/2”) min. thickness

Cold water above 5°C (41°F): Pipe dia up to NPS ¾ = 12mm (1/2”) thickness for 2m of piping at a hot water heater connection.

Pipe dia. NPS 1 and larger = 25mm min. thickness

Suction and hot gas refrig. piping: Pipe dia. up to NPS 1 = 25mm (1") min. thickness

Pipe dia. NPS 1-1/4 and larger = 40mm (1-1/2") min. thickness

Notes: Condenser water and heat pump water piping inside the building does not require insulation.

3.8 Piping Finish Schedule

.1 Conform to the following:

Duty	Type	TIAC Code
Indoors, concealed	Factory	CPF/2
Indoors, exposed in mechanical room and utility areas	Canvas Jacket	CPF/1
Indoors, exposed in parkade and elsewhere	PVC Jacket	CPF/4
Outdoors	Metal Jacket	CPF/3

END OF SECTION

1. GENERAL

1.1 Section Scope

- .1 Piping, valves and specialties serving building domestic water distribution systems to 1m (36") outside the building.

1.2 Related Requirements

- .1 This section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
- .2 Section 21 05 01 – Common Work Results for Mechanical.
- .3 Section 23 05 29 – Hangers and Supports for Mechanical Piping and Equipment.
- .4 Section 23 05 48 – Vibration and Seismic Control for Mechanical.
- .5 Section 23 05 53 – Identification for Mechanical Piping and Equipment.
- .6 Section 23 05 93 – Testing, Adjusting and Balancing for Mechanical.

1.3 References

- .1 The latest revisions of the following standards shall apply unless noted otherwise.
- .2 Applicable Building and Plumbing Code - Refer to Section 21 05 01.
- .3 Canadian Standards Association (CSA International):
 - .1 CSA B64 series - Backflow Preventers and Vacuum Breakers.
 - .2 CSA B64.10.1 - Selection and installation of backflow preventers/Maintenance and field testing of backflow preventers.
 - .3 CSA-B356 - Water Pressure Reducing Valves for Domestic Water Supply Systems.
 - .4 CSA B242 - Groove and Shoulder Type Mechanical Pipe Couplings.
 - .5 CSA B137.5 – Crosslinked Polyethylene (PEX) Tubing Systems for Pressure Applications.
 - .6 CSA B137.11 - Polypropylene (PP-R) Pipe and Fittings for Pressure Applications.
- .4 Plumbing and Drainage Institute (PDI):
 - .1 PDI-WH201 - Water Hammer Arrestors Standard.
- .5 American Society of Mechanical Engineers International (ASME):
 - .1 ASME B16.5 – Pipe Flanges and Flanged Fittings: NPS ½ Through NPS 24 Metric/Inch Standard.
 - .2 ASME B16.9 – Factory-Made Wrought Butt welding Fittings
 - .3 ASME B16.15 - Cast Bronze Threaded Fittings, Classes 125 and 250.
 - .4 ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
 - .5 ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - .6 ASME B31.9 – Building Services Piping.
 - .7 AMSE B36.19M – Stainless Steel Pipe.
- .6 American Society for Testing and Materials International, (ASTM):

- .1 ASTM A182/A 182M – Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High Temperature Service.
- .2 ASTM A193 – Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Service and Other Special Purpose Applications.
- .3 ASTM A269 – Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
- .4 ASTM A312/ A312M – Seamless, Welded and Heavily Cold Worked Austenitic Stainless Steel Pipes.
- .5 ASTM A351/ A351M – Castings, Austenitic for Pressure Containing Parts.
- .6 ASTM A403/ A403M – Wrought Austenitic Stainless Steel Fittings.
- .7 ASTM A536 – Ductile Iron Castings.
- .8 ASTM A743 – Castings, Iron-Chromium Nickel, Corrosion Resistant, for General Applications.
- .9 ASTM A744 – Castings, Iron-Chromium Nickel, Corrosion Resistant, for Severe Applications.
- .10 ASTM B88 - Standard Specification for Seamless Copper Water Tube.
- .11 ASTM F876 – Standard Specification for Crosslinked Polyethylene (PEX) Tubing.
- .12 ASTM F877 – Standard Specification for Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems.
- .13 ASTM F1960 - Standard Specification for Cold Expansion Fittings with PEX Reinforcing Rings for Use with Cross-Linked Polyethylene (PEX) Tubing.
- .14 ASTM F2389 - Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems.
- .7 American Water Works Association (AWWA):
 - .1 AWWA C111 - Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings.
 - .2 AWWA C228 – Stainless Steel Flanges for Water Services – Sizes 2 In. through 72 In (50mm through 1,800mm).
 - .3 AWWA C606 – Standard for Grooved and Shouldered joints.
 - .4 AWWA C904 - Cross-Linked Polyethylene (PEX) Pressure Pipe, 1/2 In. (12 mm) through 3 In. (76 mm), for Water Service
- .8 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).
 - .1 MSS SP 67 - Butterfly Valves.
 - .2 MSS SP 70 - Cast Iron Gate Valves, Flanged and Threaded Ends.
 - .3 MSS SP 71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends.
 - .4 MSS SP 80 - Bronze Gate, Globe, Angle and Check Valves.

1.4 Submittals

- .1 Comply with Division 1 – Submission and Closeout Procedures, Section 21 05 01 Common Work Results for Mechanical – Submittals and in addition the following:
 - .1 Copper pipe, Ductile pipe, Stainless Steel pipe, PEX, Grooved pipe, CPVC, PP-R pipe, or other piping materials and fittings and couplings.

- .2 Valves.

1.5 General Requirements

- .1 Domestic water systems include domestic cold water, domestic hot water, domestic tempered water and domestic water re-circulation systems.
- .2 Interior domestic water piping shall be provided as depicted on the drawings to all plumbing fixtures, appliances and equipment that require domestic water service.
- .3 Mechanical makeup water piping systems, sanitary and storm force mains and pressure waste water piping systems shall be constructed of materials, installed and tested as specified in this section.

1.6 Pipe, Fittings and Couplings

- .1 Provide for all pipe, fittings, couplings, valves, nipples, drains and all accessory pipe work for a complete installation within the base tender price.
- .2 No extra cost will be considered based on failure of the contractor to allow for pipe, fittings and pipe work as required during construction to provide offsets to avoid structural components, and to coordinate with other piping services, ductwork, cable trays, conduits or other obstacles whether indicated on the drawings or not.

1.7 Seismic Protection

- .1 Comply with Section 23 05 48 – Vibration and Seismic Control for Mechanical.

1.8 Substantial & Total Performance

- .1 Comply with Section 21 05 01 Common Work Results for Mechanical – Substantial and Total Performance.

2. PRODUCTS

2.1 Acceptable Manufacturers

- .1 Refer to Section 23 05 01 – Acceptable Manufacturers.

2.2 Pipe Hangers and Supports

- .1 Comply with Section 23 05 29 – Hangers and Supports for Mechanical Piping and Equipment.

2.3 Miscellaneous Metal Related to Domestic Water Systems

- .1 All miscellaneous metal related to the facility water distribution systems including all metal back up plates, stands, brackets and supports for all roof, floor or wall supported equipment and piping systems is part of this Section of the work.
- .2 Provide two coats of heavy red oxide primer to all steel components after fabrication, and touch up on site after installation.

2.4 Above Ground Pipe and Fittings

- .1 Copper Pipe:
 - .1 Type 'K' hard drawn copper tube to ASTM B88M.
 - .2 Flange fittings: Bronze pipe flanges and flanged fittings, Class 150 or 300 to suit operating pressure and complying with ASME B16.24.

- .3 Threaded fittings:
 - .1 Cast bronze, Class 125 or 250 to suit operating pressure and complying with ASME B16.15.
- .4 Solder fittings:
 - .1 Cast copper, complying with ASME B16.18.
 - .2 Wrought copper and copper alloy complying with ASME B16.22.
- .5 Roll groove fittings for 2 NPS and larger, cooper-tube dimensioned grooved ends. (Flaring tube or fitting ends to accommodate alternate sized couplings is not permitted.) Complying with CSA B242, ASME B16.18 or ASME B16.22.
- .6 Grooved couplings: designed with angle bolt pads to provide rigid joint at cooper tubing sizes, EPDM-HP flush seal type gasket, suitable for water temperature to 120°C (250°F).
- .7 Pressure joint fittings for 1 NPS and smaller, cast copper joint with 301 stainless steel internal components and EPDM seals, complying with ASME B16.18. Suitable for operating pressure to 1380 kPa (200 psi).

2.5 Pipe Joints

- .1 Solder joints: Solder: 95/5 - tin copper alloy: lead free.
- .2 Threaded joints: Provide teflon tape for threaded joints.
- .3 Flanged joints: Rubber gaskets, latex-free, 1.6 mm thick: to AWWA C111. Bolts, nuts, hex head and washers: to ASTM A307, heavy series.
- .4 Provide dielectric connections between dissimilar metals. Dielectric fittings complete with thermoplastic liner and complying ASTM F492.

2.6 Valves

- .1 Gate Valve (for shut-off and isolation):
 - .1 2 NPS and smaller, soldered or screwed:
 - .1 Bronze body, solid wedge disc, bronze or stainless steel trim, non-rising stem, 860 kPa (125 psi) rating complying with MSS SP 80.
 - .2 Soldered Red-White/Toyo Fig. 281, Kitz Fig. 41.
 - .3 Screwed Red-White/Toyo Fig. 280, Kitz Fig. 40.
- .2 Ball Valve (in lieu of gate valves or as specified):
 - .1 2 NPS and smaller, soldered or screwed:
 - .1 Brass two piece body, blow-out proof stem, PTFE seats, brass chrome plate ball, lever handle operator, 1035 kPa (150 psi) rating complying with ASME B16.18.
 - .2 Soldered Red-White/Toyo Fig. 5049, Kitz Fig. 59, MAS Fig. B-4.
 - .3 Screwed Red-White/Toyo Fig. 5044, Kitz Fig. 58, MAS Fig. B-3.
- .3 Globe Valve (for throttling, bypass and make-up applications):
 - .1 2 NPS and smaller, soldered or screwed:
 - .1 Bronze body, bronze or stainless steel trim, 860 kPa (125 psi) rating. Solder joint with bronze solid wedge type disc. Threaded joint type with composition disc.

- .2 Soldered Red-White/Toyo Fig. 212, Kitz Fig. 12.
 - .3 Screwed Red-White/Toyo Fig. 221, Kitz Fig. 09.
 - .4 *Note: Threaded is 1030 kPa (150 psi) rating, lockshield handles not available, solid wedge disc.
- .4 Thermostatic Mixing Valves:
- .1 Point of use lavatory tempering valve:
 - .1 Adjustable temperature selection, tamper proof, lead free brass body, internal checks with screens, rough bronze finish and complying with CSA B125.
 - .2 Maximum pressure 861 kPa (125psi).
 - .3 Inlet range hot: 49 - 82°C (120 - 180°F), cold: 4 -27°C (40 - 80°F), temperature adjustment 27 - 49°C (80 - 120°F).
 - .4 Minimum flow 1 Lpm (0.25gpm) single duty, 2 Lpm (0.5gpm) up to 2 lavatories.
 - .5 $\frac{3}{8}$ NPS compression for single lavatory application.
 - .6 $\frac{1}{2}$ NPS screwed for two (2) lavatory application.

2.7 Vacuum Breakers

- .1 Pressure type: mechanically independent spring loaded poppet type check valve with a down steam spring loaded air inlet valve, with upstream and downstream isolation valves and test cocks. CSA approved. Provide 12mm ($\frac{1}{2}$ ") VB up to 1 NPS pipe size, 19mm ($\frac{3}{4}$ ") VB for $1\frac{1}{4}$ to $1\frac{1}{2}$ NPS pipe size and 25mm (1") VB for 2 to 3 NPS pipe size.
- .2 Atmospheric type: Bronze body, full size orifice, suitable for domestic service up to 82°C (180°F) sized to match full pipe size. CSA approved.

2.8 Strainers

- .1 $\frac{1}{4}$ - 2 NPS threaded ends, bronze body, 1034 kPa (150 psi) rating.
- .2 Red-White/Toyo Fig. 380, Kitz Fig. 15, Mueller Fig. LF351 (lead free)
- .3 $2\frac{1}{2}$ NPS and larger, flanged ends, cast iron body, 860 kPa (125 psi) rating.
- .4 Red-White/Toyo Fig. 381, Kitz Fig. 80, Mueller Fig. 758.
- .5 With copper grooved end pipe systems use bronze body grooved end Y-strainer with stainless steel screen, 2068 kPa (300 psi) rating.

2.9 Water Hammer Arrestors

- .1 Bellows type with welded stainless steel nesting bellows or piston style and stainless steel casing.
- .2 Air chambers are unacceptable.

3. EXECUTION

3.1 Above Ground Pipe and Fittings

- .1 General:
 - .1 Provide expansion joints or flexible couplings at building expansion joints, building earthquake joints, building firewalls and other locations as required. Refer to Section 23 05 16 – Expansion Fittings and Loops for Piping.

- .2 All off site prefabrication of piping shall be at the contractor's own risk.
- .3 Install piping to maximize headroom in all areas, including exposed installations. Coordinate space requirements with other installation Contractors.
- .4 Combustible pipe cannot be installed in vertical shafts.
- .5 Comply with hanger and supports requirements of the manufacturer for all combustible piping. Where the manufacturers recommendations conflict with Section 23 05 29 Hangers and Supports for Mechanical Piping and Equipment, the more stringent shall apply.
- .6 Concealed water supply piping to plumbing fixtures and equipment shall be installed using cast brass 90 degree drop ear elbow or drop ear tees as the piping design dictates.
- .7 Provide blocking within the concealed space. Secure elbows and tees to the blocking using brass screws to provide a rigid installation.

3.2 Pipe Joints

- .1 Install dielectric type couplings where copper piping and accessories connect to plumbing equipment such as steel storage tanks, pressure reducing stations and ductile iron pipe.
- .2 Provide flanges or unions on all connections to pumps, reducing valves, control valves, fixtures, and equipment.
- .3 Connections up to and including 2 NPS shall be all bronze union, 1,035 kPa (150 psi) rating with ground seat; larger connections shall be flanged.

3.3 Valves

- .1 General
 - .1 Coordinate with the fire suppression contractor regarding all valves in piping systems that serve both domestic and fire suppression systems. These valves shall be ULC and / or FM labeled for use in fire suppression systems and shall be provided with supervisory switches for monitoring their valve position by the fire alarm system.
 - .2 Disassemble solder end joint valves before soldering.
- .2 Shut Off Applications:
 - .1 Provide shut-off valves whether indicated on the drawings or not at the following locations:
 - .1 At the point where the water service first enters the building.
 - .2 At the base of each building riser.
 - .3 At each main branch supply point; provide a valve on each outlet leg from the tee or cross.
 - .4 At each single plumbing fixture (i.e. normally satisfied by the angle stop valve).
 - .5 At each single piece of equipment.
 - .6 As indicated on the drawings.
 - .7 As indicated in the applicable Plumbing Code.
- .3 Circuit Setter Valve: (for domestic hot water recirculation):
 - .1 Provide in hot water recirculating main and branch connections to main whether indicated on drawings or not.
- .4 Thermostatic Mixing Valves

- .1 Point of use lavatory tempering valve:
 - .1 Provide a tempering valve to all lavatories with domestic water service in excess of 48°C (118°F) and all lavatories served by automatic faucets.
 - .2 Tempering valve shall be concealed but accessible for service and adjustment.
 - .3 Tempering valve shall be adjusted to provide domestic hot water from 43°C to 48°C (109°F to 118°F).

3.4 Vacuum Breaker

- .1 Install at each fixture or item of equipment where contamination of the domestic water system can occur.
- .2 Vacuum breaker installation shall be in complete accordance with the manual "Cross Connection Control Manual" published by the Pacific Northwest Section of the American Water Works Association.
- .3 All atmospheric type vacuum breakers shall be installed at least 300mm (12") above flood level rim of fixture.
- .4 All vacuum breakers serving fume hoods shall be installed outside fume hood.
- .5 Provide drain pan with water deflecting enclosure on concealed pressure type vacuum breakers with drain line to appropriate drain.
- .6 Complete testing of all vacuum breakers shall be carried out under this section of the work prior to final acceptance of plumbing systems. A certificate shall be submitted duly signed and witnessed that testing was satisfactory.

3.5 Water Hammer Arrestors

- .1 Size in accordance with the Plumbing and Drainage Institute PD1-WH-201 sizing procedures.
- .2 Install on branch lines to flush valves, solenoid valves, self-closing faucets, quick closing valves and on refrigeration, kitchen and laundry equipment incorporating solenoid valves.

3.6 Pressure Tests

- .1 Test pressure shall be the greater of 1.5 times maximum system operating pressure or 860 kPa (125psi) for 8 hours.

3.7 Cleaning

- .1 Disinfection: The domestic hot and cold water metallic distribution system shall be disinfected prior to being placed in service. The system shall be disinfected in accordance with AWWA C651 or the following requirements:
 - .1 The piping system shall be flushed with potable water until discolored water does not appear at any of the outlets.
 - .2 Non-metallic piping shall be isolated. The metallic system shall be filled with a water chlorine solution containing at least 50 parts per million of chlorine. The system shall be valved in the closed position and allowed to stand for 24 hours.
 - .3 Following the standing time, the system shall be flushed with water until the chlorine is purged from the system.

END OF SECTION

1. GENERAL

1.1 Section Scope

- .1 Sanitary drain waste and vent piping, equipment and accessories between plumbing fixtures to 1m from the building.
- .2 Interior sanitary waste and vent piping shall be provided as depicted on the drawings to plumbing fixtures that will discharge sanitary waste and shall be connected to discharge to the
 - .1 Existing sanitary waste piping as depicted on the drawings.
 - .2 Exterior sanitary building service as depicted on the drawings and specified in Division 2 [33].
- .3 Non-functioning 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. Abandoned piping shall be identified on as-built drawings and tagged as abandoned.

1.2 General Requirements

- .1 All buried sanitary drain and waste piping shall be a minimum of 3 NPS.
- .2 Buried sanitary drain and waste piping shall be one size larger than the above ground size up to 4 NPS
- .3 Like product and materials shall be of one manufacturer
- .4 Non-functioning existing interior sanitary waste piping shall be removed where access is readily available or capped off and abandoned in place as referenced on the drawings. Abandoned piping shall be identified on as-built drawings and tagged as abandoned.

1.3 Municipal Service Fees

- .1 Arrange and pay for any Municipal connection fee for sanitary sewer connection to the Municipal sewer system under this Section of work.

1.4 Related Requirements

- .1 This section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
- .2 Section 21 05 01 – Common Work Results for Mechanical
- .3 Section 22 05 00 – Common Work Results for Plumbing Section 22 05 76 – Facility Drainage Piping Cleanouts

1.5 References

- .1 The latest revisions of the following standards shall apply unless noted otherwise.
- .2 Applicable Building Code - Refer to Section 21 05 01
- .3 ASTM B32: Standard Specification for Solder Metal.
- .4 ASTM B306: Copper DWV tube drainage type, drawn temper.
- .5 ASME B16.23 or ASME B16.29 : Copper drainage fittings cast copper or wrought copper.
- .6 ASTM F 628 : Acrylonitrile-butadiene-styrene (ABS) drainage, waste, and vent pipe – cellular core.
- .7 ASTM C564: Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings

- .8 CAN/CSA-B70: Cast Iron Soil Pipe, Fittings, and Means of Joining.
- .9 CAN/CSA-B602: Mechanical Couplings for Cast Iron Drain, Waste, Vent Pipe and Sewer Pipe.
- .10 CAN/CSA B181.1: Acrylonitrile-butadiene-styrene (ABS) drain, waste, and vent pipe and pipe fittings
- .11 CAN/CSA B181.2: PVC solid wall DWV pipe, schedule 40, drain, waste, and vent piping and pipe fittings.
- .12 CAN/ULC S102.2 Standard method of Test for Surface Burning Characteristics of Building Materials and Assemblies

1.6 Submittals

- .1 Comply with Division 1 – Submission and Closeout Procedures, Section 21 05 01 Common Work Results for Mechanical – Submittals and in addition the following:
- .2 Shop drawings:
 - .1 Floor drains
 - .2 Backwater valve
 - .3 Clean out

1.7 Pipe, Fittings and Couplings

- .1 Provide for all pipe, fittings, couplings, nipples, drains and all accessory pipe work for a complete installation within the base tender price.
- .2 No extra cost will be considered based on failure of the contractor to allow for pipe, fittings and pipe work as required during construction to provide offsets to avoid structural components, and to coordinate with other piping services, ductwork, cable trays, conduits or other obstacles whether indicated on the drawings or not.

1.8 Seismic Protection

- .1 Comply with Section 23 05 48 – Vibration and Seismic Control for Mechanical

1.9 Substantial & Total Performance

- .1 Comply with Section 21 05 01 Common Work Results for Mechanical – Substantial and Total Performance.

2. PRODUCTS

2.1 Acceptable Manufacturers

- .1 Refer to Section 00 01 10 – Acceptable Manufacturers

2.2 Pipe Hangers and Supports

- .1 Comply with Section 23 05 29 – Hangers and Supports for Mechanical Piping and Equipment.

2.3 Cleanouts

- .1 Comply with Section 22 05 76 – Facility Drainage Piping Cleanouts

2.4 Above Ground Pipe and Fittings

- .1 Cast Iron drain, waste and vent pipe and fittings:
 - .1 3 NPS to 15 NPS

- .2 Class 4000 cast iron mechanical joint pipe complying to CAN/CSA-B70.
- .3 Stainless steel couplings with neoprene or butyl rubber compression gaskets complying to CAN/CSA-B602.
- .2 Polyvinyl Chloride (PVC 15) (non-combustible building applications)
 - .1 1½ NPS to 16 NPS
 - .2 Polyvinyl chloride (PVC), schedule 40 solid wall pipe and fittings are permitted where the waste temperature is below 60°C (140°F).
 - .3 Pipe and fittings shall have a flame spread rating of not greater than 25 as per CAN/ULC S102.2
 - .4 PVC solid wall DWV pipe, schedule 40, with solvent weld socket joints conforming to CAN/CSA B181.2.
 - .5 PVC fittings shall be solvent welded socket type using a two-step solvent cement conforming to ASTM D2564.
- .3 Polyvinyl Chloride (PVC 15-XFR) (air plenum and/or high rise building applications)
 - .1 1½ NPS to 16 NPS
 - .2 Polyvinyl chloride (PVC), schedule 40 solid wall pipe and fittings are permitted where the waste temperature is below 60 degrees C (140 degrees F)
 - .3 Pipe and fittings shall have a flame spread rating of not greater than 25 and a smoke developed index no greater than 50 as per CAN/ULC S102.2
 - .4 PVC solid wall DWV pipe, schedule 40, with solvent weld socket joints conforming to CAN/CSA B181.2.
 - .5 PVC fittings shall be solvent welded socket type using a two-step solvent cement conforming to ASTM D2564.
- .4 Copper Tube, (DWV)
 - .1 Copper DWV tube sanitary waste, drain and vent pipe may be used for piping above ground, except for urinal drains.
 - .2 The copper DWV tube shall be drainage type, drawn temper conforming to ASTM B306.
 - .3 The copper drainage fittings shall be cast copper or wrought copper conforming to ASME B16.23 or ASME B16.29.
 - .4 The joints shall be lead free solder, using a water flushable flux, and conforming to ASTM B32.

2.5 Below Ground Piping and Fittings

- .1 Cast iron drain, waste and vent pipe and fittings:
 - .1 3 NPS to 15 NPS
 - .2 Class 4000 cast iron mechanical joint pipe complying to CAN/CSA-B70.
 - .3 Stainless steel couplings with neoprene or butyl rubber compression gaskets complying to CAN/CSA-B602.
- .2 Polyvinyl Chloride (PVC-DWV)
 - .1 3 NPS to 16 NPS
 - .2 Polyvinyl chloride (PVC) pipe, schedule 40 solid wall pipe and fittings are permitted where the waste temperature is below 60°C (140°F).
 - .3 PVC solid wall DWV pipe, schedule 40, with solvent weld socket joints conforming to CAN/CSA B181.2.

- .4 PVC fittings shall be solvent welded socket type using solvent cement conforming to ASTM D2564.

2.6 Backwater Valves

- .1 Horizontal, Cast-Iron Backwater Valves
 - .1 Size: Same as connected piping.
 - .2 Body: Cast iron, cast iron cover with bolted access check valve.
 - .3 Check Valve: Removable, bronze and PVC, swing check, factory assembled or field modified to hang open for airflow unless subject to backflow condition.
 - .4 For underground installations provide a full-size, cast-iron, soil-pipe extension to field-installed cleanout at floor. Replaces backwater valve cover.
- .2 Drain-Outlet Backwater Valves.
 - .1 Size: Same as floor drain outlet.
 - .2 Body: Cast iron or bronze made for vertical installation in bottom outlet of floor drain.
 - .3 Check Valve: Removable ball float.
 - .4 Inlet: threaded, Outlet: threaded or spigot.
- .3 Horizontal, Plastic Backwater Valves
 - .1 Size: Same as connected piping.
 - .2 Body: ABS or PVC.
 - .3 Cover: Same material as body with threaded access to check valve.
 - .4 Check Valve: Removable swing check.
 - .5 End Connections: Socket type.

2.7 Safes, Flashing and Vent Terminals

- .1 Metal Flashing: 26 gage galvanized steel.
- .2 Metal Counter flashing: 22 gage galvanized steel.
- .3 Vent flashing minimum 450 mm x 450 mm [18" x 18"] base dimension shall terminate flush with the top of 300 mm [12"] high vent pipe and the gap between the flashing and pipe shall be closed with a 25 kg/m² [5 lb/ft²] separate lead cap 75 mm [3"] high. The flashing shall not be turned over the pipe.
- .4 Lead Flashing:
 - .1 Waterproofing: 25 kg/m² [5 lb/ft²] sheet lead
 - .2 Soundproofing: 5 kg/m² [1 lb/ft²] sheet lead.
- .5 Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing.
- .6 Floor Drain and Floor Sink Flashing: 40 mil thick chlorinated polyethylene (CPE), equivalent to Chloraloy. 25 kg/m² [5 lb/ft²] sheet lead flashings.
- .7 Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements.

2.8 Floor Drains

- .1 Floor Drains General
 - .1 Unless otherwise noted:
 - .1 All floor drains shall be cast iron body with all non-plated parts coated for rust prevention.

- .2 All floor drains shall have adjustable collars.
- .3 Provide all floor drains with anchor flange and reversible membrane clamp with weep holes.
- .4 Provide all floor drains with a trap primer connection.
- .5 Provide a sediment bucket for all drains in mechanical rooms, janitorial and utility rooms and as specified below.

3. EXECUTION

3.1 General

- .1 Comply with manufacturer's installation instructions and the following:
- .2 Route piping in orderly manner, maintain gradient, conserve building space and group piping whenever practical at common elevations.
- .3 Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- .4 Pressure waste piping from pumping stations and other equipment shall be pressure piping and fittings as specified for domestic water.
- .5 Plastic (PVC or ABS) piping where used underground shall adapt to approved non-plastic material prior to penetration above the building slab.
- .6 Class 4000 mechanical joint cast iron soil pipe, fittings and mechanical joint couplings shall be of one manufacturer.
- .7 Copper to cast iron joints shall be male brass adaptors to tapped fittings.
- .8 Nipples shall be cast iron or heavy brass.
- .9 Support horizontal pipe runs and brace at intervals and points as recommended by the manufacturer and the local authority having jurisdiction.
- .10 Support vertical pipe stacks and assemblies and brace as recommended by the manufacturer and the local authority having jurisdiction.
- .11 Visually inspect materials for defects prior to installation.
- .12 Reject defective material and remove from site.
- .13 Surfaces must be clean and free of foreign matter at points of joining
- .14 Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- .15 Prepare pipe, fittings, supports, and accessories not prefinished, ready for finish painting.
- .16 Install bell and spigot pipe with bell end upstream.

3.2 Pipe Hangers and Supports

- .1 Comply with Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment.

3.3 Cleanouts

- .1 Comply with Section 22 05 76 – Facility Drainage Piping Cleanouts

3.4 Above and Below Ground Piping and Fittings

- .1 Cast Iron Pipe and Fittings:
 - .1 Connect with mechanical joint couplings.

- .2 Be aware of manufacturers torque requirements for varying coupling types and torque couplings accordingly.
- .2 ABS / PVC Pipe and Fittings:
 - .1 Solvent cement joints shall be made in a two-step process with primer conforming to ASTM F 656 and solvent cement conforming to ASTM D 2564. The system shall be protected from chemical agents, fire-stopping materials, thread sealant, plasticized-vinyl products or other aggressive chemical agents not compatible with ABS or PVC compounds.
 - .2 Do not install ABS, PVC or other plastic piping upstream of oil interceptors.
 - .3 Do not install piping with glued joints at temperatures below those recommended by the solvent manufacture.
 - .4 Do not install ABS, PVC or other plastic piping upstream of any oil interceptors.
- .3 Refer to Division 2 specification for trenching and backfilling

3.5 Back Water Valve

- .1 Back water valves shall be installed in locations as noted on the drawings.
- .2 Provide support for the backwater valve where suspended in a pit

3.6 Safes, Flashing and Vent Terminals

- .1 Provide flexible flashing and metal counter flashing where piping and ductwork penetrate weather or waterproofed walls and floors.
- .2 CPE, Chloraloy 240 lining or lead material may be used under built-up floor sinks and showers; and at floor drains and cleanouts. Chloraloy shall be solvent welded to manufacturer's installation instructions. Lead shall not be used on roofs where the roofing material is applied by a torch-on method.
- .3 Flash floor drains in floors with topping over finished areas with lead or CPE membrane, a minimum of 300mm (12") clear on sides with minimum 900mm x 900mm (36" x 36") sheet size. Fasten flashing to drain clamp device.
- .4 Seal floor, shower, mop sink, etc. drains watertight to adjacent materials.
- .5 Supply and install 25 kg/m² (5 lb/ft²) lead safes under built-up showers and mop sinks on any floor which is not slab-on-grade. The safes shall extend across the floors and up walls and curb to a minimum height of 150 mm (6") and shall be turned into the floor drain flange, unless specifically noted otherwise. Seams shall be welded (burned), not soldered. Any metal shall be commercially pure lead only. Treat both sides of the safe with two coats of asphalt.
- .6 Provide acoustical lead flashing around pipes penetrating equipment rooms, installed in accordance with manufacturer's instructions for sound control.
- .7 Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.
- .8 Terminate all vent terminals a minimum of 25 mm (1") above the water level at which roof drainage overflows through roof overflow scuppers or drains.
- .9 Vent flashing minimum 450 mm x 450 mm (18" x 18") base dimension shall terminate flush with the top of 300 mm (12") high vent pipe and the gap between the flashing and pipe shall be closed with a 25 kg/m² (5 lb/ft²) separate lead cap 75 mm (3") high. The main flashing shall not be turned over the pipe.

3.7 Floor Drains

- .1 Install floor drains set low to provide proper drainage.

- .2 Generally do not locate floor drains in the center of mechanical rooms. Locate floor drains in close proximity to the equipment and / or devices that will be discharging water to them, such that drain connections from the equipment and / or devices can be piped to the floor drains without creating a tripping hazard.
- .3 Water piping from trap primer to floor drain to be PEX tubing where cast into concrete and protected in a polyethylene sleeve where buried below slab. Provide Type L copper where exposed within the building.

3.8 Excavation & Backfilling

- .1 Refer to Division 02 for excavation, trenching and backfill requirements and the following:
- .2 Provide excavation and backfill required for the installation of the mechanical work. Do not undertake any cutting, boring or excavating in or about the building which may cause interference with the progress of the work or weaken the structure in any way, without the prior approval of the Consultant.
- .3 Trenching for buried services shall be excavated deep enough to accommodate the required pipe grade and bedding material depth. Support each length of pipe with concrete block or brick to maintain grade, backfill and compact in uniform layers not exceeding 300mm (12") in thickness for the full width of the trench and each layer shall be compacted to 95% of the maximum dry density before a subsequent layer is placed.
- .4 Backfilling in all trenches shall be with clean river sand (pea gravel where approved), 150 mm (6") below pipe and up to 150 mm over top of piping, then flushed with water so as to ensure the total length of each pipe is resting on solid footing. Remainder of all trenches shall be filled by the General Contractor.
- .5 Where sanitary sewer pipes pass under a grade beam or footing the trench around the piping up to and in contact with the footing shall be provided with a 450 kg concrete grouting so as to seal the outside trenching from normal storm runoff and backflow of rain water through the trenching and into the crawl space and/or under the basement floor.
- .6 Where sanitary sewer, pipes pass through exterior walls below grade, the General Contractor shall install corbels on the exterior walls and run bridging from corbel to undisturbed soil for the support of the pipes. 25mm (1") thick waterproof mastic shall be applied around the pipes which pass through the wall.
- .7 Be responsible for repairing and making good, to match original condition, all existing concrete walls, pavement, walkways etc., where these have been damaged by this Division

3.9 Testing and Adjustment

- .1 General:
 - .1 In accordance with Section 22 08 00 Commissioning of Plumbing and the following:
 - .2 Test for leaks and defects all new plumbing piping systems and parts of existing systems, which have been altered, extended or repaired. Submit to the Consultant a copy of a Pipe Pressure Test Log for each section of piping tested.
 - .3 Leave uncovered and unconcealed all new, altered, extended, or replaced piping until it has been tested and reviewed. Expose all such work for testing that has been covered or concealed before it has been tested and approved.
 - .4 Repair all leaks and defects using new materials and retest all plumbing systems until satisfactory results are obtained.
- .2 Plumbing Piping Pressure Testing
 - .1 Tests on the sanitary waste drainage systems shall consist of a hydraulic pressure testing of 3000 mm (10') for 8 hours.
 - .2 An air test in accordance with the Plumbing Code may be used during freezing conditions.

- .3 Floor drains:
 - .1 Verify operation of trap seal primer.
 - .2 Prime using trap primer. Adjust flow rate to suit site conditions.
 - .3 Check operations of flushing features.
 - .4 Check security, accessibility, removability of basket strainers.
 - .5 Clean out baskets.
- .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.

END OF SECTION

1. GENERAL

1.1 Section Scope

- .1 Storm drain piping, equipment and accessories between roof drains, area drains, planter drains and catch basins that will discharge storm drainage or clear unpolluted waste water to 1m from the building
- .2 Interior storm piping shall be provided as depicted on the drawings to plumbing fixtures that will discharge storm water and shall be connected to discharge to the
 - .1 Existing storm piping as depicted on the drawings.
 - .2 Exterior storm building service as depicted on the drawings and specified in Division 2 [33].
- .3 Non-functioning existing interior storm drainage piping shall be removed where access is readily available or capped off and abandoned in place as referenced on the drawings. Abandoned piping shall be identified on as-built drawings and tagged as abandoned.

1.2 General Requirements

- .1 All buried storm drainage piping shall be a minimum of 4 NPS.
- .2 Like product and materials shall be of one manufacturer
- .3 Non-functioning existing interior storm drainage piping shall be removed where access is readily available or capped off and abandoned in place as referenced on the drawings

1.3 Related Requirements

- .1 This section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
- .2 Section 21 05 01 – Common Work Results for Mechanical
- .3 Section 22 05 76 – Facility Drainage Piping Cleanouts

1.4 References

- .1 The latest revisions of the following standards shall apply unless noted otherwise.
- .2 Applicable Building Code - Refer to Section 21 05 01
- .3 ASTM B32: Standard Specification for Solder Metal.
- .4 ASTM B306: Standard Specification for Copper Drainage Tube (DWV).
- .5 ASTM C564: Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- .6 ASTM B306: Copper DWV tube drainage type, drawn temper.
- .7 ASME B16.23 or ASME B16.29 : Copper drainage fittings cast copper or wrought copper.
- .8 ASTM F 628 : Acrylonitrile-butadiene-styrene (ABS) drainage, waste, and vent pipe – cellular core.
- .9 CAN/CSA-B70: Cast Iron Soil Pipe, Fittings, and Means of Joining.
- .10 CAN/CSA-B602: Mechanical Couplings for Cast Iron Drain, Waste, Vent Pipe and Sewer Pipe.
- .11 CAN/CSA B181.1: Acrylonitrile-butadiene-styrene (ABS) drain, waste, and vent pipe and pipe fittings

- .12 CAN/CSA B181.2: PVC solid wall DWV pipe, schedule 40, drain, waste, and vent piping and pipe fittings.
- .13 CAN/ULC S102.2: Standard method of Test for Surface Burning Characteristics of Building Materials and Assemblies

1.5 Submittals

- .1 Comply with Division 1 – Submission and Closeout Procedures, Section 21 05 01 Common Work Results for Mechanical – Submittals and in addition the following:
 - .2 Shop drawings:
 - .1 Backwater valves
 - .2 Roof drains

1.6 Pipe, Fittings and Couplings

- .1 Provide for all pipe, fittings, couplings, nipples, drains and all accessory pipe work for a complete installation within the base tender price.
- .2 No extra cost will be considered based on failure of the contractor to allow for pipe, fittings and pipe work as required during construction to provide offsets to avoid structural components, and to coordinate with other piping services, ductwork, cable trays, conduits or other obstacles whether indicated on the drawings or not.

1.7 Seismic Protection

- .1 Comply with Section 22 05 48 – Vibration and Seismic Control for Plumbing Piping and Equipment.

1.8 Substantial & Total Performance

- .1 Comply with Section 21 05 01 Common Work Results for Mechanical – Substantial and Total Performance.

2. PRODUCTS

2.1 Acceptable Manufacturers

- .1 Refer to Section 00 01 10 – Acceptable Manufacturers

2.2 Pipe Hangers and Supports

- .1 Comply with Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment.2Cleanouts
- .2 Comply with Section 22 05 76 – Facility Drainage Piping Cleanouts

2.3 Above Ground Pipe and Fittings

- .1 Cast Iron DWV drainage pipe and fittings:
 - .1 3 NPS to 15 NPS
 - .2 Class 4000 cast iron mechanical joint pipe complying to CAN/CSA-B70.
 - .3 Stainless steel couplings with neoprene or butyl rubber compression gaskets complying to CAN/CSA-B602.
- .2 Polyvinyl Chloride (PVC 15) (non-combustible building applications)
 - .1 1½ NPS to 16 NPS
 - .2 Polyvinyl chloride (PVC), schedule 40 solid wall pipe and fittings.

- .3 Pipe and fittings shall have a flame spread rating of not greater than 25 as per CAN/ULC S102.2
- .4 PVC solid wall DWV pipe, schedule 40, with solvent weld socket joints conforming to CAN/CSA B181.2.
- .5 PVC fittings shall be solvent welded socket type using a two-step solvent cement conforming to ASTM D2564.
- .3 Polyvinyl Chloride (PVC 15-XFR) (air plenum and/or high rise building applications)
 - .1 1½ NPS to 16 NPS
 - .2 Polyvinyl chloride (PVC), schedule 40 solid wall pipe and fittings.
 - .3 Pipe and fittings shall have a flame spread rating of not greater than 25 and a smoke developed index no greater than 50 as per CAN/ULC S102.2
 - .4 PVC solid wall DWV pipe, schedule 40, with solvent weld socket joints conforming to CAN/CSA B181.2.
 - .5 PVC fittings shall be solvent welded socket type using a two-step solvent cement conforming to ASTM D2564.
- .4 Copper Tube, (DWV)
 - .1 Copper DWV tube drainage pipe may be used for piping above ground.
 - .2 The copper DWV tube shall be drainage type, drawn temper conforming to ASTM B306.
 - .3 The copper drainage fittings shall be cast copper or wrought copper conforming to ASME B16.23 or ASME B16.29.
 - .4 The joints shall be lead free solder, using a water flushable flux, and conforming to ASTM B32.

2.4 Below Ground Piping and Fittings

- .1 Cast iron drain, waste and vent pipe and fittings:
 - .1 3 NPS to 15 NPS
 - .2 Class 4000 cast iron mechanical joint pipe complying to CAN/CSA-B70.
 - .3 Stainless steel couplings with neoprene or butyl rubber compression gaskets complying to CAN/CSA-B602.
- .2 Polyvinyl Chloride (PVC-DWV)
 - .1 3 NPS to 16 NPS
 - .2 Polyvinyl chloride (PVC) pipe, schedule 40 solid wall pipe and fittings.
 - .3 PVC solid wall DWV pipe, schedule 40, with solvent weld socket joints conforming to CAN/CSA B181.2.
 - .4 PVC fittings shall be solvent welded socket type using solvent cement conforming to ASTM D2564.

2.5 Backwater Valves

- .1 Horizontal, Cast-Iron Backwater Valves
 - .1 Size: Same as connected piping.
 - .2 Body: Cast iron, cast iron cover with bolted access check valve.
 - .3 Check Valve: Removable, bronze and PVC, swing check, factory assembled or field modified to hang open for airflow unless subject to backflow condition.

- .4 For underground installations provide a full-size, cast-iron, soil-pipe extension to field-installed cleanout at floor. Replaces backwater valve cover.
- .2 Drain-Outlet Backwater Valves.
 - .1 Size: Same as floor drain outlet.
 - .2 Body: Cast iron or bronze made for vertical installation in bottom outlet of floor drain.
 - .3 Check Valve: Removable ball float.
 - .4 Inlet: Threaded, Outlet: threaded or spigot.
- .3 Horizontal, Plastic Backwater Valves
 - .1 Size: Same as connected piping.
 - .2 Body: ABS or PVC.
 - .3 Cover: Same material as body with threaded access to check valve.
 - .4 Check Valve: Removable swing check.
 - .5 End Connections: Socket type.

2.6 Safes, Flashing and Vent Terminals

- .1 Metal Flashing: 26 gage galvanized steel.
- .2 Metal Counter flashing: 22 gage galvanized steel.
- .3 Lead Flashing:
 - .1 Waterproofing: 25 kg/m² [5 lb/ft²] sheet lead
 - .2 Soundproofing: 15 kg/m² [1 lb/ft²] sheet lead.
- .4 Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing.
- .5 Floor Drain Flashing: 40 mil thick chlorinated polyethylene (CPE), equivalent to Chloraloy. 25 kg/m² [5 lb/ft²] sheet lead flashings.
- .6 Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements.

3. EXECUTION

3.1 General:

- .1 Comply with manufacturer's installation instructions and the following:
- .2 Route piping in orderly manner, maintain gradient, conserve building space and group piping whenever practical at common elevations.
- .3 Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- .4 Pressure waste piping from pumping stations and other equipment shall be pressure piping and fittings as specified for domestic water.
- .5 Plastic (PVC or ABS) piping where used underground and not above shall adapt to approved non-plastic material prior to penetration above the building slab.
- .6 Class 4000 mechanical joint cast iron soil pipe, fittings and mechanical joint couplings shall be of one manufacturer.
- .7 Copper to cast iron joints shall be male brass adaptors to tapped fittings.
- .8 Nipples shall be cast iron or heavy brass.
- .9 Support horizontal pipe runs and brace at intervals and points as recommended by the manufacturer and the local authority having jurisdiction.

- .10 Support vertical pipe stacks and assemblies and brace as recommended by the manufacturer and the local authority having jurisdiction.
- .11 Visually inspect materials for defects prior to installation.
- .12 Reject defective material and remove from site.
- .13 Surfaces must be clean and free of foreign matter at points of joining
- .14 Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- .15 Prepare pipe, fittings, supports, and accessories not prefinished, ready for finish painting.
- .16 Install bell and spigot pipe with bell end upstream.

3.2 Pipe Hangers and Supports

- .1 Comply with Section 23 05 29 – Hangers and Supports for Plumbing Piping and Equipment.

3.3 Cleanouts

- .1 Comply with Section 22 05 76 – Facility Drainage Piping Cleanouts

3.4 Above and Below Ground Piping and Fittings

- .1 Cast Iron Pipe and Fittings:
 - .1 Connect with mechanical joint couplings.
 - .2 Be aware of manufacturers torque requirements for varying coupling types and torque couplings accordingly.
- .2 ABS / PVC Pipe and Fittings:
 - .1 Solvent cement joints shall be made in a two-step process with primer conforming to ASTM F 656 and solvent cement conforming to ASTM D 2564. The system shall be protected from chemical agents, fire-stopping materials, thread sealant, plasticized-vinyl products or other aggressive chemical agents not compatible with ABS or PVC compounds.
 - .2 Do not install ABS, PVC or other plastic piping upstream of oil interceptors.
 - .3 Do not install piping with glued joints at temperatures below those recommended by the solvent manufacture.
 - .4 Do not install ABS, PVC or other plastic piping upstream of any oil interceptors.
- .3 Refer to Division 2 specification for trenching and backfilling

3.5 Safes, Flashing and Vent Terminals

- .1 Provide flexible flashing and metal counter flashing where piping penetrates weather or waterproofed walls and floors.
- .2 CPE, Chloraloy 240 lining or lead material may be used at floor drains and cleanouts. Chloraloy shall be solvent welded to manufacturer's installation instructions. Lead shall not be used on roofs where the roofing material is applied by a torch-on method.
- .3 Flash floor drains in floors with topping over occupied areas with lead or CPE membrane, a minimum of 300mm (12") clear on sides with minimum 900mm x 900mm (36" x 36") sheet size. Fasten flashing to drain clamp device.
- .4 Provide acoustical lead flashing around pipes penetrating equipment rooms, installed in accordance with manufacturer's instructions for sound control.

3.6 Testing and Adjustment

- .1 General:
 - .1 Test for leaks and defects all new plumbing piping systems and parts of existing systems, which have been altered, extended or repaired. Submit to the Consultant a copy of a Pipe Pressure Test Log for each section of piping tested.
 - .2 Leave uncovered and unconcealed all new, altered, extended, or replaced piping until it has been tested and reviewed. Expose all such work for testing that has been covered or concealed before it has been tested and approved.
 - .3 Repair all leaks and defects using new materials and retest all plumbing systems until satisfactory results are obtained.
- .2 Plumbing Piping Pressure Testing
 - .1 Tests on the storm drainage systems shall consist of a hydraulic pressure testing of 3000 mm (10') for 8 hours.
 - .2 An air test in accordance with the Plumbing Code may be used during freezing conditions.
- .3 Area drains:
 - .1 Check security, accessibility, removability of basket strainers.
 - .2 Clean out baskets.
- .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.

3.7 Excavation & Backfilling

- .1 Refer to Division 02 for excavation, trenching and backfill requirements and the following:
- .2 Provide excavation and backfill required for the installation of the mechanical work. Do not undertake any cutting, boring or excavating in or about the building which may cause interference with the progress of the work or weaken the structure in any way, without the prior approval of the Consultant.
- .3 Trenching for buried services shall be excavated deep enough to accommodate the required pipe grade and bedding material depth. Support each length of pipe with concrete block or brick to maintain grade, backfill and compact in uniform layers not exceeding 300mm (12") in thickness for the full width of the trench and each layer shall be compacted to 95% of the maximum dry density before a subsequent layer is placed.
- .4 Backfilling in all trenches shall be with clean river sand (pea gravel where approved), 150 mm (6") below pipe and up to 150 mm over top of piping, then flushed with water so as to ensure the total length of each pipe is resting on solid footing. Remainder of all trenches shall be filled by the General Contractor.
- .5 Where storm pipes pass under a grade beam or footing the trench around the piping up to and in contact with the footing shall be provided with a 450 kg concrete grouting so as to seal the outside trenching from normal storm runoff and backflow of rain water through the trenching and into the crawl space and/or under the basement floor.
- .6 Where storm pipes pass through exterior walls below grade, the General Contractor shall install corbels on the exterior walls and run bridging from corbel to undisturbed soil for the support of the pipes. 25mm (1") thick waterproof mastic shall be applied around the pipes which pass through the wall.

- .7 Be responsible for repairing and making good, to match original condition, all existing concrete walls, pavement, walkways etc., where these have been damaged by this Division

3.8 Roof Drains and Area Drains

- .1 Install roof drains at low points on roof to provide proper drainage. Coordinate with roofing contractor.
- .2 Install in accordance with the applicable provincial roofing contractors association standards to maintain integrity of roof guarantee.
- .3 Install integral expansion joints where roof drains are installed directly above rainwater leaders.
- .4 Install area drains at low points to provide proper drainage. Coordinate with the General Contractor top of grate invert elevations.

END OF SECTION

1. GENERAL

1.1 Section Scope

- .1 Subdrainage systems for foundations and underslab areas.

1.2 Related Requirements

- .1 This section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
- .2 Section 21 05 01 – Common Work Results for Mechanical
- .3 Section 22 05 76 – Facility Drainage Piping Cleanouts
- .4 Division 33 – Excavation, Trenching and Backfill

1.3 References

- .1 The latest revisions of the following standards shall apply unless noted otherwise.
- .2 Applicable Building Code - Refer to Section 21 05 01

1.4 Submittals

- .1 Comply with Division 1 – Submission and Closeout Procedures, Section 21 05 01 Common Work Results for Mechanical – Submittals and in addition the following:
 - .1 Product data for each type of drainage panel indicated

2. PRODUCTS

2.1 Acceptable Manufacturers

- .1 Refer to Section 23 05 01 –Acceptable Manufacturers

2.2 Perforated Wall Pipes and Fittings

- .1 4 NPS to 6 NPS: Straight PVC pipe certified to CSA-B182.1, Perforated wall, minimum stiffness 200 kPa, 16mm holes at 120° angle (no secondary hole), bell-and-spigot ends, loose joints.
- .2 Fittings: PVC made to SDR35 wall certified to CSA-B182.2, bell-and-spigot ends, loose joints.

2.3 Plain Wall Pipes and Fittings

- .1 4 NPS to 6 NPS: Straight PVC pipe certified to CSA-B182.1, Plain wall, minimum stiffness 320 kPa, bell-and-spigot ends, solvent weld joints.
- .2 Fittings: PVC made to SDR35 wall certified to CSA-B182.2, bell-and-spigot ends, solvent weld joints.
- .3 PVC solvent cement: to ASTM D2564.

2.4 Cleanouts

- .1 Refer to Section 22 05 76 – Facility Drainage Piping Cleanouts

2.5 Geotextile Filter Fabrics

- .1 Fabric of polypropylene or polyester fibers or combination of both, with flow rate range from 38 L/min/sq.m to 116 L/min/sq.m (110 to 330 gpm/sq.ft.) when tested according to ASTM D 4491.

- .1 Structure Type: Nonwoven, needle-punched continuous filament or woven, monofilament or multifilament.
- .2 Apparent Opening Size: No. 40 sieve, maximum.

2.6 Drainage Panels

- .1 Molded-Sheet Drainage Panels: Prefabricated geocomposite, 900mm to 1500mm (36" to 60") wide with drainage core faced with geotextile filter fabric
 - .1 Drainage Core: Three-dimensional, nonbiodegradable, molded Poly Propylene or Poly Styrene.
 - .2 Minimum Compressive Strength: 479 kPa (10,000 lbf/sf) when tested according to ASTM D 1621.
 - .3 Minimum In-Plane Flow Rate: 86L/min/metre (7 gpm/ft.) of unit width at hydraulic gradient of 1.0 and compressive stress of 172 kPa (3600 lbf/sf) when tested according to ASTM D 4716.
 - .4 Filter Fabric: Nonwoven needle-punched geotextile, manufactured for subsurface drainage, made from polypropylene or polyesters; with elongation greater than 50 percent.
 - .5 Film Backing: Polymeric film bonded to drainage core surface

3. EXECUTION

3.1 Earthwork

- .1 Excavating, trenching, and backfilling are specified elsewhere in these specifications

3.2 General

- .1 The width of the trench shall not exceed the manufacturer's recommendations for earth load. In the absence of manufacturer's recommendations, trench width at the piping shall not exceed 700mm (28").
- .2 Unless otherwise specified trenches shall have a gradient of not less than 1 in 100;
- .3 Minimum depth of cover over buried PVC pipes shall be:
 - .1 750mm for unsealed traveled areas/embankment conditions etc.
 - .2 600mm for sealed traveled areas
 - .3 450mm for non- traveled areas.

3.3 Bedding

- .1 Bedding and installation shall be as per Division 33. In the absence of Division 33 bedding material and installation shall comply with ASTM D 2321. Recommended practice for underground installation of flexible thermoplastic sewer pipe.

3.4 Foundation Drainage Installation

- .1 Perforated wall piping:
 - .1 Place impervious fill material on subgrade adjacent to bottom of footing after concrete footing forms have been removed. Place and compact impervious fill to dimensions indicated, but not less than 150mm (6") deep and 300mm (12") wide.
 - .2 Lay flat-style geotextile filter fabric in trench and overlap trench sides.
 - .3 Place supporting layer of drainage course over compacted subgrade and geotextile filter fabric, to compacted depth of not less than 100mm (4").

- .4 Install drainage piping as indicated in Part 3 "Piping Installation"
 - .5 Add drainage course to width of at least 150mm (6") on the side away from wall and to top of pipe to perform tests.
 - .6 After satisfactory testing, cover drainage piping to width of at least 150mm (6") on side away from footing and above top of pipe to within 300mm (12") of finish grade.
 - .7 Install drainage course and wrap top of drainage course with flat-style geotextile filter fabric.
 - .8 Place layer of flat-style geotextile filter fabric over top of drainage course, overlapping edges at least 100mm (4").
- .2 Vertical drainage panels:
- .1 Coordinate placement with other drainage materials.
 - .2 Lay perforated drainage pipe at base of footing. Install as indicated above but do not install aggregate.
 - .3 Separate 100mm of fabric at beginning of roll and cut away 100mm of core. Wrap fabric around end of remaining core.
 - .4 Wrap bottom of panel around drainage pipe.
 - .5 Attach panel to wall at horizontal mark and at beginning of pipe. Place core side of panel against wall. Use concrete nails with washers through product cylinders, construction adhesives, metal stick pins, or double-sided tape to attach panel to wall. Do not penetrate waterproofing. Before using adhesives, discuss with waterproofing manufacturer for compatibility.
 - .6 Cut panel as necessary to keep top 300mm (12") below finish grade.
 - .7 For inside corners, bend panel. For outside corners, cut core to provide 75mm for overlap.
 - .8 Place initial backfill material over compacted drainage course. Place material in loose depth layers not exceeding 150mm (6"). Thoroughly compact each layer. Final backfill to finish elevations and slope away from building.

3.5 Underslab Drainage Installation

- .1 Excavate for underslab drainage system after subgrade material has been compacted but before drainage course has been placed. Include horizontal distance of at least 150mm (6") between drainage pipe and trench walls. Grade bottom of trench excavations to required slope, and compact to firm, solid bed for drainage system.
- .2 Lay flat-style geotextile filter fabric in trench and overlap trench sides.
- .3 Place supporting layer of drainage course over compacted subgrade and geotextile filter fabric, to compacted depth of not less than 100mm.
- .4 Install drainage piping as indicated in Part 3 "Piping Installation".
- .5 Add drainage course to width of at least 150mm on the side away from wall and to top of pipe to perform tests.
- .6 After satisfactory testing, cover drainage piping with drainage course to elevation of bottom of slab, and compact and wrap top of drainage course with flat-style geotextile filter fabric.

3.6 Piping Installation

- .1 Install piping beginning at low points of system, true to grades and alignment indicated, with unbroken continuity of invert. Bed piping with full bearing in filtering material. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions and other requirements indicated.

- .2 Foundation Subdrainage: Install piping pitched down in direction of flow, at a minimum slope of 0.5 percent and with a minimum cover of 900mm, unless otherwise indicated.
- .3 Underslab Subdrainage: Install piping pitched down in direction of flow, at a minimum slope of 0.5 percent.
- .4 Lay perforated pipe with perforations down.
- .5 Excavate recesses in trench bottom for bell ends of pipe. Lay pipe with bells facing upslope and with spigot end entered fully into adjacent bell.
- .6 Use increasers, reducers, and couplings made for different sizes or materials of pipes and fittings being connected. Reduction of pipe size in direction of flow is prohibited.
- .7 Install PVC piping according to ASTM D 2321.

3.7 Testing

- .1 After installing drainage course to top of piping, test drain piping with water to ensure free flow before backfilling. Remove obstructions, replace damaged components, and repeat test until results are satisfactory.

3.8 Cleaning

- .1 Clear interior of installed piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed. Place plugs in ends of uncompleted pipe at end of each day or when work stops.

END OF SECTION

1. GENERAL

1.1 Section Scope

- .1 The supply and installation of Plumbing Fixtures and Trim.
- .2 Fixtures and trim installed but not supplied under this section.

1.2 Related Requirements

- .1 This section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
- .2 Section 21 05 01 – Common Work Results for Mechanical.
- .3 Section 23 05 01 – Acceptable Manufacturers.

1.3 References

- .1 The latest revisions of the following standards shall apply unless noted otherwise:
- .2 Canadian Standards Association (CSA International).
 - .1 CAN/CSA-B45 Series, Plumbing Fixtures.
 - .2 CAN/CSA-B125, Plumbing Fittings.
 - .3 CAN/CSA-B651-95 (R2001), Barrier-Free Design.
- .3 British Columbia Building Access Handbook

1.4 General Requirements

- .1 Provide new fixtures, CSA approved, free from flaws and blemishes with finished surfaces clear, smooth and bright.
- .2 Provide CSA approved plumbing fittings. Visible parts of fixture brass and accessories shall be heavily chrome plated.
- .3 Fixtures shall be the product of one manufacturer. Fittings of the same type shall be the product of one manufacturer.
- .4 Protect fixtures against use and damage during construction.

1.5 Submittals

- .1 Comply with Division 1 – Submission and Closeout Procedures, Section 21 05 01 Common Work Results for Mechanical – Submittals and in addition the following:
 - .1 Shop drawings for all fixtures and fittings.

2. PRODUCTS

2.1 Acceptable Manufacturers

- .1 The design base only is listed in this section. Refer to Section 23 05 01 – Acceptable Manufacturers for alternate submissions.
- .2 Alternate acceptable manufacturer`s must be visually similar and match the quality and water efficiency of the specified design base product.

2.2 Manufactured Units

- .1 Fixtures: manufacture in accordance with CAN/CSA-B45 series.
- .2 Trim, fittings: manufacture in accordance with CAN/CSA-B125.

- .3 Vitreous china fixtures shall be white unless otherwise noted.
- .4 Stainless steel fixtures shall be satin and/or mirror finish or combination thereof.
- .5 Exposed plumbing brass and metal work shall be heavy chromium plated.

2.3 General

- .1 ABS P-traps and waste arms are not permitted.
- .2 Plumbing fixture quantity and locations indicated on the architectural drawings shall govern.
- .3 Laboratory brass fittings shall have a chemical resistant finish and be colour coded and indexed.
- .4 Laboratory water faucets with gooseneck spouts shall be protected by vacuum breakers.

2.4 Trap Seal Primers

- .1 Flow actuated type priming device, vacuum breaker ports and internal back-flow protection, lead free brass body, stainless steel screen, factory pre-set, activation by a minimum flow rate of 0.03l/s @ 138 kPa (0.5 GPM @ 20 psi). ½ NPS inlet and outlet, capable of serving 1 to 4 traps.
- .2 Timer / solenoid activated priming system.
 - .1 Solenoid: ½ NPT Slow closing solenoid valve, forged brass body, Buna "N" disc, stainless steel parts, enclosure to suit environmental conditions, UL and CSA approved, 120 volt.
 - .2 Provide ½ NPT globe valve upstream of the solenoid valve for throttling.
 - .3 Provide a relay and building automation system interface. Coordinate with Division 25 to provide the DDC connection and an adjustable schedule such that the valve is actuated for 3 minutes (adjustable) once a week.
 - .4 Coordinate with Division 26 for solenoid power requirements and location.

3. EXECUTION

3.1 Installation General

- .1 Sinks shall not be used to clean paint brushes, trowels, etc. Do not dispose construction waste down any plumbing fixtures.
- .2 Provide chrome flexible risers or supplies to fixtures, reducers and escutcheons.
- .3 Provide Sealant Dow Corning #786 or equal, between finished walls and horizontal surfaces of water closets and lavatories etc. Sealant shall be a continuous smooth with a beveled watershed, sealant shall be mildew/algae resistant.
- .4 Provide necessary hangers, supports, brackets, reinforcements, steel back-up plates and floor flanges to set fixtures level and square. Mount fixtures so 91 Kg (200lb) mass will not loosen or distort mounting.
- .5 Install hose end faucets and hose connections with vacuum breakers.
- .6 Provide water hammer arrestors or shock absorbers on fixtures with flush valves and/or quick closing valves or solenoid valves.
- .7 Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.
- .8 All bathtubs and shower bases shall be provided with slip resistant surface regardless of units specified.
- .9 All waste arms from traps shall be mechanical joint to risers not soldered.

- .10 Provide minimum 18 ga circular stainless steel shrouds for concealing services dropping to island or bench fixtures from ceiling spaces complete with ceiling and counter flanges. Diameter shall be to accommodate services; however, all shrouds shall be of the same diameter in one room or area.

3.2 Installation of Accessible Fixtures

- .1 Comply with the latest edition of the British Columbia Office of Housing and Construction Standards "Building Access Handbook" for fixture mounting heights, spacing and plumbing trim requirements on all accessible fixture installations.
- .2 http://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/construction-industry/building-codes-and-standards/guides/2014_building_access_handbook.pdf
- .3 Accessible Water Closets:
 - .1 Provide water closets with a seat at 430mm to 480mm above the floor
 - .2 Provide trim with accessible hand operated flushing controls
 - .3 Provide an offset tailpiece on accessible water closet flush valve connection to eliminate interference with grab bar mounting.
 - .4 Install flush valve handle facing transfer or non-grab bar side of water closet.
- .4 Accessible Lavatories:
 - .1 Provide offset P-traps.
 - .2 P-traps and waste arms shall be insulated with manufactured insulation kit with polyvinyl chloride jacket.

3.3 Installation of Lavatories and Sinks

- .1 Install wall mounted lavatories with approved wall carriers.
- .2 Polished chrome flexible pipe supplied with metal compression rings are acceptable for lavatories and sinks. Supply shall incorporate NPS 1/2 x 3/8 compression outlet angle stop complete with a minimum 375mm long flexible riser to fixture.
- .3 Fixture punchings for faucets or other trim shall match holes necessary for specified trim.
- .4 Double waste fittings for lavatories and sinks shall be double sanitary tee.
- .5 Provide gaskets and/or sealing washers to prevent entry of water into fixture trim, faucet holes or punchings in millwork.
- .6 Gooseneck spouts shall have clearance of 200mm from nozzle tip to countertop, unless otherwise specified.
- .7 Provide fixture and templates to applicable trades for holes and cut outs required in millwork.
- .8 Plastic control handles and spouts are unacceptable.
- .9 Lavatory and sink P-traps shall be complete with either a cleanout or slip joint connection.

3.4 Installation of Water Closets:

- .1 All water closets shall be complete with flange, wax seal, bolt caps, etc.
- .2 Water closets shall be connected to waste utilizing brass or cast-iron floor flanges with lead stub or mechanical joint connections and wax seals.
- .3 Solidly attach floor mounted water closets to floor with lag screws. Lead flashing shall not hold closet in place.

- .4 Polished chrome flexible pipe supplied with metal compression rings are acceptable for tank type water closets. Supply shall incorporate NPS 1/2 x 3/8 compression outlet angle stop complete with 300mm long flexible riser to fixture. PEX or other plastic supplies are not acceptable.
- .5 Provide NPS 4 drain pipe connections and branch drains from all water closets. Use staggered wye connections at toilet branch drain connections; avoid flat double wye connections.

3.5 Installation of Urinals

- .1 Piping, fittings and P-traps from urinals shall not be copper; vents above urinal rim may be copper.
- .2 Urinals shall have individual wastes.

3.6 Installation of Hose Bibbs

- .1 Provide operating keys to the Owner for all hose bibbs that do not possess an attached handle.
- .2 Provide an isolating shut-off valve upstream of all hose bibbs.
- .3 Exterior ground type hose bibb boxes shall be set flush and anchored in a 450 mm (18") square x 200 mm (8") thick concrete collar all set at 25 mm (1") above surrounding grade.
- .4 Connect drain ports on floor mount type hose bibbs indirectly to drainage system where such drainage ports are located within the confines of the building.
- .5 Seal around the perimeter of hose bibbs with silicone caulk in a neat manner, for a waterproofing seal. Where a water proof membrane is present, provide a hose bibb with a membrane clamp.
- .6 All exposed hose bibbs shall be chrome plate finish.

3.7 Installation of Trap Seal Primers

- .1 Install trap primer on all drains which do not receive water daily. Primers shall be installed in an area accessible for easy maintenance.

3.8 Adjusting

- .1 Adjustments: Adjust pressure to fixtures to ensure no splashing at maximum pressures.
- .2 Checks: Aerators: operation, cleanliness. Vacuum breakers, backflow preventers: operation under all conditions.
- .3 Thermostatic controls: Verify temperature settings, operation of control, limit and safety controls.
- .4 Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.
- .5 Adjust and commission dual flush toilets for lever and flush mechanism play as well as tank level fill to manufacturer's specific settings and installation instructions.

3.9 Schedules

- .1 Fixture Rough-Ins

Fixture	Water Supply	Sanitary Drain
water closet - flush valve	NPS 1	NPS 4
water closet - flush tank	NPS 1/2	NPS 4
urinal - flush valve	NPS 3/4	NPS 1-1/2
urinal - flush tank	NPS 1/2	NPS 1-1/2
lavatory	NPS 1/2	NPS 1-1/2
sink	NPS 1/2	NPS 1-1/2
service sink	NPS 1/2	NPS 2
shower	NPS 1/2	NPS 1-1/2

END OF SECTION

1. GENERAL

1.1 Section Scope

- .1 This section defines the minimum requirements necessary to render HVAC components clean, and to verify the cleanliness through inspection and/or testing in accordance with applicable Standards.
- .2 The Contractor shall be responsible for the removal of visible surface contaminants and deposits from within the HVAC system in strict accordance with these specifications.
- .3 The HVAC system includes any interior surface of the facility's air distribution system for conditioned spaces and/or occupied zones. This includes the entire heating, air-conditioning and ventilation system from the points where the air enters the system to the points where the air is discharged from the system. The return air grilles, return air ducts to the air handling unit (AHU), the interior surfaces of the AHU, mixing box, coil compartment, condensate drain pans, humidifiers and dehumidifiers, supply air ducts, fans, fan housing, fan blades, air wash systems, spray eliminators, turning vanes, filters, filter housings, reheat coils, and supply diffusers are all considered part of the HVAC system. The HVAC system may also include other components such as dedicated exhaust and ventilation components and make-up air systems.

1.2 Related Requirements

- .1 This section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
- .2 Section 21 05 01 – Common Work Results for Mechanical.
- .3 Section 23 33 00 – Air Duct Accessories.

1.3 References

- .1 The latest revisions of the following standards shall apply unless noted otherwise.
 - .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):
 - .1 Standard 62 Ventilation for Acceptable Indoor Air Quality,
 - .2 National Air Duct Cleaners Association (NADCA):
 - .1 Standard for Assessment Cleaning Restoration of HVAC Systems (ACR).

1.4 Submittals

- .1 Comply with Division 1 – Submission and Closeout Procedures, Section 21 05 01 Common Work Results for Mechanical – Submittals and in addition the following:
 - .1 Material Safety Data Sheets (MSDS) for all chemical products used in the cleaning process.
 - .2 Proof of qualification requirements for HVAC system cleaning Contractor.
 - .3 Post Cleaning Inspection Report.

1.5 Definitions

- .1 Ductwork:

- .1 All structures designed to transfer air to or from conditioned spaces. For the purposes of this specification section, ductwork will include all structures and internal control devices (dampers, turning vanes, probes, grills and diffusers, etc.) leading to or from air handler units and their enclosures.

1.6 Qualification of the HVAC System Cleaning Contractor

- .1 The HVAC system cleaning contractor shall be a certified member of the National Air Duct Cleaners Association (NADCA), or shall maintain membership in a nationally recognized non-profit industry organization dedicated to the cleaning of HVAC systems.
- .2 The HVAC system cleaning contractor shall have a minimum of one (1) Air System Cleaning Specialist (ASCS) certified by NADCA on a full time basis, or shall have staff certified by a nationally recognized certification program and organization dedicated to the cleaning of HVAC systems.
- .3 The HVAC system cleaning contractor shall submit records indicating five (5) years experience in the field of HVAC system cleaning. Records shall only be considered from firms which are regularly engaged in HVAC system maintenance with an emphasis on HVAC system cleaning and decontamination.

1.7 General

- .1 The HVAC system cleaning contractor shall possess and furnish all necessary equipment, materials and labor to adequately perform the specified services.
- .2 The contractor shall confirm in writing that its employees for this project have received safety equipment training, medical surveillance programs, individual health protection measures, and manufacturer's product and material safety data sheets (MSDS) as required for the work.
- .3 The HVAC system cleaning contractor shall perform the services specified here in accordance with the current published standards of the National Air Duct Cleaners Association (NADCA).

2. PRODUCTS

2.1 Acceptable Manufacturers

- .1 Refer to Section 23 05 01 – Acceptable Manufacturers.

2.2 Cleaning Equipment

- .1 Provide equipment and materials for cleaning, repairing and inspection work including scaffolding, wire brushes, rotary brushes, filters, air lances, mechanical agitators, fiber-optic borescopes, vacuums or other equipment and materials necessary for workmen to perform work specified.
- .2 Any chemicals utilized in this project shall have MSDS (Material Safety Data Sheet) submitted to the maintenance department before product usage, and shall be pre-approved by the Consultant.

2.3 Access Doors

- .1 All access doors and hatches shall comply with Section 23 33 00 Air Duct Accessories.

3. EXECUTION

3.1 HVAC System Component Inspections and Site Preparations

- .1 Contractor shall conduct a site evaluation, and establish a specific, coordinated plan which details a lay out plan for video survey, identifies camera and cleaning apparatus insertion points and how each area of the building will be protected during the various phases of the project.
- .2 Prior to the commencement of any cleaning work, the HVAC system cleaning contractor shall perform a visual inspection of the HVAC system. Determine appropriate methods, tools, and equipment required to satisfactorily complete this project.
- .3 The cleanliness inspection should include air handling units and representative areas of the HVAC system components and ductwork. In HVAC systems that include multiple air handling units, a representative sample of the units should be inspected.
- .4 The cleanliness inspection shall be conducted without negatively impacting the indoor environment through excessive disruption of settled dust, microbial amplification or other debris. In cases where contamination is suspected, and/or in sensitive environments where even small amounts of contaminant may be of concern, environmental engineering control measures should be implemented.
- .5 Damaged system components found during the inspection shall be documented and brought to the attention of the Consultant.

3.2 General HVAC System Cleaning Requirements

- .1 Debris removed during cleaning shall be collected and precautions must be taken to ensure that debris is not otherwise dispersed outside the HVAC system during the cleaning process.
- .2 Where the particulate collection equipment is exhausting inside the building, HEPA filtration with 99.97% collection efficiency for 0.3-micron size (or greater) particles shall be used.
- .3 When the particulate collection equipment is exhausting outside the building, mechanical cleaning operations shall be undertaken only with particulate collection equipment in place, including adequate filtration to contain debris removed from the HVAC system.
- .4 When the particulate collection equipment is exhausting outside the building, precautions shall be taken to locate the equipment down wind and away from all air intakes and other points of entry into the building.
- .5 Measures shall be employed to control odors and/or mist vapors during the cleaning process.
- .6 Upon completion, all components must be returned to those settings recorded just prior to cleaning operations.
- .7 Dampers and any air-directional mechanical devices inside the HVAC system must have their position marked prior to cleaning and, upon completion, must be restored to their marked position.
- .8 The contractor shall utilize service openings, as required for proper cleaning, at various points of the HVAC system for physical and mechanical entry, and inspection. Utilize existing service openings in the HVAC system where possible. Create new service openings in the system as necessary in order to accommodate cleaning of otherwise inaccessible areas. New openings created shall comply with Section 23 33 00 – Air Duct Accessories.
- .9 Cutting service openings into flexible duct is not permitted. Flexible duct shall be disconnected at the ends as needed for proper cleaning and inspection.

- .10 Clean all air distribution devices, air handling units, terminal units (VAV, Dual duct boxes, etc.), blowers and exhaust fans.
- .11 Clean supply return, and exhaust fans and blowers. Include blowers, fan housings, plenums (except ceiling supply and return plenums), scrolls, blades, or vanes, shafts, baffles, dampers and drive assemblies.
- .12 All visible surface contamination deposits shall be removed in accordance with NADCA Standards.
- .13 Assure that a suitable operating drainage system is in place prior to beginning wash down procedures.
- .14 Clean all coils and related components, including evaporator fins.
- .15 Replace air handler pre-filters on completion of cleaning. Advise the Owner if mid or final filters are requiring replacement.
- .16 Source Removal Cleaning Methods:
 - .1 It is the contractor's responsibility to select source removal methods that will render the HVAC system visibly clean and capable of passing cleaning verification methods and other specified tests, in accordance with all general requirements.
 - .2 No cleaning method, or combination of methods, shall be used which could potentially damage components of the HVAC system or negatively alter the integrity of the system.
 - .3 All methods used shall incorporate the use of vacuum collection devices that are operated continuously during cleaning. A vacuum device shall be connected to the downstream end of the section being cleaned through a predetermined opening. The vacuum collection device must be of sufficient power to render all areas being cleaned under negative pressure, such that containment of debris and the protection of the indoor environment are assured.
 - .4 All vacuum devices exhausting air inside the building shall be equipped with HEPA filters (minimum efficiency), including hand-held vacuums and wet-vacuums.
 - .5 All vacuum devices exhausting air outside the facility shall be equipped with particulate collection including adequate filtration to contain debris removed from the HVAC system. Such devices shall exhaust in a manner that will not allow contaminants to re-enter the facility. Release of debris outdoors must not violate any outdoor environmental standards, codes or regulations.
 - .6 All methods require mechanical agitation devices to dislodge debris adhered to interior HVAC system surfaces, such that debris may be safely conveyed to vacuum collection devices. Acceptable methods will include those, which will not potentially damage the integrity of the ductwork, nor damage porous surface materials such as liners inside the ductwork or system components.
- .17 Methods of Cleaning Glass Fibre Insulated Components
 - .1 Glass fibre thermal or acoustical insulation elements in equipment or ductwork shall be thoroughly cleaned with HEPA vacuuming equipment, while the HVAC system is under constant negative pressure, and not permitted to get wet.
 - .2 Cleaning methods used shall not cause damage to fibrous glass components and will render the system capable of passing cleaning verification tests as per the NADCA Standards.
- .18 Damaged Glass Fibre Material

- .1 If there is any evidence of damage, deterioration, delaminating, friable material, mold or fungus growth, or moisture such that fibrous glass materials cannot be restored by cleaning or resurfacing with an acceptable insulation repair coating, they shall be identified to the Consultant for replacement.
- .2 Replacement of damaged insulation is not covered by this Section.
- .19 Cleaning of coils
 - .1 Any cleaning method may be used which will render the coil visibly clean and capable of passing coil cleaning verification.
 - .2 Coil drain pans shall be subject to non-porous surfaces cleaning verification. The drain for the condensate drain pan shall be operational.
 - .3 Cleaning methods shall not cause any appreciable damage to, displacement of, inhibit heat transfer, or erosion of the coil surface or fins, and shall conform to coil manufacturer recommendations when available.
 - .4 Coils shall be thoroughly rinsed with clean water to remove any latent residues.
- .20 Antimicrobial Agents and Coatings
 - .1 Antimicrobial agents shall only be applied if active fungal growth is reasonably suspected, or where unacceptable levels of fungal contamination have been verified through testing.
 - .2 Application of any antimicrobial agents used to control the growth of fungal or bacteriological contaminants shall be performed after the removal of surface deposits and debris.
 - .3 When used, antimicrobial treatments and coatings shall be applied in strict accordance with the manufacturer's written recommendations.
 - .4 Coatings shall be sprayed directly onto interior ductwork surfaces, rather than "fogged" downstream onto surfaces.

3.3 Cleanliness Verification

- .1 Verification of HVAC System cleanliness will be determined after mechanical cleaning and before the application of any treatment or introduction of any treatment-related substance to the HVAC system, including biocidal agents and coatings.
- .2 The HVAC system shall be inspected using [robotic camera and other] [visual inspection methods] to ensure that no visible contaminants are present. If no contaminants are evident through visual inspection, the HVAC system shall be considered clean; however, the Consultant reserves the right to further verify system cleanliness through "Surface Comparison Testing" or the NADCA vacuum test specified in the NADCA standard ACR.
- .3 If visible contaminants are evident through visual inspection, those portions of the system where contaminants are visible shall be re-cleaned and subjected to re-inspection for cleanliness.
- .4 Verification of Coil Cleaning
 - .1 Cleaning must restore the coil pressure drop to within 10 percent of the pressure drop measured when the coil was first installed. If the original pressure drop is not known, the coil will be considered clean only if the coil is free of foreign matter and chemical residue, based on a thorough visual inspection.

3.4 Post Cleaning Inspection Report

- .1 Post Cleaning Inspection Report: submit [4] copies of Final Inspection Report, including data collected, observations and recommendations as well as following information:

- .1 Name and address of facility;
 - .2 Name and address of HVAC cleaning contractor;
 - .3 Description of HVAC systems with drawings or sketches identifying systems cleaned;
 - .4 Identification scheme for location points in systems that were inspected with accompanying notes describing methods of inspection or tests used;
 - .5 Identify systems tested, observations, actions taken and recommendations for future maintenance.
- .2 Submit verification of delivery of hazardous or toxic waste materials to contaminated waste facility.

END OF SECTION

1. GENERAL

1.1 Section Scope

- .1 This section provides a list of manufacturers that meet the performance specifications for this project. Alternative, equivalent materials will be considered if they meet performance criteria, established standards for operation, space, capacity and noise requirements.

1.2 Related Requirements

- .1 This section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
- .2 Section 21 05 01 – Common Work Results for Mechanical.

1.3 Submittals

- .1 Requests for alternate equivalent materials or equipment must be submitted to the Owner’s Consultant no later than seven (7) working days prior to the Mechanical trades’ closing tender date. Submit all applicable technical data, including performance curves and physical details for review. Approval of requests shall only be given by addendum.

1.4 General Requirements

- .1 The price submitted for this contract shall be based on the use of materials and equipment as specified or as contained within the Acceptable Manufacturers List.
- .2 Approved equivalents and/or alternatives to specified products shall be equal to the specified product in every respect, operate as intended, and meet the space, capacity, and noise requirements outlined.
- .3 The Contractor shall be fully responsible for any additional labour and materials required by any trades or other Contractors to accommodate the use of other than specified materials or equipment. The Contractor shall bear any and all costs for design/system modifications to accommodate the “alternate” equipment. Extras will not be approved to cover such work.

2. PRODUCTS

2.1 Approved Manufacturers

- .1 The following listed Manufacturers are approved for their ability to meet the general design intent, quality and performance characteristics of the specified product. The list does not endorse the acceptability of all products available from the listed Manufacturers/Suppliers.
- .2 It remains the responsibility of the Contractor to ensure the products supplied are equal to the specified products in every respect, operate as intended, and meet the performance specifications and physical dimensions of the specified product.
- .3 The contractor shall be fully responsible for any additional work or materials, to accommodate the use of equipment from the acceptable Manufacturers and Suppliers list.
- .4 Any manufacturers not included on the list of acceptable manufacturers must submit a formal request to be included on this list.
- .5 List of approved Manufacturers:

Type of Equipment	Approved Manufacturers	Unacceptable
Access Doors - Wall	Maxam, Acudor, Milcor, Can.Aqua, Mifab, Bilco, Baucoplus	
Access doors - drywall	Baucoplus	
Actuators	Belimo, Honeywell, Siemens	

Type of Equipment	Approved Manufacturers	Unacceptable
Air Outlets - Grilles, Registers, Diffusers	E.H. Price, Titus, Anemostat, Nailor, Krueger, Tuttle & Bailey, Trox, Nailor Industries	
Air Terminals - Supply grille	EH Price, Titus, Krueger	
Air Terminals - Supply Diffuser	Price SPD, EH Price, Titus, Krueger	
Air Terminals - Return grille	EH Price, Titus, Krueger	
Air Terminals - Door grille	EH Price, Titus, Krueger	
Air Terminals - Fixed Louvre	Airolite, EH Price	
Air Terminals - motorized louvre	Airolite, EH Price	
Balancing Agents (BC)	KD Engineering, MDT Systems, Western Mechanical Systems, Flotech Mechanical	
Baseboard Heaters (Hydronic)	Rosemex, Trane, Engineered Air, Slant Fin	
Carriers - Fixtures	Ancon, Zurn, Enpoco, Mifab	
Commissioning Agents	KD Engineering, Airmec, MDT Systems, Western Mechanical Services, Kane Consulting	
Controllers	QEL, MSA, CET, Vulcain	
Dampers - Backdraft	Airolite, Vent-Aire, Penn, T.A. Morrison, Ruskin	
Dampers - Balancing	Maxam, Ruskin	
Dampers - Control	Ruskin, Tamco	
Dampers - Fire	Controlled Air, Ruskin, Canadian Advanced Air, Maxam, Nailor	
Dampers - Motorized	Controlled Air, Nailor Industries, Ruskin, Maxam, Tamco, Alumavent	
Drains - Floor, Roof, Cleanouts Trap Primers, Water Hammer Arrestors	Zurn, Ancon, PPP, J.R. Smith, Wade, Enpoco, Mifab, Menzies	
Ductwork - Duct sealer	Foster 32-14, Hardcast Versa Grip, Hardcast Foil Grip 1402, United Duct Sealer, Trans Continental Multi-Purpose	
Ductwork - Access Doors	Nailor Industries, Ventlok	
Ductwork - Duct connectors - vibration	Dynair "Hypalon", Ventfabrics "Ventlon"	
Fans - Centrifugal	Greenheck, PennBarry, Loren Cook, Twin City, Buffalo, Trane, Chicago Blower, Barry Blower, Northern, Acme, Penn-Domex, Jenn-Air	
Fans - In-Line Centrifugal	Greenheck, PennBarry, Loren Cook, Twin City, Chicago Blower, Jenn Air, Ammerman, ILG, Delhi	
Firestopping	Hilti, 3M, Tremco, AD Firebarrier	
Flexible Ductwork	Flexaust, Flexmaster, Thermaflex, Wiremold, GI Industries	
Insulation - Thermal - Duct	Fibreglass Canada, Manson, Knauf, Johns Manville	
Insulation - Vapour Barrier Jacket Adhesive	Bakor, Epolux, Nacan, Foster, Childers	

Type of Equipment	Approved Manufacturers	Unacceptable
Insulation - Fabric adhesive, coatings	Robson, Bakelite, Childers, Epolux, Foster	
Insulation - Canvas jacket	Robson, Fattal, Tai-Can	
Insulation - PVC jacket	Speedline, Proto, Zeston, Sure-Fit, Belform, Proto	
Insulation - Undersink piping covers		
Louvres and Roof Hoods	Airolite, Penn, Airstream, West Vent, Nailor, Ruskin, CS Louvre (Exhaust Use Only), Alumavent	
Piping - Ductile iron grooved pipe	Victaulic	
Piping - Copper roll grooved pipe	Victaulic copper connection, Grinnell Gruvlok	
Piping - CPVC pipe and fittings	Ipex	
Piping - PP-R pipe and fittings	Aquatherm	
Piping - Insulation sheilds	Klo-Shure	
Piping – PEX	Wirsbo, Rehau, Uponor, Heatlink, Viega	
Plumbing Fixtures - Faucets	Crane, American Standard, Cambridge Brass, Waltec, Kohler, Symmons, Toto, Zurn, Delta, Chicgo Faucets, Mansfield, Elijer	
Plumbing Fixtures - Flush Valves	Sloan, Zurn, Crane, Chicago, Delta, Moen	
Plumbing Fixtures - Sinks - Stainless Steel	Franke/Kindred, American Standard, Elkay, AMI	
Plumbing Fixtures - Showers - Fixtures	Symmons, Acorn, Bradley	
Plumbing Fixtures - Thermostatic Mixing Valves	Symmons, Bradley, Powers, Lawler, Leonard, Watts, Zurn, Crane	
Plumbing Fixtures - Water Closets	Toto, American Standard, Kohler	
Plumbing Fixtures - Water Closets - Seats	Centoco, Bemis, Olsonite, Moldex, Beneke	
Plumbing Specialties - Air Vents	Watts, Bell & Gossett, Caleffi, Braukmann, Armstrong, Maid-O-Mist, Hoffman, Maid-O-Mist, Taco	
Plumbing Specialties – Cleanouts	Watts, Jay R. Smith, Zurn	
Plumbing Specialties - Drains – Floor	Jay R. Smith, Watts, Zurn	
Plumbing Specialties - Drains - Roof	Jay R. Smith, Watts, Zurn, Menzies	
Plumbing Specialties - Hose Bibbs/Wall Hydrants	Jay R. Smith, Watts, Zurn, Enpoco, Ancon, Jenkins, Dahl, Toyo, Kitz, Mifab, Woodford, Acorn, Crane	
Plumbing Specialties - Water Hammer Arrestors	Sioux Chief, Zurn, Watts	
Radiant Floor Heating System	Uponor, Rehau, Heat Link, Viega	Watts (PEX-B product)
Rainwater Harvesting	Green Turtle	

Type of Equipment	Approved Manufacturers	Unacceptable
Systems		
Sprinklers	Tyco, Reliable, Viking	
Terminal Units - Mixing, CV & VAV	E.H. Price, Titus, Trane, Nailor Industries, McQuay, Tuttle and Bailey, Kruegar	

3. EXECUTION

3.1 Post Tender Submission Requirement

- .1 Submit within 14 days of contract award a copy of the list underlining the name of the Manufacturer whose price was carried in the tender. If no Manufacturer's names are submitted, it will be assumed that the price carried in the tender was that of the specified Manufacturer or where the specified product is generic, the first acceptable Manufacturer listed for each item and equipment.

END OF SECTION

1. GENERAL

1.1 Section Scope

- .1 Materials and installation for hangers and supports for mechanical and plumbing piping, ducting and equipment.

1.2 Related Requirements

- .1 This section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
- .2 Section 21 05 01 – Common Work Results for Mechanical
- .3 Section 23 05 48 – Vibration and Seismic Control for HVAC.

1.3 References

- .1 The latest revisions of the following standards shall apply unless noted otherwise.
- .2 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)
 - .1 ANSI/ASME B31.1 – Power Piping.
- .3 ASTM International
 - .1 ASTM A125 – Standard Specification for Steel Springs, Helical, Heat-Treated.
 - .2 ASTM A307 – Standard Specification for Carbon Steel Bolts, Studs and Threaded Rod, 60,000 PSI Tensile Strength.
 - .3 ASTM A563 – Standard Specification for Carbon and Alloy Steel Nuts.
- .4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
 - .1 MSS SP58 – Pipe Hangers and Supports - Materials, Design and Manufacture.
- .5 Underwriter's Laboratories of Canada (ULC)

1.4 Submittals

- .1 Comply with Division 1 – Submission and Closeout Procedures, Section 21 05 01 Common Work Results for Mechanical – Submittals and additionally the following:
 - .1 Submit shop drawings for:
 - .1 Bases, hangers and supports.
 - .2 Connections to equipment and structure.
 - .3 Structural assemblies.
 - .2 Certificates:
 - .1 Submit certificates from the manufacturer certifying that materials comply with specified performance characteristics and physical properties of the listed Related Standards.
 - .3 Manufacturers' Instructions:
 - .1 Provide manufacturer's installation instructions.

1.5 General Requirements

- .1 Plumbing piping: to BC Plumbing Code

- .2 Fire protection: to applicable NFPA Standards.
- .3 Construct pipe hangers and supports to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
- .4 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP58.
- .5 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
- .6 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
- .7 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP58.
- .8 Provide hangers and supports to secure equipment in place, prevent vibration, protect against damage from earthquake, maintain grade, provide for expansion and contraction and accommodate insulation.
- .9 Support from (top of) structural members. Where structural bearings do not exist or inserts are not in suitable locations, suspend hangers from steel channels or angles. Provide supplementary structural members, as necessary.
- .10 Arrange and pay for the services of a BC registered professional engineer to provide all required engineering services necessary for the complete design, sizing and detailing of all anchors and anchor supports to structure required for the project.

2. PRODUCTS

2.1 Acceptable Manufacturers

- .1 Refer to Section 23 05 01 – Acceptable Manufacturers

2.2 General

- .1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP58.
- .2 Use components for intended design purpose only. Do not use for rigging or erection purposes.
- .3 Toggle hangers and/or strap hangers shall not be used.
- .4 Power actuated fasteners and “drop-in” anchors shall not be used for tension load applications such as pipe and duct hangers.

2.3 Pipe Hangers

- .1 Finishes:
 - .1 Pipe hangers and supports: galvanized.
 - .2 Ensure steel hangers in contact with copper piping are copper plated, epoxy coated or have a non-metallic sleeve coupling between the dissimilar metals.
- .2 Upper attachment structural: suspension from lower flange of I-Beam:
 - .1 Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.

- .2 Cold piping NPS 2½ or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed, FM approved to MSS-SP58.
- .3 Upper attachment structural: suspension from upper flange of I-Beam:
 - .1 Cold piping NPS 2 maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed, FM approved.
 - .2 Cold piping NPS 2 ½ or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut UL listed, FM approved.
- .4 Upper attachment to concrete:
 - .1 Ceiling: carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm (¹/₄") minimum greater than rod diameter.
 - .2 Concrete inserts: wedge shaped body with knockout protector plate UL listed, FM approved. Size inserts to suit threaded hanger rod diameter. Refer to "minimum rod diameter" table below.
- .5 Shop and field-fabricated assemblies:
 - .1 Trapeze hanger assemblies and steel brackets: to ASME B31.1 and MSS SP58.
 - .2 Sway braces for seismic restraint systems: to Section 23 05 49 - Seismic Restraint for HVAC Piping and Equipment.
- .6 Hanger rods: threaded rod material to MSS SP58:
 - .1 Minimum rod for fire suppression is 9 mm (³/₈") UL listed or 13 mm (½ inch) for FM approved.
 - .2 Ensure that hanger rods are subject to tensile loading only.
 - .3 Provide linkages where lateral or axial movement of pipework is anticipated.

Maximum Pipe Size NPS	Minimum Rod Diameter mm (in)	Maximum Rod Length mm (in)
up to 2	9 (3/8)	n/a
2-1/2 to 3	12 (1/2)	635 (25)
4 to 5	16 (5/8)	785 (31)
6	20 (3/4)	940 (37)
8 to 12	22 (7/8)	1090 (43)
14	25 (1)	1270 (50)
16	30 (1-1/4)	1575 (62)

- .4 Provide reinforcing hanger angle for rod lengths in excess of maximum length as scheduled by the Seismic Engineer. Refer to Section 23 05 48 – Vibration and Seismic Control for HVAC.
- .7 Pipe attachments: material to MSS SP58:
 - .1 Attachments for steel piping: carbon steel galvanized.
 - .2 Attachments for copper piping: copper plated black steel.
 - .3 Use insulation shields for hot pipework.
 - .4 Oversize pipe hangers and supports to accommodate insulation thickness and maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
- .8 Adjustable clevis: material UL listed and FM approved, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.

- .9 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll.
- .10 U-bolts: carbon steel with 2 nuts at each end to ASTM A563.
 - .1 Finishes for steel pipework: galvanized.
 - .2 Finishes for copper, glass, brass or aluminum pipework: galvanized with formed portion plastic coated or epoxy coated.
- .11 Pipe rollers: cast iron roll and roll stand with carbon steel rod.

2.4 Riser Clamps

- .1 Steel or cast iron pipe: galvanized carbon steel to MSS SP58, type 42, UL listed, FM approved.
- .2 Copper pipe: carbon steel copper plated to MSS SP58, type 42.
- .3 Bolts: to ASTM A307.
- .4 Nuts: to ASTM A563.

2.5 Insulation Protection Shields

- .1 Insulated cold piping:
 - .1 64 kg/m³ (4 lb/ft³) density insulation plus insulation protection shield, galvanized sheet carbon steel. Length designed for maximum 3 m (10 foot) span.
 - .2 Non-metallic support coupling, sized to suit standard and millimeter pipe O.D. UL listed, meeting 25/50 flame and smoke spread ratings. Supplied with hanger and/or strut mount as a complete support assembly.
- .2 Insulated hot piping:
 - .1 Curved plate 300 mm (12 inch) long, with edges turned up, welded-in centre plate for pipe sizes NPS 300 mm (12 inch) and over.
 - .2 For piping to 60°C (140°F) Non-metallic support coupling, sized to suit standard and millimeter pipe O.D. UL listed, meeting 25/50 flame and smoke spread ratings. Supplied with hanger and/or strut mount as a complete support assembly.

2.6 Constant Support Spring Hangers

- .1 Springs: alloy steel to ASTM A125, shot peened, magnetic particle inspected, with +/-5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with Certified Mill Test Report (CMTR).
- .2 Load adjustability: 10 % minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.
- .3 Provide upper and lower factory set travel stops.
- .4 Provide load adjustment scale for field adjustments.
- .5 Total travel to be actual travel + 20%. Difference between total travel and actual travel 25 mm (1") minimum.
- .6 Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.

2.7 Variable Support Spring Hangers

- .1 Vertical movement: 13 mm (½") minimum, 50 mm (2") maximum, use single spring pre-compressed variable spring hangers.

- .2 Vertical movement greater than 50 mm (2"): use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.
- .3 Variable spring hanger complete with factory calibrated travel stops. Provide certificate of calibration for each hanger.
- .4 Steel alloy springs: to ASTM A125, shot peened, magnetic particle inspected, with +/-5 % spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR

2.8 Equipment Supports

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of Division 5. Submit calculations with shop drawings.

2.9 Equipment Anchor Bolts and Templates

- .1 Provide templates to ensure accurate location of anchor bolts.

2.10 Other Equipment Supports

- .1 Fabricate equipment supports from structural grade steel meeting requirements of Division 5.
- .2 Submit structural calculations with shop drawings.

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 manufacturer's instructions and recommendations.
- .2 Vibration Control Devices:
 - .1 Install on piping systems at pumps, boilers, chillers, cooling towers, and as indicated.
- .3 Clamps on riser piping:
 - .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
 - .2 Bolt-tightening torques to industry standards.
 - .3 Steel pipes: install below coupling or shear lugs welded to pipe.
 - .4 Cast iron pipes: install below joint.
- .4 Clevis plates:
 - .1 Attach to concrete with 4 minimum concrete inserts, one at each corner.
- .5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.
- .6 Use approved constant support type hangers where:
 - .1 Vertical movement of pipework is 13 mm (½") or more,
 - .2 Transfer of load to adjacent hangers or connected equipment is not permitted.
- .7 Use variable support spring hangers where:

- .1 Transfer of load to adjacent piping or to connected equipment is not critical.
- .2 Variation in supporting effect does not exceed 25 % of total load.

3.3 Hanger Spacing

- .1 Flexible joint roll groove pipe: in accordance with table below, but not less than one hanger at joints.
- .2 Within 300 mm (12") of each elbow.

Maximum Pipe Size NPS	Maximum Spacing Steel m (ft)	Maximum Spacing Copper m (ft)	Minimum Rod Dia mm (in)
up to 1/2	1.8 (6)	1.5 (5)	9 (3/8)
3/4, 1, 1-1/4	2.4 (8)	1.8 (6)	9 (3/8)
1-1/2, 2	3.0 (10)	2.4 (8)	9 (3/8)
2-1/2, 3, 4	3.7 (12)	3.0 (10)	12 (1/2)
5, 6, 8	4.3 (14)		16 (5/8)
10, 12	4.9 (16)		

- .3 Install PEX-a pipe support vertically or horizontally for plenum and non-plenum applications or support PEX pipe at 900 mm (36") intervals with manufactured hanger fittings regardless of size. PEX installed with PEX-a pipe support shall follow the manufacturers pipe support recommendations for hanger spacing
- .4 For other plastic piping, provide supports at intervals recommended by manufacturer.

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.
- .4 Do not support from metal deck.
- .5 Install hangers to provide minimum 13 mm (1/2") space between finished covering and adjacent work.
- .6 Support vertical piping at every other floor.
- .7 Where several pipes can be installed in parallel and at the same elevation, provide multiple or trapeze hangers.
- .8 Support riser piping independently of connected horizontal piping.
- .9 Install plastic inserts between steel studs and piping.
- .10 Provide insulation protection saddles on all insulated piping.

3.5 Horizontal Movement

- .1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.
- .2 Where horizontal pipe movement is less than 13 mm (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.
- .2 Adjustable clevis:
 - .1 Tighten hanger load nut securely to ensure proper hanger performance.
 - .2 Tighten upper nut after adjustment.
- .3 C-clamps:
 - .1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.
- .4 Beam clamps:
 - .1 Hammer jaw firmly against underside of beam.

3.7 Inserts

- .1 Install in accordance with manufacturer's recommendations.
- .2 Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams wherever practical.
- .3 Set inserts in position in advance of concrete work. Use grid system in equipment rooms.
- .4 Provide reinforcement rod in concrete for inserts carrying piping over 100 mm (4") or ducts over 1500 mm (60") wide.
- .5 Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

END OF SECTION

1. GENERAL

1.1 Section Scope

- .1 The work in this section includes, but is not limited to the following:
 - .1 Vibration isolation for piping, ductwork and equipment.
 - .2 Equipment isolation bases.
 - .3 Flexible piping connections.
 - .4 Seismic restraints for isolated equipment.
 - .5 Seismic restraints for non-isolated equipment.
 - .6 Certification of seismic restraint designs and installation supervision.
 - .7 Certification of seismic attachment of housekeeping pads.

1.2 Related Requirements

- .1 This section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
- .2 Section 21 05 01 – Common Work Results for Mechanical.

1.3 References

- .1 The latest revisions of the following standards shall apply unless noted otherwise.
- .2 National Fire Protection Association (NFPA):
 - .1 NFPA 13-[2007] – Standard for the Installation of Sprinkler Systems.
- .3 Sheet Metal and Air Conditioning Contractors National Association (SMACNA):
 - .1 SMACNA – Seismic Restraint Manual Guidelines for Mechanical Systems.
- .4 American Society of Heating, Refrigeration and Air Conditioning Engineers ASHRAE):
 - .1 ASHRAE HVAC Applications Handbook (Seismic Design Chapter 54).
- .5 Federal Emergency Management Agency (FEMA):
 - .1 FEMA – Installing Seismic Restraints for Mechanical Equipment.
- .6 Vibration Isolation and Seismic Control Manufacturers Association (VISCMA):
 - .1 VISCMA – Installing Seismic Restraints for Mechanical Equipment.

1.4 Submittals

- .1 Comply with Division 1 – Submission and Closeout Procedures, Section 21 05 01 Common Work Results for Mechanical – Submittals and additionally the following:
 - .1 Consultant Assurance of Professional Design and Commitment for Field Review Schedule B and Assurance of Professional Field Review and Compliance Schedule C-B for seismic engineering.
 - .2 Shop drawings: submit drawings for vibration control stamped and signed by a Professional Engineer.
 - .3 Shop drawings: submit drawings for seismic control stamped and signed by a Professional Engineer registered or licensed in Province of British Columbia.
 - .4 Provide separate shop drawings for each isolated system complete with performance and product data.

1.5 General Requirements

- .1 All mechanical equipment, piping and ductwork as noted on the equipment schedule or in the specification shall be mounted on vibration isolators to prevent the transmission of vibration and mechanically transmitted sound to the building structure. Vibration isolators shall be selected in accordance with the weight distribution so as to produce reasonably uniform deflections.
- .2 Provide seismic restraints for all required equipment, piping and ductwork.
- .3 Responsibilities:
 - .1 The Contractor shall retain the services of a qualified professional seismic engineer (Seismic Engineer) registered in the Province of British Columbia. The Seismic Engineer shall design and review the installation of all seismic restraints as well as mechanical equipment and mechanical system supports. The restraints and supports shall be specifically designed to fasten to the structure indicated in the contract documents and installed in the field. The complete design for these systems shall comply with all applicable building code requirements.
 - .2 Seismic Engineer shall provide and submit to the Owner's Consultant Assurance of Professional Design and Commitment for Field Review Schedule B and Assurance of Professional Field Review and Compliance Schedule C-B for seismic engineering.
 - .3 Manufacturer of vibration isolation and seismic control equipment shall have the following responsibilities:
 - .1 Determine vibration isolation and seismic restraint sizes and locations.
 - .2 Provide vibration isolation and seismic restraints as scheduled or specified.
 - .3 Provide calculations and materials if required for restraint of non-isolated equipment.
 - .4 Provide installation instructions, drawings and trained field supervision to insure proper installation and performance.
- .4 All isolators and isolation materials shall be of the same manufacturer and shall be certified by the manufacturer.
- .5 It is the intent of the seismic portion of this specification to keep all mechanical and electrical building system components in place during a seismic event.
- .6 All such systems must be installed in strict accordance with seismic codes, component manufacturer's and building construction standards. Whenever a conflict occurs between the standards, the most stringent shall apply.
- .7 Seismic restraints shall be designed in accordance with seismic force levels as indicated in the Building Code for the specific region of the project.
- .8 All elastomeric components in isolation pads, mounts, and seismic snubbers shall be bridge bearing neoprene, meeting CSA Standard CAN3-S6 Section 11.10.
- .9 Provide an acceptable means of corrosion protection for all equipment, attachments and accessories supplied under this section, suitable for the conditions in which this equipment, etc. will be installed.
- .10 Bolt all equipment to the structure. Do not bridge isolation elements.
- .11 Use ductile materials in all vibration isolation equipment.
- .12 Motor Drive Equipment:
 - .1 Provide vibration isolation on all motor driven fans regardless of power rating and all other motor driven equipment over 0.35 kW (0.5 HP) (as indicated on the motor nameplate), and on piping and ductwork specified herein.

- .2 For fans less than 0.35 kW (0.5 HP), provide isolation with neoprene grommets at the support points. Select isolators for a minimum static deflection of 3mm.
 - .3 Fire pumps and jockey pumps driven by electric motors are excluded.
 - .4 Provide horizontal limit springs on all fans (except vertical discharge) having a static pressure in excess of 1.0 kPa static pressure, and on hanger supported, horizontally mounted axial fans with more than 330 N thrust due to static pressure. The springs shall limit the movement of flexible duct connections to 25% of the fabric width under steady state conditions and to 40% at start-up.
- .13 Isolators:
- .1 Provide neoprene isolators for deflections 6mm ($\frac{1}{4}$ ") and under.
 - .2 Provide either neoprene or steel spring isolators for deflections between 6mm and 12mm ($\frac{1}{2}$ ").
 - .3 Provide steel spring isolators for deflections of 12mm ($\frac{1}{2}$ ") and over.
 - .4 Provide adjustable limit stops for spring isolation mounts on equipment with operating weights substantially different from the installed weights.
 - .5 All spring isolators shall be "open spring" unless otherwise stated. Seismically rated housed spring isolators may be used in lieu provided that they meet this project's requirements for seismic restraint.
 - .6 Isolators and bases which are factory supplied with equipment shall meet the requirements of this section. Where internal isolation is provided, the isolation requirements specified in the minimum static deflection table apply to all separate vibration sources in the unit. Where internal vibration isolation is not provided, the unit frame shall be rigid enough such that the isolators can be attached directly without additional stiffening.
 - .7 Space isolators under equipment so that the minimum distance between adjacent corner isolators is at least equal to the height of the center of gravity of the equipment. Include height of center of gravity on shop drawings. Otherwise, provide suitable horizontal restraint isolators.
 - .8 Select isolators in accordance with equipment weight distribution to allow for an average deflection meeting or exceeding the specified deflection requirements and so that no isolator has a deflection less than 80% of the static deflection specified. A minimum of 4 isolators are required for each piece of equipment, unless specified otherwise. Number and colour code each isolator to show location. Mark code number and colour on shop drawings, on each isolator and on each base to ensure proper placement. Clearly tag all springs to show undeflected height and static deflection.
 - .9 Refer to the minimum static deflection table contained in this Section.
- .14 Ducting:
- .1 Install flexible duct connectors on all ductwork connected to isolated equipment.
- .15 Piping Hangers:
- .1 Provide resilient hangers on all piping, etc., rigidly connected to vibration isolated equipment. Provide the hangers for a distance of 3.0m (9.75') for a 1 NPS pipe and 13.5m (44') for a 10 NPS pipe. Isolate other pipe sizes for a proportionate distance (both interpolation and extrapolation may be required). Select the three closest hangers to the vibration source for the lesser of 25mm (1") static deflection or the static deflection of the isolated equipment. Select the remaining isolators for the lesser of 25mm (1") static deflection or one-half the static deflection of the isolated equipment.

- .2 Where resilient hangers cannot be provided for piping rigidly connected to vibration isolated equipment (such as a rigid fire-stop falling within the required isolation distance), provide flexible connectors. One end of each flexible connector shall be installed directly to a flange of the isolated equipment (between the equipment and isolation valves) unless otherwise indicated on the drawings.
- .16 Electrical Connections:
 - .1 Coordinate with the Division 26 to ensure all electrical connections to vibration isolated equipment is made with flexible conduit or other flexible means and does not restrict the maximum anticipated movement.

2. PRODUCTS

2.1 General

- .1 Isolation, anchors, bolts, bases, restraints, etc., are to be designed to withstand without failure or yielding, the dynamic G load as specified in Code for the seismic zone in which building is located. Design loads are ultimate limit state loads (1.5 times working load) acting through the centre of gravity of the anchored or restrained equipment. "Fail Safe" designs are acceptable.
- .2 For both isolated and non-isolated floor mounted equipment, i.e. tanks, heat exchangers, boilers, etc., design and provide anchors and bolts to withstand, without failure or yielding, a dynamic ultimate limit state load as defined in Code, of the greater of 0.3 g or as required by Code, applied horizontally through the centre of gravity.
- .3 Where impact forces may be significant, use ductile materials.
- .4 Seismic restraining devices factory supplied with equipment are to meet requirements of this Section.

2.2 Acceptable Manufacturers

- .1 Refer to Section 23 05 01 – Acceptable Manufacturers.

2.3 Neoprene Washer/Bushing

- .1 A one piece molded bridge bearing neoprene washer/bushing. The bushing shall surround the anchor bolt and have a flat washer face to avoid metal to metal contact.
- .2 Use washer/bushing only on light-weight equipment.

2.4 Neoprene Pad Isolators

- .1 Neoprene or neoprene / steel / neoprene pad isolators.
- .2 Minimum static deflection 2.5 mm (0.1") or greater.
- .3 Use hold down bolts selected for seismic loads. Isolate bolts from base of unit using neoprene washer/bushing.
- .4 Size bolt and washer/bushing for minimum lateral clearance.

2.5 Spring Hangers

- .1 Hangers shall consist of rigid steel frames containing minimum 32mm (1 1/4") thick neoprene elements at the top and a steel spring seated in a steel washer reinforced neoprene cup on the bottom. The neoprene element and the cup shall have neoprene bushings projecting through the steel box.
- .2 Provide a combination rubber and steel rebound washer as the seismic up stop for suspended piping, ductwork and equipment. Rubber thickness shall be a minimum of 6mm (1/4").

- .3 To maintain stability the boxes shall not be articulated as clevis hangers nor the neoprene element stacked on top of the spring.
- .4 Colour coded springs, rust resistant, painted box type hangers.

2.6 Neoprene Hanger Isolators

- .1 Neoprene double deflection rod isolators with steel housing and hanger rod bushing, selected for a minimum 4 mm (0.15") static deflection unless otherwise specified.

2.7 Anchor Bolts

- .1 Equal to Mason Industries type SAB seismic anchor bolts.

2.8 Flexible Piping Connections

- .1 Flexible piping connectors are to be supplied with seismic restraint materials. Where flexible connections are not specified with piping in other Sections they are to be equal to Mason Industries twin sphere, non-metallic connectors with hose lengths pre-set in strict accordance with manufacturer's instructions and to approval of Seismic Consultant, each rated for continuous operation at 1725 kPa at 87.7°C (250 psi at 190°F) or 1380 kPa at 121°C (200 psi at 250°F), and complete with:
 - .1 Nylon tire cord reinforced EPDM body;
 - .2 Ductile iron reinforcing ring and ductile iron screwed or flanged connections as required and to suit piping system operating pressure.

2.9 Flexible Duct Connectors

- .1 Flexible duct connectors of Durodyne with Durolon fabric or approved equal.
- .2 Provide 75 mm (3") flexible duct connectors and a 40 mm (1½") metal to metal gap.
- .3 Provide stabilizing springs limiting movement at flexible connections to 25% of fabric width under steady state conditions and 40% at start up.
- .4 Flexible duct connections shall be installed so that duct size is not reduced by the deflection of the flexible connector.

2.10 Seismic Cable Restraints

- .1 Galvanized steel aircraft cables sized to resist seismic loads with a minimum safety factor of two and arranged to provide all-directional restraint.
- .2 Cables must be pre-stretched to achieve a certified minimum modulus of elasticity. Cable end connections shall be steel assemblies that swivel to final installation angle and utilize two clamping bolts to provide proper cable engagement.
- .3 Cables must not be allowed to bend across sharp edges.
- .4 Cable assemblies shall suit installation type:
 - .1 Ceiling and at the clevis bolt.
 - .2 Between the hanger rod nut and the clevis.
 - .3 Clamped to a beam.

3. EXECUTION

3.1 General

- .1 All vibration isolators and seismic restraint systems must be installed in strict accordance with the manufacturers written instructions and all certified submittal data.

- .2 Brace in-line equipment independently of ducts and pipes.
- .3 Do not mix solid and cable bracing.
- .4 All runs to have a minimum of two transverse and one longitudinal brace. A run is defined as any change in direction except offsets.
- .5 Following Mechanical Components Restraint Guide is to be used as a general guide only to establish appropriate restraint methods, hardware, and attachments, however, due to differences in construction, size, weight, and configuration of different manufacturer's equipment and variety of ways and means that equipment and components can be installed, specific restraint methods are to be confirmed in the field. Seismic restraint materials and methods are to be reviewed and approved by Seismic Consultant

MECHANICAL COMPONENT RESTRAINT GUIDE

ITEM	TYPE OF RESTRAINT	MINIMUM NO. OF RESTRAINTS	NOTES
Unit Heaters	TSR-SCR	4	
Force Flow Heaters	TSR-SCR	4	
Fans – Suspended			
- Isolated	SCR	4	
- Non-Isolated	SCR	4	
Grilles, Registers, Diffusers	SCR	4	Where not bolted to duct (i.e. in tee-bar ceilings)
Piping	SCR TSR	As required	As per Specification
Ductwork	SCR TSR	As required	As per Specification

LEGEND	
SCR	Slack cable restraint (bolted to structure)
SNBR	Seismic snubber (bolted to structure)
TSR	Threaded support rod (bolted or clamped to structure)
BTSLPR	Bolt to sleeper (sleeper bolted to structure)
BTHP	Bolt to concrete housekeeping pad (pad to be keyed to structure)
CSSB	Custom steel shoe base (bolted to structure)
BTRC	Bolt to roof curb (roof curb bolted to roof structure)

- .6 Seismic restrain all piping as follows:
 - .1 Seismically restrain all piping as follows:
 - .1 Fuel oil piping, gas piping, medical gas piping, and compressed air piping that is 1 NPS or larger.
 - .2 Piping located in boiler rooms, mechanical equipment rooms, and refrigeration equipment rooms that is 1 ¼ NPS and larger.
 - .3 All other piping 2 ½ NPS and larger.
 - .2 Provide transverse piping restraints at 12m (40') maximum spacing for all pipe sizes, except where lesser spacing is required to limit anchorage loads.
 - .3 Provide longitudinal restraints shall be at 24m (80') maximum spacing for all pipe sizes, except where lesser spacing is required to limit anchorage loads.
 - .4 Hold down clamps must be used to attach pipe to all trapeze members before applying restraints in a manner similar to clevis supports.
- .7 Seismically restrain all ductwork as follows:

- .1 Restrain all ductwork and duct mounted equipment.
- .2 Transverse restraints shall occur at 9m (30') intervals or at both ends of the duct run if less than the specified interval. Transverse restraints shall be installed at each duct turn and at each end of a duct run.
- .3 Longitudinal restraints shall occur at 18m (60') intervals with at least one restraint per duct run.
- .4 The ductwork must be reinforced at the restraint locations. Reinforcement shall consist of an additional angle on top of the ductwork that is attached to the support hanger rods. Ductwork is to be attached to both upper angle and lower trapeze.
- .5 A group of ducts may be combined in a larger frame so that the combined weights and dimensions of the ducts are less than or equal to the maximum weight and dimensions of the duct for which bracing details are selected.
- .6 Walls, including gypsum board non-bearing partitions, which have ducts running through them, may replace a typical transverse brace. Provide channel framing around ducts and solid blocking between the duct and frame.
- .8 Unless otherwise specified, vibration isolation products are to be product of one manufacturer.
- .9 Ensure vibration isolation manufacturer coordinates material selections with equipment provided in order to ensure adherence to performance criteria. Allow for expansion and contraction when material is selected and installed.
- .10 Isolate piping larger than 25 mm (1") dia. directly connected to motorized and/or vibration isolated equipment with 25 mm (1") static deflection spring hangers at spacing intervals in accordance with following:
 - .1 For pipe less than or equal to 100 mm (4") dia. – first 3 points of support;
- .8 First point of isolated piping support is to have a static deflection of twice the deflection of the isolated equipment but maximum 50 mm (2").
- .9 Provide hot dipped galvanized housings and neoprene coated springs, or other acceptable weather protection, for all isolation equipment located outdoors or in areas of high moisture which may cause corrosion.
- .10 Provide a minimum clearance of 50mm (2") to other structures, piping, equipment, etc., for all equipment mounted on vibration isolators.
- .11 Before bolting isolators to the structure, start equipment and balance the systems so that the isolators can be adjusted to the correct operating position before installing drilled inserts.
- .12 When spring isolators are used for equipment with operating weights substantially different from installed weights, block the equipment with temporary shims to the final heights prior to making piping connections. When full load is applied, adjust the isolators to take up the load just enough to allow shim removal.
- .13 After installation and adjustment of isolators, verify deflection under load to ensure loading is within specified range.
- .14 Where hold-down bolts for isolators or attachments penetrate roofing membranes, coordinate with Division 7 and with roofing contractor.
- .15 For all pump installations, ensure that pumps are installed and aligned such that no piping loads are imposed on the pump. Pumps and piping should be independently supported and aligned prior to final connection.

- .16 Where isolated piping connected to noise generating equipment is routed from the mechanical room through plumbing chases or other openings, position isolated piping to avoid contact with the structure, framing, gypsum wallboard and other elements which may radiate noise.
- .17 Ensure that the installed seismic restraints do not adversely affect the proper functioning of any vibration isolation products required by this section.
- .18 All fire protection piping shall be braced in accordance with NFPA 13 and 14.

3.2 Neoprene Washer/Bushing

- .1 Isolate variable frequency drive controller using neoprene washer/bushing isolators or soft grommets such that structure borne noise transmission to occupied space is less than airborne noise transmission.

3.3 Spring Hangers

- .1 Locate isolation hangers as near to the overhead support structure as possible.
- .2 Installation shall permit hanger box or rod to move through a 30 degrees arc without metal to metal contact.
- .3 All discharge ductwork runs for a distance of 15m (50') from the connected equipment shall be isolated from the building structure by means of spring hangers. Spring deflection shall be a minimum of 19mm (0.75").

3.4 Seismic Snubbers

- .1 Neoprene bushings shall be rotated to insure no short circuits exist before systems are activated.

3.5 Closed Cell Foam Gaskets

- .1 Select width for nominal 21kPa (3psi) loading under weight of equipment and allow for 25% compression 5mm (³/₁₆").
- .2 Increase width of curb using steel shim if necessary to accommodate gasket.
- .3 For light equipment such as exhaust fans, deflection should be a minimum of 1mm (0.05").

3.6 Seismic Cable Restraints

- .1 Cable restraints shall be installed slightly slack to avoid short circuiting the isolated suspended equipment, piping or conduit.
- .2 Cable assemblies are installed taut on non-isolated systems
- .3 Where cable restraints are installed on support rods with spring isolators, the spring isolation hangers must be specification type.

3.7 Flexible Piping Connectors

- .1 Supply flexible piping connectors for connections (including plumbing) to seismically restrained equipment. Hand connectors to appropriate piping trade at site for installation.

3.8 Flexible Duct Connectors

- .1 Install flexible duct connectors so that duct cross-section is not reduced by the deflection of the flexible connector.

3.9 Field Quality Control

- .1 Seismic Engineer:

- .1 The Seismic Engineer shall perform all field services as required to fulfil the Building Code obligation for the provision of the Assurance of Professional Field Review and Compliance Schedule C-B for seismic engineering.
 - .2 Submit concise field reports to the Consultant within 3 days of each site review.
 - .3 Make adjustments and corrections in accordance with written report.
- .2 Manufacturer's Field Services:
- .1 Arrange with manufacturer's representative to review work of this Section and submit written reports to verify compliance with Contract Documents.
 - .2 Manufacturer's Field Services: consisting of product use recommendations and periodic site visits to review installation, scheduled as follows:
 - .1 Twice during the installation, at [25] % and [60] % completion stages.
 - .2 Upon completion of installation.
 - .3 Submit a concise manufacturer's report to the Consultant within 3 days of manufacturer representative's review.
 - .4 Make adjustments and corrections in accordance with written report.

END OF SECTION

1. GENERAL

1.1 Section Scope

- .1 Materials and installation for the identification of all mechanical piping, ducting, equipment and controls.

1.2 Related Requirements

- .1 This section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
- .2 Section 21 05 01 – Common Work Results for Mechanical.

1.3 References

- .1 The latest revisions of the following standards shall apply unless noted otherwise.
- .2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-1.60 – Interior Alkyd Gloss Enamel.
 - .2 CAN/CGSB-24.3 – Identification of Piping Systems.
- .3 National Fire Protection Association (NFPA):
 - .1 NFPA 13 – Standard for the Installation of Sprinkler Systems.

1.4 Submittals

- .1 Comply with Division 1 – Submission and Closeout Procedures, Section 21 05 01 Common Work Results for Mechanical – Submittals and additionally the following:
 - .1 Submit data on all materials.

1.5 General Requirements

- .1 Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.
- .2 Identify each system and system component according to the nomenclature used on the drawings and specifications. Identification to be consistent throughout the project.
- .3 When identifying systems and components in existing buildings, the new items shall be numbered sequentially with existing systems. Where possible include the zone or building area serviced by each system.
- .4 Submit list of system and component labels to be Consultant for review prior to engraving

2. PRODUCTS

2.1 Acceptable Manufacturers

- .1 Refer to Section 23 05 01 – Acceptable Manufacturers.

2.2 Piping Systems Governed by Codes

- .1 Any piping that is governed by CSA/NFPA or any other applicable code as addressed in contract documents, is to comply with those applicable codes concerning identification.

2.3 Manufacturer's Equipment Nameplates

- .1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.

- .2 Lettering and numbers raised or recessed.
- .3 Information to include, as appropriate:
 - .1 Equipment: manufacturer's name, model, size, serial number, capacity.
 - .2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.4 System Equipment Nameplates

- .1 Each piece of equipment shall be identified with its equipment schedule identification, e.g. supply fan SF-1, cooling coil CC-1, pump P-1.
 - .1 Coordinate equipment with drawings and with owner's requirements
- .2 Colours:
 - .1 Hazardous: red letters, white background.
 - .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).
- .3 Construction:
 - .1 3 mm ($\frac{1}{8}$ ") thick laminated plastic or white anodized aluminum, matte finish, with square corners, letters accurately aligned and machine engraved into core.
- .4 Sizes:
 - .1 Conform to following table:

Size No.	Size (mm)	No. of Lines	Height of Letters (mm)
1	10 x 50	1	3
2	13 x 75	1	5
3	13 x 75	2	3
4	20 x 100	1	8
5	20 x 100	2	5
6	20 x 200	1	8
7	25 x 125	1	12
8	25 x 125	2	8
9	35 x 200	1	20

- .2 Use maximum of 25 letters/numbers per line.
- .5 Locations:
 - .1 Terminal cabinets, control panels: use size # 5.
 - .2 Equipment in Mechanical Rooms: use size # 9.

2.5 Piping Systems Identification

- .1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.
- .2 Medical Gas Pipeline Systems:
 - .1 All medical gas pipelines shall have a permanent label at intervals of 6.0 m [20 ft.], immediately before and after barriers, at each valve, and behind access doors and inlet and outlet points.
 - .2 Lettering colour, background colour, lettering height and gas or gas mixture symbol shall be in accordance with CAN/CSA Z7396.1 Medical Gas Pipeline Systems – Part 1.
- .3 Pictograms:

- .1 Where required by Workplace Hazardous Materials Information System (WHMIS) regulations.
- .4 Arrows showing direction of flow:
 - .1 Outside diameter of pipe or insulation less than 75mm (3"): 100mm long x 50mm high (4" x 2").
 - .2 Outside diameter of pipe or insulation 75mm (3") and greater: 150mm long x 50mm high (6" x 2").
 - .3 Use double-headed arrows where flow is reversible.
- .5 Extent of background colour marking:
 - .1 To full circumference of pipe or insulation.
 - .2 Length to accommodate pictogram, full length of legend and arrows.
- .6 Materials for background colour marking, legend, arrows:
 - .1 Pipes and tubing 20mm (³/₄") and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.
 - .2 Other pipes: pressure sensitive plastic-coated cloth or vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150°C (302°F) and intermittent temperature of 200°C (392°F).
- .7 Colours and Legends:
 - .1 Where not listed, obtain direction from the Consultant.
 - .2 Colours for legends, arrows: to following table:

Background Colour	Legend, Arrows
Yellow	BLACK
Green	WHITE
Red	WHITE
Blue	WHITE

- .3 Background colour marking and legends for piping systems:

- .2 Valves on steam trap stations.
- .3 Plumbing fixture stops or hose bibbs.
- .4 System drain valves.
- .5 Provide a valve tag schedule. Include in the identification of each tagged item, valve type, service, function, normal position and location of tagged item.
- .6 Provide a flow diagram for each system, reference applicable charts and schedules.

2.7 Ductwork Systems Identification

- .1 50mm ($\frac{1}{2}$ ") high stencilled letters and directional arrows 150mm long x 50mm high (6" x 2").
- .2 Colours: back, or co-ordinated with base colour to ensure strong contrast.

2.8 Ductwork Access Identification

- .1 Secure 50 mm (2") high, self-adhesive stick on-letters, on duct access panels to identify their usage, according to the following:
 - .1 Cleaning and service access, colour black, tag "C.A"
 - .2 Controls including sensors, colour black, tag "C"
 - .3 Backdraft dampers, balance dampers and control dampers, colour black, tag "D"
 - .4 Fire dampers, colour red, tag "F.D."
 - .5 Smoke dampers and duct smoke detectors, colour red, tag "S.D."

2.9 Controls Components Identification

- .1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section. Include: sensors, transmitters, BMS controlled valve and damper actuators, end-devices, distributed control panels (DCP)'s, application specific controllers (ASC)'s and field panels.
- .2 Inscriptions to include function and (where appropriate) fail safe position.
- .3 Provide warning notices on all Distributed Control Panel doors indicating that hand held radio transmitters are not to be keyed within 3 meters or the DCP.

2.10 Ceiling Access Identification

- .1 Provide 6 mm ($\frac{1}{4}$ ") self adhesive coloured dots to the T-bar framing, adjacent to panel to be removed or to access doors in solid ceilings. Identify the location of equipment concealed above as follows:
 - .1 **Yellow** - Concealed equipment and cleaning access.
 - .2 **Black** - Control equipment, including control valves, dampers and sensors.
 - .3 **Red** - Fire and smoke dampers, fire protection equipment and fire system drains.
 - .4 **Green** – Heating water, chilled water, domestic cold water, domestic hot water isolation valves.

3. EXECUTION

3.1 General

- .1 Provide identification only after painting has been completed.
- .2 Perform work in accordance with CAN/CGSB-24.3 Identification of Piping Systems except as specified otherwise.

- .3 Provide ULC and/or CSA registration plates as required by respective agency.

3.2 Nameplates

- .1 Location shall be in conspicuous location to facilitate easy reading and identification from operating floor.
- .2 Provide standoffs for nameplates on hot and/or insulated surfaces.
- .3 Do not paint, insulate or cover nameplate data.

3.3 Location of Identification on Piping and Ductwork Systems

- .1 Provide on long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 17m (55') intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
- .2 Provide adjacent to each change in direction.
- .3 Provide at least once in each small room through which piping or ductwork passes.
- .4 Provide on both sides of visual obstruction or where run is difficult to follow.
- .5 Provide on both sides of separations such as walls, floors, partitions.
- .6 Provide where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.
- .7 Provide at beginning and end points of each run and at each piece of equipment in run.
- .8 Provide at point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.
- .9 Identification shall be easily and accurately readable from usual operating areas and from access points. Position the identification approximately at right angles to the most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.4 Valves, Controllers Identification

- .1 Provide identification on valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve.
- .2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass located in the main mechanical room. Provide one copy in each operating and maintenance manual.
- .3 Number valves in each system consecutively.
 - .1 Identification coding is to start with a utility description followed by a maximum of three numerals:
 - .2 Domestic Water DW-1, DW-2, DW-3...
 - .3 Natural Gas G-1, G-2, G-3...
 - .4 HVAC to be numbered H-1, H-2, H-3...

END OF SECTION

1. GENERAL

1.1 Section Scope

- .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 and document results.

1.2 Related Requirements

- .1 This section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
- .2 Section 21 05 01 – Common Work Results for Mechanical.
- .3 Section 23 08 00 – Commissioning for HVAC.

1.3 References

- .1 The latest revisions of the following standards shall apply unless noted otherwise.
- .2 Associated Air Balance Council (AABC)
 - .1 National Standards for Total System Balance, MN-1.
- .3 National Environmental Balancing Bureau (NEBB)
 - .1 Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems.
- .4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
 - .1 HVAC Systems – Testing, Adjusting and Balancing.
- .5 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
 - .1 ASHRAE 62.1 – Ventilation for Acceptable Indoor Air Quality.
 - .2 ASHRAE 62.2 – Ventilation for Acceptable Indoor Air Quality in Low Rise Residential Buildings.

1.4 General Requirements

- .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.

1.5 Approved TAB Agencies

- .1 Refer to Section 21 05 01 – Common Work Results for Mechanical - Acceptable Manufacturers These are listed under 23 05 01. Does 23 05 01 match the working spreadsheet?

1.6 Qualifications of TAB Personnel

- .1 Employ an approved independent testing and balancing agency to test and balance the following systems.

- .2 Submit names of personnel to perform TAB to the Owner's Consultant within 90 days of award of contract. Provide documentation confirming qualifications, years of direct field testing and balancing experience and successful experience. Provide a list of a minimum of ten comparable projects successfully completed by all key members of the balancing team and the Standard under which the projects were completed.
- .3 TAB shall be performed in accordance with the requirements of the standard under which the TAB Firm's qualifications are approved:
 - .1 AABC – National Standards for Total System Balance, MN-1
 - .2 NEBB – Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems
 - .3 SMACNA -HVAC Systems – Testing, Adjusting and Balancing
- .4 Recommendations and suggested practices contained in the TAB Standard are mandatory.
- .5 Use TAB Standard provisions, including checklists, and report forms to satisfy the Contract requirements.
- .6 Where the instrument manufacturer's calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.
- .7 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.
 - .1 For systems or system components not covered in TAB Standard, use TAB procedures developed by the TAB Specialist.
 - .2 Where new procedures, and requirements, are applicable to the Contract requirements, procedures shall have been published or adopted by the body responsible for the TAB Standard used (AABC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

1.7 Exceptions

- .1 TAB of systems and equipment regulated by codes, standards to satisfaction of authority having jurisdiction.

1.8 Submittals

- .1 Comply with Section 21 05 01 – Common Work Results for Mechanical, Submittals and the following:
- .2 Preliminary TAB Report
 - .1 Submit for checking and approval of the Owner's Consultant, prior to submission of formal TAB report, sample of rough TAB sheets. Include:
 - .1 Details of instruments used.
 - .2 Details of TAB procedures employed.
 - .3 Calculations procedures.
 - .4 List of air and liquid systems to be TAB
 - .5 Summaries.
- .3 TAB Report
 - .1 Format in accordance with referenced standards.
 - .2 TAB report to show results in SI units and to include:
 - .1 Project record drawings.
 - .2 System schematics.

- .3 Date of test, Name and address of building and balancing technician's name.
 - .4 Range of outdoor air temperature during the balancing period.
 - .5 Main branch duct traverses. Maximum and minimum outdoor air quantities.
 - .6 Static pressure across each component in an air handling system at full flow.
 - .7 Static pressure across each fan.
 - .8 Fans: Tag, service and location, motor speed, fan specified and actual capacity. Fan motor size, starting time, amps and voltage.
 - .9 Flow measuring devices: Flow rates.
 - .10 Terminal heating/cooling elements: Entering and leaving liquid temperatures, and flow rates
 - .11 Provide fan performance curve for each new air handling system and pump performance curve for each new pump system.
 - .12 Fire damper drop test confirmation.
- .3 Submit copies of TAB Report to the Owner's Consultant for verification and approval.

1.9 Co-ordination

- .1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule to ensure completion before acceptance of project.
- .2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

1.10 Pre-TAB Review

- .1 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.
- .2 Ensure devices are accessible and maintainable. Advise the installing Contractor of omissions or conflicts affecting the scope of this section.
- .3 Review contract documents before project construction is started and confirm in writing to Consultant the adequacy of provisions for TAB and that other aspects of design and installation are pertinent to the success of TAB.
- .4 Review specified standards and report to Consultant in writing describing any proposed procedures which vary from the standard.

1.11 Start-up

- .1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.
- .2 Follow special start-up procedures specified elsewhere in Divisions 21, 22, 23 and 25

2. PRODUCTS

2.1 Instruments

- .1 Prior to TAB, submit to the Owner's Consultant a list of instruments used together with serial numbers.
- .2 Calibrate in accordance with requirements of most stringent of referenced standards for applicable system.
- .3 Calibration shall be within 6 months of TAB. Provide certificate of calibration to the Owner's Consultant.

3. EXECUTION

3.1 Start of TAB

- .1 Notify the Consultant 7 days prior to start of TAB.
- .2 Start TAB when building is essentially completed, including:
 - .1 Installation of ceilings, doors, windows, other construction affecting TAB.
 - .2 Application of weather-stripping, sealing, and caulking.
 - .3 Pressure, leakage, other tests specified elsewhere Division 23.
 - .4 Provisions for TAB installed and operational.
- .3 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:
 - .1 Proper thermal overload protection in place for electrical equipment.
 - .2 Air systems:
 - .1 Filters in place, clean.
 - .2 Duct systems clean.
 - .3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.
 - .4 Correct fan rotation.
 - .5 Fire, smoke, volume control dampers installed and open.
 - .6 Coil fins combed, clean.
 - .7 Access doors, installed, closed.
 - .8 Outlets installed, volume control dampers open.

3.2 Tolerances

- .1 Application Tolerances:
 - .1 Do TAB to following tolerances of design values:
 - .1 Laboratory/Healthcare HVAC systems: plus 10%, minus 0%.
 - .2 General HVAC systems: plus or minus 5%.
 - .3 Hydronic systems: plus or minus 10%.
- .2 Accuracy Tolerances:
 - .1 Measured values accurate to within plus or minus 2% of actual values.
- .3 Site Tolerances:
 - .1 System leakage tolerances specified are stated as percentage of total flow rate handled by system. Pro-rate specified system leakage tolerances. Leakage for sections of duct systems: not to exceed total allowable leakage.
 - .2 Leakage tests on following systems not to exceed specified leakage rates.
 - .3 Small duct systems up to 250Pa (1"WC): leakage 2%.
 - .4 Large low pressure duct systems up to 500Pa (2"WC): leakage 2 %.
 - .5 Evaluation of test results to use surface area of duct and pressure in duct as basic parameters.

3.3 Testing

- .1 Test ducts and piping before installation of insulation or other forms of concealment. Do not externally insulate or conceal work until tested and approved.
- .2 Test after seals have cured.
- .3 Test when ambient temperature will not affect effectiveness of seals, and gaskets.
- .4 Conduct tests in presence of the Owner's Consultant or Owner's representative.
- .5 Bear costs including retesting and making good.
- .6 Refer to Piping Sections for specific test requirements.
- .7 Prior to tests, isolate all equipment or other parts which are not designed to withstand test pressures.

3.4 Air System Procedure

- .1 Perform balancing, adjusting and testing with building doors and windows in their normal operation position.
- .2 Perform drop test on all fire dampers and reset to open position.
- .3 The following procedure shall be adopted for central systems:
 - .1 Ensure dampers or volume control devices are in fully open position.
 - .2 Balance central apparatus to $\pm 10\%$ air flow.
 - .3 Balance branches, mains to $\pm 10\%$ air flow.
 - .4 Recheck central apparatus.
 - .5 Balance all terminal air outlets to $\pm 10\%$.
 - .6 Rebalance central apparatus to $\pm 5\%$.
 - .7 Recheck all air outlets.
 - .8 Perform acoustical measurements.
 - .9 Perform building pressurization tests and measurements at minimum and maximum outdoor air damper positions of the main air unit(s).
- .4 When balancing air outlets:
 - .1 Rough balance furthest outlets and then balance sequentially back to source.
 - .2 Fine balance furthest outlet back to source.
- .5 Take static pressure readings and air supply temperature readings at 10 points on each air system.
- .6 Make air quantity measurements in ducts by "Pitot Tube" traverse of entire cross sectional area. If readings are inconsistent across duct, relocate to two duct *diameters *widths and re-do traverse.
- .7 Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Effect volume control only by duct internal devices such as dampers and splitters.
- .8 Vary total system air quantities by adjustment of fan speeds. Vary branch air quantities by damper regulation.
- .9 Where modulating dampers are provided, take measurements and balance at extreme conditions. (Balance variable volume systems at maximum air flow rate - full cooling, and at minimum air flow rate - full heating).

- .10 The final balanced condition of each area shall include testing and adjusting of pressure conditions. Test and record building pressurization levels in the aquatic space throughout full range of fan delivery rates, under both clean & dirty filter conditions. Document abnormal building leakage conditions noted.
- .11 Complete balancing to achieve positive building pressure with respect to lobby. A positive pressure relative to outside of 10 Pa minimum and 20 Pa maximum shall be achieved, measured with negligible outside wind velocity.
- .12 Adjust building zones to achieve the following pressure differentials:
 - .1 Aquatic space to be negative to lobby.
 - .2 Aquatic to be neutral to change rooms.

3.5 Balancing and Adjusting of Domestic Water Systems

- .1 Adjust PRV on main line to 550kPa (80psi) maximum.
- .2 Balance domestic hot water recirculating system piping to ensure flow from all points in the system. Ensure all hot and cold supply shut off valves are fully open.

3.6 Verification

- .1 Reported results subject to verification by the Owner's Consultant.
- .2 Provide personnel and instrumentation to verify up to 30% of reported results.
- .3 Number and location of verified results as directed by the Owner's Consultant.
- .4 Pay costs to repeat TAB as required to satisfaction of the Owner's Consultant.

3.7 Settings

- .1 After TAB is completed to satisfaction of the Owner's Consultant, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.
- .2 Permanently mark settings to allow restoration at any time during life of facility. Do not eradicate or cover markings.

3.8 Completion of TAB

- .1 TAB is considered complete when final TAB Report received and all results are accepted by the Owner's Consultant.

END OF SECTION

1. GENERAL

1.1 Section Scope

- .1 Internal and external thermal duct insulation, accessories, sealers and finishes.

1.2 Related Requirements

- .1 This section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
- .2 Section 21 05 01 – Common Work Results for Mechanical.

1.3 References

- .1 The latest revisions of the following standards shall apply unless noted otherwise.
- .2 Applicable Building Code – Refer to Section 21 05 01 – Common Work Results for Mechanical
- .3 National Energy Code of Canada for Buildings [2011]
- .4 ASHRAE 90.1-2010 – Energy Standard for Buildings except Low Rise Residential Buildings
- .5 Thermal Insulation Association of Canada (TIAC) – National Insulation Standards.
- .6 CAN/ULC S102-M88 – Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
- .7 CGSB 51-GP-52MA – Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation
- .8 ASTM C612 – Standard Specification for Mineral Fiber Block and Board Thermal Insulation
- .9 ASTM C534 Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- .10 ASTM C553 – Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
- .11 ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining.
- .12 ASTM C1290 – Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.

1.4 Submittals

- .1 Comply with Division 1 – Submission and Closeout Procedures, Section 21 05 01 Common Work Results for Mechanical – Submittals and in addition the following:
 - .1 Certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Manufacturer's installation instructions.
 - .3 Manufacturer's declaration that products are either Declare – Living Building Challenge (LBC), Red List free or LBC compliant.

1.5 General Requirements

- .1 The Installation firm shall be a current member of the Thermal Insulation Association of Canada (TIAC).
- .2 Definitions:

- .1 "CONCEALED" insulated mechanical services in trenches, chases, furred spaces, shafts and hung ceilings (services in tunnels are not considered to be concealed.)
 - .2 "EXPOSED" will mean not concealed.
 - .3 "K" value means Thermal Conductivity
 - .4 "UNCONDITIONED SPACE" referred to in the duct thickness tables are crawlspaces (vented or not vented), parkades, warehouse space, shipping and receiving areas and other areas noted on the drawings.
 - .5 "EXTERIOR SPACE" referred to in the duct thickness tables are all spaces outside the building insulation envelope, including attic spaces, unless noted otherwise.
 - .6 UL GREENGUARD: Provides independent third-party, Indoor Air Quality (IAQ) certification of products for emissions of respirable particles and Volatile Organic Compounds (VOC's), including formaldehyde and other specific product-related pollutants. Certification is based upon criteria used by Environmental Protection Agency (EPA), Occupational Safety and Health Administration (OSHA) and World Health Organization (WHO).
 - .7 ASJ: All Service Jacket composed of aluminum foil reinforced with glass scrim bonded to a kraft paper
 - .8 SSL: Self-Sealing Lap.
 - .9 FSK: Foil Scrim Kraft; jacketing.
 - .10 PSK: Poly Scrim Kraft; jacketing.
 - .11 PVC: PolyVinyl Chloride.
- .3 Unless otherwise specified, insulation system materials inside building must have a fire hazard rating of not more than 25 for flame spread and 50 for smoke developed when tested in accordance with ULC S102, Surface Burning Characteristics of Building Materials and Assemblies.
- .4 Provide thermal insulation on all HVAC ductwork and as follows:
- .1 Heating only duct and plenum – service temperature 20°C to 65°C (68°F to 149°F)
 - .2 Cooling only or combined cooling and heating duct and plenum - service temperature 5°C to 65°C (41°F to 149°F)
 - .3 Outside air duct and plenum - -40°C (-40°F) to ambient
 - .4 All exhaust air ductwork from outside wall or roof to damper but a minimum of 3 m (10 ft.) inside building.
 - .5 Combustion intake / relief air
 - .6 Supply and return ductwork exposed in the space being served does not require insulation unless noted otherwise.
 - .7 Where an internal duct liner is used in lieu of external insulation, the internal thickness shall match that of the "Rigid Exterior Duct Insulation" table.
 - .8 Insulation may be omitted on heating only ductwork in return air plenums provided the ductwork serves that area.
- .5 Provide acoustic internal insulation on ductwork as follows:
- .1 All ductwork indicated on drawings with cross hatching.
 - .2 All exposed supply and return ductwork in mechanical rooms from fan discharge to duct shaft or mechanical room perimeter wall.
 - .3 Where internal insulation is required, external insulation may be reduced or omitted by an equivalent thickness.

- .6 If the Contractor, during renovations, should discover asbestos (or material suspected to be asbestos) on piping, ductwork, etc., he shall immediately cease all work in that area and contact Owner's representative.
- .7 Make good all existing insulation disturbed or removed to facilitate alterations and additions to existing piping.

2. PRODUCTS

2.1 Acceptable Manufacturers

- .1 Refer to Section 23 05 01 – Acceptable Manufacturers

2.2 General

- .1 Products shall not contain asbestos, lead, mercury, mercury compounds or Polybrominated diphenyl ethers (PBDE).
- .2 Mineral fibre specified includes glass wool and rock wool.
- .3 The RSI value shall not be reduced from the specified values when tested in accordance with ASTM C1290.
- .4 Insulation and jacketing materials shall not exceed 25 flame spread, 50 smoke developed rating when tested in accordance with CAN/ULC S102-M88.
- .5 Elastomeric insulation shall comply with NFPA 90A, 90B and ASTM C1534
- .6 Foam insulation products shall not use CFC or HCFC blowing agents in the manufacturing process and be formaldehyde free.
- .7 Glass mineral wool products shall have a recycled content of a minimum of 50 percent recycled glass content.
- .8 Low Emitting Materials: For all thermal and acoustical applications of glass mineral wool insulation, insulation shall be UL GREENGUARD Certified.
- .9 Products shall be either Declare LBC Red List free or LBC compliant.

2.3 Intermediate Temperature Range Insulation

- .1 External rigid Insulation (TIAC C-1):
 - .1 Service temperature 5°C to 232°C (41°F to 450°F)
 - .2 Glass mineral wool board for low and medium temperature applications.
 - .3 Complying with ASTM C1071 and CGSB 51-GP-52MA
 - .4 All service aluminum foil-scrim kraft (FSK) jacket with glass fibre reinforcement, factory applied.
 - .5 Density 36kg/m³ (2.25 PCF)
 - .6 Minimum RSI 0.76/25mm (R 4.3/in)
- .2 External flexible duct wrap insulation (TIAC C-2):
 - .1 Service temperature 5°C to 121°C (41°F to 250°F)
 - .2 For service temperatures above 121°C refer to 2.4 High Temperature Insulation
 - .3 Glass mineral wool flexible blanket for low and medium temperature applications.
 - .4 Complying with CGSB 51-GP-52MA, ASTM C1071 and ASTM C553.
 - .5 All service aluminum foil-scrim kraft (FSK) jacket with glass fibre reinforcement, factory applied.

- .6 Density 12kg/m³ (0.75PCF),
- .7 Minimum RSI 0.49/25mm (R 2.8/in) (installed)
- .3 Internal rigid duct liner:
 - .1 Rigid glass mineral wool board, for low and medium temperature acoustical applications.
 - .2 Complying with ASTM C1071 and CGSB 51-GP-52MA
 - .3 Airstream surface faced with a black mat bonded to the glass mineral wool substrate.
 - .4 Air velocity rating 25.4 m/s (5,000 ft/min)
 - .5 Density 48kg/m³ (3 PCF),
 - .6 Minimum RSI 0.76/25mm (R 4.3/in)
 - .7 Insertion loss:

Thickness		Frequency (Hz.)						
mm	inches	125	250	500	1000	2000	4000	NRC
25	1	0.13	0.24	0.56	0.83	0.92	0.98	0.65
40	1.5	0.19	0.41	0.89	1.02	1.03	1.04	0.85
50	2	0.33	0.67	1.07	1.07	1.03	1.06	0.95

- .4 Internal flexible duct liner:
 - .1 Flexible glass mineral wool blanket, for low and medium temperature acoustical applications.
 - .2 Complying with CGSB 51-GP-52MA, ASTM C1071 and ASTM C553
 - .3 Airstream surface faced with a black mat bonded to the glass mineral wool substrate.
 - .4 Air velocity rating 25.4 m/s (5,000 ft/min)
 - .5 Density 24kg/m³ (1.5 PCF)
 - .6 Minimum RSI 0.74/25mm (R 4.2/in)
 - .7 Insertion loss:

Thickness		Frequency (Hz.)						
mm	inches	125	250	500	1000	2000	4000	NRC
25	1	0.18	0.36	0.59	0.86	0.95	0.9	0.7
40	1.5	0.35	0.51	0.83	0.93	0.97	0.96	0.8
50	2	0.34	0.64	0.96	1.03	1	1.03	0.9

- .5 Internal fibre free elastomeric duct liner:
 - .1 Service temperature -40°C to 93°C (-40°F to 200°F)
 - .2 Flexible, closed-cell elastomeric insulation in sheet form, for low and medium temperature acoustical applications.
 - .3 Complying with ASTM C534, NFPA 90A and 90B.
 - .4 Insulation materials shall be manufactured without the use of CFC's, HFC's, HCFC's PBDE or formaldehyde.
 - .5 Insulation materials shall be low VOCs, fibre free, dust free and resist mold and mildew, be ultra violet and weather resistant.
 - .6 Factory applied pressure sensitive adhesive or field applied adhesive.

- .7 Air velocity rating 20.3 m/s (4,000 ft/min)
- .8 Density 48kg/m³ (3 PCF)
- .9 Minimum RSI 0.74/25mm (R 4.2/in)
- .10 Insertion loss:

Thickness		Frequency (Hz.)						
mm	inches	125	250	500	1000	2000	4000	NRC
25	1	0.06	0.17	1.06	0.32	0.67	0.54	0.55
40	1.5	0.15	0.51	0.69	0.46	0.53	0.43	0.55
50	2	0.23	0.84	0.32	0.6	0.39	0.31	0.55

2.4 Fastenings, Adhesives and Coatings

- .1 Insulation Fastenings:
 - .1 Min. 1.6 mm thick (16 ga) galvanized wire , 0.6 mm thick aluminium wire, 0.6 mm thick type 304 stainless steel wire or 1.6 mm thick copper wire.
 - .2 Mechanical fasteners, welded fasteners or adhesive fasteners to meet SMACNA HVAC Duct Construction Standard for mechanical fasteners.
- .2 Corner Beads: Galvanized steel or aluminum 38 mm x 38 mm x 0.37 mm thick.
- .3 Jacket Fastenings:
 - .1 Thermocanvas and All Service Jacket: Staples (flare type), compatible jacket finishing tape, contact adhesives recommended by the jacket manufacturer.
 - .2 Metal Jackets: Sheet metal screws, pop rivets.
- .4 Adhesives:
 - .1 Fabric adhesive to insulation covering, water based, ultra white, washable, anti-microbial.
 - .2 Internal elastomeric insulation adhesive shall be as per manufacturer's recommendations.
- .5 Coatings: Vapour barrier coating on reinforcing membrane.

2.5 Finish Jackets

- .1 Thermocanvas Jacket: fire rated, 170g (6 oz) fire retardant canvas jacket for covering mechanical insulation indoors, 25/50 fire class, plain wave cotton, no dyes.

3. EXECUTION

3.1 General

- .1 Installation shall be to Thermal Insulation Association of Canada (TIAC): National Insulation Standards and the following:

3.2 Flexible Insulation External Application

- .1 Heating only Duct and Plenum – Service Temperature 20°C to 65°C (CEF/1)
 - .1 On rectangular ducts ≥ 600mm in width, apply mechanical fasteners to the bottom surface at approximately 300 mm centres.
 - .2 Apply insulation without integral vapour retarder with 50 mm overlap at each joint. Secure insulation with wire fastening on approximately 300 mm centres, or by stapling laps.

- .2 Cooling only or Combined Cooling and Heating Duct and Plenum – Service Temperature 5°C to 65°C (CEF/2)
 - .1 On rectangular ducts \geq 600 mm in width, apply to bottom surface mechanical fasteners at approximately 300 mm centers.
 - .2 Apply insulation with vapor retarder to the outside.
 - .3 Where mechanical fasteners or staples penetrate the vapor retarder and at all joints apply vapor retarder tape or vapor retarder strips adhered with vapor retarder adhesive.
 - .4 All joints shall be overlapped a minimum of 50 mm and stapled on approximately 100 mm centers.
 - .5 Secure insulation with wire fastening on approximately 300 mm centers.
- .3 Heating only Duct and Plenum Fire Barrier – ambient to 538°C (1000°F)
 - .1 As per manufacturers installation instructions

3.3 Duct Insulation Minimum Thickness Table (ASHRAE 90.1-2010 Zone 5)

FLEXIBLE EXTERIOR DUCT INSULATION				
Duty	Plenum- Concealed (4)	Duct Location		
		Interior		Exterior
		Conditioned Space	Unconditioned Space	
Minimum Insulation R-Value RSI (R)				
Cooling Only Air Supply	38 (1-1/2")	38 (1-1/2")	38 (1-1/2")	75 (3")
Heating or H/C Air Supply	50 (2")	50 (2")	50 (2")	75 (3")
Outdoor Air Supply	50 (2")	50 (2")	50 (2")	0
Combustion Air	50 (2")	50 (2")	50 (2")	0
Return Air	38 (1-1/2")	0	38 (1-1/2")	75 (3")
Exhaust Air (1)(2)	38 (1-1/2")	0	38 (1-1/2")	38 (1-1/2")
Grease Hood Exhaust (5)	N/A	38 (1-1/2")	38 (1-1/2")	0
Tempered Air Supply or Makeup Air	0	0	38 (1-1/2")	75 (3")
Mixed Air (3)	38 (1-1/2")	38 (1-1/2")	38 (1-1/2")	75 (3")

Note (1): Air temperatures 15°C to 49°C (60°F to 120°F)

Note (2): Provide 38mm (1-1/2") flexible duct insulation on all exhaust air ductwork from outside wall or roof to damper but a minimum of 1.5 m (5 ft.) inside building.

Note (3): Mixed Air includes tempered air downstream of heat recovery units

Note (4): Plenums located outside the building shall be insulated to the values listed in the exterior column.

Note (5): Provides 1 hour fire rating. Thickness shall be doubled for 2 hour applications.

Note (6): Factory installed ductwork and plenums provided with equipment need not comply with this table provided they meet the requirements of the relevant CSA Standard for that equipment and is insulated to RSI 0.58 (R3.3) or greater. Refer to NECB article 5.2.12.1 for relevant CSA Standards.

3.4 Liner Internal Application

- .1 General
 - .1 Where an interior duct liner is used, external insulation shall not be applied unless noted otherwise.
 - .2 Where an interior duct liner is used the thickness shall be selected to match the thickness specified for external rigid insulation. Where no external insulation is required internal acoustic duct liner shall be a minimum 25mm (1").
- .2 Rigid Duct Liner (CIR/1)
 - .1 Fix mechanical fasteners to both horizontal and vertical surfaces at approximately 300 mm centers each direction.
 - .2 Apply insulation with surfaces overlapping vertical surfaces and with edges tightly butted together.
 - .3 Insulation shall be applied to the ductwork with a minimum 90% coverage of adhesive and mechanical fasteners.
 - .4 Where mechanical fasteners penetrate factory finish and at all joints, apply a heavy layer of seal coating.
 - .5 On high velocity duct systems 20 m/s to 30 m/s (4000 fpm -6000 fpm) apply reinforcing membrane over the entire insulation joint surface.
 - .6 Seal off leading edge of insulation to duct surface on low velocity ductwork with reinforced seal coating or metal nosing. On high velocity duct systems (over 20 m/s (4000 fpm) use metal nosing.
- .3 Flexible Duct Liner (CIF/1)
 - .1 Fix mechanical fasteners to both horizontal and vertical surfaces at approximately 300 mm centers each direction.
 - .2 Apply insulation with edges tightly butted together.
 - .3 Insulation shall be applied to the ductwork with a minimum 90% coverage of adhesive and mechanical fasteners.
 - .4 Where mechanical fasteners penetrate factory finish and at all joints, apply a heavy layer of seal coating.
 - .5 On high velocity duct systems 20 m/s to 30 m/s (4000 fpm -6000 fpm) apply reinforcing membrane over the entire insulation joint surface.
 - .6 Seal off leading edge of insulation to duct surface on low velocity ductwork with reinforced seal coating or metal nosing. On high velocity duct systems (over 20 m/s (4000 fpm) use metal nosing.
- .4 Elastomeric Duct Liner
 - .1 Install in accordance with TIAC National Standards and / or British Columbia Insulation Contractors Association (BCICA) Quality Standards Manual for Mechanical Insulation.
 - .2 Apply materials in accordance with manufacturer's instructions and as indicated.
 - .3 Work shall be performed at the temperatures recommended by the product manufacturer.
 - .4 The skin side (smooth side) shall be exposed to the airstream.
 - .5 Butt-edge seams using manufacturer's adhesive by compression fit method to allow for expansion/contraction. Leave a ½" wide uncoated border at the butt-edge seams on the duct surface and the insulation surface. Overlap the insulation ¼" at the butt-edges and compress the edges into place. Apply adhesive.

- .6 Allow minimum 48 hours for full adhesive cure before operating air system.
- .7 Maintain uninterrupted continuity and integrity of insulation.

3.5 External Flexible Fire Barrier Insulation

- .1 Install as per manufacturers installation instructions.

3.6 Finishes

- .1 General
 - .1 Insulation on concealed ductwork shall be left with factory finish. No further finish is required.
 - .2 The following finishes apply to exposed ductwork and plenums only.
- .2 Canvas Jacket – Indoor (CRF/1) (CRD/1)
 - .1 Use over rigid insulation for rectangular ductwork and flexible insulation for round ductwork, all with an integral vapor retarder. Apply continuous metal corner bead to all corners. Adhere vapor retarder tape over all joints and breaks in vapor retarder, and at all corners.
 - .2 Secure canvas jacket over insulation using fire resistive lagging coating and adhesive, and finish with one (1) coat of fire resistive lagging coating adhesive.

3.7 Duct Finishes Table

- .1 Conform to the following:

Duty	Rectangular Duct		Round Duct	
	Type	TIAC Code	Type	TIAC Code
Indoor Concealed	None	None	None	None
Indoor Exposed in Mechanical Room & Elsewhere Except Utility Areas	Canvas Jacket	CRF/1	Canvas Jacket	CRD/1

END OF SECTION

1. GENERAL

1.1 Section Scope

- .1 Materials and installation of low-pressure and high pressure metallic ductwork, flexible ductwork, underground ductwork, joints and accessories.

1.2 Related Requirements

- .1 This section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
- .2 Section 21 05 01 – Common Work Results for Mechanical
- .3 Section 23 32 00 – Air Plenums and Casings
- .4 Section 23 33 00 – Air Duct Accessories

1.3 References

- .1 The latest revisions of the following standards shall apply unless noted otherwise.
 - .1 National Fire Protection Association (NFPA)
 - .1 NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.
 - .2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
 - .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
 - .2 SMACNA - HVAC Air Duct Leakage Test Manual.

1.4 Submittals

- .1 Comply with Division 1 – Submission and Closeout Procedures, Section 21 05 01 Common Work Results for Mechanical – Submittals and in addition the following:
 - .1 Shop Drawings:
 - .1 Sealants, tapes, proprietary joints.
 - .2 In-slab duct test data
 - .3 Fabric duct system materials and performance data including NC values at desired flow characteristics.
 - .4 PVS ductwork, fittings and accessories
 - .5 HDPE ductwork, fittings and accessories

1.5 General Requirements

- .1 Duct sizes on drawings indicate clear inside dimensions. For acoustically lined or internally insulated ducts, maintain inside duct dimensions.
- .2 Where duct sizes are shown in nominal metric sizes, round and oval duct sizes may be supplied in nearest available sizes in equivalent imperial units.
- .3 Provide openings of correct size and locations through slabs and walls. Openings shall be planned to include installation of fire dampers at all rated fire separations.
- .4 Where ducts penetrate roofs, provide roof curbs with flashing and counter flashing, ensure that penetration details are coordinated with the Building Envelope Consultant and Architect.

- .5 The project drawings are diagrammatic and although efforts have been made to provide information regarding the number of offsets and transitions, not all are necessarily shown. Changes may be required in duct routings, elevation and duct shape to eliminate interference with structure and other services. All required adjustments shall be established when coordinating and field measuring the work prior to fabrication and must be provided as part of the contract and all associated costs must be considered and included.
- .6 Ductwork shall be clean and free from scale, corrosion and deposits. Ductwork shall be degreased and wiped clean of all oil and other surface films with appropriate solvents prior to installation.
- .7 Ductwork shall be delivered clean to the site and maintained in clean condition. Dirty ductwork shall be removed from site.
- .8 Where welded ductwork is indicated, the welding shall be continuous. Tack welding is unacceptable, except as specifically noted. Paint damaged areas with zinc coating after welding.
- .9 In exposed ductwork installations, the contractor shall have a consistent ductwork fabrication methodology. Longitudinal seam ducts shall not be intermixed with spiral seamed ductwork. Slip joint seams shall not be intermixed with flanged type seams where practical. Shop drawing submittals shall also indicate the duct fabrication type - spiral seam versus longitudinal seam, and duct joining method etc.
- .10 The contractor shall allow for the design, supply, and installation of all transition fittings required to connect ductwork to all mechanical equipment (both inlet and outlet connections). Where feasible, the fittings shall be fabricated per SMACNA standards in terms of maximum angles of convergence and divergence. Flexible connections shall be provided for all equipment / duct connections.

2. PRODUCTS

2.1 Acceptable Manufacturers

- .1 Refer to Section 23 05 01 – Acceptable Manufacturers.

2.2 Ductwork and Plenum Pressures

- .1 Provide ductwork constructed, reinforced, sealed and installed to withstand 1½ times the working static pressure
- .2 Low Pressure Galvanized Steel Ductwork 500 Pa (2" W.G.) and under
 - .1 Supply ductwork and plenums on systems without terminal mixing boxes or air valves.
 - .2 Supply ductwork downstream from terminal mixing boxes or air valves.
 - .3 Outdoor air ductwork and plenums, unless noted otherwise.
 - .4 Return air ductwork and plenums, unless noted otherwise.
 - .5 Exhaust and relief air ductwork and plenums, unless noted otherwise.
- .3 Low Pressure Flexible Ductwork 500 Pa (2" W.G.) and under
 - .1 Connect outlet terminals to low pressure ducts with 900mm (36") maximum length of stretched flexible duct. Hold in place with strap or clamp, caulk sealed. Do not use flexible duct to change directions.
 - .2 Provide a flexible connection where low pressure ducts are connected to fan equipment, terminal boxes or any other apparatus. Joint shall be screwed or bolted flexible gasketed joint, minimum 50mm (2") wide.
- .4 Medium Pressure Galvanized Steel Ductwork to 1000 Pa (4"W.G.)

- .1 Supply air ductwork downstream from supply air handling units discharge, to terminal mixing boxes or air valves.
- .2 Exhaust and return air ductwork downstream of return/exhaust air valves to the return/exhaust fans and discharge ductwork from the return/exhaust fans to the air handling units and/or relief opening.
- .3 Outdoor intake plenums in mechanical room(s).
- .4 Where flexible air ducts are used to connect terminal mixing boxes or air valves to metal ducts, the flexible air ducts shall be rated for 30.5 m/s (6000 fpm) velocity and 2500 Pa (10" W.G.). Maximum stretched length of flexible air duct shall be 300 mm (12"). Do not use flexible duct to change direction. Where flexible air ducts are attached to metal insulated duct, furnish flexible air ducts with fiberglass wool insulation and metalized jacket.
- .5 Medium Pressure Galvanized Steel Ductwork to 1500 Pa (6"W.G.)
 - .1 Stair, vestibule and elevator pressurization ducts.
 - .2 Smoke evacuation ducts.

2.3 Duct Sealing Galvanized Steel.

- .1 Low Pressure Ductwork 500 Pa (2" W.G.) and under shall be SMACNA seal class A. Seal all supply, return and exhaust duct joints, longitudinal as well as transverse joints as follows:
 - .1 Slip Joints: Apply heavy brush-on high pressure duct sealant. Apply second application after the first application has completely dried out. Where metal clearance exceeds 1.5 mm ($\frac{1}{16}$ ") use heavy mastic type sealant.
 - .2 Flanged Joints: Soft elastomer butyl or extruded form of sealant between flanges followed by an application of heavy brush-on high pressure duct sealant.
 - .3 Other Joints: Heavy mastic type sealant.
- .2 Medium Pressure Ductwork to 1000 Pa (4"W.G.) shall be SMACNA seal class A. Seal all supply, return and exhaust duct joints, longitudinal as well as transverse joints as follows:
 - .1 Combination of woven fabrics and sealing compound followed by an application of high pressure duct sealant.
 - .3 Duct tapes as sealing method are not permitted, except on residential ductwork – minimum 2 wraps of 2" wide (50mm) foil duct tape is acceptable.
 - .4 Surfaces to receive sealant should be free from oil, dust, dirt, moisture, rust and other substances that inhibit or prevent bonding.
 - .5 Do not insulate any section of the ductwork until it has been inspected and approved of duct sealant application, by the Consultant.

2.4 Rigid Ductwork - 500 Pa (2" W.G.) Static Pressure

- .1 Provide galvanized steel ductwork for system operating pressures 500 Pa (2" W.G.) and less. Ductwork shall be constructed, reinforced, sealed and installed to withstand 1½ times the working static pressure.
- .2 Construct rectangular ductwork in accordance with SMACNA Duct Standards Section I.
- .3 Nomasco "Ductmate System, Lockformer TDC" or Exanno "Nexus System" may be used for rectangular duct joints.
- .4 Construct rectangular duct fittings in accordance with the SMACNA Duct Standards Section II.
- .5 Construct round ductwork in accordance with the SMACNA Duct Standards Section III, but excluding beaded crimp joints and snaplock seams.

- .6 Construct flat oval ductwork in accordance with the SMACNA Duct Standards Section III. Joints and seams shall be similar to those indicated for round ducts. Flat oval duct to be used for positive pressure application only.
- .7 Construct round and flat oval duct fittings in accordance the SMACNA Duct Standards Section III. Round elbows shall have a centreline radius of 1.0 times duct diameter. Sheet metal gauge of fittings and elbows shall be not less than the thickness of that specified for longitudinal seam straight duct. Adjustable elbows are not permitted.

2.5 Flexible Plain Ductwork

- .1 Minimum Requirements:
 - .1 Non-corrosive spiral wire reinforcing with flexible vinyl coated fiberglass cloth membrane.
 - .2 Rated for use up to 30.7 m/s (6000 fpm) air velocity
 - .3 Suitable for up to 2500 Pa (10" w.g.) positive static pressure and 500 Pa (2" w.g.) negative static pressure.
 - .4 U.L. or U.L.C. labelled, Class 1, duct connector.
 - .5 Flame spread rating not to exceed 25. Smoke developed rating not to exceed 50.

2.6 Flexible Insulated Ductwork

- .1 Minimum Requirements:
 - .1 Flexible vinyl coated steel helix bonded to inner duct liner. Fibrous glass thermal insulation.
 - .2 Outer jacket of metalized fire-resistant vapour barrier.
 - .3 Rated for use up to 30.7 m/s (6000 fpm) air velocity
 - .4 Suitable for up to 2500 Pa (10" w.g.) positive static pressure and 500 Pa (2" w.g.) negative static pressure.
 - .5 UL or ULC labelled, Class 1, duct connector.
 - .6 Flame spread rating not to exceed 25. Smoke developed rating not to exceed 50.
 - .7 Acoustically rated.

2.7 Metallic Fittings

- .1 Fabrication: to SMACNA HVAC Duct Construction Standards - Metal and Flexible, latest edition.
- .2 Radius elbows.
 - .1 Rectangular: standard radius with single thickness turning vanes Centreline radius: 1.5 times width of duct.
 - .2 Round: smooth radius piece.
 - .1 Centreline radius: 1.5 times diameter for ductwork 750 Pa (3" W.G.) and greater
 - .2 Centreline radius: 1 times diameter for ductwork 500 Pa (2" W.G.) and less.
- .3 Mitred elbows, rectangular:
 - .1 Install mitred elbows where space will not permit the use of full radius elbows.

- .2 Provide single thickness turning vanes. Vanes in galvanized sheet metal ducts shall be constructed from galvanized steel, minimum thickness 0.76 mm (22 ga). Vanes shall be spaced at 40 mm (1½") centres and shall turn through 90 deg., with a radius of 50 mm (2"). Vanes shall not include a straight trailing edge. The maximum supported vane length shall be 750 mm (30"). Use multiple single thickness turning vane sections for wider ducts. Install vanes tangent to airflow. Refer to Figs. 2-3 and 2-4 of the SMACNA Duct Construction Standards. Vanes and runners in aluminum ducts shall be constructed from aluminum. Aluminum vanes shall be 0.86 mm (18 ga) thick.
- .4 Branches:
 - .1 Rectangular main and branch: with radius on branch 1.5 times width of duct and 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.
- .5 Transitions:
 - .1 In accordance with Fig. 2-9 of the SMACNA Duct Construction Standards.
 - .2 Diverging: 20 degrees maximum included angle.
 - .3 Converging: 30 degrees maximum included angle.
 - .4 Maximum divergence upstream of equipment to be 30 deg. and 45 deg. Convergence downstream.
- .6 Offsets:
 - .1 Short radius elbows.
 - .2 Obstruction deflectors: maintain full cross-sectional area.

2.8 Ductwork – Acoustically Lined

- .1 Where round ductwork is indicated to be acoustically insulated, it shall consist of two concentric round ducts with 25 mm (1") thick flexible fibrous glass duct liner between the two ducts. The inner duct shall be perforated and correspond to the duct diameter noted on the drawings. The outer duct shall be suitable for the static pressure and shall be sealed airtight where it joins the adjacent ductwork.

2.9 Hangers and Supports

- .1 Hangers and Supports: in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- .2 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.
 - .1 Maximum size duct supported by strap hanger: 500 mm.
- .3 Hanger configuration: to SMACNA.
- .4 Hangers: galvanized steel angle with galvanized steel rods to SMACNA per the following table:

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25 x 25 x 3	6
751 to 1050	40 x 40 x 3	6
1051 to 1500	40 x 40 x 3	10
1501 to 2100	50 x 50 x 3	10
2101 to 2400	50 x 50 x 5	10
2401 and over	50 x 50 x 6	10

- .5 Upper hanger attachments:
 - .1 For concrete: manufactured concrete inserts.
 - .2 For steel joist: manufactured joist clamp.
 - .3 For steel beams: manufactured beam clamps.

3. EXECUTION

3.1 Flexible Ductwork - 500 Pa (2" W.G.) Static Pressure

- .1 Installed lengths shall be limited to 6 times duct diameter but not longer than 900 mm (3 ft). Do not use for changes in direction greater than 60°.
- .2 Connect to ductwork and diffusers with stainless steel worm drive clamps or Panduit adjustable clamps or Thermaflex duct strap applied over two wraps of duct tape. Use stainless steel clamps on connections to fire dampers.
- .3 Minimum centreline radius of flexible ductwork bends shall be 1.5 times the duct diameter, alternatively, sheet metal elbows may be used at branch takeoffs and boot/diffuser connections. Very sharp turns and reduction in the area of the duct will not be permitted.
- .4 Support with 25 mm x 0.76 mm (1"x22 ga) galvanized steel straps at a maximum of 600mm (24"). Straps shall completely encircle duct. Support to prevent sagging of duct.
- .5 Support clear of ceiling assembly, light fixtures and hot surfaces.
- .6 Do not use flexible ductwork in secure areas.

3.2 Ductwork Leakage Test

- .1 Leakage test all 750 Pa (3") and greater static pressure supply ductwork installed under this contract, as recommended in the SMACNA H.V.A.C. Air Duct Leakage Test Manual to a static pressure 500 Pa (2" W.G.) in excess of the specified ductwork design static pressure.
- .2 Use equipment capable of demonstrating leakage.
- .3 Test the first 30 m (100 ft) of installed ductwork in the presence of the Consultant.
- .4 Test a representative 30m (100ft) section of 500 Pa (2") static pressure ductwork, where complete systems over 30m (100 ft) long are installed.
- .5 The total allowable leakage for the entire system shall be not greater than 5 percent of the total system capacity.
- .6 Submit test reports for all ducts tested.

END OF SECTION

1. GENERAL

1.1 Section Scope

- .1 Materials and installation for duct accessories including flexible connections, access doors and collars.

1.2 Related Requirements

- .1 This section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
- .2 Section 21 05 01 – Common Work Results for Mechanical
- .3 Section 23 31 00 – HVAC Ducts and Casings
- .4 Section 23 32 00 – Air Plenums and Casings

1.3 References

- .1 The latest revisions of the following standards shall apply unless noted otherwise.
 - .1 National Fire Protection Association (NFPA)
 - .1 NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.
 - .2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
 - .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
 - .3 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S112, Fire Test of Fire Damper Assemblies.
 - .2 CAN/ULC-S112.2, Standard Method of Fire Test of Ceiling Firestop Flap Assemblies.
 - .3 ULC-S505, Fusible Links for Fire Protection Service.

1.4 Submittals

- .1 Comply with Division 1 – Submission and Closeout Procedures, Section 21 05 01 Common Work Results for Mechanical – Submittals and in addition the following:
 - .1 Submit shop drawings for the following:
 - .1 Flexible connections.
 - .2 Duct access doors.
 - .3 Instrument test ports.
 - .4 Fire dampers and combination fire/smoke dampers
 - .5 Control dampers
 - .6 balancing dampers
 - .7 backdraft dampers

2. PRODUCTS

2.1 Acceptable Manufacturers

- .1 Refer to Section 23 05 01 – Acceptable Manufacturers

2.2 General

- .1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.

2.3 Backdraft Dampers – Light Duty

- .1 Minimum Requirements:
 - .1 1.4 mm thick (16 ga) galvanized steel or aluminum channel frame.
 - .2 0.41 mm thick (24 ga) embossed aluminum blades.
 - .3 Full blade length shafts, brass bearings.
 - .4 Felt or neoprene anti-chatter blade strips.
 - .5 Maximum blade height per section, 610 mm (24"), uses multiple sections for larger dimensions.
 - .6 Maximum blade length of 460 mm (18"), use multiple sections for larger dimensions.
 - .7 Manufacturer's label.
 - .8 Where a balanced backdraft damper (BBD) is indicated the damper shall incorporate an adjustable counterbalance weight and lever.
 - .9 Maximum pressure drop across damper at 4.06 m/s (800 FPM) shall be 35 Pa (0.14" w.g.).

2.4 Backdraft Dampers – Medium Duty

- .1 Minimum Requirements:
 - .1 1.4 mm thick (16 ga) galvanized steel or aluminum channel frame.
 - .2 1.2 mm thick (15 ga) aluminum blades, complete with stiffening ribs/bends.
 - .3 Full blade length shafts; brass, ball or nylon bearings.
 - .4 Felt or neoprene anti-chatter blade strips.
 - .5 Blade connecting linkage with eyelet and pin bearings.
 - .6 Maximum blade length of 760 mm (30"), use multiple sections for larger dimensions.
 - .7 Manufacturer's label.
 - .8 Where a balanced backdraft damper (BBD) is indicated the damper shall incorporate an adjustable counterbalance weight and lever.
 - .9 Maximum pressure drop across damper at 4.06 m/s (800 FPM) shall be 45 Pa (0.18" w.g.)

2.5 Balancing Dampers

- .1 Minimum Requirements:
 - .1 Rectangular ducts:
 - .1 Up to 300 mm (12") deep - single blade (butterfly type).
 - .2 330 mm (13") to 400 mm (16") deep - two opposed blades, mechanically interlocked with pivots at quarter points.
 - .3 430 mm (17") deep and over - multiple opposed blades, mechanically interlocked with blades not greater than 200 mm (8") deep and pivots equally spaced.
 - .2 Round Ducts:
 - .1 Single blade (butterfly type).

- .3 Material:
 - .1 Minimum 1.47 mm (16 ga) thick galvanized steel blade on all butterfly dampers.
 - .2 Minimum 1.47 mm (16 ga) thick galvanized steel blades on multi-blade dampers with rigidly constructed galvanized steel frame (no frame required on single blade dampers).
 - .3 Minimum 1.14 mm (18 ga) thick stainless steel blades for fume exhaust ducts.
- .4 Bearings:
 - .1 End bearings on all low pressure single blade dampers above 300 mm (12") dia.
 - .2 Bearings on multiple blade dampers shall be bronze oilite type.
- .5 Operating Mechanism:
 - .1 Lockable quadrant type with end bearing on accessible rectangular ducts up to 400 mm (16") deep and on accessible round ducts.
 - .2 Wide pitch screw mechanism type with crank operator on accessible rectangular ducts 430 mm (17") and over in depth and on inaccessible rectangular and round ducts.
 - .3 Override limiting stops.
 - .4 No blade movement in set position.
- .6 Concealed Regulators:
 - .1 For all drywall ceilings which do not have access panels provide concealed balancing damper regulators embedded in the finished ceiling, mounted behind grilles, on or inside plenum slot diffusers and various types of diffusers. Concealed damper regulator to be connected to balancing damper by means of flexible cable and to be installed flush with ceiling. Cover plate to be held in place with 2 screws and to be easily removed for damper adjustment.
 - .2 Optional concealed regulator shall be either remotely accessible as coordinated on the drawings, or accessible at the face of the diffuser/grille to meet installation requirements of the concealed regulator.

2.6 Duct and Plenum Access

- .1 Locations: Refer to Part 3 (Execution).
- .2 Dimensions:
 - .1 Doors:
 - .1 500 mm (20") wide x 1370 mm (54") high.
 - .2 Head of door 1780 mm (70") above floor.
 - .2 Panels:
 - .1 380 mm x 500 mm (15"x20").
 - .2 Where the far corners of the duct are closer than 500 mm (20") and the equipment within the duct is closer than 300 mm (12") the size may be reduced to 400 mm x 300 mm (16"x12") or 450 mm x 250 mm (18"x10") elliptical.
 - .3 Where space will not permit the above dimensions to be attained they should be matched as closely as possible and where necessary additional access be provided.
- .3 Products:

- .1 Doors - construct in accordance with SMACNA Duct Standards. 40 mm (1½") thick insulation.
- .2 Panels:
 - .1 Non-Insulated Duct: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.7 mm (22 ga) thick complete with sheet metal angle frame.
 - .2 Insulated Duct: as above with 25 mm (1") thick insulation.
- .3 Gaskets - neoprene or foam rubber.
- .4 Hardware:
 - .1 Panels up to 400 mm x 300 mm (16"x12") - 2 Cam locks complete with safety chain.
 - .2 Panels - 380 mm x 500 mm (15"x20") - 4 Cam locks complete with safety chain.
 - .3 Doors - piano hinge and Ventlok 310 latches c/w front and inside handles and front door pull.

2.7 Duct Connectors – Thermal breaks

- .1 Provide flexible duct connections to provide thermal breaks in all sheet metal ducts and plenums passing through or terminating at the exterior of the building. Install inside the building.
- .2 Minimum Requirements:
 - .1 Pre-assembled 75 mm (3") long thermal barrier with 75 mm (3") long, 0.61 mm (24 ga) galvanized steel duct connectors on each side of the thermal break.
 - .2 Thermal break – heavy duty glass fabric with elastomer coating.

2.8 Duct Connectors – Vibration Isolation

- .1 Provide flexible duct connections to provide vibration isolation at all duct and plenum connections to fan and air handling units. See Figure 2-19 SMACNA Duct Standards.
- .2 Minimum Requirements:
 - .1 Pre-assembled 75 mm (3") minimum long flexible connection with 75 mm (3") long 0.62 mm (24 ga) galvanized steel duct connectors on each side of the flexible connection. Flexible connector - fiber glass fabric with elastomer coating.
 - .2 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at minus 40 degrees C to plus 90 degrees C, density of 1.3 kg/m².
- .3 Centrifugal fans with 900 mm (36") diameter and larger fan wheels, use 150 mm (6") long flexible connection.
- .4 Do not install connectors on perchloric acid fume exhaust systems.

2.9 Instrument Test Ports

- .1 1.35 mm (16 ga) thick steel zinc plated after manufacture.
- .2 Cam lock handles with neoprene expansion plug and handle chain.
- .3 25 mm (1") minimum inside diameter. Length to suit insulation thickness.
- .4 Neoprene mounting gasket.

2.10 Spin-In Collars

- .1 Conical galvanized sheet metal spin-in collars with lockable butterfly damper.
- .2 Sheet metal thickness to co-responding round duct standards.

2.11 Control Dampers

- .1 Unless otherwise specified elsewhere, shall be as follows.
- .2 Type: Control dampers shall be the parallel or opposed-blade type as specified below or as scheduled on drawings or as per the following:
 - .1 Outdoor and return air mixing dampers and face-and-bypass dampers shall be parallel-blade and shall direct airstreams toward each other.
 - .2 Other modulating dampers shall be opposed-blade.
 - .3 Two-position shutoff dampers shall be parallel- or opposed-blade with blade and side seals.
- .3 Frame: Damper frames shall be 2.38 mm (13 gauge) galvanized steel channel or 3.175 mm (1/8 in.) extruded aluminium with reinforced corner bracing.
- .4 Blades: Damper blades shall not exceed 20 cm (8 in.) in width or 125 cm (48 in.) in length. Blades shall be suitable for medium velocity (10 m/s (2000 fpm)) performance. Blades shall be not less than 1.5875 mm (16 gauge).
- .5 Shaft Bearings: Damper shaft bearings shall be as recommended by manufacturer for application, oil impregnated sintered bronze, or better.
- .6 Seals: Blade edges and frame top and bottom shall have replaceable seals of butyl rubber or neoprene. Side seals shall be spring-loaded stainless steel. Blade seals shall leak no more than 50 L/s·m² (10 cfm per ft²) at 1000 Pa (4 in. w.g.) differential pressure. Blades shall be air foil type suitable for wide-open face velocity of 7.5 m/s (1500 fpm).
- .7 Sections: Individual damper sections shall not exceed 125 cm × 150 cm (48 in. × 60 in.). Each section shall have at least one damper actuator.
- .8 Modulating dampers shall provide a linear flow characteristic where possible.
- .9 Linkages: Dampers shall have exposed linkages.
- .10 Sizing and Selection: Refer to Control Damper Schedule.
- .11 Control dampers subjected to outdoor air conditions, including but not limited to outdoor air intake, exhaust air and relief air dampers shall be provided complete with thermally insulated blades and thermally broken frames, suitable for operation to -40°C.

2.12 Air Distribution Plates

- .1 Provide perforated air distribution plates at the discharge of supply fans as shown on the drawings.
- .2 Modify and reposition plates as necessary to balance airflow through downstream filters and coils to plus or minus 15%.

2.13 Coil End Covers

- .1 Provide coil end casings to eliminate coil frame air leakage.
- .2 Provide for cooling coil ends to drip condensate to the coil drain pan. Insulate the inside of the coil end casing to prevent casing condensation and provide closure panels to retain insulation.

2.14 Wire Mesh Screens

- .1 Provide wire mesh screens in all air intake openings where noted on the drawings.
- .2 Screens shall be constructed from aluminum wire 1.3 mm diameter (16 ga).
- .3 Screen mesh shall be 15 mm (1/2").
- .4 Mount screens in 0.66 mm thick (20 ga) folded aluminum frames.

2.15 Counter Flashings

- .1 Counter Flashings – galvanized sheet steel of 0.8 mm (22 ga) minimum thickness.
- .2 Counter flashings are attached to mechanical equipment and lap the base flashings on the roof curbs.
- .3 All joints in counter flashings shall be flattened and solder double seam. Storm collars shall be adjustable to draw tight to pipe with bolts. Caulk around the top edge. Storm collars shall be used above all roof jacks.
- .4 Vertical flange section of roof jacks shall be screwed to face of curb.

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.

3.2 Balancing Dampers

- .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's recommendations.
- .2 Provide balancing dampers at points on low pressure supply, return and exhaust systems where branches are taken from larger duct as required for proper air balancing.
- .3 Provide balancing dampers at each run out to a grille or diffuser. Install damper as close to branch take-off as possible.
- .4 Identify the airflow direction and blade rotation and open and closed position.
- .5 On all round ductwork larger than 300 mm (12") diameter and on externally insulated rectangular ductwork, provide sheet metal bridge to raise quadrant type operators above the insulation thickness (coordinate with Duct Insulation Section 23 07 13). Provide an open end bearing where bridges are used. Bridges on uninsulated round ducts shall be at least 25 mm (1") high.
- .6 Where quadrant type operators are used, the lever shall be arranged parallel with the damper blade.
- .7 Where balancing dampers are located above hard-ceilings (e.g. drywall), provide access panels or a remote operating device actuated by a socket or screwdriver.
- .8 Coordinate the installation of all dampers with the balancing contractor to ensure all dampers are accessible for system balancing.

3.3 Backdraft Dampers

- .1 Install backdraft dampers on all exhaust and relief openings through the building walls and roof on all exhaust fans where control dampers are not called for or indicated.

3.4 Control Dampers – Automatic

- .1 Packaged equipment specified to be complete with control dampers, shall include control dampers as normally supplied by the equipment manufacturer unless otherwise noted.
- .2 All other automatic control dampers shall be provided and installed under this Section.
- .3 Damper submittals shall be coordinated for type, quantity, and size to ensure compatibility with sheet metal design.
- .4 Duct openings shall be free of any obstruction or irregularities that might interfere with blade or linkage rotation or actuator mounting. Duct openings shall measure 6 mm (¼ in.) larger than damper dimensions and shall be square, straight, and level.

- .5 Individual damper sections, as well as entire multiple section assemblies, must be completely square and free from racking, twisting, or bending. Measure diagonally from upper corners to opposite lower corners of each damper section. Both dimensions must be within 3 mm (1/8 in.) of each other.
- .6 Follow the manufacturer's instructions for field installation of control dampers. Unless specifically designed for vertical blade application, dampers must be mounted with blade axis horizontal.
- .7 Install extended shaft or jackshaft according to manufacturer's instructions. (Typically, a sticker on the damper face shows recommended extended shaft location. Attach shaft on labeled side of damper to that blade.)
- .8 Damper blades, axles, and linkage must operate without binding. Before system operation, cycle damper after installation to ensure proper operation. On multiple section assemblies, all sections must open and close simultaneously.
- .9 Support ductwork in area of damper when required to prevent sagging due to damper weight.
- .10 After installation of low-leakage dampers with seals, caulk between frame and duct or opening to prevent leakage around perimeter of damper.
- .11 The indicated size of control dampers is the dimension outside the frame. Oversize the ductwork to include the depth of the damper frame if the pressure drop across the damper exceeds 25 Pa (0.1" w.g.).
- .12 Control damper frames shall be fitted tightly into ductwork and sealed airtight.
- .13 Check that dampers are installed square and true. Ensure that damper end linkages are easily accessible.
- .14 Do not install control dampers within the thickness of any wall unless otherwise indicated.

3.5 Duct and Plenum Access

- .1 Locations: Provide access doors and panels as follows:
 - .1 Doors: where shown on the drawings.
 - .2 Panels:
 - .1 Every 12 m (40 ft) on all ductwork.
 - .2 At the base of each duct riser.
 - .3 Both sides of equipment blocking the duct e.g.
 - .1 Air flow measuring stations
 - .2 Coils
 - .4 At or to one side of other equipment in duct e.g.
 - .1 Backdraft dampers (counter weight side)
 - .2 Balance dampers serving multiple outlets/inlets
 - .3 Bearings (fans/motors)
 - .4 Control dampers
 - .5 Control sensors
 - .6 Fire dampers (rectangular ducts and round ducts 330 mm (13") dia. and larger - latch side)
 - .7 Heat detectors (upstream from device)
 - .8 Smoke dampers (operator side)

- .9 Smoke detectors (upstream from device)
- .5 Panels need not be provided where access is available through a door or a register mounted on the side of the duct.
- .6 Kitchen exhaust access requirement specified under "Ductwork - Kitchen Exhaust".
- .3 Patches:
 - .1 Where required for cleaning and where access panels are not specified, e.g. on both sides of turning vanes.
 - .4 Flexible duct - on round duct and round fire dampers up to 300 mm (12") dia.
- .2 Seal frames airtight.
- .3 Install so as not to interfere with airflow.
- .4 Install to provide easiest possible access for service and cleaning.
- .5 Do not use sheet metal screws for attaching access panels to ductwork.
- .6 Round ducts 330 mm (13") dia. and larger shall include a short collar for the installation of access panels.
- .7 Small rectangular ducts shall be transitioned to a minimum dimension across the duct of 330 mm (13") for the installation of access panels.

3.6 Duct Connectors – Vibration Isolation

- .1 Install in the following locations:
 - .1 Inlets and outlets to supply air units and fans.
 - .2 Inlets and outlets of exhaust and return air fans.
 - .3 As indicated.
- .2 Ensure flexible duct connectors do not reduce free area on suction side of fans.
- .3 Ducting on sides of flexible connection to be in alignment.
- .4 Ensure slack material in flexible connection.

3.7 Ductwork – Flexible

- .1 Installed lengths shall be limited to 6 times duct diameter but not longer than 900 mm (3 ft). Do not use for changes in direction greater than 60°.
- .2 Connect to ductwork and diffusers with stainless steel worm drive clamps or Panduit adjustable clamps or Thermaflex duct strap applied over two wraps of duct tape. Use stainless steel clamps on connections to fire dampers.
- .3 Minimum centreline radius of flexible ductwork bends shall be 1.5 times the duct diameter, alternatively, sheet metal elbows may be used at branch takeoffs and boot/diffuser connections. Very sharp turns and reduction in the area of the duct will not be permitted.
- .4 Support with 25 mm x 0.76 mm (1"x22 ga) galvanized steel straps at a maximum of 600mm (24"). Straps shall completely encircle duct. Support to prevent sagging of duct.
- .5 Support clear of ceiling assembly, light fixtures and hot surfaces.
- .6 Do not use flexible ductwork in secure areas.

3.8 Flow Measuring Devices – Air

- .1 All flow measuring devices are specified in the Controls Section.

- .2 Under this section be responsible for receipt, handling, storage and installation of air flow measuring devices supplied under the Controls Sections.
- .3 Install in accordance with manufacturers recommendations. The minimum distances from air turbulence - producing fittings, transitions etc. shall be maintained.
- .4 When specified mount air volume gauges at a convenient height for easy visual inspection and install interconnecting piping.

3.9 Instrument Test Ports

- .1 Locate to permit easy manipulation of instruments.
- .2 Install insulation port extensions as required.
- .3 Locations:
 - .1 For traverse readings:
 - .1 Ducted inlets to roof and wall exhausters.
 - .2 Inlets and outlets of other fan systems.
 - .3 Main and sub-main ducts.
 - .4 As indicated.
 - .2 For temperature readings:
 - .1 At outside air intakes.
 - .2 In mixed air applications in locations as approved by the Consultant.
 - .3 At inlet and outlet of coils.
 - .4 Downstream of junction of two converging air streams of different temperatures.
 - .5 As indicated.
 - .3 In addition to the locations specified, install instrument test ports in ductwork as directed by the Testing and Balancing Contractor. Test port covers are to be installed after the balancing is complete, however insure the insulation is repaired at test port locations. Install heavy duty locking quadrant handles at all balancing dampers (except splitter dampers). Ensure handles are marked in the final set position by the Testing and Balancing Contractor.

END OF SECTION

1. GENERAL

1.1 Summary

- .1 Section Includes:
 - .1 Fans, motors, accessories and hardware for commercial use.
 - .2 Sustainable requirements for construction and verification.

1.2 References

- .1 Air Conditioning and Mechanical Contractors (AMCA)
 - .1 AMCA Publication 99, Standards Handbook.
 - .2 AMCA 300, Reverberant Room Method for Sound Testing of Fans.
 - .3 AMCA 301, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- .2 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
 - .1 ANSI/AMCA 210, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB 1.181, Ready-Mixed Organic Zinc-Rich Coating.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.3 System Description

- .1 Performance Requirements:
 - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.
 - .2 Capacity: flow rate, static pressure, bhp, efficiency, revolutions per minute, power, model, size, sound power data and as indicated on schedule.
 - .3 Fans: statically and dynamically balanced, constructed in conformity with AMCA 99.
 - .4 Sound ratings: comply with AMCA 301, tested to AMCA 300. Supply unit with AMCA certified sound rating seal.
 - .5 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210. Supply unit with AMCA certified rating seal, except for propeller fans smaller than 300 mm diameter.

1.4 Submittals

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

- .2 Shop Drawings:
 - .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Provide:
 - .1 Fan performance curves showing point of operation, BHP and efficiency.
 - .2 Sound rating data at point of operation.
- .4 Indicate:
 - .1 Motors, sheaves, bearings, shaft details.
 - .2 Minimum performance achievable with variable speed controllers and variable inlet vanes as appropriate.
- .5 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .6 Closeout Submittals:
 - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 10 - Closeout Submittals.

1.5 Quality Assurance

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety.

1.6 Maintenance

- .1 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 10 - Closeout Submittals.
 - .1 Spare parts to include:
 - .1 Matched sets of belts.
 - .2 Furnish list of individual manufacturer's recommended spare parts for equipment, include:
 - .1 Bearings and seals.
 - .2 Addresses of suppliers.
 - .3 List of specialized tools necessary for adjusting, repairing or replacing.

1.7 Delivery, Storage, and Handling

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 61 00 – Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:

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

2. PRODUCTS

2.1 Fans General

- .1 Motors:
 - .1 In accordance with Section 23 05 13 - Common Motors Requirements for Mechanical Equipment supplemented as specified herein.
 - .2 Sizes as indicated.
- .2 Accessories and hardware: matched sets of V-belt drives, adjustable slide rail motor bases, belt guards, coupling guards fan inlet safety screens as indicated and as specified in Section 23 05 13 - Common Motor Requirements for Mechanical Equipment
- .3 Factory primed before assembly in colour standard to manufacturer.
- .4 Scroll casing drains: as indicated.
- .5 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.
- .6 Vibration isolation: to Section 23 05 48 - Vibration and Seismic Controls for Piping and Equipment.
- .7 Flexible connections: to Section 23 33 00 - Air Duct Accessories.

2.2 Cabinet Fans - General Purpose

- .1 Fan characteristics and construction: as centrifugal fans.
- .2 Cabinet hung single with DWDI centrifugal fans in factory fabricated casing complete with vibration isolators and seismic control measures, motor, V-belt drive and guard outside casing.
- .3 Fabricate casing of aluminum reinforced and braced for rigidity. Provide removable panels for access to interior. Integral duct connection flanges, adjustable motor pulley, corrosion resistant fasteners, stainless steel shaft, aluminum rub ring, housing and motor cover for corrosive environments.
- .4 Acceptable Manufacturer:
 - .1 Dehli
 - .2 Greenheck
 - .3 Nutone
 - .4 Broan
 - .5 Penn
 - .6 Cook

2.3 Cabinet Fans - General Purpose

- .1 Fan characteristics and construction: as centrifugal fans.

- .2 Cabinet hung single or multiple wheel with DWDI centrifugal fans in factory fabricated casing complete with vibration isolators, motor, V-belt drive and guard outside casing.
- .3 Fabricate casing of zinc coated or phosphate treated steel reinforced and braced for rigidity. Provide removable panels for access to interior. Paint uncoated, steel parts with corrosion resistant paint to CAN/CGSB 1.181. Finish inside and out, over prime coat, with rust resistant enamel. Internally line cabinet with 50 mm thick rigid acoustic insulation.

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 resilient mountings specified in Section 23 05 48 - Vibration Isolation for Piping and Equipment, flexible electrical leads and flexible connections in accordance with Section 23 33 00 - Air Duct Accessories.
- .2 Provide sheaves and belts required for final air balance.
- .3 Bearings and extension tubes to be easily accessible.
- .4 Access doors and access panels to be easily accessible.

3.3 Anchor Bolts and Templates

- .1 Size anchor bolts to withstand seismic acceleration and velocity forces as specified.

END OF SECTION

1. GENERAL

1.1 Section Scope

- .1 Supply, return and exhaust grilles, registers, diffusers and louvres for commercial and residential use.

1.2 Related Requirements

- .1 This section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
- .2 Section 21 05 01 – Common Work Results for Mechanical
- .3 Section 23 05 01 – Acceptable Manufacturers

1.3 References

- .1 The latest revisions of the following standards shall apply unless noted otherwise.
 - .1 Applicable Building Code - Refer to Section 21 05 01

1.4 Submittals

- .1 Comply with Division 1 – Submission and Closeout Procedures, Section 21 05 01 Common Work Results for Mechanical – Submittals and in addition the following:
 - .1 For all grilles, diffusers and louvres provide manufacturer's printed product literature, specifications and datasheet include product characteristics, performance criteria, and limitations.
 - .2 Indicate following:
 - .1 Capacity.
 - .2 Throw and terminal velocity.
 - .3 Noise criteria.
 - .4 Pressure drop.
 - .5 Neck velocity.
 - .3 Closeout submittals: submit all reviewed shop drawings for incorporation into manual specified in Section 21 05 01 – Common Work Results - Mechanical

1.5 Quality Assurance

- .1 Air flow tests and sound level measurement shall be made in accordance with applicable ADC equipment test codes, ASHRAE Standards and AMCA Standards.
- .2 Unit rating shall be approved by ADC and AMCA.
- .3 Manufacturer shall certify catalogued performance and ensure correct application of air outlet types.
- .4 Outside louvres shall bear AMCA seal for free area and water penetration.

1.6 Project Conditions

- .1 Review requirements of outlets as to size, finish and type of mounting prior to submitting shop drawings and schedules of outlets.
- .2 Positions indicated are approximate only. Check locations of outlets and make necessary adjustments in position to conform to Architectural features, symmetry and lighting arrangement.

- .3 Review exterior wall details and structural requirements/drawings. Ensure exterior louvre installation is fully coordinated with all other building elements.

1.7 Maintenance

- .1 Provide keys for volume control adjustment and/or keys for air flow pattern adjustment as applicable.

2. PRODUCTS

2.1 Acceptable Manufacturers

- .1 Refer to Section 23 05 01 – Acceptable Manufacturers

2.2 General

- .1 Base air outlet application on space noise level of NC 20 maximum.
- .2 Provide supply outlets with sponge rubber seal around the edge.
- .3 Provide baffles to direct air away from walls, columns or other obstructions within the radius of diffuser operation.
- .4 Provide plaster frame for diffusers located in plaster surfaces.
- .5 Provide anti-smudge frames or plaques on diffusers located in rough textured surfaces such as acoustical plaster.
- .6 Provide 30 mm margin frame with concealed fastening.
- .7 Fabricate with heavy aluminum extrusions.
- .8 Provide grilles with integral, gang-operated opposed blade dampers with removable key operator, operable from face.
- .9 Finish in factory baked enamel finish color by Architect if indicated on schedule.
- .10 Refer to Air Outlet Schedule on drawings for capacities.

2.3 Wall Caps

- .1 0.025 Aluminum natural finish wall cap.
- .2 Built in spring loaded backdraft damper for exhaust applications only
- .3 Built in spring loaded backdraft damper without bird screen for dryer venting
- .4 Bird screen without backdraft damper for supply applications
- .5 Refer to drawings and schedules for size and capacities.

2.4 Fixed Louvres

- .1 Drainable louver with concealed vertical mullions
- .2 Louvers shall be 102mm (4") deep
- .3 Material: minimum 20 gauge galvanized steel blades, 16 gauge galvanized steel frame
- .4 Blade: Stormproof pattern, stationary with centre watershed in blade, reinforcing bosses and maximum blade length of 1500 mm.
- .5 Percent Free Area: 44%
- .6 Beginning point of Water Penetration: 6.35 m/s (1,250 fpm)
- .7 Screen: 16 ga diameter aluminum wire bird screen with 12 mm (1/2") mesh on inside face of louvres in formed U-frame.

- .8 Finish: Factory applied baked enamel finish to Consultants colour choice, unless specifically noted otherwise in the equipment schedule.
- .9 Drainable louver with concealed vertical mullions
- .10 Louvers shall be 152mm (6") deep
- .11 Material: 0.81" extruded aluminum blades and frame. All welded construction with integral perimeter caulking stop.
- .12 Blade: drainable, blades positioned at 35° angle.
- .13 Percent Free Area: 55.9%
- .14 Beginning point of Water Penetration: 5.28 m/s (1,041 fpm)
- .15 Screen: 16 ga diameter aluminum wire bird screen with 12 mm (1/2") mesh on inside face of louvres in formed U-frame.
- .16 Finish: Factory applied baked enamel finish to Consultants colour choice, unless specifically noted otherwise in the equipment schedule.

2.5 Louvres - Motorized

- .1 Adjustable louver in a single frame.
- .2 Louvers shall be 102mm (4") deep
- .3 Material: minimum 16 gauge galvanized steel blades, 16 gauge galvanized steel frame
- .4 Blade: Adjustable blades positioned at 45-degrees and spaced 114 mm (4-1/2") on center.
- .5 The blade linkage assembly shall be fully-enclosed within the louver jamb frame and isolated from the active airstream
- .6 Concealed motor operator and connections.
- .7 Electric motor to be included (120/1/60).
- .8 Percent Free Area: 37%
- .9 Beginning point of Water Penetration: 3.51 m/s (691 fpm)
- .10 Screen: 16 ga diameter aluminum wire bird screen with 12 mm (1/2") mesh on inside face of louvres in formed U-frame.
- .11 Finish: Factory applied baked enamel finish to Consultants colour choice, unless specifically noted otherwise in the equipment schedule.

3. EXECUTION

3.1 Priming

- .1 Paint ductwork visible behind air outlets matte black.

3.2 Sizing

- .1 Size outside air louvres as indicated on drawings.
- .2 Size air outlets as indicated on drawings.

3.3 Air Terminals

- .1 Install with cadmium plated screws in countersunk holes where fastenings are visible.
- .2 Install ductwork as high as practical, using offsets where required to obtain maximum duct neck lengths for diffusers.
- .3 Refer to Architectural Reflected Ceiling plans for exact locations of air terminals.

- .4 Attach registers and grilles to branch ducts with duct necks having minimum length to prevent grille or register damper from protruding into branch duct.
- .5 Where air terminals are installed in mechanical grid ceilings, provide at least two 12 ASWG galvanized steel wire seismic security bridles per air terminal tied either to the building structure or to ceiling hanger wires. Attach security bridles at opposite corners of each air terminal and in such a manner that the air terminal cannot fall.
- .6 Hand over door grilles to the General Contractor for installation.

3.4 Louvres

- .1 Provide all necessary flashing and counterflashing for louvres installed in walls.
- .2 Caulk louvre and flashing and counterflashing to make installation water tight.
- .3 Blank-off panels shall be constructed to SMACNA standards, minimum 20 Ga. Sandwich panel with 25 mm (1") thick fibreglass insulation.
- .4 All blank-off panels shall have a painted flat black enamel finish.

END OF SECTION

PART 1 **GENERAL**

1.1 **RELATED REQUIREMENTS**

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 **SUMMARY OF WORK**

- .1 The scope of work for this project includes but is not limited to:
 - .1 Lighting luminaires,
 - .2 Low voltage lighting control,
 - .3 Branch circuit power and devices,
 - .4 Structural cabling and infrastructure,
 - .5 Reconfiguration of AV speakers, cabling and controls
 - .6 Security access control
 - .7 PTZ security cameras and PTZ security controls
 - .8 Fire alarm, emergency lighting, and exit signage

1.3 **CODES AND REFERENCES**

- .1 Definitions:
 - .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.
- .2 Any reference to Codes, Standards, and Regulations contained within the Contract Documents shall be taken as the latest or most current in effect at time of Tender.
- .3 In no instance shall the standards established by the Contract Documents be reduced by any referenced Code or Regulation.
- .4 Reference Standards:
 - .1 CSA Group
 - .1 CSA C22.1, Canadian Electrical Code, Part 1 (Current Edition), Safety Standard for Electrical Installations.
 - .2 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
 - .1 IEEE SP1122, The Authoritative Dictionary of IEEE Standards Terms, Current Edition.

1.4 **DEFINITIONS**

- .1 The word 'Provide' means the supply, delivery, and installation of device or equipment referenced to the level required to be complete and operational.
- .2 The word 'Supply' means to obtain and deliver to the project site, ready for unpacking, assembly, and installation.
- .3 The word 'Install' means the unloading, unpacking, assembling, erecting, applying, finishing, protecting, cleaning and similar operations at the project site to complete items of work supplied by others.

- .4 AHJ: Authority Having Jurisdiction

1.1 RESPONSIBILITY AND COORDINATION

- .1 Provide all labour, materials, equipment, tools, and incidentals necessary to provide a complete electrical installation as indicated on the Drawings and as set out in these Specifications.
- .2 Without relieving the Contractor of his responsibilities, the Specifications have been divided into approximate trade sections for convenience. These Sections do not, however, limit the responsibility of any subcontractor or supplier. The Consultant will not arbitrate on any dispute between the subcontractors' responsibilities. The onus of defining the extent of the subcontractors' work remains with the Contractor, who, when awarding subcontracts, will ensure that the area of responsibility of any particular subcontractor is set out in full detail.
- .3 The Contractor shall advise the Consultant during the tender period of any specified material or equipment which is either no longer available from manufacturers or whose delivery is likely to exceed the requirements of the anticipated Construction Schedule. Failure of the Contractor to perform the above shall cause the Contractor to supply, at his own expense, alternate material or equipment as selected by the Consultant at a later date. Alternatively, the Contractor shall procure the specified material or equipment at his own additional expense by means of air freight or other special means of transportation.
- .4 The Drawings and Specifications complement each other and what is called for by one is binding as if called for by both. If there is any doubt as to the meaning or true intent due to a discrepancy between the Drawings and Specifications, obtain a ruling from the Consultant prior to tender closing. Failing this, the most expensive alternative is to be allowed for.
- .5 Advise the Consultant of any specified equipment, material, or installation of same which appears inadequate or unsuitable or which is in violation of laws, ordinances, rules, or regulations of authorities having jurisdiction. Provide all labour and materials which are obviously necessary or reasonably implied to be necessary to complete the work as if the work was shown on the Drawings and/or described in the Specifications.
- .6 Check Drawings of all trades and coordinate the installation of all material and equipment to ensure adequate space and free access and to maintain headroom limitations for all proposed and indicated future work. Work out jointly, with all Subcontractors on the site, solutions to interference problems. Coordinate all work before fabricating or installing any material or equipment. It is incumbent on all Subcontractors on the site to ensure that all materials and equipment fit into the allocated spaces and that all equipment can be properly inspected, serviced, and replaced if and when required. Advise the Consultant of space problems before fabricating or installing any material or equipment. Demonstrate to the Consultant on completion of his work that all equipment and material installed by him can be properly and safely serviced and replaced. Make no deviations from the intent of the design, or any involving additional cost, without the Consultant's written direction.
- .7 Where electrical work and materials are noted as being provided by the Owner or under other Divisions of these Specifications, the responsibility for integrating, to the extent required, such work and materials into the complete installation, shall remain within Division 26.

- .8 Ensure that any building structure loaded during the installation is adequate to carry such load.
- .9 Testing in accordance with Section 26 05 10 Testing and Commissioning.
- .10 A contractor is entitled to engage in the regulated work for which the contractor is licensed.
 - .1 A licensed contractor must not:
 - .1 Manage or do regulated work that is:
 - .1 Outside the scope of the license,
 - .2 Contrary to any term or condition of the license, or
 - .3 Contrary to any term or condition imposed by the regulations on the use of the license, or
 - .2 Permit regulated work to be undertaken by persons under the control of the licensed contractor if they are not authorized.
 - .2 A licensed contractor must:
 - .1 Maintain current knowledge of the Acts, relevant regulations, relevant directives, relevant safety orders and any other relevant material that the minister makes publicly available, and
 - .2 Ensure that individuals who do regulated work for the licensed contractor maintain similar current knowledge.

1.5 PERMITS, FEES, AND INSPECTIONS

- .1 Before commencing work obtain and pay for all necessary approvals and permits. The Consultant shall provide printed drawings required by the AHJ to obtain such permits.
- .2 Arrange for inspection of the work at rough-in completion, prior to Substantial Completion, and as otherwise required by all applicable Authorities Having Jurisdiction.
 - .1 Notify Consultant of any changes required by the Authorities Having Jurisdiction prior to proceeding with changes.
- .3 Provide Consultant with a certificate of unconditional approval for all electrical work from the appropriate Authorities Having Jurisdiction. Final payment to the Contractor shall not be made prior to submission of the inspection certificate.

1.6 EVALUATION OF CONTRACT CHANGES

- .1 Notwithstanding other provisions of the Contract, this Contractor shall supply detailed information for the valuation of all changes to the Contract. Such information shall include, but not necessarily be limited to, the following:
 - .1 Labour hours per unit of material or equipment to be added, deleted, or altered.
 - .2 Units of material or equipment to be added or deleted.
 - .3 Cost to the Contractor per unit of material, equipment and labour broken down by category of labour and type of material or equipment.
 - .4 Extensions of the above to arrive at total costs.
 - .5 Other miscellaneous and identifiable charges such as delivery, restocking, overhead, profit, etc.
 - .6 Include in the valuation of any change to the Contract the cost, if any, of recording such change on the record drawings as previously specified.

1.7 MEASUREMENT AND PAYMENT

- .1 Notwithstanding any other provisions of this Contract, supply the following general information and any additional information as may be requested by the Consultant as part of each Monthly Progress Claim.
 - .1 Indicate the labour cost and the material cost separately for each Item of Work within Divisions 26, 27, and 28.
 - .2 Progress claims will be certified as per contract requirements.
 - .3 Format for Monthly Progress Draws shall be approved by the Consultant prior to the first submission.
 - .4 For each Monthly Progress Draw, each change order shall be listed separately.
 - .5 Indicate both the Change Order number and title on the progress draw.

1.8 REVIEW OF WORK

- .1 The Consultant will make periodic visits to the site during construction to ascertain reasonable conformity to plans and specifications but will not execute quality control. The Contractor shall be responsible for the execution of his work in conformity with the construction documents and with the requirements of the inspection authority.
 - .1 The Contractor shall notify the Consultant a minimum of 48 hours prior to completion of rough-in to allow review prior to Work being concealed.

1.9 SCHEDULING OF WORK

- .1 Work shall be scheduled as required to coordinate with other Divisions and Owner's work restrictions.
- .2 Work Restrictions:
As set out in the contract
- .3 No additional monies will be paid for contractor's requirement to comply with work phasing conditions.

1.10 GUARANTEE

- .1 Furnish a written guarantee to the Owner prior to final contract payment, which will be in effect for one year from the date of final acceptance of the complete work. Replace or repair at no cost to the Owner any defective material or workmanship except where, in the opinion of the Consultant, such defects are due to the misuse or neglect by the Owner.
- .2 This general guarantee shall not act as a waiver of any specified of special equipment guarantees which cover a greater length of time.

1.11 FIRE RATING OF PENETRATIONS

- .1 Maintain fire ratings around conduits passing through floors, ceilings and fire rated walls.
- .2 Use fire stop products, approved by the Consultant, at each penetration.
- .3 Material of the same manufacturer is to be used throughout the entire project as part of a fully rated fire stop system.
- .4 Acceptable manufacturers: Hilti, 3M or approved equal.
- .5 Refer to Section 07

1.12 ACTION AND INFORMATIONAL SUBMITTALS

- .1 All submissions shall be provided in electronic PDF format.
- .2 Submit the following documents to the Consultant a maximum of 14 days after Contract award:
 - .1 Project schedule in Gantt chart format.
 - .2 Schedule of Values for payment certification.
 - .3 WCB Letter of Proof of Insurance
 - .4 Certificate of Insurance for CGL with the Owner listed as a Certificate Holder.
- .3 Accompany submissions with transmittal letter, containing:
 - .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Identification and quantity of each shop drawing, product data and sample.
 - .5 Other pertinent data.
- .4 Certificates:
 - .1 Submit test results of installed electrical systems and instrumentation.
 - .2 Submit, upon completion of Work, load balance report as described in PART 3 - LOAD BALANCE.
- .5 Manufacturer's Field Reports: submit to Consultant manufacturer's written report, within 3 days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in PART 3 - FIELD QUALITY CONTROL.
- .6 Submit for review single line electrical diagrams under plexiglass and locate as indicated by site operations staff.
 - .1 Electrical distribution system in main electrical room.
 - .2 Electrical power generation and distribution systems in power plant rooms.
- .7 Submit for review fire alarm riser diagram, plan and zoning of building in glazed frames at fire alarm control panel and annunciator.

1.13 SHOP DRAWINGS:

- .1 Accompany submissions with transmittal letter, containing:
 - .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Identification and quantity of each shop drawing, product data and sample.
 - .5 Other pertinent data.
- .2 Submissions include:
 - .1 Where specifically noted in other Sections in Divisions 26, 27, and 28, submit drawings stamped and signed by professional Consultant registered or licensed in Province of BC Canada.
 - .2 Shop Drawings shall be provided for but not limited to the following systems:
 - .1 Firestopping systems for all firestopping required to be installed under Divisions 26, 27, and 28.

- .2 Distribution equipment including switchgear, switchboards, panelboards, transformers, and motor control centres.
- .3 Moulded case breakers whether installed in distribution equipment supplied as part of this project or provided loose.
- .4 Lighting.
- .5 Cables.
- .6 Wiring devices including but not limited to receptacles and switches.
- .7 Wire duct.
- .8 Digital metering.
- .3 Refer to other Sections within Divisions 26, 27, and 28 for detailed shop drawing submission requirements.
- .4 Contractor shall review all shop drawings prior to submittal. All shop drawings shall be stamped and signed by both the Electrical Contractor and General Contractor. Unstamped drawings will be returned without comment.
- .5 Each shop drawing shall clearly indicate the equipment ID and equipment type (e.g. Luminaire Type 'A', Panelboard SD-A) where applicable.
- .6 Where manufactures' brochures that include multiple equipment or device models are submitted, they shall be clearly labelled with the equipment model and options to be supplied. Submit relevant sections of manufacturer's catalogues only. Submissions of complete catalogues will be rejected.
- .7 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.
- .8 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
- .9 Indicate of drawings clearances for operation, maintenance, and replacement of operating equipment devices.
- .10 Submit complete shop drawing packages for each system. Partial submissions will be returned without comment.
- .11 Review of shop drawings by the Consultant is for the sole purpose of ascertaining conformance with the general design intent. The review shall not mean approval of the detail design inherent in the shop drawings, responsibility for which shall remain with the Contractor submitting same, and such review shall not relieve the contractor of his responsibility for errors or omissions in the shop drawings or of his responsibility for meeting all requirements of the Contract Documents. The Contractor is responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for coordination of the work of all sub-trades.
- .12 Ensure that copies of all shop drawings are available at the job site.

1.14 CLOSEOUT SUBMITTALS

- .1 Provide spare parts, maintenance materials and special tools of same quality and manufacture as products provided in Work.
- .2 Operation and Maintenance Manuals:
 - .1 Refer to Section 26 05 11 Electrical Operations and Maintenance Data.
 - .2 Provide draft version of Operations and Maintenance Manual to Consultant two weeks prior to Substantial Performance Review.

- .3 Submit record drawings including all as-built information and changes on completion of project. Refer to Section 1.1 As-Built Documents and Samples.
 - .1 Each record drawing as defined above shall bear the Contractor's identification and signature, the date of record, and the notation: "We hereby certify that these Drawings represent the building as built."
 - .2 Provide a copy of record drawings to Consultant for review at Substantial Completion.

1.2 AS -BUILT DOCUMENTS AND SAMPLES

- .1 Maintain, at site for Project Manager and Consultant one record copy of:
 - .3 Contract Drawings.
 - .4 Specifications.
 - .5 Addenda.
 - .6 Change Orders and other modifications to Contract.
 - .7 Reviewed shop drawings, product data, and samples.
 - .8 Field test records.
 - .9 Inspection certificates.
 - .10 Manufacturer's certificates.
- .4 Store record documents and samples in field office apart from documents used for construction in secure location.
- .5 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual.
- .6 Maintain record documents in clean, dry and legible condition.
 - .1 Do not use record documents for construction purposes.
- .7 Keep record documents and samples available for inspection by Consultant.
- .8 Obtain and pay for three sets of white prints. As the project progresses, mark these prints to accurately indicate installed work. Have the white prints available for inspection at the site at all times and present for scrutiny at each project meeting.
- .9 Show on the record drawings the installed inverts of all services entering and leaving the building and the property. Dimension underground services at key points of every run in relation to the structure and building.
- .10 Indicate exact location of all services for future work. Show and dimension all work embedded in the structure.
- .11 Maintain in the job site office in up-to-date condition, one (1) complete set of whiteprints of each of the Electrical Contract Drawings and one (1) set of Specifications, including Revision Drawings, marked clearly and indelibly in red, indicating as-built conditions where such conditions deviate from the original directions of the Contract Documents, and indicating final installation of feeders and branch circuits.
- .12 Record Drawing markings shall include but shall not be limited to the following
 - .1 All changes in circuiting
 - .2 Size and routing of all conduits for all branch circuits including power, lighting and systems.
 - .3 Size and routing of all installed raceways and cables.
 - .4 Number and size of conductors (#12 AWG and larger) in raceways and cables.

- .5 Location of all junction boxes and pull boxes
- .6 Location of all access panels
- .7 Location of all conduit or duct stubs, installed equipment, devices and fixtures
- .8 All changes to electrical installation resulting from Addenda,
- .9 Change Orders and Site Instructions
- .10 Exact location of all services left for future work
- .11 Location by accurate horizontal and vertical dimensions of the routes and terminations of all raceways
- .12 Other items of instruction as recommended by manufacturer of each system or item of equipment.
- .2 Recording Information on Project Record Documents.
 - .13 Record information on set of drawings, and in copy of Project Manual, provided by Project Manager.
 - .14 Use felt tip marking pens, maintaining separate colours for each major system, for recording information.
 - .15 Record information concurrently with construction progress.
 - .1 Do not conceal Work until required information is recorded.
 - .16 Contract Drawings and shop drawings: mark each item to record actual construction, including:
 - .1 Changes made by change orders.
 - .2 Details not on original Contract Drawings.
 - .3 References to related shop drawings and modifications.
 - .17 Specifications: mark each item to record actual construction, including:
 - .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
 - .2 Changes made by Addenda and change orders.
 - .18 Other Documents: maintain manufacturer's certifications, inspection certifications, field test records, as required by individual specifications sections.
 - .19 Provide digital photos, if requested, for site records.

1.15 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .2 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .1 Except for equipment intended for installation outdoors, store equipment indoors in dry location.
 - .2 Store and protect equipment and materials from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .3 Packaging Waste Management: remove and dispose of all packaging waste materials.
 - .1 Where possible, return packaging materials to supplier for re-use.
 - .2 Divert all recyclable materials from landfill.

PART 2 **PRODUCTS**

2.1 **DESIGN REQUIREMENTS**

- .1 Operating voltages: to CAN3-C235.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.
 - .1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .3 Language operating requirements: provide identification nameplates and labels in English.

2.2 **MATERIALS AND EQUIPMENT**

- .1 Equipment and material shall be new and certified by a certification body accredited by the Standards Council of Canada (SCC). Where there is no alternative to supplying equipment which is not certified, obtain special approval and pay all associated fees. Notify Consultant prior to supplying material that is not SCC approved.
- .2 Factory assemble control panels and component assemblies.
- .3 Substitution of Products After Contract Award
 - .1 After acceptance of the list of products, no substitution of any item will be permitted unless the approved item cannot be delivered in time to comply with the work schedule.
 - .2 To receive acceptance, proposed substitutes must equal or exceed the quality, finish and performance of those specified and/or shown, and must not exceed the space requirements allotted on the drawings.
 - .3 Provide to the Consultant documentary proof of equality, difference in price (if any) and delivery dates, in the form of certified quotations from suppliers of both specified items and proposed substitutions.
 - .4 Include costs for any required revisions to other structures and products to accommodate such substitutions.

2.3 **ELECTRIC MOTORS, EQUIPMENT AND CONTROLS**

- .1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.
- .2 Control wiring and conduit: to be provided in accordance with the mechanical drawings and specifications except for conduit, wiring, and connections below 50V which are related to the mechanical control systems.

2.4 **WARNING SIGNS**

- .1 Warning Signs: in accordance with requirements of the authority having jurisdiction, code requirements, and as specifically noted in the Contract Documents.
- .2 Engraved signs using rigid phenolic engraving material, minimum size 175 x 250 mm.

2.5 **WIRING TERMINATIONS**

- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

2.6 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates as follows:
 - .1 Nameplates: rigid phenolic engraving material 3 mm, lettering accurately aligned and engraved into core, mechanically attached with self tapping screws.
 - .2 Nameplate colours as follows:
 - .1 Normal Power Systems: black face, white core
 - .2 Emergency/Standby Power Systems: red face, white core
 - .3 Life Safety Systems: red face, white core
 - .4 Colours for other equipment as specified by the Consultant.
 - .3 Sizes as follows:

NAMEPLATE SIZES			
Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

- .2 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.
- .3 Wording on nameplates to be approved by Consultant prior to manufacture.
- .4 Allow for minimum of twenty-five (25) letters per nameplate.
- .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .6 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .7 Terminal cabinets and pull boxes: indicate system and voltage.
- .8 Transformers: indicate capacity, primary and secondary voltages.

2.7 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, numbered, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour coding: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.

2.8 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, boxes and metallic sheathed cables.
- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.
- .3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

Prime	Auxiliary	
up to 250 V	Yellow	
up to 600 V	Yellow	Green
up to 5 kV	Yellow	Blue
up to 15 kV	Yellow	Red

Telephone	Green	
Other Communication Systems	Green	Blue
Fire Alarm	Red	
Emergency Voice	Red	Blue
Other Security Systems	Red	Yellow

2.9 FINISHES

- .1 Shop finish metal enclosure surfaces by application of powder coat rust resistant primer inside and outside, and at least two coats of finish enamel.
 - .1 Paint outdoor electrical equipment "equipment green".
 - .2 Paint indoor switchgear and distribution enclosures light gray.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Pre-Bid Examination
 - .1 Examine the site of work and become familiar with all features and characteristics affecting this work before submitting bid.
 - .2 No additional compensation will be given for extra work due to existing conditions which such examination should have disclosed.
 - .3 Report to the Consultant any unsatisfactory conditions which may adversely affect the proper completion of this work.
- .2 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

3.2 INSTALLATION

- .1 In accordance with CSA C22.1 except where specified otherwise.
- .2 Overhead and underground systems in accordance with CAN/CSA-C22.3 No.1 except where specified otherwise.

3.3 NAMEPLATES AND LABELS

- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.4 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit and sleeves prior to pouring of concrete.
 - .1 Sleeves through concrete: sized for free passage of conduit, and protruding 50 mm.
- .2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.

- .3 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

3.5 LOCATION OF OUTLETS

- .1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- .2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.
- .4 Locate light switches on latch side of doors.
 - .1 Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

3.6 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Install electrical equipment at following heights unless indicated otherwise.
 - .1 Local switches: 1400 mm.
 - .2 Wall receptacles:
 - .1 General: 300 mm.
 - .2 Above top of continuous baseboard heater: 200 mm.
 - .3 Above top of counters or counter splash backs: 175 mm.
 - .4 In mechanical rooms: 1400 mm.
 - .3 Panelboards: as required by Code or as indicated.
 - .4 Telephone and interphone outlets: 300 mm.
 - .5 Wall mounted telephone and interphone outlets: 1500 mm.
 - .6 Fire alarm stations: 1500 mm.
 - .7 Fire alarm bells: 2100 mm.
 - .8 Television outlets: 300 mm.
 - .9 Wall mounted speakers: 2100 mm.
 - .10 Clocks: 2100 mm.
 - .11 Doorbell pushbuttons: 1500 mm.

3.7 CO-ORDINATION OF PROTECTIVE DEVICES

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

3.8 FIELD QUALITY CONTROL

- .1 Refer to Section 26 05 10 Testing & Commissioning

3.9 SUBSTANTIAL PERFORMANCE REVIEW

- .1 Prior to requesting the Consultant complete a Substantial Performance review, the Contractor shall submit written confirmation that:
 - .1 All wiring devices, coverplates, motor controls, light fixtures and other equipment are operational, plumb, clean, and correctly labelled.
 - .2 All electrical equipment has been cleaned and vacuumed
 - .3 All Test Reports have been submitted including but not limited to data test reports and fire alarm verification reports with no exceptions noted.
 - .4 Factory finished equipment has been cleaned, touched up, or refinished as necessary to present a new appearance.
 - .5 All firestoppingt/smoke sealing of conduits, cables, cable trays, wireways, etc. at all wall and floor penetrations has been completed.
 - .6 All light fixtures, fixture lenses, and reflectors have been cleaned.
 - .7 All loose equipment including spare parts have been turned over to the Owner.
 - .8 Verification letter from the Seismic Consultant.
 - .9 Draft copy of the Maintenance Manual.

3.10 SYSTEM STARTUP

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

3.11 CLEANING

- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.
- .3 Where work is performed in a phased manner, or Owner will take partial occupancy of the area of Work, perform final cleaning at the end of each Phase or prior to Owner taking occupancy of each area.
- .4 Waste Management: separate waste materials for reuse and recycling.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

PART 1 **GENERAL**

1.1 **DOCUMENTS**

- .1 This Section of the Specification forms a part of the Contract Documents and is to be read, coordinated and implemented in conjunction with all other parts.

1.2 **RELATED SECTIONS**

- .1 Section 26 05 00 – Common Work Results – Electrical

1.3 **REGULATORY REQUIREMENTS**

- .1 Restraints shall meet the requirements of the latest edition of the British Columbia Building Code and amendments.
- .2 The Seismic Consulting Engineer should be able to provide a proof of professional insurance and the related practice credentials if requested by the Electrical Consultant. The Seismic Consulting Engineer should be familiar with SMACNA, ECABC & NFPA guidelines as well as BCBC requirements.
- .3 The Contractor's Seismic Consultant shall submit original signed BC Building Code Letters of Assurance Schedules S-B and S-C to the Prime Consultant.
- .4 Importance Factor: 1.5.
- .5 Use the Electrical Contractors Association of BC details in the absence of any local requirements.
- .6 The above requirements shall not restrict or supplant the requirements of any local bylaws, codes, or other certified agencies which may have jurisdiction over all or part of the installation.

1.4 **SCOPE**

- .1 It is the responsibility of equipment manufacturers to design their equipment so that the strength and anchorage of internal components of the equipment exceeds the force level used to restrain and anchor the unit itself to the supporting structure.
- .2 Manufacturer's shop drawings to be submitted with seismic information on equipment structure, bracing and internal components and as required by Division 01 and other Division 26 specification sections.
- .3 Provide restraint on all equipment and machinery, which is part of the building electrical services and systems, to prevent injury or hazard to persons and equipment in and around the structure. Restrain all such equipment in its normal position in the event of an earthquake.
- .4 The total electrical seismic restraint design and field review and inspection will be by a B.C. registered professional structural engineer who specializes in the restraint of building elements. Contractor to allow for coordination, provision of seismic restraints, as well as all costs for the services of the Seismic Restraint Engineer. This Engineer, herein referred to as the Seismic Consultant, will provide normal engineering functions as they pertain to seismic restraint of electrical installations.

- .5 The Contractor shall be aware of, and comply with, all current seismic restraining requirements and make provision for those that may come into effect during construction of the project. Make proper allowance for such conditions in the tender. The contractor shall include for all costs related to seismic restraint.
- .6 The Seismic Consultant shall provide detailed seismic restraint installation shop drawings to the Contractor. Copies of the shop drawings to be included in the final project manual.
- .7 Provide seismic restraints on all equipment, and/or installations or assemblies, which are suspended, pendant, shelf mounted, freestanding and/or bolted to the building structure or support slabs.
- .8 The Seismic Consultant shall provide inspections during and after installation. The Contractor shall correct any deficiencies noted without additional cost to the contract.
- .9 Include all costs associated with the Seismic installation and certification in the base tender.

1.5 SHOP DRAWINGS & SUBMITTALS

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

PART 2 PRODUCTS

2.1 SLACK CABLE SYSTEMS

- .1 Slack cable restraint systems shall be as designed and supplied by Vibra-Sonic Control or equal.
- .2 Slack cable systems to allow normal maintenance of equipment and shall not create additional hazard by their location or configurations. Contractor shall rectify any such installations at no additional cost, all to the satisfaction of the engineer and inspection authority having jurisdiction.
- .3 Coordinate requirements of slack cables with suppliers prior to installation.

PART 3 EXECUTION

3.1 GENERAL

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

3.2 CONDUITS

- .1 Provide restraint installation information and details on conduit and equipment as indicated below:

- .2 Vertical Conduit:
 - .1 Attachment - Secure vertical conduit at sufficiently close intervals to keep the conduit in alignment and carry the weight of the conduits and wiring. Stacks shall be supported at their bases and, if over 2 stories in height, at each floor by approved metal floor clamps.
 - .2 At vertical conduit risers, wherever possible, support the weight of the riser, at a point or points above the center of gravity of the riser. Provide lateral guides at the top and bottom of the riser, and at intermediate points as required by the seismic engineer.
 - .3 Riser joints shall be braced or stabilized between floors.
- .3 Horizontal Conduits:
 - .1 Supports - Horizontal conduit shall be supported at sufficiently close intervals to keep it in alignment and prevent sagging.
 - .2 EMT tubing - tubing shall be supported at approximately 1.2 m intervals for tubing or as directed by the seismic engineer.
- .4 Provide transverse bracing at 12.2 m o.c. maximum unless otherwise noted. Provide bracing at all 90° bend assemblies, and pull box locations.
- .5 Provide longitudinal bracing at 24.4 m o.c. maximum unless otherwise noted.
- .6 Do not brace conduit runs against each other. Use separate support and restraint system.
- .7 Support all conduits in accordance with the capability of the pipe to resist seismic load requirements indicated.
- .8 Trapeze hangers may be used. Provide flexible conduit connections where conduits pass through building seismic or expansion joints, or where rigidly supported conduits connect to equipment with vibration or seismic isolators.
- .9 A conduit system shall not be braced to dissimilar parts of a building or two dissimilar building systems that may respond in a different mode during an earthquake. Examples: wall and a roof; solid concrete wall and a metal deck with lightweight concrete fill.
- .10 Provide large enough conduit sleeves through walls or floors to allow for anticipated differential movements with firestopping where required.
- .11 It is the responsibility of the contractor to ascertain that an appropriate size restraint device be selected for each individual piece of equipment. Submit details on shop drawings. Review with seismic consultant and submit shop drawings to consultants for their reference.

3.3 FLOOR MOUNTED EQUIPMENT

- .1 Bolt all equipment, e.g. transformers, switchgear, generators, motor control centres, free standing panelboards, control panels, capacitor banks, etc. to the structure. Seismic Engineer shall design anchors and bolts.

3.4 LIGHT FIXTURES

- .1 Luminaires installed in suspended ceilings shall be hung independently of the ceiling system. Fixtures shall be secured to concrete or structural deck above by at least two tight cables which are connected to the fixture at diagonal points.

- .2 Surface and recessed style fixtures shall be hung independently of the ceiling system. Fixtures shall be secured to concrete or structural deck above by taught cables.
- .3 Fixtures which are hung independently of ceiling systems shall have minimum of two seismic cable in addition to the chain or cable used to support the fixture. Seismic restraint cables shall be secured into the concrete or structural deck above.
- .4 Cables shall be corrosion resistant and approved for the application.
- .5 Fixtures which are rod hung shall have seismic ball alignment fittings at the ceiling and fixture.

END OF SECTION

PART 1 **GENERAL**

1.1 **DOCUMENTS**

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

1.2 **EXISTING CONDITIONS**

- .1 Examine site prior to submitting Tender and be responsible for ascertaining all conditions which will affect this trade whether shown on the drawings or not and to take all the necessary measurements.
- .2 Investigate and confirm the locations, the method of connections and routes of existing and new electrical facilities. Report at once any discrepancy between drawings, specifications and existing conditions.
- .3 Absorb any costs incurred by failure to carry out this investigation and examination.

1.3 **CIRCUIT TRACING**

- .1 Contractor is required to confirm and create accurate branch circuit schedules for panelboards that are being modified or part of a shutdown. Contractor is to confirm circuits on site, update any changes, and submit to the consultant for update on Record Drawings. Label all receptacles and equipment with circuit number.

1.4 **GENERAL REQUIREMENTS**

- .1 Provide and be responsible for the removal, relocation, reconnection, etc., of electrical devices, equipment, material, etc., as indicated on the drawings and/or as required by renovations to existing building and the installation of new facilities.
- .2 All electrical devices and equipment which are disconnected, removed from service, etc., and which are not reused on the job and not required are to be offered to Owner. If refused, remove from site.
- .3 Continuity of power and communication shall be maintained or restored promptly where services to other portions of a site are affected by renovation or demolition that is outlined on architectural, structural, mechanical or electrical plans or specifications.

1.5 **SHUTDOWNS**

- .1 Outage plan to be provided by the contractor to the Owner and Consultant team for review and approval prior to interruption of any existing services. The general outline of the plan to be submitted as follows:
 - .1 Electrical Power Pre-Change Over Meeting.
 - .1 Meeting time.
 - .2 Personnel required, including specialty personnel (e.g.: utility, mechanical contractor, etc.).

- .3 Pre-requisite Information: Distribution coordination studies and test results.
Generator load test results.
- .2 List all loads to be shut down.
 - .1 Distribution.
 - .2 Sub-distribution.
 - .3 Panels.
 - .4 Circuits.
- .3 Back out plan.
- .4 Monitoring plan.
- .5 List of personnel to be on site.
 - .1 Electrical contractor foreman and required personnel.
 - .2 Owner representatives and maintenance personnel
- .6 Submit confirmation sheet on panelboards. Trace circuits per Section 1.3

PART 2 **PRODUCTS**

- .1 Manufacturers of existing devices and equipment where known are indicated on the drawings or in the specifications.
- .2 Material and equipment added shall match existing wherever possible unless otherwise noted.

PART 3 **EXECUTION**

3.1 **GENERAL**

- .1 Visit site prior to submitting Tender and make survey of renovation areas. Check out locations and operation of all systems and be aware of all requirements involved in changes and modifications to systems. Consult maintenance staff for any information regarding type and operation of systems. Take into account and allow for all work required to existing facilities to meet requirements as indicated on the drawings and in the specifications.
- .2 Provide all labour and equipment required to remove existing electrical facilities in the area to be renovated as noted.
- .3 Provide all labour and materials required to revise existing electrical facilities as indicated on the drawings and/or as required by building renovations and for installation of new facilities.
- .4 Existing facilities shall remain operational during construction period. When renovations are complete, all facilities shall be checked and tested and shall be left in a proper working order and to the satisfaction of Engineer and Owner.
- .5 Where walls, ceilings, floors, etc., containing electrical devices, material and equipment, etc., are removed and the deletion of outlets in said areas disrupt service to adjacent devices and equipment, then conduit and wiring shall be provided to pick up adjacent devices and equipment to maintain continuity of service.

3.2 **DISPOSAL OF HAZARDOUS MATERIAL**

- .1 Dispose of PCB Ballasts, radioactive material in smoke detectors, PCB capacitors, and PCB transformers in accordance with:

- .1 Canadian Environmental Protection Act (Canada)
 - .2 Canadian Environmental Protection Act - Chlorobiphenyls Regulations (Canada)
 - .3 Provincial Environmental Protection Act
 - .4 Transportation of Dangerous Goods Act, (Canada)
 - .5 Dangerous Goods Transportation and Handling Act
 - .6 Other legislation and regulations which apply to the performance of the work of this section.
- .2 Perform work in accordance with the recommendations in the following Environment Canada publications:
 - .1 Handbook on PCBs in Electrical Equipment by Environment Canada.
 - .2 Identification of Fluorescent Lamp Ballasts Containing PCBs, EPS 2/CG/2, April 1986, by Environment Canada.
 - .3 Persons employed for the removal of capacitors and other energized electrical equipment shall be qualified electricians.
 - .4 Where contact with liquid PCB is possible, personnel shall be instructed in handling procedures, safety precautions, use of safety equipment and applicable Provincial and Federal legislation and regulation.
 - .5 Handling and transportation of hazardous wastes shall be performed by a company registered as a carrier with the Provincial Environment department.
 - .6 Submit proof that all persons involved in handling, packing, loading, transportation, unloading, unpacking and disposal of PCB waste are trained in accordance with the Dangerous Goods Transportation and Handling Act.
 - .7 Dispose of all radioactive smoke detector components as radioactive waste when, smoke detectors:
 - .1 contain 5 microcuries (185 kilobecquerels) or more of Americium-241 or any amount of Radium.
 - .2 containing less than 5 microcuries (185 kilobecquerels) of Americium-241 are disposed of in quantities of ten or more.
 - .8 Dispose of radioactive smoke detector components by making disposal arrangement with one of the following radioactive waste disposal facilities:
 - .1 Original equipment manufacturer.
 - .2 Waste Operations Branch
Atomic Energy of Canada Ltd.
Chalk River, Ontario K0J 1J0
 - .3 Atomic Energy of Canada licensed waste disposal facility.
 - .9 Contact selected radioactive waste disposal facility to obtain their instructions for packaging, labeling and shipping of radioactive smoke detector components.
 - .10 Package, label and ship radioactive smoke detector components in accordance with waste disposal facility's instructions and in accordance with Provincial and Federal legislation and regulations governing the handling, transportation and disposal of radioactive materials.

3.3 LAMP DISPOSAL

- .1 Contractor to recycle lamps (glass, phosphor, and metal). Provide receipt in maintenance manual for lamp recycling.

3.4 EXISTING SYSTEM SHUTDOWNS

- .1 Shutdowns for tie into existing systems may be required after normal working hour to maintain facility operation.
- .2 All costs related to non-coordinated nuisance alarms or the fire alarm system caused by this contractor will be borne by this contractor (i.e. false charges by Fire Department).

END OF SECTION

PART 1 **GENERAL**

1.1 **DOCUMENTS**

- .1 This Section of the Specifications forms a part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

1.2 **RELATED SECTIONS**

- .1 Section 26 05 00 – Common Work Results – Electrical

1.3 **SCOPE**

- .1 The Electrical Division to take note that the demolition and renovation will be done in an occupied building that is normally occupied during the day and during the evenings, seven days a week, year round. Maintain electrical and communication systems as required to minimize services disruption.
- .2 The work of this contract shall be done in a phased manner to allow operations in the renovated area to continue. Refer to the Construction Manager's phasing plan and schedule. To be confirmed prior to the work commencing.
- .3 The Electrical Division to also take note of the dust and debris control requirements as outlined in the architectural and front end specification.
- .4 Electrical tender documents do not show all existing luminaires, wiring devices, conduit, boxes or wire. Conduit routing and wire grouping is not known. During demolition, the Electrical trade(s) are to deactivate all existing electrical and communication systems affected in such a manner that complete systems are not deactivated and system circuits affected in party wall partitions to be reactivated immediately on a temporary or permanent basis as site conditions dictate.
- .5 Any discrepancies appearing on the drawings or in this specification are to be brought to the attention of the Consultant who will provide instruction.
- .6 Where devices are not shown on the new plans in walls that are not being removed, such devices are to be reinstated and remain.

1.4 **SCHEDULING**

- .1 Refer to Prime Consultant divisions

1.5 **EXAMINATION**

- .1 Refer to Prime Consultant divisions.

1.6 **PROTECTION**

- .1 Refer to Prime Consultant divisions.

PART 2 **PRODUCTS**

2.1 **STANDARDS**

- .1 Refer to applicable material standards in other specification sections and/or as detailed on drawings.

PART 3 **EXECUTION**

3.1 **DEMOLITION**

- .1 Demolition to be carried out in strict conformance to provincial, local and municipal authorities and Part 8 of the B.C. Building Code current edition.
- .2 All redundant electrical components in the areas of demolition excluding those specifically identified, shall become the property of the Electrical Division and shall be removed from site.

3.2 **DISRUPTION TO OPERATIONS**

- .1 Contractor to issue a scheduled shutdown time and coordinate installation of the new equipment as appropriate. All equipment installed and modified requires testing before startup.
- .2 Contractor to provide temporary connections to all required equipment for temporary power during the installation of any new equipment.

3.3 **REUSE OF EXISTING COMPONENTS**

- .1 Existing components may be reused only where so specifically indicated on the drawings or in the specifications, however in all cases all wiring shall be new and no splicing shall be permitted at any location. All lighting switches and all receptacles shall be new.

3.4 **DISRUPTION OF CIRCUITS**

- .1 Circuit: power, voice/data, fire alarm, control etc. which are disrupted during demolition and are essential, to be made good immediately. The Electrical Trade(s) to identify these circuits to the Consultant. Specific tasks involving the demolition of essential circuits will require that the contractor obtain permission from the Owner before proceeding.

3.5 **ABANDONED CONDUIT, WIRE AND EXISTING CIRCUITS**

- .1 Except as specifically noted, all abandoned conduit and wire to be removed and disposed of by the Electrical Divisions.
- .2 Remove all accessible (eg. Surface) wiring and cables back to source.
- .3 Remove abandoned outlets and raceway, even if in or behind drywall, where they are located behind millwork or in locations unsuitable for reuse i.e. not at standard heights for switches or outlets.
- .4 All remaining circuits to be rerouted as required and suitably secured to the building structure to CEC Standards.
- .5 Any cabling, including voice/data wiring, presently resting on any suspended ceiling system to be removed as part of the renovation process and shall be neatly bundled, protected and permanently secured to building structure. No cabling is permitted to rest on the ceiling system.

END OF SECTION

PART 1 **GENERAL**

1.1 **DOCUMENTS**

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

1.2 **SUMMARY**

- .1 Test and check all portions of the electrical systems for satisfactory operation. All tests shall be tabulated, signed and incorporated into the Operating and Maintenance Manuals. All testing and commissioning to be carried out under this contract. Procedures and tests outlined below are electrical tests required in addition to normal visual and mechanical inspections which must be carried out prior to placing equipment in service.
- .2 Prior to field testing, obtain applicable copies of factory tests for comparative results.
- .3 Additional testing requirements may be outlined in specific Sections in Division 26, 27, and 28.

PART 2 **PRODUCTS**

- .1 Not used.

PART 3 **EXECUTION**

- .1 General
 - .1 Contractor shall coordinate and pay for all testing required by the Contract Documents including any additional testing required by the Authority Having Jurisdiction.
 - .2 All deficient equipment/devices shall be replaced and retested.
 - .3 Testing for each System shall be performed after the System installation is complete and prior to the system being put into continuous operation.
 - .4 Advise the Consultant a minimum of three (3) working days in advance of each test and carry out tests in the presence of the Consultant.
 - .5 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
 - .6 Submit detailed typewritten test reports to the Consultant within five (5) working days after the completion of each test. Include all test reports in the Maintenance Manuals.
 - .1 Test reports shall clearly indicate each component that has been individually tested, test results, and whether the results are within acceptable limits.
 - .2 Each test report shall be accompanied by a cover sheet outlining the test and summarizing any items that have failed the tests.
 - .1 Cover sheet shall include names, signatures, and contact information of the individuals who conducted the tests.
 - .7 Protective Device Setting and Testing
 - .1 All work shall conform to NETA standards.

- .2 Ensure circuit protective devices including but not limited to overcurrent trips, relays, and fuses are installed to required values per protection and coordination study.
- .2 Contractor Testing:
 - .1 Infra-Red Scanning:
 - .1 Perform infrared scan of all distribution equipment under loaded conditions (new and existing).
 - .2 Load Balance:
 - .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
 - .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
 - .3 Provide upon completion of work, load balance report, phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
 - .3 Systems:
 - .1 Communication cabling testing report for the category copper cable must be submitted for review. Value smust include: wiremap, propagation delay, delay skew, length, insertion loss, return loss, NEXT, PSNEXT, ELFEXT, PSELFEXT, ACR, and PSACR. Report summary identifying lins with pass, fail, conditional pass, conditional fail must be provided. Failing or conditionally failing links must be fixed nd re-tested at the contractors expense. Conditional pass links must be highlighted and will, at the discretion of the Departmental Representative, be required to be fixed and re-tested at the contractor's expense.
 - .2 Security surveillance system PTZ camera operation must be demonstrated and witnessed by the Departmental Representative. Integration of video storage and display into the existing system software programming must be witnessed at the same time.
 - .4 Insulation resistance testing:
 - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
 - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
 - .3 Check resistance to ground before energizing.
 - .5 Breakers and Load Break Switches
 - .1 clean and lubricate;
 - .2 visual inspection;
 - .3 manual function test;
 - .4 torque test;
 - .5 contact resistant test (100 amp resistance tester);
 - .6 electrical function test;
 - .7 function trip test of all protective relay device.
 - .6 Fused or Unfused Disconnect Switches:
 - .1 Visually inspect and clean.

- .2 Ductor test across switch blade contact surfaces.
- .3 Megger test.
- .4 Mechanical function test.
- .7 Devices
 - .1 Test all receptacles for proper polarity, circuitry and grounding.
- .3 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports to Consultant for review. Include field reports in Operations and Maintenance Manuals.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Obtain manufacturer's field services for commissioning of equipment as required in other Sections of Division 26, 27, and 28 specifications.
- .4 Testing by Independent Testing Agency
 - .1 Contractor shall arrange and pay for system testing to be performed by an independent testing agency.
 - .2 All required testing shall be completed and any deficiencies corrected prior to energizing equipment.
 - .3 Check resistance to ground before energizing any equipment.
 - .4 Contractor shall provide all necessary tools, material, and labour to prepare the equipment for testing, to assist the testing agency representatives during the tests, and to re-connect equipment on completion of testing.
 - .1 Include in Bid price all costs associated with the coordination of testing, provision of labour required to carry out testing, and required materials other than testing instruments.
 - .5 The following tests shall be performed by the independent testing agency:
 - .1 Fire alarm systems
- .5 Conduct additional testing as required in other Sections in Division 26, 27, and 28.

3.2 STANDARDS

- .1 The following tests shall be conducted in accordance with latest CSA, ASTM, IEEE and IPCEA standards, recommendations for power cable and equipment testing and authority waving jurisdiction. Notwithstanding, the test levels listed in these standards, in no case shall the maximum DC test level exceed manufacturer's factory test AC level for that equipment.
- .2 Where production tests are required by EEMAC or CSA for manufactured equipment, provide records of these tests.
- .3 All tests shall be completed in accordance with manufacturer's published instructions. If these instructions do not conform to the test requirements as specified herein inform the Engineer prior to proceeding with the test.

3.3 TEST APPARATUS AND INSPECTION REPORT

- .1 The testing company to be responsible for furnishing all apparatus and labour required for the test operations.

- .2 Inspection and test results to be recorded on a suitable form which shall be furnished by the testing company. The inspection and report forms shall be submitted to the Engineer. Each form to be signed by the test technician. Space to be provided for noting approved items and their disposition.
- .3 Testing company to submit full commissioning reports and information for as-built drawings and acceptance documents signed by test technician.
- .4 Upon completion of the project, the testing company to assemble complete sets of inspection/test results/reports to be placed in the operating and maintenance manuals.

3.4 SYSTEM ACCEPTANCES

- .1 Prior to requesting inspection, submit, for review by the Consultant letters from the Manufacturers of equipment and systems indicating the their Technical Service Representative have inspected and tested the equipment and systems and are satisfied with the methods of installation, connections and operation.
- .2 Acceptance letters shall be submitted for the following:
 - .1 Low voltage lighting control
 - .2 Audio visual system
 - .3 Security access control & PTZ video camera

END OF SECTION

PART 1 **GENERAL**

1.1 **DOCUMENTS**

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

1.2 **RELATED REQUIREMENTS**

- .1 Electrical Systems Testing and Commissioning Section 26 05 10.

1.3 **WORK INCLUDED**

- .1 Provide operation and maintenance data as specified herein for incorporation in operation and maintenance manuals. Before requesting final certificates, submit copies of the operation/maintenance manuals.

1.4 **MANUALS**

- .1 Submit three (3) hard copy bound sets and one (1) digital set of the operations and maintenance manual on CD or USB memory stick.
 - .1 Submit one draft hard copy to the Consultant for review at Substantial Completion prior to final issue.
- .2 O&M Manual Format
 - .1 Organize data as instructional manual.
 - .2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 219 x 279 mm with spine and face pockets.
 - .3 When multiple binders are used correlate data into related consistent groupings.
 - .1 Identify contents of each binder on spine.
 - .4 Cover: identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.
 - .5 Arrange content by systems, under Section numbers and sequence of Table of Contents.
 - .6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
 - .7 Text: manufacturer's printed data, or typewritten data.
 - .8 Drawings: provide with reinforced punched binder tab.
 - .1 Bind in with text; fold larger drawings to size of text pages.
 - .9 Provide to scale CAD files in dwg format on CD.
- .3 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
- .4 Contents:
 - .1 Table of Contents for Each Volume: provide title of project;
 - .1 Date of submission; names.

- .2 Addresses, and telephone numbers of Consultant and Contractor with name of responsible parties.
- .3 Schedule of products and systems, indexed to content of volume.
- .2 For each product or system:
 - .1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
 - .3 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.
 - .4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
 - .5 Typewritten Text: as required to supplement product data.
 - .1 Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.
 - .6 Training: refer to Section 26 05 12 Electrical Equipment and Systems Demonstration and Training.
- .5 The divider tabs shall be laminated Mylar plastic and coloured according to Section . Plastic tabs with typewritten card insertions will not be accepted. Index manuals as follows:
 - .1 Tab 1.0 Division 26, 27, and 28 System complete with title page.
 - .2 Tab 1.1 List of Division 26, 27, and 28 Drawings
 - .3 Tab 1.2 Description of Systems
 - .4 Tab 1.3 Equipment Suppliers and Parts
 - .5 Tab 2.0 (.1, .2, etc.) Shop Drawings.
 - .6 Divider tabs shall be mylar plastic and colour coded.
- .6 Each manual shall contain:
 - .1 Table of contents. Arrange contents sequentially by systems under section numbers. Label tabs of dividers between each to match section numbers in table of contents.
 - .2 Name and contact information of all project Contractors including all Electrical subcontractors.
 - .3 Copies of all contractor and subcontractor statements of warranty.
 - .4 Name and contact information of all Electrical equipment suppliers.
 - .5 Systems Descriptions. A brief synopsis of each system typed and inserted at the beginning of each section. Include sketches and diagrams where appropriate.
 - .6 Descriptive and technical data.
 - .7 Maintenance and operating instructions for all electrical equipment and controls. (These operating instructions need not be manufacturer's data but may be typewritten instructions in simple language to guide the Owner in the proper operation and maintenance of this installation.)
 - .8 Lubricating and servicing intervals recommended.
 - .9 A copy of all wiring diagrams complete with wire coding.
 - .10 List of spare parts of all electrical equipment complete with names and addresses of sales, service representatives and suppliers.
 - .11 Copy of test data.

- .12 A motor list showing each motor number, name, horsepower, nameplate, current rating, heater size and type, and current being drawn.
- .13 Include type and accuracy of instruments used.
- .14 Set of final reviewed Shop Drawings.
- .15 Provide manufacturer's installation instructions for all systems and components.
- .16 provide manufacturer's operation instructions for all systems and components
- .17 Provide manufacturer's maintenance instructions for all systems and components. Include the following:
 - .1 Complete parts list for all serviceable components, including description and catalogue number.
 - .2 List of spare parts supplied under the Contract and list of other spare parts recommended by manufacturers.
- .18 Provide copies of all inspection certification reports from authorities having jurisdiction.
- .19 Provide copies of reports documenting the results of all tests, including factory tests, required by the Contract Documents to be performed.
- .20 Provide copies of all manufacturer's warranties.
- .21 Record Drawings.
- .22 Operating instructions to include following:
 - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
 - .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
 - .3 Safety precautions.
 - .4 Procedures to be followed in event of equipment failure.
 - .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.
 - .6 Recommended spare parts

END OF SECTION

PART 1 **OPENINGS**

1.1 **OPENINGS AND SLOTS**

- .1 Provide all openings as necessary and as specified elsewhere to permit the installation of all conduits and cables and recessed equipment and devices.
- .2 Grind and file smooth the interiors and edges of all sleeves and slots prior to pulling any cables.

PART 2 **WALL, CEILING, AND FLOOR PENETRATIONS**

- .1 Any and all penetrations through walls, ceilings and floors (fire, smoke, sound as well as all other penetrations) must be sealed after the installation of all conduits, cables, bus ducts, cable trays, wireways, etc., to maintain the integrity of the separations in a manner approved by the Consultant and the authorities having jurisdiction. Use sealing materials as specified herein and shown on the drawings.
- .2 Rated sealing systems for penetrations of Fire Rated walls, ceilings and floors: Hilti, or approved equal, refer to the drawings. Contractors are to submit ULC, cUL, WHI, or equivalent certified Design or System Data Sheets to demonstrate compliance of a particular Floor or Wall Assembly, Through Penetrant, and Sealant with requirements and for what period of time.
- .3 Provide bus ducts, cable trays, wireways, etc., with fire barriers at each floor and at each fire separation and smoke separation, and further seal against the migration of smoke.
- .4 Seal all slots, core holes, etc., not being used.
- .5 Provide fire-rated gypsum board of required thickness around all surfaces of recessed panelboards and cabinets within rated separations so as to maintain the separation rating as approved by the authorities having jurisdiction.
- .6 Provide fire-rated gypsum board enclosures for lighting fixtures recessed in fire rated ceiling assemblies, all as required by the authorities having jurisdiction.

PART 3 **WATERPROOFING/VAPOUR BARRIERS**

- .1 Generally penetrations through waterproofing members and vapour barriers will not be permitted. However, where any work must pierce vapour barriers and waterproofing membranes including waterproofed concrete, the method of installation, colour of caulking material and location of penetration shall be as approved by the Consultant and as coordinated with Structural Engineer prior to proceeding with the work. Supply and install all necessary sleeves, caulking and flashing and make the penetrations watertight. For penetrations of vapour barrier, maintain integrity of the system. Restore penetrations through existing surfaces to match the surroundings.
- .2 Provide specified caulking around all exterior recessed lighting fixtures in concrete steps, walls, etc.
- .3 Provide clear silicon bead on top and down both sides of all exterior wall mounted devices (e.g. light fixtures and gongs) where devices are exposed to the weather.

PART 4 **EQUIPMENT FINISHES**

- .1 Thoroughly degrease all metalwork and apply one overall coat of zinc chromate primer to all electrical equipment enclosures, supports, switchgear cubicles, bus ducts, gutters, panelboards, low tension and other cabinets. Unless otherwise directed, apply one overall coat of grey enamel and a second coat of gloss enamel. Paint all exposed surfaces.
- .2 Grey ASA #61 unless matching existing equipment in which case colour shall match existing.
- .3 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint. Ensure that equipment finishes are not defaced during installation. Scratched or otherwise marred surfaces shall be refinished before the job will be accepted. Other surfaces shall be completely repaired to match original paint. Patching of damaged area will not be accepted.
- .4 Clean and prime exposed non-galvanized hangers, racks, and fastenings to prevent rusting.
- .5 Generally, equipment finishes shall be as outlined under applicable sections of the specifications.

PART 5 **VIBRATION AND NOISE CONTROL**

5.1 **CONNECTIONS**

- .1 Connections to rotating, vibrating, or other noise-producing equipment such as motors, generators and transformers shall be by means of flexible conduit and flexible stranded conductors so as to minimize transmitted noise and vibration. Where equipment is mounted by means of resilient supports and is subject to physical displacement under such conditions as energizing a motor, the flexible conduit connections shall be formed into a loop of sufficient length to permit freedom of travel.

PART 6 **PRODUCTS**

- .1 Mason Z-1011 seismic restraints.
- .2 Mason SLFH open spring isolators.
- .3 Mason Super W pad isolator, 50 durometer.
- .4 Mason HD hangers.
- .5 or as required by seismic consultant or manufacturer's specifications

PART 7

Locate all electrical conduit, and lighting at least 300 mm (12") below the ceiling slab, including wall-mounted equipment. Do not locate mechanical ducts over transformer cabinets.

END OF SECTION

PART 1 **GENERAL**

1.1 **RELATED REQUIREMENTS**

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

1.2 **REFERENCES**

- .1 CSA International
 - .1 CAN/CSA-C22.2 No.18, Outlet Boxes, Conduit Boxes and Fittings.
 - .2 CAN/CSA-C22.2 No.65, Wire Connectors (Tri-National Standard with UL 486A-486B and NMX-J-543-ANCE-03).
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
 - .1 EEMAC 1Y-2, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).
- .3 National Electrical Manufacturers Association (NEMA)

1.3 **SUBMITTALS**

- .1 Submit in accordance with Section 26 05 00 Common Work Results-Electrical.

1.4 **DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with 26 05 00 Common Work Results - Electrical.

PART 2 **PRODUCTS**

2.1 **MATERIALS**

- .1 Pressure type wire connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper conductors as required.
- .2 Fixture type splicing connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- .3 Bushing stud connectors: to NEMA to consist of:
 - .1 Connector body and stud clamp for conductors.
 - .2 Clamp for round copper conductors.
 - .3 Stud clamp bolts.
 - .4 Bolts for copper conductors.
 - .5 Bolts for aluminum conductors.
 - .6 Sized for conductors as indicated.
- .4 Clamps or connectors for armoured cable, TECK cable as required to: CAN/CSA-C22.2 No.18.

PART 3 **EXECUTION**

3.1 **INSTALLATION**

- .1 Remove insulation carefully from ends of conductors and:
 - .1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.
 - .2 Install mechanical pressure type connectors and tighten screws [with appropriate compression tool recommended by manufacturer]. Installation shall meet secureness tests in accordance with CAN/CSA-C22.2 No.65.
 - .3 Install fixture type connectors and tighten to CAN/CSA-C22.2 No.65. Replace insulating cap.
 - .4 Install bushing stud connectors in accordance with NEMA.

END OF SECTION

PART 1 **GENERAL**

1.1 **RELATED REQUIREMENTS**

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

1.2 **REFERENCES**

- .1 Refer to Section 26 05 00 Common work results for electrical.

1.3 **SUBMITTALS**

- .1 Submit in accordance with Section 26 05 00 Common Work Results-Electrical.

1.4 **DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 26 05 00 Common Work Results - Electrical.

PART 2 **PRODUCTS**

2.1 **BUILDING WIRES**

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2 Copper conductors: size as indicated, with 600 V insulation of cross-linked thermosetting polyethylene material rated XLPE.

2.2 **TECK 90 CABLE**

- .1 Cable: in accordance with Section 26 05 00 - Common Work Results for Electrical. Use is restricted to exterior connections to luminaires where not directly visible to the public.
- .2 Conductors:
 - .1 Grounding conductor: copper unless otherwise indicated.
 - .2 Circuit conductors: copper, unless otherwise indicated size as indicated.
- .3 Insulation:
 - .1 Cross-linked polyethylene XLPE.
 - .2 Rating: 600V.
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: interlocking aluminum.
- .6 Overall covering: thermoplastic polyvinyl chloride, compliant to applicable Building Code classification for this project (FT6 rated if installed indoors/in plenum).
- .7 Fastenings:
 - .1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
 - .2 Channel type supports for two or more cables at supported as recommended by the cable manufacturer.
 - .3 Threaded rods: 6 mm diameter to support suspended channels.

- .8 Connectors:
 - .1 Watertight, unless noted otherwise, approved for TECK cable.

2.3 ARMoured CABLES

- .1 Conductors: insulated, copper, size as indicated.
- .2 Type: AC90.
- .3 Armour: interlocking type fabricated from aluminum strip.
- .4 Connectors: anti short connectors.

PART 3 EXECUTION

3.1 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and Section 26 05 10 – Testing and Commissioning.

3.2 GENERAL CABLE INSTALLATION

- .1 Lay cable in cable trays in accordance with Section 26 05 36 - Cable Trays for Electrical Systems.
- .2 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - (0-1000 V).
- .3 Cable Colour Coding: to Section 26 05 00 - Common Work Results for Electrical.
- .4 Conductor length for parallel feeders to be identical.
- .5 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.
- .6 Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.
- .7 Branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be 2-wire circuits only, i.e. common neutrals not permitted.
- .8 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

3.3 INSTALLATION OF BUILDING WIRES

- .1 Install wiring as follows:
 - .1 In conduit systems in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
 - .2 Building conduits and wiring to be installed concealed in walls, accessible ceilings, etc. in public areas.

3.4 INSTALLATION OF TECK90 CABLE (0 -1000 V)

- .1 Group cables wherever possible on channels.
- .2 Install cable exposed in service areas, concealed in public areas, securely supported by straps or hangers.

3.5 INSTALLATION OF ARMOURED CABLES

- .1 Group cables wherever possible on channels.

3.6 INSTALLATION OF CONTROL CABLES

- .1 Install control cables in conduit, underground ducts, or as indicated.
- .2 Ground control cable shield.

END OF SECTION

PART 1 **GENERAL**

1.1 **RELATED REQUIREMENTS**

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

1.2 **REFERENCES**

- .1 CSA Group
 - .1 CSA C22.1, Canadian Electrical Code, Part 1 (Current Edition), Safety Standard for Electrical Installations.
 - .2 CSA C22.2 No.41, Grounding and Bonding Equipment (Tri-National Standard, with NMX-J-590ANCE and UL 467).
 - .3 CSA C22.2 No.65-[13], Wire connectors (Tri-National Standard, with UL 486A-486B NMX-J-543-ANCE).

1.3 **ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section [01 33 00 - Submittal Procedures].
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Certificates: obtain inspection certificate of compliance covering high voltage stress from Departmental Representative.

1.4 **CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 26 05 00 Common Work Results
- .2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.

1.5 **DELIVERY, STORAGE AND HANDLING**

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

PART 2 **PRODUCTS**

2.1 **CONNECTORS AND TERMINATIONS**

- .1 Copper compression connectors to CSA C22.2 No.65 as required sized for conductors.
- .2 Contact aid for aluminum cables where applicable.

- .3 joint boxes dry location type in accordance with Section 26 05 33 - Raceway and Boxes for Electrical Systems.

PART 3 **EXECUTION**

3.1 **EXAMINATION**

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

3.2 **INSTALLATION**

- .1 Install stress cones, terminations, and splices in accordance with manufacturer's instructions.
- .2 Bond and ground as required to CSA C22.2No.41.

3.3 **CLEANING**

- .1 Progress Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment

END OF SECTION

PART 1 **GENERAL**

1.1 **RELATED REQUIREMENTS**

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

1.2 **REFERENCES**

- .1 Not Required.

1.3 **SUBMITTALS**

- .1 Submit in accordance with Section 26 05 00 Common Work Results - Electrical

1.4 **DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 26 05 00 Common Work Results - Electrical.

PART 2 **PRODUCTS**

2.1 **SUPPORT CHANNELS**

- .1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted.
- .2 Cord Grips: Kellems grip Type 073-03 and 073-04 or approved equal.
- .3 Wire and cable ties: nylon 'Ty-rap' or approved equal for wiring and control cable. Velcro cable wraps for data cables.
- .4 Threaded hanger rods: galvanized steel, minimum 6mm diameter; larger sizes as shown on drawings or as required.
- .5 Conduit and cable clamps for individual or pair runs:
 - .1 One-hole steel or galvanized malleable iron for sizes 53mm and smaller.
 - .2 Two-hole steel for sizes larger than 53mm.
- .6 Fixture suspension chain: #3 Tenso chain.
- .7 Backboards: New 21mm (3/4") G1S paint grade fir plywood.
- .8 Conductor supports for vertical runs: O-Z Electrical Mfg. Co. Type 'S' or 'R' as required or equal, for not more than 5 wires or cables each not greater than 250 kCMIL. Kellems grip Type 022-11 or approved equal for all manufacturer-approved combinations of wires and/or cables.

PART 3 **EXECUTION**

3.1 **INSTALLATION**

- .1 Secure equipment to surfaces per manufacturer and seismic engineer's requirements.
- .2 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.

- .3 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .4 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.
- .5 Suspended support systems.
 - .1 Support individual cable or conduit runs with 6 mm diameter threaded rods and spring clips.
 - .2 Support 2 or more cables or conduits on channels supported by 6 mm diameter threaded rod hangers where direct fastening to building construction is impractical.
- .6 For surface mounting of two or more conduits use channels at minimum of 1.5 m on centre spacing or as directed by seismic engineer.
- .7 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .8 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .9 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .10 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.
- .11 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

END OF SECTION

PART 1 **GENERAL**

1.1 **RELATED REQUIREMENTS**

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

1.2 **REFERENCES**

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1, Canadian Electrical Code, Part 1, Current Edition..

1.3 **SUBMITTALS**

- .1 Provide submittals in accordance with Section 26 05 00 Common Work Results – Electrical.

1.4 **DELIVERY, STORAGE AND HANDLING**

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

PART 2 **PRODUCTS**

2.1 **JUNCTION AND PULL BOXES**

- .1 Construction: welded steel enclosure.
- .2 Covers Flush Mounted: 25 mm minimum extension all around.
- .3 Covers Surface Mounted: screw-on flat covers.

PART 3 **EXECUTION**

3.1 **JUNCTION, PULL BOXES AND CABINETS INSTALLATION**

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1.

3.2 **IDENTIFICATION**

- .1 Equipment Identification: to Section 26 05 00 - Common Work Results for Electrical.
- .2 Identification Labels: size 2 indicating system name, voltage and phase or as indicated on Drawings.

END OF SECTION

PART 1 **GENERAL**

1.1 **RELATED REQUIREMENTS**

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

1.2 **REFERENCES**

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1, Canadian Electrical Code, Part 1, Current Edition.

1.3 **SUBMITTALS**

- .1 Provide submittals in accordance with Section 26 05 00 Common Work Results – Electrical.

1.4 **DELIVERY, STORAGE AND HANDLING**

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

PART 2 **PRODUCTS**

2.1 **OUTLET AND CONDUIT BOXES GENERAL**

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm square or larger outlet boxes as required.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.
- .5 347 V outlet boxes for 347 V switching devices.
- .6 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 **GALVANIZED STEEL OUTLET BOXES**

- .1 One-piece electro-galvanized construction.
- .2 Single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square or larger outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .3 Utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.
- .4 102 mm square or octagonal outlet boxes for lighting fixture outlets.
- .5 Extension and plaster rings for flush mounting devices in finished plaster or tile walls.

2.3 **MASONRY BOXES**

- .1 Electro-galvanized steel masonry single and multi gang boxes for devices flush mounted in exposed block walls.

2.4 CONCRETE BOXES

- .1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.5 FITTINGS - GENERAL

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 35mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Do not install reducing washers.
- .5 Vacuum clean interior of outlet boxes before installation of wiring devices.
- .6 Identify systems for outlet boxes as required.

END OF SECTION

PART 1 **GENERAL**

1.1 **RELATED REQUIREMENTS**

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

1.2 **REFERENCES**

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA C22.2 No. 18, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
 - .2 CSA C22.2 No. 45, Rigid Metal Conduit.
 - .3 CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .4 CSA C22.2 No. 83, Electrical Metallic Tubing.
 - .5 CSA C22.2 No. 211.2, Rigid PVC (Unplasticized) Conduit.
 - .6 CAN/CSA C22.2 No. 227.3, Nonmetallic Mechanical Protection Tubing (NMPT), A National Standard of Canada (Current Edition).

1.3 **SUBMITTALS**

- .1 Provide submittals in accordance with Section 26 05 00 Common Work Results – Electrical.
- .2 Quality assurance submittals:
 - .1 Test reports: submit certified test reports.
 - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .3 Instructions: submit manufacturer's installation instructions.

PART 2 **PRODUCTS**

2.1 **CABLES AND REELS**

- .1 Provide cables on reels or coils.
 - .1 Mark or tag each cable and outside of each reel or coil, to indicate cable length, voltage rating, conductor size, and manufacturer's lot number and reel number.
- .2 Each coil or reel of cable to contain only one continuous cable without splices.

2.2 **CONDUITS**

- .1 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
- .2 Rigid pvc conduit: to CSA C22.2 No. 211.2.
- .3 Flexible metal conduit: to CSA C22.2 No. 56, aluminum.

2.3 CONDUIT FASTENINGS

- .1 One hole malleable iron or galvanized steel straps to secure surface conduits 50 mm and smaller.
 - .1 Two hole steel straps for conduits larger than 50 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at 1.5 m on centre or as required by the seismic consultant.
- .4 Threaded rods, 6 mm diameter, to support suspended channels.

2.4 CONDUIT FITTINGS

- .1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified. Coating: same as conduit.
- .2 Ensure factory "ells" where 90 degrees bends for 25 mm and larger conduits.
- .3 Watertight connectors and couplings for EMT.
 - .1 Set-screws are not acceptable.

2.5 EXPANSION FITTINGS FOR RIGID CONDUIT

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 100mm linear expansion.
- .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel.

2.6 FISH CORD

- .1 Polypropylene.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 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 electrical metallic tubing (EMT) where not subject to mechanical injury.
- .4 Use rigid pvc conduit underground .
- .5 Use flexible metal conduit for connection to motors in dry areas and connection to surface or recessed lighting luminaires.

- .6 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.
- .7 Minimum conduit size for lighting and power circuits: 21 mm.
- .1 Install EMT conduit from branch circuit panel to main junction boxes centrally located in each of the rooms/spaces. Use flexible AC90 armoured cable to connect to each of the individual power outlets.
- .2 Install EMT conduit underfloor to in floor poke-thru junction boxes. If conduit is to be installed in-slab, use ridged PVC.
- .3 Bend conduit cold:
 - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .4 Mechanically bend steel conduit over 19 mm diameter.
- .5 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .6 Install fish cord in empty conduits.
- .7 Remove and replace blocked conduit sections.
 - .1 Do not use liquids to clean out conduits.
- .8 Dry conduits out before installing wire.

3.3 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Run conduits in flanged portion of structural steel.
- .3 Group conduits wherever possible on channels.
- .4 Do not pass conduits through structural members except as indicated and with review of the structural consultant.
- .5 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.4 CONCEALED CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Do not install horizontal runs in masonry walls.
- .3 Do not install conduits in terrazzo or concrete toppings.

3.5 CONDUITS IN CAST-IN-PLACE CONCRETE

- .1 Locate to suit reinforcing steel.
 - .1 Install in centre one third of slab.
- .2 Protect conduits from damage where they stub out of concrete.
- .3 Install sleeves where conduits pass through slab or wall.
- .4 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed.
 - .1 Use cold mastic between sleeve and conduit.
- .5 Conduits in slabs: minimum slab thickness 4 times conduit diameter.
- .6 Encase conduits completely in concrete with minimum 25 mm concrete cover.

- .7 Organize conduits in slab to minimize cross-overs.

3.6 CONDUITS IN CAST-IN-PLACE SLABS ON GRADE

- .1 Run conduits 27 mm and larger below slab and encase in 75 mm concrete envelope.
 - .1 Provide 50 mm of sand over concrete envelope below floor slab.

3.7 CONDUITS UNDERGROUND

- .1 Slope conduits to provide drainage.
- .2 Waterproof joints (pvc excepted) with heavy coat of bituminous paint.

END OF SECTION

PART 1 **GENERAL**

1.1 **REFERENCES**

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.2 **SUBMITTALS**

- .1 Submit in accordance with Section 26 05 00 Common Work Results – Electrical.
- .2 Shop Drawings:
 - .1 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of BC, Canada.

1.3 **DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 26 05 00 Common Work Results - Electrical.

PART 2 **PRODUCTS**

2.1 **MATERIALS**

- .1 Control system: by one manufacturer and assembled from compatible components.
- .2 Reference product: Douglas Lighting Dialogue Distributed System

2.2 **LOW VOLTAGE CONTROLS**

- .1 Low voltage controls to be distributed type localized in each space and interconnected to the controls and sensors within each space.
- .2 Low voltage controls will be 0-10V controls.
- .3 Occupancy sensors shall be dual technology
- .4 Daylight sensors shall be daylight harvesting capable of dimming
- .5 Off/on/dimming switches are to be connected to the local low voltage controls

PART 3 **EXECUTION**

3.1 **MANUFACTURER'S INSTRUCTIONS**

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

3.2 **INSTALLATION**

- .1 Locate and install equipment in accordance with manufacturer's recommendations and as indicated.

3.3 **FIELD QUALITY CONTROL**

- .1 Site Tests:
 - .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

- .2 Actuate control units in presence of Departmental Representative to demonstrate lighting circuits are controlled as designated.
- .3 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

PART 1 **GENERAL**

1.1 **RELATED REQUIREMENTS**

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

1.2 **REFERENCES**

- .1 CSA International
 - .1 CSA C22.2 No.42, General Use Receptacles, Attachment Plugs and Similar Devices.
 - .2 CAN/CSA C22.2 No.42.1, Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
 - .3 CSA C22.2 No.55, Special Use Switches.
 - .4 CSA C22.2 No.111, General-Use Snap Switches (Bi-national standard, with UL 20).

1.3 **SUBMITTALS**

- .1 Submit in accordance with Section 26 05 00 Common Work Results – Electrical.

1.4 **DELIVERY, STORAGE AND HANDLING**

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

PART 2 **PRODUCTS**

2.1 **SWITCHES**

- .1 Rating and voltage as indicated on Drawings.
- .2 Manually-operated general purpose AC switches with following features:
 - .1 Terminal holes approved for No. 10 AWG wire.
 - .2 Silver alloy contacts.
 - .3 Urea or melamine moulding for parts subject to carbon tracking.
 - .4 Suitable for back and side wiring.
 - .5 White toggle.
- .3 Horsepower rated for motor loads.
- .4 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads [heating loads].
- .5 Switches of one manufacturer throughout project.

2.2 **RECEPTACLES**

- .1 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, to: CSA C22.2 No.42 with following features:
 - .1 White urea moulded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Break-off links for use as split receptacles.

- .4 Eight back wired entrances, four side wiring screws.
- .5 Triple wipe contacts and rivetted grounding contacts.
- .2 Single receptacles CSA type 5-15 R, 125 V, 15 A, U ground with following features:
 - .1 White urea moulded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Four back wired entrances, 2 side wiring screws.
- .3 Other receptacles with ampacity and voltage as indicated.
- .4 Receptacles of one manufacturer throughout project.

2.3 SPECIAL WIRING DEVICES

- .1 Special wiring devices:
 - .1 Clock hanger outlets, 15 A, 125 V, 3 wire, grounding type, suitable for No. 10 AWG for installation in flush outlet box.

2.4 COVER PLATES

- .1 Cover plates for wiring devices to: CSA C22.2 No.42.1.
- .2 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .3 Stainless steel 1 mm thick cover plates for wiring devices mounted in flush-mounted outlet box.
- .4 Sheet metal cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
- .5 Weatherproof while in use covers where indicated

2.5 SOURCE QUALITY CONTROL

- .1 Cover plates from one manufacturer throughout project.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Switches:
 - .1 Install single throw switches with handle in "UP" position when switch closed.
 - .2 Install switches in gang type outlet box when more than one switch is required in one location.
 - .3 Mount toggle switches at height in accordance with Section 26 05 00 - Common Work Results for Electrical or as specifically indicated.
- .2 Receptacles:
 - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
 - .2 Mount receptacles at height in accordance with Section 26 05 00 - Common Work Results for Electrical or as specifically indicated.
 - .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
 - .4 Install GFI type receptacles as indicated and where required by the Canadian Electrical Code.

- .3 Cover plates:
 - .1 Install suitable common cover plates where wiring devices are grouped.
 - .2 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

3.2 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
- .3 Repair damage to adjacent materials caused by wiring device installation.

END OF SECTION

PART 1 **GENERAL**

1.1 **RELATED REQUIREMENTS**

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

1.2 **REFERENCES**

- .1 CSA International
 - .1 CSA C22.2 No. 5, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, and NMX-J-266-ANCE-2010).

1.3 **ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for circuit breakers and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Include time-current characteristic curves for breakers with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage with ampacity of 50 A and over.
 - .3 Certificates:
 - .1 Prior to installation of circuit breakers in either new or existing installation, Contractor must submit 3 copies of a production certificate of origin from the manufacturer. Production certificate of origin must be duly signed by factory and local manufacturer's representative certifying that circuit breakers come from this manufacturer and are new and meet standards and regulations.
 - .1 Production certificate of origin must be submitted to Departmental Representative for approval.
 - .2 Delay in submitting production of certificate of origin will not justify any extension of contract and additional compensation.
 - .3 Any work of manufacturing, assembly or installation to begin only after acceptance of production certificate of origin by Departmental Representative. Unless complying with this requirement, Departmental Representative reserves the right to mandate manufacturer listed on circuit breakers to authenticate new circuit breakers under the contract, and to Contractor's expense.
 - .4 Production certificate of origin must contain:
 - .1 Manufacturer's name and address and person responsible for authentication. Person responsible must sign and date certificate.
 - .2 Licensed dealer's name and address and person of distributor responsible for Contractor's account.
 - .3 Contractor's name and address and person responsible for project.
 - .4 Local manufacturer's representative name and address. Local manufacturer's representative must sign and date certificate.
 - .5 Name and address of building where circuit breakers will be installed:
 - .1 Project title: [_____].
 - .2 End user's reference number: [_____].
 - .3 List of circuit breakers: [_____].

1.4 DELIVERY, STORAGE AND HANDLING

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

PART 2 PRODUCTS

2.1 BREAKERS GENERAL

- .1 Moulded-case circuit breakers, ground-fault circuit-interrupters: to CSA C22.2 No. 5
- .2 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation .
- .3 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
 - .1 Trip settings on breakers with adjustable trips to range from [3-8] times current rating.
- .4 Circuit breakers with interchangeable trips as indicated.
- .5 Circuit breakers to have minimum symmetrical rms interrupting capacity rating.
- .6 All breakers 50A and greater shall be solid state trip.

2.2 THERMAL MAGNETIC BREAKERS

- .1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

2.3 SOLID STATE TRIP BREAKERS

- .1 Moulded case circuit breaker to operate by means of solid-state trip unit with associated current monitors and self-powered shunt trip to provide inverse time current trip under overload condition, and long time short time instantaneous tripping for phase ground fault short circuit protection.

2.4 ENCLOSURE

- .1 Minimum NEMA 1 rated in compliance with manufacturer standards and recommendations.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative

- .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Install circuit breakers as indicated.

END OF SECTION

PART 1 **GENERAL**

1.1 **RELATED REQUIREMENTS**

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

1.2 **REFERENCES**

- .1 CSA International
 - .1 CAN/CSA C22.2 No.144, Ground Fault Circuit Interrupters.
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA PG 2.2, Application Guide for Ground Fault Protection Devices for Equipment.

1.3 **SUBMITTALS**

- .1 Submit in accordance with Section 26 05 00 Common Work Results – Electrical.

1.4 **DELIVERY, STORAGE AND HANDLING**

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

PART 2 **PRODUCTS**

2.1 **MATERIALS**

- .1 Equipment and components for ground fault circuit interrupters (GFCI): to CAN/CSA C22.2 No.144.
- .2 Components comprising ground fault protective system to be of same manufacturer.

2.2 **BREAKER TYPE GROUND FAULT INTERRUPTER**

- .1 Single or two pole ground fault circuit interrupter for ampacity and voltage as indicated, 1 phase circuit c/w test and reset facilities.

2.3 **GROUND FAULT PROTECTOR UNIT**

- .1 Self-contained with 15 A, 120 V circuit interrupter and duplex receptacle complete with:
 - .1 Solid state ground sensing device.
 - .2 Facility for testing and reset.
 - .3 CSA Enclosure, flush mounted with stainless steel face plate.

PART 3 **EXECUTION**

3.1 **EXAMINATION**

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

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

3.2 INSTALLATION

- .1 Do not ground neutral on load side of ground fault relay.
- .2 Pass phase conductors [including neutral] through zero sequence transformers.
- .3 Connect supply and load wiring to equipment in accordance with manufacturer's recommendations.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical
- .2 Arrange for field testing of ground fault equipment by Contractor before commissioning service.
- .3 Demonstrate simulated ground fault tests.

END OF SECTION

PART 1 **GENERAL**

1.1 **RELATED REQUIREMENTS**

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

1.2 **REFERENCES**

- .1 American National Standards Institute (ANSI)
 - .1 ANSI C82.1, Lamp Ballasts-Line Frequency Fluorescent Lamp Ballast.
 - .2 ANSI C82.4, Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps Multi Supply Type.
- .2 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE C62.41, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
- .3 ASTM International Inc.
 - .1 ASTM F1137, Standard Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.
- .4 Canadian Standards Association (CSA International)
- .5 ICES-005-, Radio Frequency Lighting Devices.
- .6 Underwriters' Laboratories of Canada (ULC)
- .7 Illuminating Engineering Society of North America (IESNA)
 - .1 LM-79 Electrical and Photometric Measurements of Solid-State Lighting Products
 - .2 LM-80 Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays, and Modules.

1.3 **SUBMITTALS**

- .1 Provide submittals in accordance with Section 26 05 00 Common Work Results – Electrical.
- .2 Shop Drawings:
 - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Provide complete photometric data prepared by independent testing laboratory for luminaires.

1.4 **DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 26 05 00 Common Work Results - Electrical.

PART 2 **PRODUCTS**

2.1 **DRIVERS**

- .1 LED drivers to meet the manufacturer's requirements for the specified luminaires. Drivers must be on the luminaire manufacturer's list of tested drivers.
- .2 In general, drivers to be constant current type, input voltage 120, 277, 347 VAC 60Hz as indicated. 0-10V off/on/dimming control or as otherwise indicated.
- .3 Sound rated Class A

2.2 **FINISHES**

- .1 Light fixture finish and construction to meet ULC listing[s] and CSA certification[s] related to intended installation.

2.3 **OPTICAL CONTROL DEVICES**

- .1 As indicated in luminaire schedule.

2.4 **LUMINAIRES**

- .1 As indicated in luminaire schedule.

PART 3 **EXECUTION**

3.1 **INSTALLATION**

- .1 Locate and install luminaires as indicated.
- .2 Provide adequate support to suit ceiling system.

3.2 **WIRING**

- .1 Connect luminaires to lighting circuits:
 - .1 Install flexible or rigid conduit for luminaires as indicated.

3.3 **LUMINAIRE SUPPORTS**

- .1 For suspended ceiling installations support luminaires independently of ceiling in accordance with local inspection requirements and the seismic engineers direction.

3.4 **LUMINAIRE ALIGNMENT**

- .1 Align luminaires mounted in continuous rows to form straight uninterrupted line.
- .2 Align luminaires mounted individually parallel or perpendicular to building grid lines.

3.5 **TESTING AND ACCEPTANCE**

- .1 Test installed lighting systems in accordance with Section 26 05 00 Common Work Results Electrical and Section 26 05 10 Testing and Commissioning.
- .2 Lamp Replacement: Replace all burned out lamps during testing, prior to Substantial Completion.

3.6 CLEANING

- .1 Clean lighting control elements, lamps fixture interiors and exposed exterior surfaces prior to Substantial completion.

END OF SECTION

PART 1 **GENERAL**

1.1 **RELATED REQUIREMENTS**

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

1.2 **REFERENCES**

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.141, Unit Equipment for Emergency Lighting.
 - .2 CSA C860, Performance of Internally-Lighted Exit Signs.
- .2 National Fire Protection Association (NFPA)
 - .1 NFPA 101, Life Safety Code.

1.3 **SUBMITTALS**

- .1 Provide submittals in accordance with Section 26 05 00 Common Work Results – Electrical.
- .2 Submit WHMIS MSDS - Material Safety Data Sheets where applicable.

PART 2 **PRODUCTS**

2.1 **STANDARD UNITS**

- .1 Exit lights: to CSA C22.2 No.141 and CSA C860.
- .2 Housing extruded aluminum housing, brush aluminum finish].
- .3 Faceplates: extruded aluminum.
- .4 Lamps: LED 120/347 V 50,000 hours.
 - .1 Pictogram style.
 - .2 Face plate to remain captive for relamping.
 - .3 Supply voltage: 120 V, ac.
 - .4 Output voltage: 24 V dc.
 - .5 Operating time: 60 minimum.
 - .6 Recharge time: 12 hours
 - .7 Battery: sealed, maintenance free.
 - .8 Charger: solid state, voltage/current regulated, inverse temperature compensated, short circuit protected, with regulated output of plus or minus 0.01 V for plus or minus 10% V input variation.
 - .9 Solid state transfer circuit.
 - .10 Signal lights: solid state, for 'AC Power ON', 'High Charge' condition.
 - .11 Integrated emergency lighting heads where indicated on Drawings.

- .1 345 degrees horizontal and 180 degrees vertical adjustment.
- .2 Lamps shall be 6W LED.
- .12 Mounting: suitable for universal mounting directly on junction box and c/w knockouts for conduit.
 - .1 Removable or hinged front panel for easy access to batteries.
- .13 Cabinet: finish: grey
- .14 Auxiliary equipment:
 - .1 Ammeter.
 - .2 Voltmeter.
 - .3 Lamp disconnect switch.
 - .4 Test switch.
 - .5 AC/DC output terminal blocks inside cabinet.
 - .6 RFI suppressor.
 - .7 Connection for AC power supply.

PART 3 **EXECUTION**

3.1 **MANUFACTURER'S INSTRUCTIONS**

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

3.2 **INSTALLATION**

- .1 Install exit lights to manufacturer's recommendations, listing requirements, BC Building Code and local regulatory requirements.
- .2 Connect fixtures to exit light circuits.
- .3 Connect emergency lamp sockets to emergency circuits.
- .4 Ensure that exit light circuit breaker is locked in on position.

END OF SECTION

PART 1 **GENERAL**

1.1 **RELATED REQUIREMENTS**

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

1.2 **REFERENCES**

1.3 **SUBMITTALS**

- .1 Submit in accordance with Section 26 05 00 Common Work Results – Electrical.

1.4 **DELIVERY, STORAGE AND HANDLING**

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

PART 2 **PRODUCTS**

2.1 **SYSTEM DESCRIPTION**

- .1 Empty telecommunications raceways system consists of outlet boxes, cover plates, conduits, cable trays, pull boxes, sleeves and caps, fish wires.
- .2 Raceways distribution system.

2.2 **MATERIAL**

- .1 Conduits: EMT type, in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .2 Junction boxes: in accordance with Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets.
- .3 Outlet boxes, conduit boxes, and fittings: in accordance with Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets.
- .4 Fish wire: polypropylene type.

PART 3 **EXECUTION**

3.1 **INSTALLATION**

- .1 Install empty raceway system, including underfloor distribution system, fish wire, terminal cabinets, outlet boxes, floor boxes, pull boxes, cover plates, conduit, sleeves and caps, cable tray, service poles, miscellaneous and positioning material to constitute complete system.

3.2 **PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by pathways for communications systems installation.

END OF SECTION

PART 1 **GENERAL**

1.1 **RELATED REQUIREMENTS**

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

1.2 **REFERENCES**

- .1 Canadian Standards Association (CSA International)
 - .1 CSA-C22.2 No. 214, Communications Cables (Bi-National standard with UL 444).
 - .2 CSA-C22.2 No. 232, Optical Fiber Cables.
- .2 BICSI
 - .1 Telecommunications Distribution Methods Manual (TDMM) – Latest Edition.
- .3 Telecommunications Industry Association (TIA)/Electronic Industries Alliance (EIA)
 - .1 TIA/EIA-568-B.1, Commercial Building Telecommunications Cabling Standard, Part 1: General Requirements.
 - .2 TIA/EIA-568-B.2, Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted-Pair Cabling Components.
 - .3 TIA/EIA-568-B.3, Optical Fiber Cabling Components Standard.
 - .4 TIA/EIA-606-A, Administration Standard for the Commercial Telecommunications Infrastructure.
 - .5 TIA TSB-140, Telecommunications Systems Bulletin - Additional Guidelines for Field-Testing Length, Loss and Polarity of Optical Fiber Cabling Systems.
 - .6 TIA-598-C, Optical Fiber Cable Color Coding.

1.3 **DEFINITIONS**

- .1 Refer to TIA/EIA-598-C, Annex A for definitions of terms: optical-fiber interconnect, distribution, and breakout cables.

1.4 **SYSTEM DESCRIPTION**

- .1 Structured telecommunications wiring system consist of unshielded-twisted-pair and optical fiber cables, terminations, connectors, cross-connection hardware and related equipment installed inside building for occupant's telecommunications systems, including voice (telephone), data, and image.
- .2 Installed in physical star configuration with separate horizontal and backbone sub-systems.
 - .1 Horizontal cables link work areas to telecommunications room located on same floor.

1.5 **SUBMITTALS**

- .1 Provide submittals in accordance with Section 26 05 00 Common Work Results – Electrical.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with 26 05 00 Common Work Results – Electrical.

PART 2 PRODUCTS

2.1 FOUR-PAIR 100 Ω BALANCED TWISTED PAIR CABLE

- .1 Four-pair, 100 ohm balanced unshielded-twisted-pair (UTP) cable, flame test classification FT6 or CMP to: CSA-C22.2 No. 214, Category 6 (Cat 6) to: TIA -568.0-D.

2.2 MULTI-PAIR 100 Ω BALANCED TWISTED PAIR CABLE

- .1 100 ohm, 25 pairs, sheath consists of thermoplastic jacket without underlying metallic shield, Category 3 to: TIA-568-D, flame test classification FT6.

2.3 WORK AREA UTP 4-PAIR MODULAR JACK

- .1 Eight-position modular jack ("RJ-45"), type T568A Category 6 to: TIA -568.0-D:
 - .1 Each typical outlet in work area to be in self-contained recessed two-gang box with single gang mud-ring, quantity of jacks per box as indicated. Unless noted otherwise.

2.4 TERMINATION AND CROSS-CONNECTION HARDWARE FOR UTP

- .1 Patch panel, 2 rack units high, 48 ports:
 - .1 Each port equipped with factory installed "RJ-45" jacks, type T568A Category 6 to: TIA -568.0-D.
 - .2 Horizontal cable-management unit for every 48 ports.

2.5 UTP CROSS-CONNECT WIRE

- .1 Category 6, 4 pairs to: TIA-568.0-D.

2.6 UTP PATCH CORDS

- .1 3 metres long, with factory-installed male plug at one end to mate with "RJ-45" jack and with factory-installed male plug at other end to mate with "RJ-45" jack Category 6, 4 pairs to: TIA -568.0-D.

2.7 UTP EQUIPMENT CABLE

- .1 4 pair "pigtail", 3 metres long, with factory-installed male plug on one end to mate with "RJ-45" jack and other end equipped with factory-installed male plug to mate with "RJ-45" jack: Category 6 to: TIA -568.0-D.

2.8 UTP WORK AREA CORDS

- .1 3 metres long, each end equipped with "RJ-45" plug Category 6 to: TIA -568.0-D.

PART 3 EXECUTION

3.1 INSTALLATION OF TERMINATION AND CROSS-CONNECT HARDWARE

- .1 Install termination and cross-connect hardware in rack as indicated and according to manufacturers' instructions. Identify and label as indicated to: TIA/EIA-606.
- .2 Install consolidation points, as indicated according to manufacturer's instructions. Identify and label as indicated to: TIA/EIA-606.

3.2 INSTALLATION OF HORIZONTAL DISTRIBUTION CABLES

- .1 Install horizontal cables as indicated in conduits from telecommunication rooms to individual work-area jacks. Identify and label as indicated to: TIA/EIA-606.
- .2 Terminate horizontal cables in telecommunications room and at individual work-area jacks.
 - .1 Identify and label as indicated to: TIA/EIA-606.
- .3 Coil spare cables and store in ceiling space in zone.
- .4 Harness slack cable in cabinets, racks, and wall-mounted termination and cross-connection hardware.

3.3 INSTALLATION OF EQUIPMENT CABLES

- .1 Install equipment cables from equipment patch panel as indicated.
 - .1 Identify and label as indicated to: TIA/EIA-606.

3.4 IMPLEMENT CROSS-CONNECTIONS

- .1 Implement cross-connections using patch cords as specified.

3.5 FIELD QUALITY CONTROL

- .1 Test horizontal UTP cables as specified below and correct deficiencies provide complete record of results as electronic record on USB memory stick.
 - .1 Perform tests 100% of cross-connected data horizontal cabling to:
 - .1 Category 6 using certified level III tester to: TIA/EIA-568-B.2.
 - .2 Tests for CAT 6 cables shall include: wiremap, propagation delay, delay skew, length, insertion loss, return loss, NEXT, PSNEXT, ELFEXT, PSELFEXT, ACR, and PSACR.
 - .1 Provide report summary identifying links with pass, fail, conditional pass, and conditional fail.
 - .2 Failing or conditionally failing links must be corrected and re-tested at the Contractor's expense.
 - .3 Conditional Pass links must be highlighted and will, at the discretion of the Owner and Consultant, be required to be corrected and re-tested at the Contractor's expense.

END OF SECTION

PART 1 **GENERAL**

1.1 **RELATED REQUIREMENTS**

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

1.2 **REFERENCES**

- .1 Abbreviations:
 - .1 Electronic Access Control (EAC): control of people through entrances and exits of controlled area. Security utilizing hardware systems and specialized procedures to control and monitor movements within a controlled area.
 - .2 DRS: Door Release System.
 - .3 PIN: Personal Identification Number.
- .2 Reference Standards:
 - .1 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
 - .2 Underwriters' Laboratories (UL)
 - .1 UL 294, Access Control System Units.

1.3 **SUBMITTALS**

- .1 Submit in accordance with Section 26 05 00 Common Work Results – Electrical.
 - .1 Submit:
 - .1 Functional description of equipment.
 - .2 Technical data for all devices.
 - .3 Device location plans and cable lists.
 - .4 Devices mounting location detail drawings.
 - .5 Typical devices connection detail drawings.
 - .2 Shop Drawings:
 - .1 Shop drawings to indicate project layout, including details.
 - .1 Shop drawings to indicate, mounting heights and locations, wiring diagrams.
 - .2 Submit zone layout drawing indicating number and location of zones and areas covered.
 - .3 Submit wiring diagrams.
 - .4 Submit complete equipment list.
 - .3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .1 Submit ULC/UL Product Safety Certificates.
 - .4 Test and Evaluation Reports:
 - .1 Submit certified test reports from qualified manufacturer's testing personnel indicating compliance with specifications for specified performance characteristics and physical properties.

- .2 System operation must be demonstrated to the Consultant
- .5 Manufacturer's Instructions: submit manufacturer's installation instructions.
- .6 Operation and Maintenance Data: submit operation and maintenance data for access controls and equipment for incorporation into manual.
 - .1 Include:
 - .1 System configuration and equipment physical layout.
 - .2 Functional description of equipment.
 - .3 Instructions of operation of equipment.
 - .4 Illustrations and diagrams to supplement procedures.
 - .5 Operation instructions provided by manufacturer.
 - .6 Cleaning instructions.

1.4 DELIVERY, STORAGE AND HANDLING

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

1.5 WARRANTY

- .1 For minimum 12 month warranty period prescribed is extended to 60 months.
- .2 Manufacturer's Warranty: submit, for Consultant 's acceptance, manufacturer's standard warranty document executed by authorized company official.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Design Criteria:
 - .1 Design access control and security access systems using only ULC/UL listed products.
 - .2 Products must be from same manufacturer as the existing security access control system.
 - .1 System description:
 - .1 New devices must be integrated into the existing Kantech 400 access control system.
 - .2
 - .2 Monitoring station will be as per the existing system configuration. New, removed, and revised access controls must be configured in the existing system to alarm at the required stations and be correctly identified.
 - .3 Include: system power supply, junction boxes, door control panels, door activation units, system connectors, and system cables as required for a fully functional system.
 - .4 Provide system cables including coaxial cable, multi-conductor control cable, and AC power cable required.
 - .5 Power supplies: to CAN/ULC-S318.

PART 3 **EXECUTION**

3.1 **INSTALLATION: SECURITY ACCESS**

- .1 Install components in accordance with manufacturer's written installation instructions to locations, heights and surfaces shown on reviewed shop drawings.
- .2 Install components secure to walls, ceilings or other substrates.
- .3 Install required boxes in inconspicuous accessible locations.
- .4 Conceal conduit and wiring.

3.2 **SITE TEST AND INSPECTION**

- .1 Perform reviews and tests in presence of Consultant.
 - .1 Provide all necessary tools, ladders and equipment.
 - .2 Ensure appropriate subcontractors, and manufacturer's representatives, Departmental Representative are present for verification.
- .2 Pretesting procedure:
 - .1 Verify (utilizing manufacturer approved test equipment) that system is fully operational and meets all system performance requirements of this specification.
 - .2 Measure and record, control of every system channel at each of following points in the system:
 - .1 Door located actuating devices.
 - .2 Door control panel functions.
 - .3 Electronic supervisory control units inputs and outputs.
 - .4 Distribution system input and output.
 - .3 Submit to Consultant a copy of recorded system pretest measurements, along with pretest certification by the contractor that system is fully functional.
- .3 Testing:
 - .1 Test procedure:
 - .1 Visually verify that devices have been installed.
 - .2 Test operation of a random sampling of devices and observe the system functionality.
 - .3 Generate simulated alarm or trouble system signals and visually observe the system response. Contractor shall be responsible to arrange for system to be placed test mode prior to generation of simulated signals
 - .4 Contractor must provide personnel and materials as required to facilitate the testing.

3.3 **FIELD QUALITY CONTROL**

- .1 Manufacturer Services:
 - .1 Manufacturer of products, supplied under this Section, to review Work involved in the handling, installation/application, protection and cleaning, of its product[s] and submit written reports, in acceptable format, to verify compliance of Work with Contract.
 - .2 Manufacturer's Field Services:

- .1 Obtain written reports from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product.
- .2 Contractor must ensure manufacturer's representative is present before and during testing if required.
- .3 Schedule site visits to review Work at stages listed:
 - .1 Once at approximately 50% before work has been fully completed and while cabling and devices are still visible for review.
 - .2 Upon completion of Work, after cleaning is carried out.
 - .3 Once for commissioning

3.4 PROTECTION

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

END OF SECTION

PART 1 **GENERAL**

1.1 **RELATED REQUIREMENTS**

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

1.2 **REFERENCES**

- .1 Underwriters Laboratories of Canada (ULC)
 - .1 ULC-S317, Installation and Classification of Closed Circuit Video Equipment (CCVC) Systems for Institutional and Commercial Security Systems.

1.3 **SUBMITTALS**

- .1 Submit in accordance with Section 26 05 00 Common Work Results – Electrical.
- .2 Shop Drawings:
 - .1 Submit shop drawings to indicate project layout, camera locations, point-to-point diagrams, cable schematics, risers, mounting details and identification labeling scheme.
 - .2 Submit functional description of software and system operation with the newly integrated PTZ camera
- .3 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for video surveillance equipment and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit:
 - .1 Functional description of equipment.
 - .2 Technical data sheets of all devices.
 - .3 Device location plans and cable lists.
 - .4 Video camera surveillance chart.
 - .5 Video interconnection detail drawings.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .1 Submit UL Product safety Certificates.
- .5 Test and Evaluation Reports:
 - .1 Submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .6 Manufacturer's Instructions: submit manufacturer's installation instructions.
- .7 Manufacturer's Field Reports: submit manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.
- .8 Operation and Maintenance Data: submit maintenance data for incorporation into manual specified in Section 26 05 11 Operations and Maintenance Data. Include following:
 - .1 System configuration and equipment physical layout.

- .2 Functional description of equipment.
- .3 Manufacturer's Instructions for operation, adjustment and cleaning.
- .4 Illustrations and diagrams to supplement procedures.

1.4 DELIVERY, STORAGE AND HANDLING

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

1.5 WARRANTY

- .1 The minimum 12 month warranty period prescribed is extended to 60 months.
- .2 Manufacturer's Warranty: submit, for Consultant's acceptance, manufacturer's standard warranty document executed by authorized company official.

PART 2 PRODUCTS

2.1 CRITERIA

- .1 New PTZ camera must integrate into the existing PTZ camera network, PTZ control station, and display/record/storage configuration.
 - .1 Provide operator with ability to control all camera functions.
 - .2 Ceiling, indoor mounted, visible
- .2 Alarm point monitoring: system capable, upon alarm recognition, of switching CCTV cameras associated with alarm point.
- .3 Switching:
 - .1 Provide modification to existing switching to integrate new PTZ camera into existing switching system
- .4 Control: provision for any camera equipped with pan, tilt, and/or motorized zoom lens:
 - .1 Manually control pan, tilt and lens functions.
 - .2 Set pan and tilt home position.
 - .3 Set and clear movement limits of pan and tilt mechanism.
 - .4 Adjust motorized zoom lens.
- .5 Reference product: Avigilon H4PTZ, 1MP.
- .6 Enter and edit CCTV programs and save them for future use.
- .7 Set dwell time for viewing of any camera picture.
- .8 Define sequence for viewing cameras on each monitor.
- .9 Bypass cameras in system during sequencing to monitor.
- .10 Provide ability to display stored 'video image' of cardholder, and switch real-time camera to card reader location for specific card usage.
- .11 Overall control of CCTV provided through software control, which provides complete integration of security components.
- .12 Video Handling, switching, recording shall be integrated into the existing PTZ CCTV system. Provide all required components for a fully functional system.

2.2 CAMERA HOUSINGS

- .1 Indoor: ceiling mount.
- .2 Domes: indoor.

2.3 JUNCTION BOX

- .1 Metal, sized to handle all system conduit interconnections with appropriate expansion.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheet.
- .2 Install cable, boxes, mounting hardware, brackets, video cameras and system components in accordance with manufacturer's written installation instructions.
- .3 Install components secure, properly aligned and in locations shown on reviewed shop drawings.
- .4 Connect cameras to cabling in accordance with installation instructions.
- .5 Install ULC labels where required.

3.2 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Obtain written reports from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product.
 - .2 Submit manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits to review Work at stages listed:
 - .1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.
 - .2 Twice during progress of Work at 25% and 60% complete.
 - .3 Upon completion of Work, after cleaning is carried out.

3.3 SYSTEM STARTUP

- .1 Perform verification inspections and test in the presence of Consultant.
 - .1 Provide all necessary tools, ladders and equipment.
 - .2 Ensure appropriate subcontractors, and manufacturer's representatives are present for verification.
- .2 Visual verification: objective is to assess quality of installation and assembly and overall appearance to ensure compliance with Contract Documents. Visual inspection to include:
 - .1 Sturdiness of equipment fastening.
 - .2 Non-existence of installation related damages.
 - .3 Compliance of device locations with reviewed shop drawings.
 - .4 Compatibility of equipment installation with physical environment.

- .5 Inclusion of all accessories.
- .6 Device and cabling identification.
- .7 Application and location of ULC approval decals.
- .3 Technical verification: purpose to ensure that all systems and devices are properly installed and free of defects and damage. Technical verification includes:
 - .1 Measurements of tension and power.
 - .2 Connecting joints and equipment fastening.
 - .3 Measurements of signals (dB, lux, baud rate, etc).
 - .4 Compliance with manufacturer's specification, product literature and installation instructions.
- .4 Operational verification: purpose to ensure that devices and systems' performance meet or exceed established functional requirements. Operational verification includes:
 - .1 Operation of each device individually and within its environment.
 - .2 Operation of each device in relation with programmable schedule and or/specific functions.
 - .3 Operation control of camera lens, pan, tilt and zoom.
 - .4 Switching of camera to any monitor.
 - .5 Switching of system video recorder to selective monitor.
 - .6 Set dwell times.
 - .7 Demonstrate:
 - .1 Sequence viewing of cameras on each monitor.
 - .2 Bypass capability.
 - .3 Display of stored image to cardholder.

3.4 ADJUSTING

- .1 Remove protective coverings from cameras and components.
- .2 Adjust cameras for correct function.

3.5 PROTECTION

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

END OF SECTION

PART 1 **GENERAL**

1.1 **RELATED REQUIREMENTS**

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

1.2 **REFERENCES**

- .1 Occupational Safety and Health (OSH)
 - .1 Fire Protection Standard.
- .2 Underwriter's Laboratories of Canada (ULC)
 - .1 CAN/ULC-S524, Standard for the Installation of Fire Alarm Systems.
 - .2 CAN/ULC-S526, Visible Signal Devices for Fire Alarm Systems, Including Accessories.
 - .3 CAN/ULC-S527, Standard for Control Units for Fire Alarm Systems.
 - .4 CAN/ULC-S528, Manual Stations for Fire Alarm Systems, Including Accessories.
 - .5 CAN/ULC-S529, Smoke Detectors for Fire Alarm Systems.
 - .6 CAN/ULC-S530, Heat Actuated Fire Detectors for Fire Alarm Systems.
 - .7 CAN/ULC-S531, Standard for Smoke Alarms.
 - .8 CAN/ULC-S537, Standard for the Verification of Fire Alarm Systems.

1.3 **SUBMITTALS**

- .1 Submit in accordance with Section 26 05 00 Common Work Results – Electrical.
- .2 Shop Drawings:
 - .1 Indicate on shop drawings:
 - .1 Overall system riser wiring diagram identifying control equipment, initiating zones, signaling circuits; identifying conductors and raceways.
 - .2 Details for devices.
- .3 Operation and Maintenance Data: submit operation and maintenance data for fire alarm system for incorporation into manual.
- .4 Include:
 - .1 Instructions for complete fire alarm system to permit effective operation and maintenance.
 - .2 Technical data - illustrated parts lists with parts catalogue numbers.
 - .3 Copy of approved shop drawings with corrections completed and marks removed except review stamps.
 - .4 List of recommended spare parts for system.

1.4 **MAINTENANCE MATERIAL SUBMITTALS**

- .1 Submit maintenance materials in accordance with Section 26 05 11 Operations and Maintenance Data.

1.5 DELIVERY, STORAGE AND HANDLING

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

PART 2 PRODUCTS

2.1 DESCRIPTION

- .1 System is an existing fire alarm system with a main panel identified with 'Mircom' labeling. Elements of the system appear to be a conventional system.
- .2 Contractor must provide new fire alarm devices for annunciation and alarming as indicated and allow for provision of new circuits, supervising components, wiring, raceway, power supplies, and accessories to form a fully functional system.
- .3 The new devices are to match the existing system devices and are to be integrated into the existing system zones. Provide programming to add new devices to existing zones as required for a fully functional system.
- .4 Equipment and devices: ULC listed and labelled and supplied by single manufacturer.
- .5 Power supply: to CAN/ULC-S524.
- .6 Audible signal devices: to CAN/ULC-S524.
- .7 Visual signal devices: to CAN/ULC-S526.
- .8 Manual pull stations: to CAN/ULC-S528.
- .9 Smoke detectors: to CAN/ULC-S529.
- .10 Regulatory Requirements:
 - .1 System components: listed by ULC and comply with applicable provisions of BC Building Code, and meet requirements of local authority having jurisdiction.

2.2 SYSTEM OPERATION: SINGLE STAGE - SIGNALS ONLY

- .1 Actuation of any alarm initiating device shall be integrated into the existing fire alarm zone's contro sequence of operations.

2.3 INITIATING/INPUT CIRCUITS

- .1 Fire alarm receiving circuits for alarm initiating devices such as manual pull stations, smoke detectors, heat detectors and water flow switches, shall be wired to match the requirements of the existing fire alarm system.

2.4 ALARM OUTPUT CIRCUITS

- .1 Alarm output circuit: wired to match the requirements of the existing fire alarm control panel configuration and system devices.

2.5 WIRING

- .1 Twisted copper conductors: rated 600 V.
- .2 To initiating circuits: in accordance with manufacturer's requirements.
- .3 To signal circuits: in accordance with manufacturer's requirements.
- .4 To control circuits: in accordance with manufacturer's requirements.

2.6 MANUAL ALARM STATIONS

- .1 To match existing

2.7 AUTOMATIC ALARM INITIATING DEVICES

- .1 Smoke detector: To match existing

2.8 AUDIBLE SIGNAL DEVICES

- .1 Bells: to match existing

2.9 END-OF-LINE DEVICES

- .1 End-of-line devices to be provided as required. Type to match existing.

2.10 AS-BUILT RISER DIAGRAM

- .1 Provide shop drawing with risers as indicated in the drawings and specifications and provide as part of the maintenance manuals.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install systems in accordance with CAN/ULC-S524.
- .2 Install manual alarm stations and connect to alarm circuit wiring.
- .3 Locate and install detectors and connect to alarm circuit wiring. Mount detectors more than 1 m from air outlets. Maintain clear space on ceiling, below and around detectors as per CAN ULC S524 requirements.
- .4 Connect alarm circuits to main control panel.
- .5 Install bells and connect to signalling circuits.
- .6 Connect signalling circuits to main control panel.
- .7 Install end-of-line devices at end of alarm and signalling circuits.
- .8 Splices are not permitted.
- .9 Provide necessary raceways, cable and wiring to make interconnections to terminal boxes, annunciator equipment and CCU, as required by equipment manufacturer.
- .10 Ensure that wiring is free of opens, shorts or grounds, before system testing and handing over.
- .11 Identify circuits and other related wiring at central control unit, annunciators, and terminal boxes.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and CAN/ULC-S537.
- .2 Fire alarm system:
 - .1 Test such device and alarm circuit to ensure manual stations to ensure system operates correctly.
 - .2 Check annunciator panels to ensure zones are shown correctly.

- .3 Simulate grounds and breaks on alarm and signaling circuits to ensure proper operation of systems.

3.3 PROTECTION

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

3.4 CLOSEOUT ACTIVITIES

- .1 Provide on-site lectures and demonstration by fire alarm equipment manufacturer to train operational personnel in use and maintenance of fire alarm system.

END OF SECTION