



Public Works and Government Services Canada

Project No. R.073227.004

Requisition No. EZ899-17-0484

DRAWINGS & SPECIFICATIONS
for

CRA Vancouver Relocation
Interior Fit-up

APPROVED BY:

PREETIPAL PAUL
Regional Manager, AES

2016-06-16.
Date

CHRIS PATTERSON
Construction Safety Coordinator

2016-06-16
Date

TENDER:

MONIQUE SIMARD
Project Manager

2016-06-03
Date

1.1 DESIGN PROFESSIONALS OF RECORD

- .1 Architect
 - .1 IBI Group, Ron Eagleston
 - .2 Responsible for Divisions 01-10 as applicable to the project, except where indicated as prepared by other design professionals of record.



- .2 Mechanical Engineer
 - .1 AME Group, Alex Chou
 - .2 Responsible for Divisions 21-23 as applicable to the project.



- .3 Electrical Engineer
 - .1 AES Engineering, Ahmet Ulker
 - .2 Responsible for Divisions 26 and 28 as applicable to the project.



END OF SECTION

<u>DIVISION</u>	<u>SECTION</u>	<u>No. Of Pages</u>
DIVISION 00	PROCUREMENT AND CONTRACTING REQUIREMENTS	
	00 01 07 - Seals Page	1
	00 01 10 - Table of Contents	4
	00 01 15 - List of Drawings	2
DIVISION 01	GENERAL REQUIREMENTS	
	01 11 55 – General Instructions	8
	01 32 19 – Security	2
	01 33 00 – Shop Drawings, Product Data and Samples and Other Submittals	3
	01 35 33 – Health and Safety Requirements	7
	01 47 18 – Indoor Air Quality	5
	01 51 00 – Temporary Facilities	2
	01 56 00 - Temporary Barriers and Enclosures	1
	01 61 10 – Product Requirements	3
	01 74 19 – Waste Management and Disposal	2
	01 78 30 – Closeout Submittals	4
	01 91 13 - Commissioning	10
	01 91 31 - Commissioning Plan	12
	01 91 33 - Commissioning Checklists	16
	01 91 41 - Commissioning Training	2
DIVISION 02	EXISTING CONDITIONS	
	02 41 13 - Selective Demolition	3
DIVISION 05	METALS – not used	
DIVISION 06	WOOD, PLASTICS AND COMPOSITES	
	06 08 99 – Rough Carpentry for Minor Works	3
	06 40 00 – Architectural Woodwork	6
DIVISION 07	THERMAL AND MOISTURE PROTECTION	
	07 21 16 - Fibrous Insulation	2
	07 84 00 – Firestopping	4
	07 92 00 – Joint Sealing	6

DIVISION 08	OPENINGS	
	08 11 00 - Metal Doors and Frames	6
	08 14 16 – Flush Wood Doors	4
	08 71 00 – Door Hardware	11
	08 80 50 – Glazing	4
DIVISION 09	FINISHES	
	09 21 16 - Gypsum Board Assemblies	5
	09 22 00 - Non-Structural Metal Framing	4
	09 51 13 - Acoustic Panel Ceilings	4
	09 65 00 - Resilient Flooring	7
	09 68 00 - Carpeting	6
	09 72 16 - Wall Covering	3
	09 91 99 – Painting for Minor Works	6
DIVISION 10	SPECIALTIES	
	10 28 12 - Hand Washing Accessories	1
	10 56 26.13 - Manual Mobile Shelving Storage	11
DIVISION 11	EQUIPMENT - NOT USED	
DIVISION 12	FURNISHINGS - NOT USED	
DIVISION 21	FIRE SUPPRESSION	
	21 05 01 - Common Work Results	5
	21 05 10 - Fire Extinguishers	2
	21 13 13 - Wet Sprinkler Systems	3
	21 22 00 - Clean Agent Fire Extinguishing System	18
DIVISION 22	PLUMBING	
	22 05 00 - Plumbing – General Requirements	9
	22 05 05 - Firestopping - Mechanical	5
	22 05 34 - Hot Water Temperature Maintenance Systems	2
	22 07 18 - Plumbing Piping Insulation	2
	22 10 16 - Domestic Water Piping - Copper	3
	22 13 17- Drainage Waste And Vent Piping – Copper And Cast Iron	2

22 42 02 - Plumbing Fixtures	3
------------------------------	---

DIVISION 23 HEATING, VENTILATING AND AIR CONDITIONING (HVAC)

23 05 00 - Common Work Results – Mechanical	14
23 05 01- Pipe Installation	4
23 05 02 - Selective Demolition	2
23 05 09 - Access Doors	2
23 05 22 - Valves – Bronze	4
23 05 29 - Hangers And Supports for HVAC	5
23 05 48 - Vibration Isolation for Piping And Equipment	5
23 05 49 - Seismic Restraints	4
23 05 53 - Mechanical Identification	5
23 05 93 - Testing, Adjusting And Balancing – HVAC	6
23 07 11 - Firestopping	5
23 07 13 - Duct Insulation	7
23 07 19 - HVAC Piping Insulation	7
23 08 06 - Cleaning And Start-Up of Mechanical Systems	5
23 09 93 - Control - General Provisions - DCC	3
23 21 15 - Hydronic Systems - Copper	4
23 21 16 - Hydronic Systems – Steel	4
23 31 14 - Metal Ducts	8
23 33 00 - Air Duct Accessories	4
23 33 14 - Dampers – Balancing	3
23 33 16 - Dampers - Fire	3
23 33 46 - Flexible Ducts	2
23 33 53 - Acoustical Duct Lining	3
23 34 00 - HVAC Fans	4
23 37 13 - Diffusers, Registers And Grilles	3
23 82 19 - Fan Coil Units	2
23 91 13 - Commissioning Requirements - General	1

DIVISION 26 ELECTRICAL

26 05 00 Common Work Results – Electrical	8
26 05 20 Wire and Box Connectors 0-1000V	4
26 05 21 Wire and Cables (0-1000V)	4
26 05 22 Connectors and Terminations	2
26 05 28 Grounding – Secondary	4
26 05 29 Hangers and Supports For Electrical Systems	2
26 05 31 Splitters, Junction, Pull Boxes and Cabinets	2

	26 05 32 Outlet Boxes, Conduit Boxes and Fittings	2
	26 05 34 Conduits, Conduit Fastenings and Conduit Fittings	4
	26 05 36 Cable Trays for Electrical Systems	2
	26 05 37 Wireways and Auxiliary Gutters	2
	26 05 80 Fractional Horsepower Motors	2
	26 09 24 Lighting Control Devices – Low Voltage	4
	26 24 16.01 Panelboards Breaker Type	4
	26 24 16.02 Moulded Case Circuit Breakers	4
	26 27 16 Electrical Cabinets and Enclosures	2
	26 27 26 Wiring Devices	4
	26 29 10 Motor Starters to 600V	4
	26 50 00 Lighting	4
	26 53 00 Exit Signs	2
DIVISION 27	COMMUNICATION - NOT USED	
DIVISION 28	ELECTRONIC SAFETY AND SECURITY	
	28 31 00 Fire Alarm Systems	8
APPENDIX		
Appendix A	Douglas Jung Building Specification; 401 Burrard Street, Vancouver and Sample Work Permit	8
Appendix B	Pre-construction Hazard Assessment Form	4

END OF SECTION

ARCHITECTURAL

A0.00	COVER SHEET
A0.01	SITE PLAN, GENERAL INFORMATION & DRAWING LIST
A0.02	WALL ASSEMBLIES, SYMBOLS & ABBREVIATIONS
AD.01	7 TH FLOOR REFLECTED CEILING DEMOLITION PLAN
AD.02	8 TH FLOOR REFLECTED CEILING DEMOLITION PLAN
A1.01	7 TH FLOOR PLAN
A1.02	8 TH FLOOR PLAN
A4.01	ENLARGED FLOOR PLANS AND INTERIOR ELEVATIONS
A4.02	ENLARGED PLANS AND INTERIOR ELEVATIONS
A5.01	MILLWORK DETAILS
A5.02	MILLWORK DETAILS
A5.03	DETAILS
A6.01	DOOR AND WINDOW SCHEDULE
A6.02	FINISH SCHEDULE
A7.01	7 TH FLOOR REFLECTED CEILING PLAN
A7.02	8 TH FLOOR REFLECTED CEILING PLAN
A8.01	7 TH FLOOR FURNITURE PLAN
A8.02	8 TH FLOOR FURNITURE PLAN
A9.01	7 TH FLOOR FINISH PLAN
A9.02	8 TH FLOOR FINISH PLAN

MECHANICAL

M001	MECHANICAL SYMBOLS, LEGEND, AND EQUIPMENT SCHEDULES
M002	MECHANICAL EQUIPMENT SCHEDULES
M201	LEVEL 7 PLUMBING AND FIRE PROTECTION PLAN
M202	LEVEL 8 PLUMBING AND FIRE PROTECTION DEMOLITION PLAN
M301	LEVEL 7 HVAC DEMOLITION AND RELOCATION PLAN
M302	LEVEL 7 HVAC PLAN
M303	LEVEL 8 HVAC DEMOLITION AND RELOCATION PLAN
M304	LEVEL 8 HVAC PLAN
M901	MECHANICAL DETAILS
M902	MECHANICAL DETAILS

ELECTRICAL

E0	COVER SHEET AND LEGEND
E1	LIGHTING DEMOLITION PLAN LEVEL 7
E2	POWER DEMOLITION PLAN LEVEL 7

PWGSC Project No. R.073227.004
CRA-CID Fit-up
401 Burrard Street, Vancouver, BC
2016-06-15
Issued Tender

Section 00 01 15
LIST OF DRAWINGS

Page 2 of 2

E3	LIGHTING DEMOLITION PLAN LEVEL 8
E4	POWER DEMOLITION PLAN LEVEL 8
E5	NEW LIGHTING PLAN LEVEL 7
E6	NEW LIGHTING PLAN LEVEL 8
E7	NEW POWER PLAN LEVEL 7
E8	NEW POWER PLAN LEVEL 8
E9	SCHEDULES AND DETAILS

END OF SECTION

1.1 CODES

- .1 Perform work to National Building Code (NBC) of Canada, Construction Standards and Bylaws, and all other applicable codes and standards, including Amendments up to the TENDER closing date.

1.2 DESCRIPTION OF WORK

- .1 Work under this Contract covers general tenant improvement, new interior construction to two floors, whole 7th Floor and part of 8th Floor at 401 Burrard Street, Vancouver, B.C.
- .2 Work to be performed under this Contract includes, but is not limited to, the following items covered further in the Contract documents.
 - .1 Selective Demolition.
 - .2 Interior partitions.
 - .3 Finishes including floors and ceilings.
 - .4 Electrical and Electronic Safety and Security.
 - .5 Fire Suppression, Plumbing, HVAC.
- .3 “Green Requirements”:
 - .1 Use only environmentally responsible green materials/products with no VOC emissions or minimum VOC emissions of indoor off-gassing contaminants for improved indoor air quality – subject of Departmental Representative’s approval of submitted MSDS Product Data.
 - .2 Use materials/products containing highest percentage of recycled and recovered materials practicable – consistent with maintaining cost effective satisfactory levels of competition.
 - .3 Adhere to waste reduction requirement for reuse or recycling of waste materials, thus diverting materials from landfill.

1.3 CONTRACT DOCUMENTS

- .1 The Contract documents, all referenced documents, the drawings and specifications are intended to complement each other, and to provide for and include everything necessary for the completion of the work.
- .2 Drawings are, in general, diagrammatic and are intended to indicate the scope and general arrangement of the work.

1.4 DIVISION OF SPECIFICATIONS

- .1 The specifications are subdivided in accordance with the current 6-digit National Master Specifications System.
- .2 A division may consist of the work of more than 1 subcontractor. Responsibility for determining which subcontractor provides the labour, material, equipment and services required to complete the work rests solely with the Contractor.

- .3 In the event of discrepancies or conflicts when interpreting the drawings and specifications, the specifications govern.

1.5 TIME OF COMPLETION

- .1 This construction contract must be Substantially Complete (reach Substantial Performance) no later than Friday January 13th, 2017.**

- .2 This construction contract must be Complete (reach Final Completion) no later than March 31st, 2017.

- .3 Substantial Performance:

- .1 Refer to General Conditions (GC) included in this contract by reference. GC 1 deals with General Conditions and the full text can be found here:

<https://buyandsell.gc.ca/policy-and-guidelines/standard-acquisition-clauses-and-conditions-manual/5/R/R2810D/15>

- .2 More specifically, GC 1.1.4 Substantial Performance applies:

- .3 The extract from the referenced document is copied here for ease of reference only.

GC1.1.4 Substantial performance

1. *The Work shall be considered to have reached Substantial Performance when*

- a. *the Work or a substantial part thereof has passed inspection and testing and is, in the opinion of Canada, ready for use by Canada or is being used for the intended purposes; and*
- b. *the Work is, in the opinion of Canada, capable of completion or correction at a cost of not more than*
 - i. *3 percent of the first \$500,000;*
 - ii. *2 percent of the next \$500,000; and*
 - iii. *1 percent of the balance*

of the Contract Amount at the time this cost is calculated.

2. *Where the Work or a substantial part thereof is ready for use or is being used for the purposes intended and*
- a. *the remainder of the Work or a part thereof cannot be completed by the time specified in the Contract, or as amended in accordance with GC6.5, "Delays and Extension of Time", for reasons beyond the control of the Contractor; or*
 - b. *Canada and the Contractor agree not to complete a part of the Work within the specified time;*

the cost of that part of the Work that was either beyond the control of the Contractor to complete or Canada and the Contractor have agreed not to complete by the time specified, shall be deducted from the value of the Contract referred to in subparagraph 1)(b) of GC1.1.4 and the said cost

shall not form part of the cost of the Work remaining to be done in determining Substantial Performance.

- .4 The Contractor must schedule the work to ensure timely completion. Scheduling the work based on standard 40-hour work week will not suffice. The Contractor must plan all work shifts required to achieve Substantial Completion by the date shown above. The Contractor must plan to work days, evenings, nights, weekends and holidays to complete in a timely fashion as needed.**

.5 Terms of Payment:

- .1 Refer to General Conditions (GC) included in this contract by reference. GC5 deals with Terms of Payment, and the full text can be found here:

<https://buyandsell.gc.ca/policy-and-guidelines/standard-acquisition-clauses-and-conditions-manual/5/R/R2850D/7>

- .2 More specifically, GC5.10 Assessments and Damages for Late Completion applies.
- .3 The extract from the referenced document is copied here for ease of reference only.

1. *For the purposes of this clause*
 - a. *the Work shall be deemed to be completed on the date of the Certificate of Completion; and*
 - b. *the "period of delay" means the number of days commencing on the day fixed for completion of the Work and ending on the day immediately preceding the day on which the Work is completed but does not include any day within a period of extension granted pursuant to GC6.5, "Delays and Extension of Time", and any other day on which, in the opinion of Canada, completion of the Work was delayed for reasons beyond the control of the Contractor.*
2. *If the Contractor does not complete the Work by the day fixed for its completion but completes it thereafter, the Contractor shall pay Canada an amount equal to the aggregate of*
 - a. *all salaries, wages and travelling expenses incurred by Canada in respect of persons overseeing the performance of the Work during the period of delay;*
 - b. *the cost incurred by Canada as a result of the inability to use the completed Work for the period of delay; and*
 - c. *all other expenses and damages incurred or sustained by Canada during the period of delay as a result of the Work not being completed by the day fixed for its completion.*
3. *Canada may waive the right of Canada to the whole or any part of the amount payable by the Contractor pursuant to paragraph 2) of GC5.10 if, in the opinion of Canada, it is in the public interest to do so.*

1.6 HOURS OF WORK

- .1 Arrangements can be made for 24 hours/day and 7 days/week access. At times access can be limited and/or the type of work performed can be limited.
- .2 Restrictions: as required in Appendix B.

1.7 WORK SCHEDULE

- .1 Within 10 working days after Contract award, provide a schedule showing anticipated progress stages, Substantial Performance 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 trade for each phase as outlined.
 - .3 Substantial Performance date within the time period required by the Contract documents.
 - .4 Final completion date within the time period required by the Contract documents.
 - .5 Do not change approved Schedule – without approval of Departmental Representative.
 - .6 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.

1.8 COST BREAKDOWN

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

1.9 CODES, BYLAWS, STANDARDS

- .1 Perform work in accordance with the National Building Code of Canada (NBC) 2010, 2014, City of Vancouver Building By-Law and other indicated Codes, Construction Standards and/or any other Code or Bylaw of local application. The more stringent Building Code shall apply.
- .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.

1.10 DOCUMENTS REQUIRED

- .1 Maintain 1 copy each of the following at the job site:
 - .1 Contract drawings.

- .2 Contract specifications.
- .3 Addenda to Contract documents.
- .4 Copy of approved work schedule.
- .5 Reviewed/approved shop drawings.
- .6 Change orders.
- .7 Other modifications to Contract.
- .8 Field test reports.
- .9 Reviewed/approved samples.
- .10 Manufacturers' installation and application instructions.
- .11 One set of record drawings and specifications for "as-built" purposes.
- .12 National Building Code of Canada 2010.
- .13 2014 City of Vancouver Building By-Law.
- .14 Current construction standards of workmanship listed in technical Sections.
- .15 Building Safety Plan.

1.11 REGULATORY REQUIREMENTS

- .1 Obtain and pay for – Building Permit, Certificates, Licenses and other permit 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.

1.12 CONTRACTOR'S USE OF SITE

- .1 Refer to requirements of Appendix B.
- .2 In conjunction with requirements of Appendix B coordinate with Departmental Representative regarding designated contractor and sub-contractor parking locations and coordinate with Departmental Representative regarding use of elevators and designated work hours.
- .3 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 such as moving contractors and furniture installers.
- .4 Perform work in accordance with Contract documents.
- .5 Do not unreasonably encumber site with material or equipment.
- .6 Use only indicated elevators for moving workers and material.
 - .1 Protect walls of passenger elevators, to approval of Departmental Representative prior to use.
 - .2 Accept liability for damage, safety of equipment and overloading of existing equipment.

1.13 EXAMINATION

- .1 Examine site and be familiar and conversant with existing conditions likely to affect work
- .2 Provide photographs of surrounding properties, objects and structures liable to be damaged or be the subject of subsequent claims.

1.14 EXISTING SERVICES

- .1 Where work involves breaking into or connecting to existing services, carry out work at times directed by the authorities having jurisdiction.

1.15 LOCATION OF EQUIPMENT AND FIXTURES

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

1.16 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. **Note that this building is post tension structure. No drilling, coring or tracing is allowed without X-ray to ensure no structural element is damaged.**
- .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.

1.17 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.

1.18 ACCEPTANCE OF SUBSTRATES

- .1 Each trade shall examine surfaces prepared by others (outside of this contract) 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.
- .2 Each sub-trade shall examine surfaces prepared by other sub-trades and/or the General Contractor and job conditions which may affect his work, and shall report defects to the General Contractor. Commencement of work shall imply acceptance of prepared work or substrate surfaces.

1.19 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 2010, 2014 and City of Vancouver Building By-Law, and Referenced Construction Standards.
- .3 In cases of dispute, decisions as to standard or quality of work rest solely with the Departmental Representative, whose decision is final.

1.20 WORKS COORDINATION

- .1 Coordinate work of sub-trades:
 - .1 Designate one qualified person acceptable to Departmental Representative 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 particular close attention to overhead work above ceilings and within or near to building structural elements.
 - .2 Identify on coordination drawings, building elements, service 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 coordination:
 - .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.

1.21 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.

1.22 PRODUCTS SUPPLIED BY DEPARTMENTAL REPRESENTATIVE

- .1 Products supplied by Departmental Representative – refer to following sections:
 - .1 09 68 00 Carpeting.
- .2 Contractor's duties:
 - .1 Promptly inspect stored products, and give written report to Departmental Representative on condition of all items received.
 - .2 Transport from storage location in the Lower Mainland and deliver to site.
 - .3 Handle materials at site.
 - .4 Install and finish products as specified.

1.23 SECURITY CLEARANCES AND COMMISSIONAIRES SERVICES

- .1 Refer to requirements of Appendix B.
- .2 Personnel employed on this project may be subject to security clearance. Obtain requisite clearances, as instructed, for each individual required to enter the premises.
- .3 Alternately, if the Contractor and/or sub-Contractors do not have the security clearance mentioned above, Commissionaires will be retained to monitor the activities of the Contractor.
- .4 The Contractor will prepare Requests for Commissionaires Services, indicating the number of Commissionaires required, the area of work and the date, time and duration of the required services. Each area of work will need to be monitored by one commissionaire. The Commissionaires Services Requests must be submitted to the Commissionaires at the very least 48 hours in advance. The Contractor will appoint one person responsible for coordinating all the Requests from all sub-contractors and be the primary point of contact for this service.

- .5 The Departmental Representative will pay for the Commissionaires Services.
- .6 The Contractor will be responsible for any and all delays in the progress of the work caused by not requesting the commissionaires services necessary in a timely manner.

1.24 MEETINGS

- .1 Departmental Representative will arrange weekly contract administration meetings and assume responsibility for setting times and recording and distributing minutes.

1.25 TESTING AND INSPECTION

- .1 Particular requirements for inspection and testing to be carried out by testing service or laboratory approved by the Departmental Representative are specified in technical sections.
- .2 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:
 - .1 Mill tests and certificates of compliance.
 - .2 Tests specified to be carried out by Contractor under the Departmental Representative's supervision.
- .3 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 correct work.
- .4 Contractor shall furnish labour and facilities to facilitate all the required tests.
 - .1 Notify Departmental Representative 48 hours in advance of planned testing.
- .5 Where materials are specified to be tested, deliver representative samples in required quantity to testing laboratory.
- .6 Pay costs for uncovering and making good work that is covered before required inspection or testing is completed and approved by Departmental Representative.
- .7 The Departmental Representative may require, and pay for, additional inspection and testing services not included in Paragraph 27.1.
- .8 Provide Departmental Representative with .pdf of testing laboratory reports as soon as they are available.

1.26 AS-BUILT DOCUMENTS

- .1 Refer to section 01 78 30 - Closeout Submittals.

1.27 CLEANING

- .1 Refer requirements of Appendix B.
- .2 Daily conduct cleaning and disposal operations. Comply with local ordinances and anti-pollution laws.

- .3 **Ensure cleanup of the work areas each day or shift, and after completion of work.**
- .4 Clean interior building areas when ready to receive finish painting and continue cleaning on an as-needed basis until building is sufficiently completed or ready for occupancy.
- .5 In preparation for interim and final inspections:
 - .1 Examine all sight-exposed interior and exterior surfaced and concealed spaces.
 - .2 Remove grease, dust, dirt, stains, labels, fingerprints, and other foreign materials from sight-exposed interior and exterior finished surfaces, including glass and other polished surfaces.
- .6 Use cleaning materials and methods in accordance with instructions of the manufacturer of the surface to be cleaned.

1.28 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 within work area with 0.102 mm thick polyethylene film during Work. 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.

1.29 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.

1.30 MAINTENACE MATERIALS, SPECIAL TOOLS AND SPARE PARTS

- .1 Specific requirements for maintenance materials, tools and spare parts are specified in individual sections of Division 09 - 28.

1.31 ADDITIONAL DRAWINGS

- .1 The Departmental Representative may furnish additional drawings for clarification. These additional drawings have the same meaning and intent as if they were included with plans referred to in the Contract documents.
- .2 Upon request, Departmental Representative may furnish up to a maximum of 10 sets of Contract documents for use by the Contractor at no additional cost. Should more than 10 sets of documents be required the Departmental Representative will provide them at additional cost.

1.32 BUILDING SMOKING ENVIRONMENT

- .1 Smoking within the building is not permitted.

1.33 SYSTEM OF MEASUREMENT

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

1.34 FAMILIARIZATION WITH SITE

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

1.35 SUBMISSION OF BID

- .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

1.1 RESTRICTED OR SECURE AREA

- .1 In general, access to inside is restricted to the access points indicated on the drawings or as subsequently approved by the Departmental Representative. Personnel and vehicles entering or leaving the construction site must follow prescribed access routes and be under escort or surveillance.
- .2 Obtain necessary security clearance as required in Appendix B.
- .3 Workers shall have completed the Brookfield GIS Site Orientation as required in Appendix B.

1.2 CONTRACTOR'S RESPONSIBILITY

- .1 General Contractor is required to complete and submit the Work Permit Requests at least 48 hours in advance.
- .2 General Contractor and subcontractor shall be responsible for construction, personnel and vehicles employed on project and requiring access to restricted areas.
- .3 All Contract personnel and equipment must remain within designated work areas at all times.
- .4 Contractors shall be responsible for the security of their own equipment and materials.

1.3 RESPONSIBLE PERSONNEL

- .1 Provide the Departmental Representative with a list of responsible personnel and phone numbers, and those of subcontractors, who may be contacted after working hours in case of emergency.

1.4 DELIVERIES

- .1 Requirements for deliveries and use of loading docks are specified in Appendix B.

1.5 EXISTING SECURITY BARRIERS

- .1 Security barriers, such as doors, fences, gates, locks, or door hardware, which are required to be removed, must be replaced, if practicable, at the end of each work shift. If it is necessary to remove barriers for an extended period, enclose unprotected areas with temporary hoarding. Where the possibility exists that the restricted area may be left unprotected at the end of the work shift, inform Departmental Representative immediately.
- .2 Failure to restore such security barriers when required will result in their restoration by other forces and the cost of such restoration being recovered from the Contractor.

1.6 DAILY SECURITY

- .1 Ensure that access to the restricted area is secured at the end of each work day.
- .2 When work is to be done within the restricted area after scheduled working hours, seek permission from Departmental Representative and adhere to requirements of Appendix B.

PWGSC Project No. R.073227.004
CRA-CID Fit-up
401 Burrard Street, Vancouver, BC
2016-06-15
Issued Tender

Section 01 32 19
SECURITY

Page 2 of 2

END OF SECTION

1.1 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.

1.2 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 (10) ten days for Departmental Representative's review of each submission, unless noted otherwise.
- .3 Transmittals:
 - .1 Provide transmittals electronic .pdf submissions with .pdf transmittal letter to the following recipients:
 - .1 Prime Consultant.
 - .2 CC: Applicable Sub-Consultant.
 - .3 PWGSC Departmental Representative.
 - .2 E-mail submission shall clearly show the Specification Section that applies to the submittal.
 - .3 Transmittals shall contain:
 - .1 Date.
 - .2 Project title and number.

- .3 Contractor's name and address.
- .4 Identification 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.
 - .6 After Departmental Representative's review, distribute copies.
- .5 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 Sections of Division 02 to 28.

1.3 SHOP DRAWINGS

- .1 Submittals should be by e-mail with .pdf transmittal letter.
- .2 E-mail title to clearly show the spec section that applies to the submittal
- .3 Submittals to be sent as follows:
 - .1 To: Prime Consultant
 - .2 CC: applicable sub-consultant
 - .3 PWGSC Departmental Representative.

- .4 Cross-reference shop drawing information to applicable portions of the Contract documents.

1.4 SHOP DRAWINGS REVIEW

- .1 Review of shop drawings by Departmental Representative is for the sole purpose of ascertaining conformance with the general concept.
- .2 This review shall not mean that Departmental Representative 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.

1.5 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 .pdf of product data.

1.6 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.

END OF SECTION

1. 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):
 - .1 Part 8, Safety Measures at Construction and Demolition Sites.
- .3 Canadian Standards Association (CSA): as amended:
 - .1 CSA S269.1-1975 (R2003) Falsework for Construction Purposes.
 - .2 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 and Safety.
 - .2 Occupational Health and Safety Regulation.
 - .3 WorkSafeBC.

2. RELATED SECTIONS

- .1 Refer to the following current NMS sections as required:
 - .1 General Instructions Section 01 11 55
 - .2 Temporary facilities: Section 01 51 00

3. 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. NATIONAL FIRE CODE OF CANADA 2010 (AS AMENDED).

- .1 Part 5 - Hazardous Processes and Operations and Division B as applicable and required.

5. SUBMITTALS

- .1 Submit to Departmental Representative submittals listed for review in accordance with Section 01 33 00.

- .2 Work effected by submittal shall not proceed until review is complete.
- .3 Submit the following:
 - .1 Site Specific Health and Safety Plan.
 - .2 Copies of reports or directions issued by Federal and Provincial health and safety inspectors.
 - .3 Copies of incident and accident reports.
 - .4 Complete set of Material Safety Data Sheets (MSDS), and all other documentation required by Workplace Hazardous 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 5 days after receipt of the plan. Revise the plan as appropriate and resubmit to Departmental Representative.
- .5 Medical surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of work, and submit additional certifications for any new site personnel to Departmental Representative.
- .6 Submission of the 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. **RESPONSIBILITY**

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

7. **HEALTH AND SAFETY COORDINATOR**

- .1 Provide and appoint a Health and Safety Coordinator who 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. 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.

9. REGULATORY REQUIREMENTS

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

10. WORK PERMITS

- .1 Obtain specialty permits related to project before start of work. Refer to Appendix B.

11. FILING OF NOTICE

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

12. HEALTH AND SAFETY PLAN

- .1 Conduct a site-specific hazard assessment based on review of Contract documents, required work, and project site. Identify any known and potential health risks and safety hazards.
- .2 Prepare and comply with a site-specific project 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. 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..
- .2 Include the following provisions in the emergency procedures:
 - .1 Notify workers and the first-aid attendant, of the nature and location of the emergency.
 - .2 Evacuate all workers safely.
 - .3 Check and confirm the safe evacuation of all workers.
 - .4 Notify the fire department or other emergency responders.
 - .5 Notify adjacent workplaces or residences which may be affected if the risk extends beyond the workplace.
 - .6 Notify Departmental Representative.
- .3 Provide written rescue/evacuation procedures as required for, but not limited to:
 - .1 Work at high angles.
 - .2 Work in confined spaces or where there is a risk of entrapment.

- .3 Work with hazardous substances.
 - .4 Underground work.
 - .5 Work on, over, under and adjacent to water.
 - .6 Workplaces where there are persons who require physical assistance to be moved.
- .4 Design and mark emergency exit routes to provide quick and unimpeded exit.
 - .5 At least once each year, emergency drills must be held to ensure awareness and effectiveness of emergency exit routes and procedures, and a record of the drills must be kept.
 - .6 Revise and update emergency procedures as required, and re-submit to the Departmental Representative.

14. HAZARDOUS PRODUCTS

- .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage and disposal of hazardous materials, and regarding labelling and provision of Material Safety Data Sheets (MSDS) acceptable to the 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.
 - .2 Provide adequate means of ventilation in accordance with Section 01 47 18.

15. ELECTRICAL SAFETY REQUIREMENTS

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

16. ELECTRICAL LOCKOUT

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

17. OVERLOADING

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

18. POWDER-ACTUATED DEVICES

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

19. 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.

20. 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.

21. FIRE PROTECTION AND ALARM SYSTEM

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

22. 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.

23. 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.

24. MEETINGS

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

25. 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 REFERENCE STANDARDS

- .1 Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
 - .1 SMACNA 008-2008 (Chapter 3), IAQ Guidelines for Occupied Buildings Under Construction, 2nd Edition.

1.2 CONSTRUCTION INDOOR AIR QUALITY MANAGEMENT PLAN

- .1 The intent of this plan is to prevent construction and future indoor air quality problems that may result from construction affecting the comfort and well being of construction workers and building occupants.
- .2 The provision of the Construction Indoor Air Quality Management Plan or IAQ Management Plan is the responsibility of the Contractor.
- .3 Provide a fully developed IAQ Management Plan implemented through construction and pre-occupancy of the building including the following activities:
 - .1 Meet or exceed the recommended Design Approaches in SMACNA 008 (Chapter 3) and other requirements as detailed in this specification during all construction activities. These design approaches shall be applicable for all buildings regardless of whether it is a new construction or renovation.
 - .2 Protect all stored and installed absorptive materials from moisture or dust, chemical and gas damage as specified in Section 01 61 00 - Product Requirements.
 - .3 Construction use of air handling units, heat recovery ventilators, fans or any associated equipment and systems for ventilation, heating, de-humidification, humidification, dust control or any other use is strictly prohibited.
 - .4 Replace all filtration equipment for air handling units, heat recovery ventilators and fans with new filter media as specified within the technical specification sections in Division 23 at the end of construction.
- .4 Provide the following submittals to the requirements of Section 01 33 00:
 - .1 IAQ Management Plan:
 - .1 Provide a draft documented IAQ Management plan in writing for review by the Departmental Representative within 10 days of award of contract.
 - .2 The IAQ Management Plan submission is to include:
 - .1 Details of each management plan strategy including:
 - .1 The Design Approaches in SMACNA 008 (Chapter 3) including:
 - .1 HVAC Protection
 - .2 Source Control procedures.
 - .3 Pathway Interruption.
 - .4 Housekeeping.
 - .5 Scheduling.
 - .6 Reporting.

- .2 Samples of reporting documents based SMACNA 008 (Chapter 3).
 - .3 Methods for protecting all stored and installed absorptive materials from moisture or dust, chemical and gas damage.
 - .4 Declaration that air handling units, heat recovery ventilators, fans or any associated equipment and systems will not be used during construction for ventilation, heating, de-humidification, humidification and dust control.
 - .5 Schedule for filter replacement as a component of the building startup and Commissioning.
- .3 Format: submit .pdf of reports for verification and review by Departmental Representative.
 - .4 Make changes or additions to the draft IAQ Management Plan within the specified plan requirements to the satisfaction of the Departmental Representative and reissue as final draft.
 - .5 Distribute the final IAQ Management Plan to all trades working on the site.
- .2 Construction Reporting
 - .1 During the course of construction provide the following reporting to the Departmental Representative for review:
 - .1 Photographs indicating the general conformance to the IAQ Management Plan.
 - .2 Completed Planning Checklist for all trades on the project indicating scheduling and the requirements of IAQ procedures with respect to scheduled construction activities for that week.
 - .3 Inspection sheets completed by the Site Superintendent reviewing that all trades completed the scheduled requirements of the IAQ procedures for that week including any deficiencies and corrective actions taken.
 - .2 Provide all reporting on a weekly basis unless otherwise approved by the Departmental Representative during periods of low IAQ risk construction or low construction activity.
- .5 Provide the following close out submittals to the requirements of Section 01 78 30 - Closeout Submittals:
 - .1 Provide all IAQ Management Plan submittals including the following:
 - .1 The final version of the Construction IAQ Management Plan.
 - .2 Digital copies of all weekly photographs in a CD ROM Format.
 - .3 All weekly planning checklists.
 - .4 All weekly inspection sheets.
 - .5 Format: submit 5 copies of closeout report, each in "D" ring binders, complete with index tabs for verification and review by Departmental Representative.

- .6 Provide the following activities specified to meet or exceed the recommended Design Approaches in SMACNA 008 (Chapter 3) during all construction activities. These design approaches shall be applicable for all buildings regardless of whether it is a new construction or renovation:
 - .1 HVAC Protection:
 - .1 Use of air handling units, heat recovery ventilators, fans or any associated equipment and systems for ventilation, heating, dehumidification, humidification, dust control or any other use during Construction is strictly prohibited.
 - .2 Seal off all supply, return and exhaust air system openings to prevent the accumulation of dust and debris in the systems at all times unless work is being completed on the immediate area of the system using plastic seals to the approval of the Departmental Representative. This is to include overnight and longer work stoppages. All diffusers, grilles, and displacement ventilators are also to be sealed in plastic.
 - .3 Protect all stored and installed absorptive materials from moisture and dust, chemical and gas damage as specified in Section 01 61 00 – Basic Product Requirements.
 - .4 Keep all operable doors on all air handling units closed at all times unless work is being completed on the immediate area of the system.
 - .5 Do not store construction or waste materials in Fan and Mechanical Rooms.
 - .6 Keep all construction areas clean and neat as specified elsewhere in this specification.
 - .7 Replace all filtration equipment for air handling units, heat recovery ventilators and fans with new filter media as specified with the technical specification sections in Division 22 at the end of construction.
 - .8 Professionally clean where ducts become contaminated due to inadequate protection.
 - .2 Source Control:
 - .1 Use of low VOC products as specified elsewhere are to be utilized at all times.
 - .2 Restrict traffic volume and idling of motor vehicles where emissions could be drawn into the building.
 - .3 Direct fired construction heaters are not acceptable. Vent all construction heater products of combustion to the outdoors.
 - .4 Cycle heating equipment off when not being used or needed.
 - .5 Exhaust all pollution sources to the outside with portable fan systems ensuring exhaust does not re-circulate back into the building.
 - .6 Keep containers of wet products closed as much as possible. Cover and seal waste materials, which can release odour or dust.
 - .3 Pathway Interruption:
 - .1 Prevent dust from migrating to other areas with the use of dust curtains or temporary enclosures where applicable.

- .2 Relocate pollutant sources as far away as possible from construction ventilation equipment, stored materials and areas occupied by workers when feasible. Any construction supply and exhaust systems that ventilate both areas where pollutant sources are being used and areas where they are not been used should be shut down or isolated during such activity with supplemental construction ventilation provided as required.
- .3 Isolate during construction, areas of work to prevent contamination of clean or occupied areas. Utilize pressure differentials generated by mechanical means to prevent contaminated air from entering clean areas.
- .4 Ventilate contaminated air from construction areas directly to the outside during installation of VOC emitting materials.
- .4 Housekeeping:
 - .1 Cleaning activities are specified in Section 01 11 55 however provide special emphasis on HVAC equipment and building spaces to remove contaminants from the building prior to operation of any permanent ventilation equipment.
 - .2 Keep all coils, filters, fans and ductwork clean during installation as specified and clean all prior to performing the Testing, Adjusting and Balancing of the systems.
 - .3 During construction suppress dust with wetting agents or sweeping compounds. Use efficient and effective dust collecting methods such as a damp cloth, wet mop, and vacuums with particulate filters, or wet scrubbers.
 - .4 Remove accumulations of water inside the building during construction. Protect all porous materials such as insulation and ceiling tile from exposure to moisture.
- .5 Scheduling:
 - .1 Schedule work to ensure dust emitting work does not coincide with installation of absorbent materials (ceiling tiles, gypsum wall board, fabric furnishings, carpet and insulation, for example) that may act as 'sinks' for dust.
 - .2 Do not schedule any construction activities that would require the use of VOC or dust emitting activities during occupancy without the approval of the Departmental Representative.
 - .3 Schedule all use of VOC emitting and high odorous materials BEFORE installing absorbent materials (ceiling tiles, gypsum wall board, fabric furnishings, carpet and insulation, for example) that may act as 'sinks' for VOCs, odours and other contaminants.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

1.1 ACCESS AND DELIVERY

- .1 Refer to requirements of Appendix B.
- .2 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.
- .3 Use of the loading facility will be granted to the Contractor through BGIS work Permit process. Refer to Appendix B.
 - .1 The loading facility is to be used for loading and unloading purposes only.

1.2 STORAGE FACILITIES

- .1 Storage space will be limited to the area of construction.

1.3 POWER

- .1 Refer to Appendix B.
- .2 Electrical power and lighting at 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.

1.4 WATER SUPPLY

- .1 Water supply is not available. Refer to Appendix B.

1.5 SANITARY FACILITIES

- .1 Existing designated washroom facilities in the building are available. Refer to Appendix B.

1.6 HEATING AND VENTILATION

- .1 Refer to Section 01 47 18 - Indoor Air Quality.
- .2 Do not begin work until arrangements have been made with the Departmental Representative for protection of on-floor heating, ventilating and air conditioning.
 - .1 If there is dirt in the heating and ventilation system, it will be the Contractor's responsibility to return it to its original state in accordance with the Departmental Representative's specifications.
- .3 Prevent dust and odour migration to other occupied areas.
 - .1 Do not activate 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.

1.7 REMOVAL OF TEMPORARY FACILITIES

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

1.8 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 or when directed by Departmental Representative.

END OF SECTION

Part 1 General

1.1 INSTALLATION AND REMOVAL

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

1.2 DUST TIGHT SCREENS

- .1 Provide dust tight screens to localize dust generating activities, and for protection of workers, finished areas of Work and public. Coordinate with Section 01 47 18 for ventilation requirements.
- .2 Maintain and relocate protection until such work is complete.

1.3 PROTECTION FOR OFF-SITE AND PUBLIC PROPERTY

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

1.4 PROTECTION OF BUILDING FINISHES

- .1 Provide protection for finished and partially finished building finishes and equipment during performance of Work.
- .2 Provide necessary screens and covers.
- .3 Be responsible for damage incurred due to lack of or improper protection.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

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.
- .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 (meeting or exceeding specification requirements 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 within 10 days of contract award, 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**” (used for complex Mechanical or Electrical Systems): 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 may be considered provided full technical data is received in writing by Departmental Representative in accordance with “Special Instructions to Tenderers”.
- .5 When products are specified by a referenced standard or by Performance specifications, upon request of Departmental Representative obtain from manufacturer and independent laboratory report showing that the product meets or exceeds the specified requirements.

END OF SECTION

1.1 RELATED WORK

- .1 Refer to every technical section for waste management and disposal.

1.2 DEFINITIONS

- .1 Waste Audit (WA): relates to projected waste generation. Involves controlled separation of waste.
- .2 Waste Reduction Workplan (WRW): a written report which addresses opportunities for reduction, re-use or recycling of materials.
- .3 Materials Source Separation Program (MSSP): consists of a series of ongoing activities to separate re-usable and recyclable waste material into material categories from other types of waste at point of generation.

1.3 WASTE MANAGEMENT GOALS

- .1 The Owner has established that this Project shall generate the least amount of waste possible and that processes shall be employed that ensure the generation of as little waste as possible including prevention of damage due to mishandling, improper storage, contamination, inadequate protection or other factors as well as minimizing over packaging and poor quantity estimating.
- .2 Of the inevitable waste that is generated, the waste materials designated in this specification shall be salvaged for reuse and or recycling. Waste disposal in landfills or incinerators shall be minimized. On new construction projects this means careful recycling of job site waste, on demolition projects this also means careful removal for salvage.
- .3 The Contractor shall develop and implement a Construction Waste Management Plan that achieves an overall diversion of at least 75 percent of total Project Waste from landfill sites. Excavated soil and land-clearing debris do not contribute to this credit and shall not be included in the calculation of diversion from landfill.
- .4 Protect our environment and prevent environmental pollution damage associated with construction waste.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Prepare and submit following within 14 days of contract award:
 - .1 One (1) electronic copy of the Construction Waste Management Plan for Materials and Resources Credit MR-2 Construction Waste Management: Divert 75% From Landfill.
- .2 Submit monthly hauling summaries confirming monthly and project-to-date breakdown of hauled material, indicating mass of each material recycled, reused and sent to landfill. In addition, the monthly summary shall include the location where the material is recycled, reused, or sent to landfill.
- .3 Submit monthly waste disposal receipts, scale tickets, or waybills confirming the values in the monthly hauling summaries.

- .4 Submit a letter from the waste hauler or receiving facilities confirming the end use of each recycled material.
- .5 Submit prior to final payment the following:
 - .1 Waste Diversion Report, indicating final quantities in tonnes by material types salvaged for reuse, recycling or disposal in landfill and recycling centres, re-use depots, landfills and other waste processors that received waste materials.

1.5 MATERIALS SOURCE SEPARATION

- .1 Before project start-up, prepare Materials Source Separation Program. Provide separate containers for re-usable and/or recyclable materials of the following:
 - .1 Gypsum board.
 - .2 Metals.
 - .3 Wood.
 - .4 Plastics
 - .5 Other materials as indicated in technical sections.
- .2 Implement Materials Source Separation Program for waste generated on project in compliance with approved methods and as approved by Departmental Representative.
- .3 Locate containers in locations, to facilitate deposit of materials without hindering daily operations.
- .4 Locate separated materials in areas which minimize material damage.

1.6 DIVERSION OF MATERIALS

- .1 Create a list of materials to be separated from the general waste stream and stockpiled in separate containers, to the approval of the Departmental Representative and consistent with applicable fire regulations.
 - .1 Mark containers.
 - .2 Provide instruction on disposal practices.

1.7 STORAGE, HANDLING AND APPLICATION

- .1 Do work in compliance with Waste Reduction Workplan.
- .2 Handle waste materials not re-used, salvaged, or recycled in accordance with appropriate regulations and codes.
- .3 Materials in separated condition: collect, handle, store on site, and transport off-site to an approved and authorized recycling facility.
- .4 Materials must be immediately separated into required categories for re-use or recycling.
- .5 Unless specified otherwise, materials for removal become the Contractor's property.
- .6 On-site sale of salvaged/recyclable material is not permitted.
- .7 **Provide Departmental Representative with receipts** indicating quantity of material delivered to landfill.

- .8 **Provide Departmental Representative with receipts** indicating quantity and type of materials sent for recycling.

END OF SECTION

1.1 SUBMISSION

- .1 Prepare instructions and data by personnel experienced in maintenance and operation of described products.
- .2 Revise content of documents as required before final submittal.
- .3 Ensure spare parts, maintenance materials and special tools provided are new, neither damaged nor defective, and of same quality and manufacture as products provided in work.
- .4 If requested, furnish evidence as to type, source and quality of products provided.
- .5 Defective products will be rejected, regardless of previous inspections. Replace products at own expense.
- .6 Provide one hard copy in 8.5" x 11" binder, and one digital pdf version.

1.2 FORMAT

- .1 Organize data in the form of an instructional manual.
- .2 Cover: title "Project Record Documents"; list title of project and identify subject matter of contents.
- .3 Arrange content by systems under section numbers and sequence of Table of Contents.
- .4 Text: manufacturer's printed data, or typewritten data.
- .5 Drawings: electronic.

1.3 CONTENTS, EACH VOLUME

- .1 Table of contents – provide the following:
 - .1 Title of project.
Date of submission.
 - .2 Names, 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, list names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
- .3 Product data: mark each sheet to clearly identify 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.

1.4 AS-BUILT DOCUMENTS

- .1 **Contract drawings** and shop drawings: legibly mark each item to record actual construction, including:
 - .1 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
 - .2 Field changes of dimension and detail.

- .3 Changes made by change orders.
- .4 Details not on original Contract drawings.
- .5 References to related shop drawings and modifications.
- .2 **Contract Specifications:** legibly mark each item to record actual “Workmanship of Construction”, including:
 - .1 Manufacturer, trade name, and catalogue number of each “Product/Material” actually installed, particularly optional items and substitute items.
 - .2 Changes made by addenda and change orders.
- .3 As-built information:
 - .1 Record changes in red ink.
 - .2 Mark on 1 set of drawings, specifications and shop drawings at completion of project and, before final inspection, neatly transfer notations to second set.
 - .3 Retain and pay Consultants to produce As-Built documents.
 - .4 Provide 1 set of CDs in AutoCAD dwg. file format with all as-built information on the CDs.
 - .5 Submit to Departmental Representative.

1.5 EQUIPMENT AND SYSTEMS

- .1 Operating procedures – include the following:
 - .1 Start-up, break-in, and routine normal operating instructions and sequences.
 - .2 Regulation, control, stopping, shutdown, and emergency instructions.
 - .3 Summer, winter, and any special operating instructions.
- .2 Maintenance requirements – list routine procedures:
 - .1 _____
 - .2 _____
 - .3 _____
 - .4 _____
- .3 Provide servicing and lubrication schedule, and list of lubricants required.
- .4 Include manufacturer’s printed operation and maintenance instructions.
- .5 Include sequence of operation by controls manufacturer.
- .6 Provide original manufacturer’s parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- .7 Provide installed control diagrams by controls manufacturer.
- .8 Provide Contractor’s coordination drawings with installed colour coded piping diagrams.
- .9 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- .10 Provide list of original manufacturer’s spare parts, current prices, and recommended quantities to be maintained in storage.
- .11 Additional requirements: as specified in individual specification Sections.

1.6 MANUFACTURER'S DEMONSTRATION REPORTS

- .1 When specified in individual Sections, require manufacturer to provide authorized representative to demonstrate operation of equipment and system, instruct Departmental Representative's indicated facility's personnel, and provide detailed written report that demonstration and instructions have been completed.

1.7 SPARE PARTS

- .1 Provide spare parts in quantities specified in individual specification Sections.
- .2 Provide items of same manufacture and quality as items in work.
- .3 Deliver to on-site location as directed; place and store.
- .4 Receive and catalogue all items. Submit inventory listing to the Departmental Representative. Include approved listings in maintenance manual.
- .5 Obtain receipt for delivered products and submit to Departmental Representative.

1.8 MAINTENANCE MATERIALS

- .1 Provide maintenance and extra materials in quantities specified in individual specification sections.
- .2 Provide items of same manufacture and quality as items in work.
- .3 Deliver to on-site location as directed; place and store.
- .4 Receive and catalogue all items. Submit inventory listing to the Departmental Representative. Include approved listings in maintenance manual.
- .5 Obtain receipt for delivered products and submit to Departmental Representative.

1.9 SPECIAL TOOLS

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

1.10 WARRANTIES, BONDS, TEST REPORTS, INSPECTION REPORTS

- .1 Separate each Document with index tab sheets keyed to Table of Contents listing.
- .2 List subcontractor, supplier and manufacturer with name, address, and telephone number of responsible principal.
- .3 Obtain Warranties, Bonds, Test Results, Inspection Reports executed in duplicate by subcontractors, suppliers, manufacturers, and inspection agencies. Insert into Closeout Submittals.
- .4 Except for items put into use with the Departmental Representative's permission, leave date of beginning of time of warranty until the date of substantial performance is determined.

- .5 Verify that documents are in proper form, contain full information, and are notarized.
- .6 Co-execute submittals when required.
- .7 Retain warranties and bonds until time specified for submittal.

1.11 COMPLETION

- .1 Cx Documentation: submit completed Cx Documentation. Refer to Section 01 91 35.
- .2 Submit a written certificate that the following have been performed:
 - .1 Defects have been corrected and deficiencies have been completed.
 - .2 Equipment and systems have been tested, adjusted and balanced, and are fully operational.
 - .3 Operation of systems has been demonstrated to the personnel indicated by the Departmental Representative.
 - .4 Work is complete and ready for final inspection.

END OF SECTION

1 General

1.1 **APPLICABILITY**

.1 The work in this section lays out the responsibilities and the work required of the:

- .1 General contractor or Construction Manager
- .2 Mechanical contractor
- .3 Electrical Contractor
- .4 Controls Contractor
- .5 Testing, Adjusting, and Balancing Contractor
- .6 Test Agent for Electrical and Mechanical systems
- .7 Other contractors providing services under the requirements of this contract as may be noted in this or other related parts of the specifications

1.2 **DEFINITIONS**

- .1 Commissioning Authority (CxA): Person(s) overseeing the commissioning process and recommending final acceptance.
- .2 Test Agent (Testing Adjusting and Balancing): Person(s) hired by the contractor to perform testing and verification of identified systems in accordance with the contract documents and design intent. Refer to division specification for TAB qualifications. (ie contractor own forces, manufacturer rep, etc.)
- .3 Independent Third Party Agent (also known as the Commissioning Agent (CxAg): Person(s) hired by the contractor to perform specific specialized tests. Refer to division specifications for requirements.
- .4 Commissioning Plan: A document outlining the scope of work, identify systems to be commissioned, provide the format for contractor checklists, include a framework of the schedule and procedures of all tests and equipment activation, calibration and functional operation and control with the correct sequence of operation and modes
- .5 Contract Documents: The complete set of drawings, specifications, change orders, supplemental instructions etc. pertaining to the construction process.
- .6 Validate: For tests and demonstrations: to witness and confirm successful performance as per the contract documents or record deficiencies; to corroborate successful demonstration after correction; these observations of the tests become references for the Consultants' certification.
- .7 Certify: For documents including as-built drawings: Review for accuracy and completeness or record deficiencies.
- .8 Witness: The Commissioning Authority and/or Consultants will observe as required functional performance tests and record a summary of the results.

1.3 **DESCRIPTION**

- .1 Commissioning is a systematic process of ensuring that all building systems installed in accordance with the drawings and specifications, manufacturer's requirements and good industry practice. Commissioning also ensures that equipment operates and performs, in and of itself as well as in the system, as was intended by the designers in response to the owner's requirements. Finally, commissioning ensures the owner has the documentation and training required to operate the equipment and systems in a safe, efficient and long lasting manner.
 - .1 During the construction phase, commissioning will include the following specific activities:
 - .1 Verify equipment is installed in accordance with the manufacturer's recommendations and industry accepted standards including review of completed manufacturers' start-up sheets, supplemented where required with commissioning installation verification checklists provided by the Test Agent. Contractor shall complete check sheets as required by the CxA.
 - .2 Verify equipment is set-up, adjusted and balanced to perform as specified. This will include review of Testing, Adjusting, and Balancing (TAB) procedures, review of TAB reports and spot checking measurements on site. The TAB contractor shall cooperate with the CxA providing information requested and tools and manpower for spot checking measurements as required by the CxA.
 - .3 Functional Performance Testing (FPT) of mechanical and electrical equipment and systems to ensure proper, complete and efficient operation under the range of conditions they are expected to encounter. Contractors and Test Agents shall provide manpower, tools and other services as required by the CxA to perform the FPT
 - .2 Commissioning does not take away from, reduce responsibility of or in any way diminish the requirement for system designers and installing contractors to provide a complete, finished and fully functioning product.

1.4 **COORDINATION**

- .1 Commissioning Team: The following parties will be required to participate in commissioning and to assist the commissioning team with verification, testing and documentation preparation:
 - .1 General Contractor (GC or Contractor)
 - .2 Construction Manager (CM)
 - .3 Mechanical Contractor (MC)
 - .4 Electrical Contractor (EC)
 - .5 Testing, Adjusting and Balancing contractor (TAB for Electrical and Mechanical scopes)
 - .6 Controls Contractor (CC)

- .7 Any other installing Subcontractors or suppliers of equipment.
- .8 Other members of the commissioning team include:
 - .1 Commissioning Authority (CxA)
 - .2 Commissioning Agent (CxAg)
 - .3 Department Representative (DR)
 - .4 Designated representative of the owner's Operations and Maintenance personnel (O&M)
 - .5 Architect and Design Engineers - particularly the mechanical and electrical engineers (A/M/E)
- .2 Management: Contractors shall cooperate fully with the CxA who will be the Owner's representative for commissioning during all commissioning activities. Contractors shall work together and with the other members of the commissioning team as required to fulfil their contracted responsibilities and meet the objectives of commissioning.
- .3 Scheduling: The GC/CM will work with the CxA to schedule the commissioning activities required of contractors and subcontractors. All parties will address scheduling problems and make necessary notifications in a timely manner in order to expedite the commissioning process.
- .4 The CxA will provide the initial schedule of primary commissioning events at the commissioning start up meeting. As construction progresses more detailed schedules may be developed by the GC/CM.

1.5 **RELATED SECTIONS**

- | | | |
|----|---|------------------|
| .1 | Mechanical – General | Section 23 05 00 |
| .2 | Mechanical – Controls –General Provisions - DDC | Section 23 09 23 |
| .3 | Mechanical – Testing, Adjusting & Balancing | Section 23 05 93 |
| .4 | Mechanical – Fire Safety and Protection | Section 21 13 13 |
| | | Section 21 13 16 |
| .5 | Electrical – General | Section 26 05 00 |
| .6 | Electrical – Lighting | Section 26 09 24 |
| .7 | Electrical – Distribution Equipment | Section 26 24 16 |
| .8 | Electrical – Fire Alarm | Section 28 31 00 |

1.6 **RESPONSIBILITIES**

- .1 Mechanical Contractor:

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- .1 Attend all commissioning start up and progress meetings as scheduled by the CxA.
 - .2 Provide complete equipment and systems start-up including personnel and tools, as required for safe, proper and complete start-up of all mechanical equipment.
 - .3 Correct all deficiencies found during installation verification, start-up and TAB to ensure that all equipment and systems are fully functional and ready for functional performance testing.
 - .4 Prepare O&M manuals and supplementary information on all equipment and assemble in binders tabbed and indexed. Supplementary information may include, but is not limited to, such items as power/control field wiring diagrams, equipment maintenance schedule, vendor and maintenance contact lists.
 - .5 Prepare preliminary schedule for O&M manuals submission, owner training, pipe and duct system testing, flushing and cleaning, equipment start-up, and TAB. Update schedule throughout the construction period.
 - .6 Notify both CxA & CxA_g a minimum of two weeks in advance of equipment and system start-up and/or installation verification testing.
 - .7 Set-up and schedule vendors and contractors required to participate in the owner training sessions for all equipment and systems.
 - .8 Provide a complete set of as-built record drawings and schematics; include a copy to the CxA.
- .2 TAB Contractor(s)
- .1 Attend all commissioning start up and progress meetings as scheduled by the CxA.
 - .2 Submit TAB procedures to CxA and Consultants for review and acceptance.
 - .3 Provide a preliminary TAB report showing that the system is complete and capable of being balanced. Provide an additional copy of the preliminary report labelled "For CxA".
 - .4 Attend TAB review meeting scheduled by the CxA. Be prepared to discuss procedures that shall be followed in TAB and findings of preliminary TAB.
 - .5 Submittal of final TAB reports showing all flows, pressures, motor speeds, settings, control matrices, voltages and amperages etc., as required for a full and complete balancing report on all systems. Provide an additional copy of the TAB final report labelled "For CxA", and include as-built distribution systems schematics.
 - .6 Participate in verification of the TAB report, which includes of repeating selected measurement contained in the TAB report where required by the CxA for verification or diagnostic purposes.
- .3 Building Controls and Automation System Contractor(s)
- .1 Attend all commissioning start up and progress meetings as scheduled by the CxA

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- .2 Attend Sequence of Operation and Graphics review meeting scheduled by the CxA. Be prepared to discuss all sequences including all changes, and provide a schematic for each proposed graphic.
- .3 Provide the following submittals to the CxA at time of Functional Performance Testing (FPT). (Note: The following shall be updated to as-built conditions).
 - .1 Hardware and software submittals and shop drawings.
 - .2 Narrative description of each control sequence for each piece of equipment or system controlled.
 - .3 Point-to-point and sensor calibration verification checklists
 - .4 As-built diagrams showing all control points, sensor locations, point names, actuators, controllers and, where necessary, points of access, superimposed on diagrams of the physical equipment.
 - .5 Printout of panel layouts including all analog input, analog output, digital input, and digital output connections. Provide a separate list for each stand-alone control unit.
 - .6 Printout of final control programming algorithms, include current values of all parameters for each system point.
 - .7 Owners operation and maintenance manuals.
- .4 Provide complete training to operating personnel on hardware, operation and programming, and the application program for the system.
- .5 Demonstrate system performance to CxA. including all modes of system operation. (e.g. normal, abnormal, emergency).
- .6 Provide control system technician to operate systems as required by and under the direction of the CxA during system verification and functional performance testing.
- .7 Provide support and coordination with TAB contractor on all interfaces between their scopes of work. Provide all devices, such as portable operators' terminals, for TAB use in completing TAB procedures.
- .8 Provide any trend logs as may be required by the CxA.
- .4 Electrical Contractor
 - .1 Attend all commissioning start up and progress meetings as scheduled by the CxA.
 - .2 Provide complete equipment and system start-up including personnel and tools, as required for safe, proper and complete start-up of all mechanical equipment.
 - .3 Perform installation verification, start-up and complete documentation as directed by CxA.

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- .4 Correct all deficiencies found during installation verification, start-up and TAB to ensure that all equipment and systems are fully functional and ready for functional performance testing.
- .5 Prepare O&M manuals and supplementary information on all equipment and assemble in binders tabbed and indexed. Supplementary information may include, but is not limited to, such items as power/control field wiring diagrams, equipment maintenance schedule, vendor and maintenance contact lists.
- .6 Notify CxA a minimum of two weeks in advance of equipment and system start-up and/or installation verification testing.
- .7 Set-up and schedule vendors and contractors required to participate in the owner training sessions for all equipment and systems.
- .5 Electrical Test Agent
 - .1 The Electrical Test Agent shall perform Cx activities on behalf of the electrical contractor.
 - .2 The Test Agent may be the Electrical Contractors' own forces as allowed by the division specification.
- .6 Commissioning Agent (CxAg)
 - .1 Attend all commissioning start up and progress meetings as scheduled by the CxA
 - .2 Develop for approval (by the CxA) installation verification checklists for all equipment for the project.
 - .3 All issues encountered during inspections and testing are to be documented in an on-going commissioning issues log report. To be updated no less than biweekly.
- .7 Commissioning Authority (CxA)
 - .1 The CxA shall direct, witness and validate the commissioning process as required.
 - .2 Involvement of an CxA shall not void and guarantees or warranties nor shall it relieve Contractor of any contractual responsibilities.
 - .3 The CxA shall review Contractors' approved shop drawings, review the commissioning agents (CxAg) testing procedures to ensure proposed tests and recorded observations, sequences and methods of test conform to the contract requirements.
 - .4 The CxA will oversee the Cx process, issue deficiency reports, arrange and chair meetings, witness and validate tests and issue progress reports.
- 1.7 **EQUIPMENT/SYSTEMS TO BE COMMISSIONED**
 - .1 Specific mechanical and electrical equipment and their controls will be commissioned using a series of installation verification and functional checks. Equipment to be commissioned during the course of this project includes but is not limited to:
 - .1 Building Automation System (Controls System)

- .2 All newly installed HVAC equipment
- .3 Existing HVAC equipment that is being reused.
- .4 Life safety systems such as fire alarm, sprinkler, fire pumps
- .5 Distribution Equipment
- .6 Lighting Controls
- .7 Other major equipment as may be included in construction but may have been left off of this list will also be required to be included in commissioning.

2 Products

2.1 **TEST EQUIPMENT**

- .1 All standard testing equipment required to perform start-up and installation verification and required functional performance testing shall be provided by the division contractor for the equipment being tested.
- .2 Special test equipment, tools or instruments required by the contract documents shall be provided for commissioning and shall be left on site.
- .3 All testing equipment shall have had a certified calibration, traceable to a national standard, performed within the past year. If not otherwise noted, temperature sensors and digital thermometers shall have an accuracy of $\pm 0.1^{\circ}\text{F}$, pressure sensors shall have an accuracy of $\pm 1.0\%$ for each range available on the instrument (not the full range of the meter). All equipment shall be re-calibrated when dropped or damaged.

3 Execution

3.1 **MEETINGS**

- .1 Commissioning Meetings: Soon after construction commences, the CxA will conduct an initial commissioning scoping meeting with the entire commissioning team in attendance. Commissioning requirements, procedures, responsibilities and schedule will be reviewed.
- .2 Other commissioning meetings will be conducted as required throughout construction. These meetings will cover coordination, deficiency resolution and planning issues with particular Contractors and Subs.

3.2 **SUBMITTALS**

- .1 Contractors and Subs shall comply with specific requests for submittal documentation from the CxA in a timely fashion to ensure commissioning work continues as scheduled. At a minimum, the request will include installation and verification check sheets, the manufacturer's printed installation and start-up procedures, O&M data and manuals, final shop drawings, power and control field wiring drawings, sequences of operation, and results of required tests.

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- .2 Final completion of the O&M manuals including all required submittals is the responsibility of the Contractor.
- .3 TAB contractor shall supply an extra copy of the preliminary and the final TAB report marked "for CxA" for review. The CxA will review and forward comments to the engineer of record for follow-up.

3.3 **START-UP AND INSTALLATION VERIFICATION CHECKS**

- .1 The installing Contractor or Sub-contractor shall be responsible for performing and documenting start-up based on manufacturer's requirements and/or good industry practice. They shall perform all required procedures and checks and document the results. Start-up documents as requested by the CxA shall be provided.
- .2 Controls and Sensor Point-to-Point Checks. Control system point-to-point checks and calibration checks for all sensors shall be included as part of installation verification. The results shall be documented and provided to CxA.
- .3 Execution of Start-up and Installation Verification (IV/S-U).
 - .1 IV/S-U checklists shall be developed and provided by CxA. Where appropriate manufacturers checklists and procedures shall be combined or accepted in lieu of CxAs checklists.
 - .2 The contractor, sub-contractor, test agent, manufacturer's rep or supplier shall perform IV/S-U. They shall complete the checklist on each piece of equipment. IV/S-U shall be successfully completed prior to any FPT.
 - .3 At their sole discretion the CxA shall observe, recheck or verify the IV/S-U documentation of any or all equipment. The contractor shall cooperate with and provide support to the CxA as requested.
 - .4 Only individuals with direct knowledge of and who personally witnessed any IV/S-U shall sign off the checklists.
 - .5 It will be the responsibility of the contractor to remedy all deficiencies found. Retesting by the contractor may be required to demonstrate corrections have been made.
- .4 Deficiencies, Non-Conformance and Approval of IV/S-U Checklists.
 - .1 Dates for remedy of deficiencies shall be provided to the CxA with the initial IV/S-U documents.
 - .2 The CxA will work with all parties as required to affect proper corrective measures, correct and retest deficiencies or uncompleted items.
 - .3 Items left incomplete or not properly corrected, causing delays or multiple call-backs for retest may result in back-charges to the party at fault.

3.4 **TESTING, ADJUSTING, AND BALANCING (TAB) ELECTRICAL and MECHANICAL**

Issued for Tender

- .1 A preliminary TAB balancing shall be done prior to final balancing. System deficiencies requiring correction prior to final TAB shall be documented.
- .2 All deficiencies shall be corrected by the contractor prior to final balancing.
- .3 Participate in repeating selected measurement as required by the CxA for verification or diagnostic purposes.

3.5 **FUNCTIONAL PERFORMANCE TESTING (FPT)**

- .1 In general, functional performance testing is conducted after IV/S-U have been satisfactorily completed, the control system is fully operational, and TAB is complete, submitted and reviewed.
- .2 The installing Contractor, Sub-contractor, or Test Agent under the direction of the CxA, shall execute all FPT and shall maintain responsibility for all equipment tested.
- .3 In general, each system shall be operated through all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, part-load, full-load). Proper responses to such modes and emergency conditions (e.g., power failure, freeze condition, no flow, equipment failure, etc.) shall be verified.
- .4 FPT verification may be achieved by manual testing (persons manipulate the equipment and observe performance) or by monitoring the performance and analysing the results using the control system's trend log capabilities or by stand-alone data loggers. The CxA will determine which method is most appropriate.
- .5 The CxA will schedule FPTs through the GC/CM and affected Contractors and Subs. Tests which have not been witnessed shall not be accepted and shall be repeated.
- .6 Corrections of minor deficiencies identified during FPT may be made by the Contractor or Sub during the tests.
- .7 Where a deficiency cannot be corrected immediately, the Contractor or Sub shall provide a reasonable timeline for correction. The CxA shall document the deficiency and reschedule the FPT.
- .8 Where there is a dispute regarding whether a problem is a deficiency or who is responsible, the deficiency shall be documented and resolution attempted by parties in attendance. Final acceptance of proposed resolution lies with the Owner or designated representative.
- .9 The burden of responsibility to solve and correct deficiencies lies with the A/M/E, manufacturers, vendors, GC/CM, Contractors, and Subs. The CxA may recommend solutions to problems in consultation with these parties.
- .10 Cost of Retesting:
 - .1 If the Contractor or Sub is responsible for a deficiency then they shall carry the cost to rework the deficiency and complete the IV/S-U or FPT.
 - .2 The CxA will direct the first retesting of the equipment at no charge.

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- .3 If corrections of deficiencies have been reported to be successfully completed but are determined during testing to be faulty or otherwise incomplete, the time for the CxA to direct second or subsequent retests will be charged back.

3.6

DEFERRED TESTING

- .1 If any check or test cannot be completed due to weather conditions, the building structure, required occupancy condition or other deficiency, execution of IV/S-U and/or FPT may be delayed upon approval of the Department Representative.

END OF SECTION

1 GENERAL

1.1 COMMISSIONING OVERVIEW

- .1 Commissioning is a quality control process that checks given systems for proper and complete installation, and runs them through tests to verify proper functioning of individual components and, more importantly, total systems. Commissioning helps to ensure building staff understand and are able to operate the facility successfully over the life of the building. This is achieved through:
 - .1 Periodic site reviews of the installation during construction
 - .2 Detailed review, testing and verification of the operation of equipment and systems
 - .3 Reviewing the owner's operations and maintenance documentation and contractor training on the equipment and systems.
 - .4 Ensuring issues uncovered during construction, start-up, testing and operation and corrected before the expiry of the warranty period

1.2 SYSTEMS INCLUDED IN COMMISSIONING

- .1 The systems included in commissioning of this project include but are not limited to:
 - .2 Terminal Equipment
 - .1 Air moving and heating and cooling systems
 - .2 Hydronic pumping and heating and cooling systems
 - .3 Domestic water systems
 - .3 Air Handling Systems
 - .1 Exhaust Fans
 - .4 Electrical Systems:
 - .1 Lighting controls
 - .2 Power Distribution
 - .5 Electrical Systems:
 - .1 Lighting controls
 - .2 Power Distribution
 - .6 Fire Systems:
 - .1 Fire alarm system
 - .2 Fire sprinkler system
 - .3 Chemical-based fire suppression system for server room.
 - .7 Building Automation Systems (Bas)
 - .1 Direct digital control (DDC) systems operating any of the above systems.

- .8 *audio/video, telephone, networking, elevators, process equipment and other specialty systems normally commissioned by the supplier / installer are not included in the scope of Commissioning.*

1.3 PROJECT TEAM MEMBERS

- .1 Commissioning team members with roles and responsibilities for this project are listed in Appendix B along with a list of responsibilities for commissioning and construction team members are also provided in the Commissioning Specification. Each team member will be asked to designate a representative to attend regularly scheduled Cx meetings.
 - .1 The commissioning team involves the following members:
 - .1 IBI, Architectural Firm
 - .2 MMM Group Ltd, Mechanical Commissioning Authority
 - .3 _____, Mechanical Contractor
 - .4 _____, Electrical Contractors
 - .5 _____, Controls Contractor
 - .6 _____, General Contractor
 - .7 AME, Mechanical Design Consultant
 - .8 AES, Electrical Design Consultant
 - .9 _____, Testing and Balancing Contractor, test agents, manufacturer reps, etc

1.4 COMMUNICATIONS PORTOCOL

- .1 The following protocols will be used on this project.
 - .1 Minor issues may be handled through more informal discussions between the contractor, the designers or other parties directly involved and/or the CxA as appropriate.
 - .2 Requests for information or formal documentation by the CxA are handled through the normal communication channels. Minor issues may be handled through more informal discussions between the contractor, the designers or other parties directly involved and/or the CxA as appropriate.

Issue	Protocol
Requests for information or formal documentation.	CxA goes first through the PM.
Minor or verbal information and clarifications	CxA goes direct to the informed party.
Notifying contractors of deficiencies	CxA documents deficiencies through the PM, but may discuss deficiency issues with contractors and Design Consultants prior to notifying the PM.

Scheduling functional tests or training	CxA provides input and schedule review of testing and training. Scheduling is done through the GC / PM.
Scheduling commissioning meetings	CxA requests the date and schedules through the GC / PM.
Request for significant changes	CxA has no authority to issue change orders.
Making minor changes to the installed sequences of operations	Minor changes in sequences of operations and graphical representations required to correct or enhance system operations may be requested by the CxA, but must be documented
Making significant changes to the installed sequences of operations	The CxA may recommend to the design engineer PM changes in sequences of operation to improve efficiency or control.
Subcontractors disagreeing with requests or interpretations by the CxA	Resolve issues at the lowest level possible. First with the CxA, then with the GC and PM. Some issues may require input from the A/E team.

.3 Copies of the following documents should be sent to the CxA

- .1 Addendums
- .2 Contemplated Changes c/w all related sketches
- .3 Change Orders c/w all related sketches
- .4 Site instructions
- .5 Field review reports
- .6 Construction meeting minutes

1.5 COMMISSIONING PROCESS OVERVIEW

- .1 There are four main project phases for commissioning on the project. For each of these project phases, the various commissioning activities, and milestones are identified below.

1.6 COMMISSIONING PHASES

- .1 PHASE 1 – SYSTEM READINESS
 - .1 Before starting any of separate systems, provide certificate or company letter stating specific system is ready for startup and the following conditions have been met:
 - .1 Safety controls installed and fully operational (dry run test).
 - .2 Qualified personnel available to operate plant.

-
- .3 Permanent electrical connections made to equipment.

 - .2 System Readiness shall include, but not be limited to the following:
 - .1 Checking system physical completion, including instrumentation.
 - .2 Confirm connections are secure and labeled
 - .3 Flushing, chemical cleaning (as required), charging, fluid treating (expecting this to occur in parallel with units start up)
 - .4 Equipment lubrication and prestart checks
 - .5 Rotational checks.
 - .6 Air system cleaning complete.
 - .7 Filter systems installed and sealed in place.
 - .8 Adjusting vibration isolation and seismic restraints.
 - .9 Alignment of drives (direct and belt).
 - .10 Control function checks, including alarms. Confirm sequence of operations and cascade (if required)
 - .11 Self-diagnostic packaged control items checked.
 - .12 Provide Seismic engineer field review reports
 - .13 Deficiencies recorded, reviewed by commissioning team and corrected before proceeding to

 - .2 PHASE 2 – SYSTEM START-UP, TESTING, BALANCING
 - .1 System commissioning shall include, but not be limited to
 - .1 Activation of equipment and systems
 - .2 Testing and adjusting of equipment and systems.
 - .3 Deficiencies recorded, reviewed by commissioning team and corrected

 - .2 PHASE 2 is concluded when the installation is in full working order and acceptable for use. Work will include the following:
 - .1 Balancing of air systems as specified in Section 23 05 93.
 - .2 Balancing of hydronic systems as specified in Section 23 05 93.
 - .3 Set up automatic control valves/dampers and automatic temperature control devices.
 - .4 Adjust vibration isolators and earthquake restraints as necessary.
 - .5 Verification and certification of sealing of HVAC penetration through fire separations (rated and non-rated) and sound separations.
 - .6 Verification of water tightness of roof and exterior wall penetrations.
 - .7 Verification that coil drain pans operate.
 - .8 Testing and debugging of Building Management System (BMS).
 - .9 Set up and test alarm protective devices.
 - .10 Calibration and adjustment of smoke venting and pressurization systems.

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- .11 Testing, calibration and verification of energy meters, including "house" gas meters, water submeters, hydronic energy meters, and electrical meters. Confirm and verify correct meter ready and totalization data is enabled and reporting properly at BMS.
 - .12 Final verification of the fire alarm system is complete. Submit documentation.
 - .13 Breaker set up is complete and confirmation report is available indicating the settings match the design intent and the Short Circuit Study in the Coordination Study. Submit documentation
 - .14 Final testing and review of the lighting control system is complete. Submit documentation.
- .3 Fine Tuning:
 - .1 Set up automatic controls for accurate response and precise sequencing
 - .4 Testing:
 - .1 Detailed check by commissioning agent. Check to include items and functions to be later demonstrated to Consultant and Owner's Representatives.
- .3 PHASE 3 – VERIFICATION OF SYSTEM PERFORMANCE
 - .1 Verification of system performance by Consultant and Commissioning Authority will not commence until PHASE 2 has been totally completed. Submit test procedure completion certificates at time of requesting commencement of verification procedure. Verification process will include demonstration of the following:
 - .1 Random sampling of fire alarm devices to confirm functionality and sequence of operation.
 - .2 Random sampling of voltage reading at various devices.
 - .3 Visual review of the installation of power distribution equipment
 - .4 Random sampling of lighting controllers to confirm functionality and sequence of operations.
 - .5 Ease of access provided for servicing coils, motors, drives, fusible fire damper links, control and smoke dampers and damper operators.
 - .6 Location of opening and closing of access panels.
 - .7 Operation of automatic control dampers and automatic temperature control devices.
 - .8 Proper response of mixing boxes and variable volume air valves to thermostats and volume adjustment controls.
 - .9 Operation of smoke dampers and smoke pressurization and removal provisions.
 - .10 Operability of randomly selected fire dampers.
 - .11 Noise level from typical mixing boxes and variable volume air valves under extreme operating conditions.

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- .12 Operation of equipment and systems, under each mode of operation, including:
 - .1 DDC Control features.
 - .2 Automatic controls.
 - .3 Packaged air-conditioners and air handling equipment.
 - .4 Heat exchangers/immersion heaters.
 - .5 Pumps.
 - .6 Cabinet unit heaters.
 - .7 Unit heaters.
 - .8 8. Fans.
 - .9 9. Coils.
 - .10 10. Humidifiers.
 - .11 11. Boilers and associated gas systems.
 - .12 12. Air source heat recovery heat pumps.
 - .13 13. Tanks (domestic hot water, and expansion).
 - .14 14. Flow and energy (Inc. Gas & Elec. Sub-meters) meters.

 - .2 At the completion of PHASE 3, Contractor shall submit the following to Consultant and Commissioning Authority:
 - .1 Letter certifying that work specified is complete, clean and operational in accordance with specifications and drawings.
 - .2 Commissioning report which should include completed copies of PHASE 2 documentation outlined in commissioning plan plus copies of start- up reports from specialty Contractors and Vendors and any other relevant information for inclusion in operating and maintenance manuals.
 - .3 BC Boiler Inspection Department approval of boiler, pressure vessels and pressure piping installations.
 - .4 Fire Commissioner's approval of fuel oil installations.
 - .5 BC Gas Inspection Department approval of boiler and gas firing.
 - .6 Record drawings as specified, update to include changes resulting from commissioning.
 - .7 Statement confirming completion of DDC system acceptance test.
 - .8 Letter statement confirming that all energy and flow meters have been calibrated in accordance with Manufacturer's recommendations, and Weights and Measures Canada requirements. Obtain and append BMS Contractor's verification of trend logging and data collection database

 - .4 PHASE 4 – DEMONSTRATION & ACCEPTANCE
 - .1 Demonstration and acceptance shall not commence until commissioning process PHASE 3 has been completed.
 - .2 Demonstration process requires pre- plan approval before commencement and signed statement of satisfaction from Owner upon completion.

- .3 Systems operation in fire mode (pressurization and smoke removal) shall be demonstrated to Authorities having jurisdiction. Obtain written statement/certificate of approval.\
- .4 Post Substantial Performance Visits
 - .1 Provide follow-up visits at one month and six months after substantial performance for minimum period of two days, to ensure systems are operating correctly and are being operated and maintained properly.
 - .2 Submit report to Consultant and Owner indicating any problems that have arisen and correction action required.

1.7 COMMISSIONING PROCESS AND WORK PRODUCTS

- .1 COMMISSIONING PLAN (BY CXA)
 - .1 The commissioning plan (this document) is developed by the CxA and summarizes the tasks involved at each stage of the commissioning process. The document also outlines the responsibilities of each member of the commissioning Team. The Cx Plan is a living document and is updated as the project evolves.
- .2 SCHEDULE TESTING ACTIVITIES (BY CXA)
 - .1 The CxA will develop a commissioning schedule and ensure commissioning activities fit within project milestones. The commissioning schedule follows the design and construction schedules and works within the time constraints of the project. The CxA will participate in commissioning meetings throughout the project, maintain meeting minutes and produce action items to ensure that commissioning activities stay on track.
- .3 SPECIFICATIONS (BY ARCHITECT, DESIGN ENGINEERS)
 - .1 Commissioning specifications are developed by the architect and design engineers with input from the CxA. Specifications outline the responsibilities of the contractors in the commissioning process. This includes requirements in meetings participation, submittals for review, installation verification, deficiency remediation, equipment start-up, TAB, functional performance testing, O&M documentation, owner training, and warranty period site review.
- .4 INSTALLATION VERIFICATION CHECKLISTS (IVC) (BY CXA)
 - .1 IVC (also called Pre-Functional Checklists) are developed by the CxA and completed by the contractors with spot checks by the CxA. IV checklists review the quality of the installation including equipment condition, accessibility, and serviceability, adherence to installation requirements, completeness, and operational preparedness.
 - .2 On major pieces of equipment, basic start-up parameters are also included such as voltage, motor amps, on/off control, and motor rotation direction and quality of the installation. Pre-balancing inspection reports also constitute part of installation verification

.5 FUNCTIONAL PERFORMANCE TESTING (FPT) (BY CXA)

FPT forms and procedures are developed by the CxA. On-site testing is performed by the contractors and test agents (as required) under direction of the CxA. FPT is a collection of dynamic tests that evaluates the various systems through all expected as well as emergency modes of operation. FPT verifies operation of the equipment, controls and controls sequences, as well as interconnected systems. Seasonally dependent tests can be deferred until appropriate weather.

.6 O & M MANUALS (BY CONTRACTORS)

.1 Contractors are responsible for compiling the O & M manuals for all equipment supplied. The CxA will review and comment on completeness. The main sections required:

- .1 Information is specific to the equipment installed on-site
- .2 Preventative maintenance schedule
- .3 Troubleshooting guide
- .4 Parts list
- .5 Contact information of supplier/vendor and installing contractor
- .6 Engineering, shop, and as-built drawings
- .7 Wiring Schematics and Sequence of Operation
- .8 Warranty Information

.7 O & M TRAINING (BY CONTRACTORS / MANUFACTURER'S REP)

.1 O&M training timetable is developed by the PM and contractor in conjunction with the CxA and delivered by the contractor or manufacturer's rep for each major piece of equipment or equipment type installed. The party performing the training shall provide complete and relevant handouts to the attendees, and shall cover the topics of the training session, which shall include:

- .1 General description of the system and its operation
- .2 Identification of major components and access to same
- .3 Identification of operating controls and safeties including normal and abnormal sensor readings
- .4 Review of the O&M manuals for identification of service requirements, procedures, wiring diagrams, parts identification, safety procedures, etc.
- .5 Review of system drawings and schematics
- .6 Review of control drawings and schematics
- .7 Operational review for
 - .1 Start-up,
 - .2 normal operation,
 - .3 shut down,
 - .4 unoccupied operation,
 - .5 seasonal changeover,
 - .6 manual operation,
 - .7 controls set-up and programming,

- .8 troubleshooting and alarms
- .9 Interactions with other systems
- .10 Adjustments and optimizing methods for energy conservation
- .11 Health and safety issues
- .12 Regular maintenance requirements including frequency, parts and equipment, and tools needed, replacement parts sources
- .13 Special maintenance needs
- .14 Tenant interaction issues
- .15 Discussion of environmentally responsible system features
- .16 Identification of contacts for service support and maintenance parts

.8 COMMISSIONING REPORT (BY CXA)

- .1 Prepared by the CxA, the commissioning report will be submitted to the owner soon after testing is complete. The commissioning report will contain the following:
 - .1 Final copies of OPR and BOD
 - .2 Copy of commissioning specifications
 - .3 Completed IVC and FPT checklists (Appendix)
 - .4 O&M documentation evaluation
 - .5 O&M Training program evaluation
 - .6 Value of commissioning process
 - .7 Outstanding commissioning issues
 - .8 Site reports history of deficiencies and corrective actions (Appendix)

1.8 **SYSTEMS TO BE COMMISSIONED**

- .1 Electrical:
 - .1 Power Distribution
 - .2 Lighting Control
 - .3 Fire Alarm System
- .2 Mechanical:
 - .1 All HVAC Related systems
 - .2 Domestic Water systems
 - .3 DDC

1.9 ROLES AND RESPONSIBILITIES

.1 MECHANICAL CONTRACTOR:

- .1 Attend initial commissioning coordination meeting.
- .2 Provide complete equipment and systems start-up including personnel and tools, as required for safe, proper and complete start-up of all mechanical equipment.
- .3 Correct all deficiencies found during installation verification, start-up and TAB to ensure that all equipment and systems are fully functional and ready for functional performance testing.
- .4 Prepare O&M manuals and supplementary information on all equipment as directed by CxA and assemble in binders tabbed and indexed. Supplementary information may include, but is not limited to, such items as power/control field wiring diagrams, equipment maintenance schedule, vendor and maintenance contact lists. Submit to CxA when requested.
- .5 Prepare preliminary schedule for O&M manuals submission, owner training, pipe and duct system testing, flushing and cleaning, equipment start-up, and TAB for use by the CxA. Update schedule throughout the construction period.
- .6 Notify CxA a minimum of two weeks in advance of equipment and system start-up and/or installation verification testing.
- .7 Set-up and schedule vendors and contractors required to participate in the owner training sessions for all equipment and systems.
- .8 Provide a complete set of as-built record drawings and schematics with a copy to the CxA.

.2 TAB CONTRACTOR(S)

- .1 Attend initial commissioning coordination meeting.
- .2 Submit TAB procedures to CxA and Mechanical Consultant for review and acceptance.
- .3 Provide a preliminary TAB report showing that the system is complete and capable of being balanced. Provide an additional copy of the report labeled "For CA".
- .4 Submittal of final TAB report showing all flows, pressures, motor speeds, voltages and amperages etc., as required for a full and complete balancing report on all systems. Provide an additional copy of the TAB final report labeled "For CA", and include as-built distribution systems schematics.

.3 BUILDING CONTROLS AND AUTOMATION SYSTEM CONTRACTOR(S)

- .1 Attend initial commissioning coordination meeting.
- .2 Attend Sequence of Operation and Graphics review meeting scheduled by the CxA. Be prepared to discuss all sequences including all changes, and provide a schematic for each proposed graphic.
- .3 Provide the following submittals to the CxA at time of FPT. (Note: The following shall be updated to as-built conditions).
 - .1 Hardware and software submittals and shop drawings.
 - .2 Narrative description of each control sequence for each piece of equipment or system controlled.

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- .3 Point-to-point and sensor calibration verification checklists
 - .4 As-built diagrams showing all control points, sensor locations, point names, actuators, controllers and, where necessary, points of access, superimposed on diagrams of the physical equipment.
 - .5 Printout of panel layouts including all analog input, analog output, digital input, and digital output connections. Provide a separate list for each stand-alone control unit.
 - .6 Printout of final control programming algorithms, include current values of all parameters for each system point.
 - .7 Owner's operation and maintenance manuals.
 - .4 Provide thorough training to operating personnel on hardware, operation and programming, and the application program for the system.
 - .5 Demonstrate system performance to CxA. including all modes of system operation. (e.g. normal, abnormal, emergency).
 - .6 Provide control system technician to operate systems as required by and under the direction of the CxA during system verification and functional performance testing.
 - .7 Provide support and coordination with TAB contractor on all interfaces between their scopes of work. Provide all devices, such as portable operators' terminals, for TAB use in completing TAB procedures.
 - .8 Provide any trend logs as may be required by the CxA.
 - .9 Return to site with the GC and CxA approximately 10 months after the start of the warranty period to review system operation and to address operational issues.
- .4 ELECTRICAL CONTRACTOR**
- .1 Attend commissioning meetings scheduled by the CxA.
 - .2 Provide a copy of the electrical Coordination Study and Short Circuit Study (if any).
 - .3 Attend Fire Alarm and Lighting Control Sequence of Operation and Graphics review meeting scheduled by the CxA.
 - .4 Complete checksheets for each system to be commissioned and submit to the CxA
 - .5 Correct all deficiencies found during Installation Verification Inspection (IVI), start-up, TAB and FPT to ensure all equipment and systems are fully functional and in complete and proper working order.
 - .6 Prior to occupancy, but following the completion of all changes, certify that all protection devices have been checked and reset to conform to the Coordination Study settings.
 - .7 Participate in the verification of all protective device settings.
 - .8 Provide electrical system technicians to assist during system verification and functional performance testing as required by the CxA.
 - .9 Provide a complete set of as-built record drawings and schematics with a copy to the CxA.

END OF SECTION

- 1 General
- 1.1 **Mechanical and Electrical Checklists**
 - .1 Checklists are provided to ensure the correct installation and operation of the mechanical and electrical systems.
 - .2 List of Mechanical checklists:
 - .1 Fan Coil Installation / Start up (2 Pages)
 - .2 Domestic Hot Water Tanks installation / Start up (2 Pages)
 - .3 Air Conditioning Unit installation / Start up (2 Pages)
 - .3 List of Electrical checklists:
 - .1 Panels (2 Pages)
 - .2 Low Voltage Lighting Controls
 - .3 Fire Alarms
 - .4 Feeders
 - .5 Demonstration
 - .6 Electrical Commissioning Plan.(2 Pages)



HVAC COMMISSIONING INSTALLATION VERIFICATION CHECKLIST

FAN COILS

PROJECT: 8915171-000

Unit Tag Number				
Location				
Area served				
Make/Model				
General Installation				
Unit tag & certification labels affixed				
Casing free of damage and paint scratches				
Unit properly suspended, mounted and secured				
Doors open, close, lock & seal properly				
Insulation complete and not damaged				
Service access for unit is maintained				
Shipping locks removed				
Vibration isolation free, no rubbing				
Equipment clean up complete inside and out				
Proper filters installed				
Piping, Coils and Accessories				
Pipes properly supported				
Piping insulation complete & sealed				
Piping labelled for duty & direction				
Coils clean, no fin or tube damage				
Valves installed (isolation, 2-way, balance, etc)				
Thermometers, pressure gauges, test plugs				
Coil pump installation and operation verified				
Condensate drain/trap installed properly				
Fans, Ducts & Dampers				
Duct connections properly sized				
Duct connections & joints completely sealed				
Duct insulation complete and sealed.				
Ducts labelled for duty & direction				
Accessories installed (balancing damper, flex conn)				
Fan rotates freely in proper direction				
Belt tension and alignment verified				
Checks By Company Signature Date				
Witness to Testing Company Signature Date				

Comments:



HVAC COMMISSIONING START-UP CHECKLIST

FAN COILS

PROJECT: 8915171-000

Unit Tag Number						
Safeties, controls & interlock operation verified						
Factory electrical schematic posted in unit.						
Field wiring complete & drawing provided						
Power disconnects labelled and tested						
Electrical connections tested & tight.						
Actual overload setting (Amps)						
Checks By	Company	Signature		Date		
Witness to Testing	Company	Signature		Date		

Comments:



HVAC COMMISSIONING INSTALLATION VERIFICATION CHECKLIST

DOMESTIC HOT WATER TANKS

PROJECT: 8915171-000

Unit Tag Number			
Location			
Area served			
Make/Model			
General Installation			
Unit tag & certification labels affixed			
Casing free of damage and paint scratches			
Insulation complete and not damaged			
Service access for unit is maintained			
TPRV piping to drain complete			
Flue installed per manufacturers specs			
Combustion air supply complete			
Equipment clean up complete			
Mounting/support system			
Piping			
Piping complete and adequately supported			
Piping insulation complete & sealed			
Piping labelled for duty & direction			
Valves installed (isolation, pressure relief)			
Thermometers, pressure gauges & test plugs installed			
Gas Heating			
Gas piping and valving complete			
Gas inspection certificate complete			
Checks By	Company	Signature	Date
Witness to Testing	Company	Signature	Date
Comments:			



HVAC COMMISSIONING START-UP CHECKLIST

DOMESTIC HOT WATER TANKS

PROJECT: 8915171-000

Unit Tag Number				
Electrical				
Safeties, controls & interlock operation verified				
Factory electrical schematic posted in unit				
Field wiring complete & drawing provided				
Power disconnects labelled and tested				
Electrical connections tested & tight				
Actual overload setting (Amps)				
Gas Heating				
All air purged from gas lines				
Inlet gas pressure (" W.C.)				
Verify pilot spark				
Combustion efficiency report attached				

Checks By	Company	Signature	Date
Witness to Testing	Company	Signature	Date

Comments:



HVAC COMMISSIONING INSTALLATION VERIFICATION CHECKLIST

AIR CONDITIONING UNITS			
PROJECT: 8915171-000			
Unit Tag Number			
Location (gridline intersection)			
Area served			
Make/Model			
General Installation			
Unit tag & certification labels affixed			
Casing free of damage and paint scratches			
Doors open, close, lock & seal properly			
Unit properly suspended, mounted and secured			
Insulation complete and not damaged			
Service access for unit is maintained			
Shipping locks removed			
Vibration isolation free, no rubbing			
Equipment clean up complete inside and out			
Supplier pre-start report attached			
Piping			
Pipes properly installed, insulated & labelled			
Piping adequately supported			
Field installed piping tested and tagged			
FAN COIL / EVAPORATOR			
General Installation			
Access doors operate properly			
Proper air filters installed			
Condensate drain installed correctly			
Air flow sensors properly installed			
Evaporator coil clean with no fin damage			
Fan			
Fan rotates freely in proper direction			
Alignment & belt tension verified			
Free of noise & vibration			
CONDENSER			
General Installation			
Permanent unit tags affixed and visible			
Access doors operate properly			
Condenser coil clean with no fin damage			
Fan			
Fans rotate freely in proper direction			
Free of noise & vibration			
COMPRESSOR			
General Installation			
Refrigerant relief vented outdoors			
Sump heater installed			
Checks By	Company	Signature	Date
Witness to Testing	Company	Signature	Date
Comments:			



HVAC COMMISSIONING START-UP CHECKLIST

AIR CONDITIONING UNITS				
PROJECT: 8915171-000				
Unit Tag Number				
Safeties, controls & interlock operation verified				
Electrical schematic posted in unit				
Field wiring complete, including grounding				
Refrigerant level verification attached				
FAN COIL / EVAPORATOR				
Power disconnects labelled and tested				
Electrical connections tested & tight				
Actual overload setting (Amps)				
Note: Only required if not included in TAB report				
	Rated	Measured	Rated	Measured
Volts / Amps p1	/	/	/	/
Volts / Amps p2	/	/	/	/
Volts / Amps p3	/	/	/	/
CONDENSER				
Power disconnects labelled and tested.				
Electrical connections tested & tight.				
Actual overload setting (Amps)				
Note: Only required if not included in TAB report				
	Rated	Measured	Rated	Measured
Volts / Amps p1	/	/	/	/
Volts / Amps p2	/	/	/	/
Volts / Amps p3	/	/	/	/
COMPRESSOR				
Power disconnects labelled and tested.				
Electrical connections tested & tight.				
Oil level verified				
Actual overload setting (Amps)				
Note: Only required if not included in TAB report				
	Rated	Measured	Rated	Measured
Volts / Amps p1	/	/	/	/
Volts / Amps p2	/	/	/	/
Volts / Amps p3	/	/	/	/
Checks By	Company	Signature	Date	
Witness to Testing	Company	Signature	Date	
Comments:				

Project: CRA-CID Vancouver, British Columbia
 Electrical Commissioning Plan Spreadsheet
 Date Modified: May 19, 2016
 MMM Group Ltd - Commissioning

System and Equipment Testing	Test Required as specified in the Electrical Specifications (FC) or codes	Description of Testing to be carried-out by the Contractor (CTR), Manufacturer (MAN), Electrical Test Contractor - (TBC), Commissioning Authority (MMM)	To be Notified of Testing and Commissioning						Date for Testing and/or Commissioning	Date for Staff Training	Submission of Documents to Consultant and MMM Group Ltd Commissioning	Remarks
			MMM Cx	Electrical Consultant (AES)	Mechanical Consultant (AME)	Architect -IBI	Designated Representative (Owner)	System and Equipment Start-up Date				
Pre-testing Documentation	Section 01 91 00	Not Applicable	✓	✓	✓	✓	✓			Contractor Cx Plan Check sheets for each identified system Test Equipment List Construction Schedule Testing Schedule Updated list of CO		
During Construction	Section 01 91 00 Section 26 05 00 - 1.3 Section 26 05 00 - 1.4 Section 26 09 24 - 1.4 Section 26 09 24 - 3.3 Section 26 24 16 01 -1.3 Section 26 24 16 01 -1.4 Section 26 28 16 02 - 1.2 Section 28 31 00 -1.4 Section 28 31 00 - 2.32 Section 28 31 00 - 3.2.1	Not Applicable	✓	✓	✓	✓	✓			Updated Test Schedule Updated Construction Schedule Updated List of CO Completed Check Sheets (system ready for CxA) Test Reports as available		
Post Construction	Section 01 91 00	Not Applicable	✓	✓	✓	✓	✓			Operation and Maintenance Manual As-builts Final Test reports with deficiencies Contractor sign off that all deficiencies are remediated Confirmation that Owner Training is completed satisfactorily		

Documentation

Project No. 8915171-000
 Note: Fields left blank are to be completed by the Contractor.
 Issued Date: Page 1 of 2

Project: CRA-CID Vancouver, British Columbia
 Electrical Commissioning Plan Spreadsheet
 Date Modified: May 13, 2016
 MMM Group Ltd - Commissioning

System and Equipment Testing	Test Required as specified in the Electrical Specifications (FC) or codes	Description of Testing to be carried-out by the Contractor (CTR), Manufacturer (MAN), Electrical Test Contractor - (TBC), Commissioning Authority (MMM)	MMM Cx	Electrical Consultant (AES)	Mechanical Consultant (AME)	Architect -IBI	Designated Representative (Owner)	System and Equipment Start-up Date	Date for Testing and/or Commissioning	Date for Staff Training	Submission of Documents to Consultant and MMM Group Ltd Commissioning	Remarks
Low Voltage Equipment (under 750V)												
Panelboards	Section 01 91 00 and Appendices Section 26 05 00 - 3.8 Section 26 05 00 - 3.9 Section 26 24 16.01	CTR - Inspected and functionally verified AES - To review results and provide acceptance sign off (OA)	✓	✓	✓	✓	✓				CTR Check Sheets	
Circuit Breakers	Section 01 91 00, Appendices	MAN - Testing by Eaton PE - Quality Assurance	✓	✓	✓	✓	✓				CTR Check Sheets	
Emergency Equipment												
Fire Alarm Systems	Section 01 91 00 and Appendices Section 28 31 01 - 3.3	MAN - System startup and programming CTR - Installation and functional check sheets.	✓	✓	✓	✓	✓				CTR Check Sheets Fire alarm verification and Appendix C	
Conductors												
Low Voltage Feeder and Branch Circuit Conductors #410 and larger (600V and below)	Section 01 91 00 and Appendices Section 26 05 00 -2.7 Section 26 05 00 - 3.8,2.6	CTR - Inspected and tested in coordination with manufacturer requirements.	✓	✓	✓	✓	✓				Test Procedures Megger Test Report CTR Check Sheets	
Low Tension Systems												
Low Voltage Lighting Control	Section 01 91 00 and Appendices Section 26 09 24 -3.3.1	MAN - System startup and programming CTR - Installation and functional check sheets.	✓	✓	✓	✓	✓				Manufacturer Detailed Start Up Report CTR Check Sheets	

Project No. 8915171-000
 Note: Fields left blank are to be completed by the Contractor.
 Issued Date: Page 2 of 2

END OF SECTION

1 General

1.1 **TRAINING OF OWNER PERSONNEL**

- .1 The contractor supplying each piece of equipment shall be responsible for providing complete and satisfactory training on that piece of equipment. Training may be performed by the contractor, supplier, manufacturer or others as proposed by the contractor and accepted by the Owner best able to provide that training.
- .2 Refer to specification section for the system / equipment for additional training requirements.
- .3 The training session shall not be part of the system commissioning and must take place after the system operational tests have been completed.
- .4 Owner personnel shall be provided with completed O&M Manuals at least 1 week prior to training. In addition, up to five (5) copies of the related maintenance booklet and wiring as-builts shall be provided to owner personnel for the purpose of training.
- .5 All training sessions are to have written sign-in sheets for confirmation of attendance.
- .6 The GC shall be responsible for training coordination and scheduling and ultimately for ensuring that training is completed. Sessions shall be coordinated and videotaped by the Contractor as requested by the Owner.
- .7 At the end of training, obtain and submit to the CxA, signature of Department Representative stating that they understand system and equipment installation, operation and maintenance requirements.
- .8 Basic training for each piece of equipment shall include the following items at a minimum:
 - .1 General description of the system and its operation (Design Intent)
 - .2 Detailed itemization and identification of major components and access to same.
 - .3 Detailed itemization and identification of operating controls and safeties including normal and abnormal sensor readings
 - .4 Review of the O&M manuals for identification of service requirements, procedures, wiring diagrams, parts identification, safety procedures, etc.
 - .5 Review of system drawings and schematics
 - .6 Review of control drawings and schematics.
 - .7 Software and hardware modification training.
 - .8 Operational review for functionality including but not limited to:
 - .1 Complete system as well as component level demonstration
 - .2 Start-up
 - .3 Normal and emergency operation

-
- .4 Shut down
 - .5 Unoccupied operation
 - .6 Seasonal changeover
 - .7 Manual operation
 - .8 Controls set-up and programming
 - .9 Troubleshooting and alarms
 - .9 Interactions with other systems
 - .10 Familiarization with software and user customization options
 - .11 Adjustments and optimizing methods for energy conservation
 - .12 Health and safety issues
 - .13 Regular maintenance requirements including frequency, parts and equipment, and tools needed, replacement parts sources
 - .14 Special maintenance needs
 - .15 Tenant interaction issues
 - .16 Discussion of environmentally responsible system features
 - .17 Identification of contacts for service support and maintenance parts

1.2

DEFERRED TESTING

- .1 If any check or test cannot be completed due to weather conditions, the building structure, required occupancy condition or other deficiency, execution of IV/S-U and/or FPT may be delayed upon approval of the Department Representative.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Methods and procedures for demolishing, salvaging, recycling and removing materials and items designated to be removed in whole or in part.
- .2 Refer to Drawings for details and extent of demolition.

1.2 ALTERATION PROJECT PROCEDURES

- .1 Remove, cut, and patch Work in a manner to minimize damage and to provide means of restoring Products and finishes to original or specified condition.
- .2 Refinish existing visible surfaces to remain in renovated rooms and spaces, to specified condition for each material, with a neat transition to adjacent finishes.
- .3 Where new Work abuts or aligns with existing, provide a smooth and even transition. Patch Work to match existing adjacent Work in texture and appearance.
- .4 When finished surfaces are cut so that a smooth transition with new Work is not possible, terminate existing surface along a straight line at a natural line of division and submit recommendation to Consultant for review.
- .5 Where a change of plane of 6 mm or more occurs, submit recommendation for providing a smooth transition to Departmental Representative.
- .6 Patch or replace portions of existing surfaces which are damaged, lifted, discoloured, or showing other imperfections.
- .7 Finish surfaces as specified in individual technical sections.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Scheduling: Schedule work to occur within the hours indicated in Appendix B.

1.4 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Hazardous Materials: If found, provide description of Hazardous Materials and Notification of Filing with proper authorities prior to beginning of Work as required.

1.5 QUALITY ASSURANCE

- .1 Regulatory Requirements:
 - .1 Ensure Work is performed in compliance with applicable Provincial regulations.
 - .1 Conform to applicable regulatory procedures when discovering hazardous or contaminated materials.
- .2 Do not close or obstruct egress width to any building or site exit.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 As specified in Section 01 74 19.

1.7 SITE CONDITIONS

- .1 Site Environmental Requirements:
 - .1 Do not dispose of waste of volatile materials including but not limited to, mineral spirits, oil, petroleum based lubricants, or toxic cleaning solutions into watercourses, storm or sanitary sewers. Ensure proper disposal procedures are maintained throughout the project.
 - .2 Do not pump water containing suspended materials into watercourses, storm or sanitary sewers or onto adjacent properties.
- .2 Existing Conditions.
 - .1 Remove contaminated or materials listed as hazardous as directed by Project Manager from site, prior to start of demolition Work, and dispose of at designated disposal facilities in safe manner in accordance with applicable regulatory requirements.
- .3 Conduct demolition to minimize interference with adjacent and occupied building areas.

Part 2 Products

- .1 Refer to Drawing Notes for full extent of demolition.
- .2 Materials: As indicated on Drawings and specified in respective technical sections; to match existing materials for patching and extending work.

Part 3 Execution

3.1 PREPARATION

- .1 Inspect site with Departmental Representative and verify extent and location of items designated for removal, disposal, alternative disposal, recycling, salvage and items to remain.
- .2 Locate and protect utilities. Preserve active utilities traversing site in operating condition.
- .3 Notify and obtain approval of utility companies before starting demolition.
- .4 Provide, erect, and maintain temporary barriers at locations indicated.
- .5 Provide dust barrier as specified in Section 01 56 00 - Temporary Barriers and Enclosures.
- .6 Protect HVAC systems as required in 01 47 18 – Indoor Air Quality.
- .7 Protect existing materials and surfaces which are not to be demolished.
- .8 Provide appropriate temporary signage including signage for exit or building egress.

3.2 REMOVAL OF HAZARDOUS WASTES

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

3.3 DEMOLITION OPERATIONS

- .1 Demolish items as indicated on Drawings in an orderly and careful manner.
- .2 Do not disturb items designated to remain in place.
- .3 Remove demolished materials from site except where specifically noted otherwise.
- .4 Remove materials as Work progresses. Upon completion of Work, leave areas in clean condition.
- .5 Remove temporary Work.
- .6 Salvage: Dismantle, remove and salvage items for reuse as indicated on the Drawings.
- .7 Dispose of materials not designated for reuse in accordance with applicable regulations.

3.4 CLEANING

- .1 Remove debris, trim surfaces and leave work site clean, upon completion of Work
- .2 Use cleaning solutions and procedures which are not harmful to health, are not injurious to plants, and do not endanger wildlife, adjacent water courses or ground water.
- .3 Progress Cleaning: clean in accordance with Section 01 11 55 – General Instructions.
 - .1 Leave Work area clean at end of each shift.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 09 22 16 - Non-Structural Metal Framing

1.2 REFERENCES

- .1 CSA International
 - .1 CSA B111-74(R2003), Wire Nails, Spikes and Staples.
 - .2 CAN/CSA-G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .3 CAN/CSA-O80 Series-08 (R2012), Wood Preservation, Includes Update No. 1 (2008), Update No. 2 (2011), Update No. 3 (2012), Update No. 4 (2012)
 - .4 CSA O141-05 (R2014), Softwood Lumber
 - .5 CSA O151-09 (R2014), Canadian Softwood Plywood
 - .6 CAN/CSA-Z809-08, Sustainable forest management, Includes Update No. 1 (2010).
- .2 National Lumber Grades Authority (NLGA)
 - .1 NLGA Standard Grading Rules for Canadian Lumber, 2014

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Compatibility: provide written compatibility statement for peel and stick membrane.
- .3 Submit manufacturer's instructions, printed product literature and data sheets for product characteristics, performance criteria, physical size, finish and limitations.
- .4 Forest Stewardship Council (FSC)
 - .1 FSC-STD-01-001-2004, FSC Principle and Criteria for Forest Stewardship.
- .5 Green Seal Environmental Standards (GS)
 - .1 GS-11-11, Paints and Coatings.
- .6 National Lumber Grades Authority (NLGA)
 - .1 Standard Grading Rules for Canadian Lumber 2014.
- .7 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
 - .1 SCAQMD Rule 1113-A2011, Architectural Coatings.

1.4 QUALITY ASSURANCE

- .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 CSA standards.
- .3 Plywood, OSB and wood based composite panel construction sheathing identification: by grademark in accordance with applicable CSA standards.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 10 - Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.
- .4 Separate and recycle waste materials in accordance with Section 01 74 19 –Waste Management and Disposal.

Part 2 Products

2.1 MATERIALS

- .1 Lumber: unless specified otherwise, softwood, S4S, moisture content 19% or less in accordance with following standards:
 - .1 FSC Certified.
 - .2 CAN/CSA-O141.
 - .3 NLGA Standard Grading Rules for Canadian Lumber.
- .2 Furring, blocking, nailing strips, grounds, rough bucks:
 - .1 FSC Certified.
 - .2 Urea-formaldehyde free.
 - .3 S4S.
 - .4 Board sizes: "Standard" or better grade.
 - .5 Dimension sizes: "Standard" light framing or better grade.
- .3 Panel Materials:
 - .1 FSC Certified.
 - .2 Douglas fir plywood (DFP): to CSA O121, standard construction.
 - .1 Pressure treated to CSA O80, Fire retardant treated, FSC 25 maximum, smoke developed not more than 75.

2.2 ACCESSORIES

- .1 Fasteners: to CAN/CSA-G164, for treated material.

- .2 Nails, spikes and staples: to CSA B111.
- .3 Bolts: 12.5 mm diameter unless indicated otherwise, complete with nuts and washers.
- .4 Proprietary fasteners: toggle bolts, expansion shields and lag bolts, screws and lead or inorganic fibre plugs, recommended for purpose by manufacturer.

Part 3 Execution

3.1 EXAMINATION

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

3.2 INSTALLATION

- .1 Comply with requirements of NBC, supplemented by the following paragraphs.
- .2 Install furring and blocking as required to space-out and support casework, cabinets, wall and ceiling finishes, and other work as required.
- .3 Align and plumb faces of furring and blocking to tolerance of 1:600.
- .4 Install rough bucks, nailers and linings to rough openings as required to provide backing for frames and other work.
- .5 Countersink bolts where necessary to provide clearance for other work.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 11 55 – General Instructions.
 - .1 Leave Work area clean at end of each shift.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 11 55 – General Instructions.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 07 92 00 – Joint Sealing
- .2 Section 09 21 16 – Gypsum Board Assemblies
- .3 Section 09 22 00 – Non-Structural Metal Framing
- .4 Division 26 – Electrical

1.2 REFERENCES

- .1 American National Standards Institute (ANSI):
 - .1 ANSI/NPA A208.1-2009, Particleboard
- .2 Architectural Woodwork Manufacturers Association of Canada (AWMAC):
 - .1 AWS (Architectural Woodwork Standards), Edition 1, 2009.
- .3 Canadian Standards Association (CSA):
 - .1 CSA B111-74(R2003), Wire Nails, Spikes and Staples.
 - .2 CAN/CSA-G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .3 CSA O112 SERIES-M1977(R2006), CSA Standards for Wood Adhesives.
 - .4 CSA O121-08 (R2013), Douglas Fir Plywood, Includes Update No. 1 (2013).
- .4 Green Seal (GS)
 - .1 Green Seal Standard GS-36, Aerosol Adhesives, October 19, 2000.
- .5 National Electrical Manufacturers Association (NEMA):
 - .1 ANSI/NEMA LD 3-2005, High-Pressure Decorative Laminates (HPDL)
- .6 South Coast Air Quality Management District (SCAQMD), California State (SCAQMD)
 - .1 SCAQMD Rule 1168, Adhesives and Sealants, January 5, 2005 amendment, effective date July 1, 2005.

1.3 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Submit product data sheets for each product specified.
- .3 Shop drawings:
 - .1 Indicate details of construction, profiles, jointing, fastening and other related details.
 - .1 Scales: profiles full size, details half full size.
 - .2 Indicate materials, thicknesses, finishes and hardware.

- .3 Indicate locations of service outlets in casework, typical and special installation conditions and connections, attachments, anchorage and location of exposed fastenings.
- .4 Samples:
 - .1 Provide full range of colour samples for selection by Departmental Representative.
 - .2 Submit duplicate samples of each material and thickness: sample size 300 x 300 mm or 450 mm long unless specified otherwise, with selected finish.
 - .3 Provide duplicate colour samples of laminated plastic for verification of colour and texture.

1.4 QUALITY ASSURANCE

- .1 Lumber by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.
- .2 Sustainable Standards Certification:
 - .1 Certified Wood: submit listing of wood products and materials used in accordance FSC.
- .3 Architectural woodwork provided in project shall meet requirements of the AWS.
- .4 Materials and installation shall be in Metric measurement as specified.
- .5 Plywood, particleboard, OSB and wood based composite panels in accordance with CSA and ANSI standards.

1.5 DELIVERY, STORAGE, AND HANDLING:

- .1 Deliver, handle, store and protect materials of this section in accordance with manufacturer's instructions.
 - .1 Protect millwork against dampness and damage during and after delivery.
 - .2 Store millwork in ventilated areas, protected from extreme changes of temperature or humidity.

1.6 WASTE MANAGEMENT AND DISPOSAL

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

Part 2 Products

2.1 MATERIALS

- .1 Panel materials shall not be manufactured with or contain added urea-formaldehyde.
- .2 Particleboard to ANSI A208.1, of thickness indicated, and maximum size sheets application and as follows:
 - .1 Urea Formaldehyde Free.
 - .2 FCS Certified.

- .3 AWS premium grade, for plastic laminate and melamine finishes.
- .4 Core Construction: particleboard.

2.2 FINISHES

- .1 Thermofused Melamine: to NEMA LD3 Grade VGL.
 - .1 High wear resistant thermofused melamine: equal or exceed 400 cycles (Minimum standard for HPL abrasion test).
 - .2 Colour: to be selected by Consultant from manufacturer's full range.
 - .3 Laminating adhesives to be Urea Formaldehyde Free.
- .2 Plastic Laminate:
 - .1 Horizontal General Purpose Grade (HGS): thickness of 1.2 mm \pm 0.12 mm
 - .2 Vertical General Purpose Grade (VGS): thickness of 0.7 mm \pm 0.10 mm.

2.3 HARDWARE

- .1 Provide the following cabinet hardware, in quantity required, complete with all screws, bolts, washers for complete installation.
- .2 Hardware: Bolts, nuts, washers, screws, cup washers for removal panels, etc., all hot dip heavy zinc-coated.
- .3 Draw Bolt Fasteners.
- .4 Spacers: Rigid PVC to size and profile indicated.
- .5 Hinges: Concealed Type for casework: nickel-plated, self closing, three-way adjustment and adjustable mounting plate, size and type to suit door, 170 degree opening, except 90 degrees where door opens against adjacent wall.
- .6 Drawer slides: heavy duty, full extension with overtravel protection, ball bearing slide, steel construction, zinc finish.
- .7 Cabinet pulls: Stainless steel, "D", 100 mm, polished finish.
- .8 Door bumpers: 9mm dia. clear, nylon, peel and stick.
- .9 Cable Grommets: plastic, 50 mm diameter with cover, black colour.

2.4 ACCESSORIES

- .1 Nails and staples: to CSA B111; galvanized to CAN/CSA-G164 for interior humid areas and for treated lumber; plain finish elsewhere.
- .2 Wood screws: electroplated steel, type and size to suit application.
- .3 Splines: wood.
- .4 Wood Adhesive: recommended by manufacturer, VOC content less than 30 g/l.
- .5 Sealant: mould and mildew resistant silicone as specified in Section 07 92 00, VOC content less than 250 g/l.
- .6 Laminated plastic adhesive:
 - .1 Contact adhesives: urea-formaldehyde free, VOC content less than 80 g/l.

2.5 MANUFACTURED UNITS

- .1 Casework Construction: flush overlay system, AWS Custom Grade.
 - .1 Cases, doors and drawerfronts:
 - .1 Minimum core thicknesses, composition and face finish as follows:
 - .1 Particleboard core 19 mm thick.
 - .2 Backs against walls: 12.5 mm ply core.
 - .3 Edge band:
 - .1 Unless otherwise indicated or specified; square, material same as exposed surface.
 - .4 Finish:
 - .1 Exposed Exterior: plastic laminate VGS.
 - .1 Colour: to be selected by Departmental Representative.
 - .2 Exposed Interior: plastic laminate VGS.
 - .1 Colour: to be selected by Departmental Representative.
 - .3 Semi-exposed: thermofused melamine.
 - .1 Colour: to be selected by Departmental Representative.
 - .2 Drawer boxes: 12.5 mm particleboard core, melamine finish.
 - .2 Plastic laminate countertops:
 - .1 Top: Horizontal General Purpose Grade plastic laminate.
 - .1 Colour: to be selected by Departmental Representative.
 - .2 Core: Plywood substrate, Douglas Fir plywood grade B or better, sound sanded faces free from voids, 19mm thick.
 - .3 Front edge: post-formed.

2.6 FABRICATION

- .1 Fabricate to AWS Custom Grade, flush overlay and in accordance with Sections 10 and 11 of the AWS.
- .2 Obtain governing dimensions before fabricating items which are to accommodate or abut appliances, equipment and other materials.
- .3 Shop assemble work for delivery to site in size easily handled and to ensure passage through building openings.
- .4 Fabricate gables and edges meeting walls oversize to allow for scribing to fit on site.
- .5 Assemble Work with flush butt hairline corners and joints. Cut outs for services to be done on site during installation. No hairline cracks will be allowed in the face area of cabinet work modules unless approved in writing by the Consultant.
- .6 Joints to be carefully fitted, coped or mitred and well glued up. There shall be no end wood visible on finished surfaces.

- .7 Set nail heads in finished surfaces. Countersink screws and bolts, except those detailed to be exposed, and fill holes with edge grain wood plugs to match colour and grain.
- .8 Ensure adjacent part of continuous work match in colour and pattern.
- .9 Glue, dowel, mortise, lock joint or dado all cabinet work and cabinet work. Do not use staples. Nailing and screws are acceptable. Do not surface nail or screw through countertops.
- .10 Blocking, framing, web frames to be solid lumber.
- .11 Shop install cabinet hinge hardware.
- .12 Door and drawer pull hardware may be installed on site at cabinet maker's option, considering packaging and shipping requirements.
- .13 Cabinetwork shelving to be adjustable unless otherwise noted.
- .14 Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes and other fixtures.
- .15 Shop install metal fabrications where required.
- .16 Ensure adjacent parts of continuous laminate work match in colour and pattern.
- .17 Veneer laminated plastic to core material: in accordance with adhesive manufacturer's instructions. Ensure core and laminate profiles coincide to provide continuous support and bond over entire surface. Use continuous lengths up to 3000 mm. Keep joints 600 mm from sink cutouts.

Part 3 Execution

3.1 EXAMINATION

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

3.2 INSTALLATION

- .1 In accordance with AWS.
- .2 Install prefinished millwork at locations shown on drawings. Position accurately, level, plumb straight.
- .3 Fasten and anchor millwork securely. Provide heavy duty fixture attachments for wall mounted cabinets.
- .4 Use draw bolts in countertop joints.
- .5 Scribe and cut as required to fit abutting walls and to fit properly into recesses and to accommodate piping, columns, fixtures, outlets or other projecting, intersecting or penetrating objects.

- .6 At junction of plastic laminate counter back splash and adjacent wall finish, apply small bead of sealant.
- .7 Fit hardware accurately and securely in accordance with manufacturer's written instructions.
- .8 Coordinate and install metal fabrications for support as indicated.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 11 55 – General Instructions.
 - .1 Leave Work area clean at end of each shift.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 11 55 – General Instructions.

3.4 PROTECTION

- .1 Protect work from damage until Substantial Performance.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 09 21 16 – Gypsum Board Assemblies
- .2 Section 09 22 16 – Non-Structural Metal Framing

1.2 REFERENCES

- .1 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S702-14, Standard for Mineral Fibre Insulation for Buildings.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for blanket insulation and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Certificates:
 - .1 Submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .4 Test Reports:
 - .1 Submit certified test reports showing compliance with specified performance characteristics and physical properties.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 10 - Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.

1.5 WASTE MANAGEMENT AND DISPOSAL

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

Part 2 Products

2.1 INSULATION

- .1 Batt and blanket mineral fibre: to CAN/ULC-S702.
 - .1 Type: 1.
 - .2 Thickness: as indicated.

Part 3 Execution

3.1 EXAMINATION

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

3.2 INSULATION INSTALLATION

- .1 Fit insulation between stud 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 Do not enclose insulation until it has been reviewed by Departmental Representative.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 11 55 – General Instructions.
 - .1 Leave Work area clean at end of each shift.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 11 55 – General Instructions.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 09 21 16 – Gypsum Board Assemblies
- .2 Section 09 22 16 – Non-Structural Metal Framing

1.2 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .2 South Coast Air Quality Management District (SCAQMD), California State (SCAQMD)
 - .1 SCAQMD Rule 1168, Adhesives and Sealants, January 5, 2005 amendment, effective date July 1, 2005.
- .3 Underwriter's Laboratories of Canada (ULC)
 - .1 ULC-S115-11, Fire Tests of Fire stop Systems.

1.3 DEFINITIONS

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

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit WHMIS MSDS - Material Safety Data Sheets.
- .3 Shop Drawings:

- .1 Submit shop drawings to show listing, location, proposed material, reinforcement, anchorage, fastenings and method of installation.
- .2 Construction details should accurately reflect actual job conditions.
- .3 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures.

1.5 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installer: company or person specializing in fire stopping installations approved by manufacturer with five 5 years documented experience.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle materials in accordance with Section 01 61 10 - Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
 - .3 Deliver materials to the site in undamaged condition and in original unopened containers, marked to indicate brand name, manufacturer, ULC markings.
- .2 Storage and Protection:
 - .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.

1.7 WASTE MANAGEMENT AND DISPOSAL

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

Part 2 Products

2.1 MATERIALS

- .1 Unless otherwise specified, VOC content limits of sealants shall be in accordance with SCAQMD Rule 1168 and as follows:
 - .1 Architectural Materials:
 - .1 Firestopping Sealants: VOC content limit 250 g/L.
- .2 Fire stopping and smoke seal systems: in accordance with CAN-ULC-S115.
 - .1 Asbestos-free materials and systems capable of maintaining effective barrier against flame, smoke and gases in compliance with requirements of CAN-ULC-S115 and not to exceed opening sizes for which they are intended and conforming to specified special requirements described in PART 3.

- .3 Service penetration assemblies: systems tested to CAN-ULC-S115.
- .4 Service penetration fire stop components: certified by test laboratory to CAN-ULC-S115.
- .5 Fire-resistance rating of installed fire stopping assembly in accordance with NBC and Vancouver Building By-Law, which ever is more stringent.
- .6 Fire stopping and smoke seals at openings intended for ease of re-entry such as cables: elastomeric seal.
- .7 Fire stopping and smoke seals at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control: elastomeric seal.
- .8 Primers: to manufacturer's recommendation for specific material, substrate, and end use.
- .9 Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.
- .10 Damming and backup materials, supports and anchoring devices: to manufacturer's recommendations, and in accordance with tested assembly being installed as acceptable to authorities having jurisdiction.
- .11 Sealants for vertical joints: non-sagging.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 PREPARATION

- .1 Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials.
 - .1 Ensure that substrates and surfaces are clean, dry.
- .2 Prepare surfaces in contact with fire stopping materials and smoke seals to manufacturer's instructions.
- .3 Maintain insulation around pipes and ducts penetrating fire separation without interruption to vapour barrier.
- .4 Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.

3.3 INSTALLATION

- .1 Install fire stopping and smoke seal material and components in accordance with manufacturer's certified tested system listing.

- .2 Seal holes or voids made by through penetrations, poke-through termination devices, and unpenetrated openings or joints to ensure continuity and integrity of fire separation are maintained.
- .3 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.
- .4 Tool or trowel exposed surfaces to neat finish.
- .5 Remove excess compound promptly as work progresses and upon completion.

3.4 SEQUENCES OF OPERATION

- .1 Proceed with installation only when submittals have been reviewed by Departmental Representative.
- .2 Install floor fire stopping before interior partition erections.
- .3 Metal deck bonding: fire stopping to precede spray applied fireproofing to ensure required bonding.
- .4 Mechanical pipe insulation: certified fire stop system component.
 - .1 Ensure pipe insulation installation precedes fire stopping.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 11 55 – General Instructions.
 - .1 Leave Work area clean at end of each shift.
- .2 Remove temporary dams after initial set of fire stopping and smoke seal materials.

3.6 SCHEDULE

- .1 Fire stop and smoke seal at:
 - .1 Penetrations through fire-resistance rated masonry, concrete, and gypsum board partitions and walls.
 - .2 Top of fire-resistance gypsum board partitions.
 - .3 Penetrations through fire-resistance rated floor slabs, ceilings.
 - .4 Openings and sleeves installed for future use through fire separations.
 - .5 Around mechanical and electrical assemblies penetrating fire separations.
 - .6 Rigid ducts: greater than 129 cm² : fire stopping to consist of bead of fire stopping material between retaining angle and fire separation and between retaining angle and duct, on each side of fire separation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 08 11 00 – Metal Doors and Frames
- .2 Section 08 80 50 – Glazing
- .3 Section 09 21 16 – Gypsum Board Assemblies
- .4 Section 09 22 16 – Non-Structural Metal Framing

1.2 REFERENCES

- .1 ASTM International
 - .1 ASTM C509-06(2011), Standard Specification for Elastomeric Cellular Preformed Gasket and Sealing Material.
 - .2 ASTM C834-14, Standard Specification for Latex Sealants.
 - .3 ASTM C919-12, Standard Practice for Use of Sealants in Acoustical Applications.
 - .4 ASTM C920-14a, Standard Specification for Elastomeric Joint Sealants.
 - .5 ASTM C1193-13, Standard Guide for Use of Joint Sealants.
 - .6 ASTM C1330-02(2013), Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants.
 - .7 ASTM D2240-05(2010), Standard Test Methods for Rubber Property, Durometer Hardness.
 - .8 ASTM C919-14, Standard Practice for Use of Sealants in Acoustical Applications.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .3 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
 - .1 SCAQMD Rule 1168, Adhesives and Sealants, January 5, 2005 amendment, effective date July 1, 2005.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for joint sealants and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Manufacturer's product to describe:

- .1 Sealant.
- .2 Primers.
- .3 Sealing compound, each type, including compatibility when different sealants are in contact with each other.
- .3 Submit WHMIS MSDS.
- .3 Manufacturer's Instructions:
 - .1 Submit instructions to include installation instructions for each product used.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 30 - Closeout Submittals.
- .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 Section 01 61 10 - Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.

1.6 WASTE MANAGEMENT AND DISPOSAL

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

1.7 SITE CONDITIONS

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

- .3 Joint-Substrate Conditions:
 - .1 Proceed with installation of joint sealants only after contaminants capable of interfering with adhesion are removed from joint substrates.

1.8 ENVIRONMENTAL REQUIREMENTS

- .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and provision of Material Safety Data Sheets (MSDS) acceptable to Health Canada.
- .2 Ventilate area of work as directed by Departmental Representative by use of approved portable supply and exhaust fans.

Part 2 Products

2.1 SEALANT MATERIALS

- .1 Unless otherwise specified, VOC content limits of sealants shall be in accordance with SCAQMD Rule 1168 and as follows:
 - .1 Architectural Materials:
 - .1 Sealants: VOC content limit 250 g/L.
 - .2 Do not use sealants that emit strong odours, contains toxic chemicals or is not certified as mould resistant in air handling units.
 - .3 Where sealants are qualified with primers use only these primers.

2.2 SEALANT MATERIAL DESIGNATIONS

- .1 Urethanes one part:
 - .1 Non-sag: to ASTM C920.
- .2 Silicones one part: to ASTM C920.
- .3 Acrylic latex one part: to ASTM C834.
- .4 Acoustical butyl sealant: to ASTM C919.
- .5 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 30 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 Architectural Woodwork: at joints between splash and counter, and splash and wall: sealant type: clear silicone.
- .2 Joints with very low movement and to be painted over: acrylic.
- .3 Perimeters of interior frames, as detailed and itemized: sealant type: acrylic.
- .4 Perimeter of plumbing fixtures (e.g. sinks, urinals, water closets, basins, vanities): sealant type: silicones.
- .5 Applications as specified in Section 09 21 16: Acoustical sealant.
- .6 Exposed interior control joints in drywall: sealant type: urethane.
- .7 Penetrations of pipe and electrical wiring: acoustical butyl sealant.

2.4 JOINT CLEANER

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

Part 3 Execution

3.1 EXAMINATION

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

3.2 SURFACE PREPARATION

- .1 Examine joint sizes and conditions to establish correct depth to width relationship for installation of backup materials and sealants.
- .2 Clean bonding joint surfaces of harmful matter substances including dust, rust, oil grease, and other matter which may impair Work.
- .3 Do not apply sealants to joint surfaces treated with sealer, curing compound, water repellent, or other coatings unless tests have been performed to ensure compatibility of materials. Remove coatings as required.

- .4 Ensure joint surfaces are dry and frost free.
- .5 Prepare surfaces in accordance with manufacturer's directions.

3.3 PRIMING

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

3.4 BACKUP MATERIAL

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

3.5 MIXING

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

3.6 APPLICATION

- .1 Sealant:
 - .1 Apply sealant in accordance with manufacturer's written instructions.
 - .2 Mask edges of joint where irregular surface or sensitive joint border exists to provide neat joint.
 - .3 Apply sealant in continuous beads.
 - .4 Apply sealant using gun with proper size nozzle.
 - .5 Use sufficient pressure to fill voids and joints solid.
 - .6 Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities.
 - .7 Tool exposed surfaces before skinning begins to give slightly concave shape.
 - .8 Remove excess compound promptly as work progresses and upon completion.
 - .9 In Server Room seal each instance of pipe or wire penetration with acoustical butyl sealant.
- .2 Curing:
 - .1 Cure sealants in accordance with sealant manufacturer's instructions.
 - .2 Do not cover up sealants until proper curing has taken place.

3.7 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 11 55 – General Instructions.
 - .1 Leave Work area clean at end of each shift.

- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 11 55 – General Instructions.

3.8 PROTECTION

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 08 14 16 – Flush Wood Doors
- .2 Section 08 71 00 - Hardware
- .3 Section 08 80 50 - Glazing
- .4 Section 09 21 16 – Gypsum Board Assemblies
- .5 Section 09 22 16 – Non-Structural Metal Framing

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A653/A653M-15, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .2 Canadian Standards Association (CSA International)
 - .1 CSA-G40.20/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel, Includes Update No. 1 (2014)
 - .2 CSA W59-13, Welded Steel Construction (Metal Arc Welding), Includes Update No. 1 (2014), Update No. 3 (2015).
- .3 Canadian Steel Door Manufacturers' Association (CSDMA)
 - .1 CSDMA, Recommended Specifications for Commercial Steel Doors and Frames, 2000.
 - .2 CSDMA, Selection and Usage Guide for Commercial Steel Doors, 1990.
- .4 Hollow Metal Manufacturers Association (HMMA) & National Association of Architectural Metal Manufacturers
 - .1 HMMA 840-07, Guide Specification for Installation and Storage of Hollow Metal Doors and Frames
- .5 National Fire Protection Association (NFPA).
 - .1 NFPA (Fire) 80, Standard for Fire Doors and Other Opening Protectives, 2007 Edition
 - .2 NFPA (Fire) 252, Fire Tests of Door Assemblies, 2012 Edition.
- .6 South Coast Air Quality Management District (SCAQMD), California State
 - .1 SCAQMD Rule 1113-04, Architectural Coatings.
- .7 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC S104-15, Fire Tests of Door Assemblies

- .2 CAN/ULC S105-09, Standard Specification for Fire Door Frames Meeting the Performance Required by CAN/ULC-S104.
- .3 ULC CAN4-S106-M80, Standard Method for Fire Tests of Window and Glass Block Assemblies

1.3 SYSTEM DESCRIPTION

- .1 Design Requirements:
 - .1 Steel fire rated doors and frames: labelled and listed by an organization accredited by Standards Council of Canada in conformance with CAN/ULC S104 and NFPA 252 for ratings specified or indicated.
 - .2 Provide fire labelled frames for openings requiring fire protection ratings. Test products in conformance with CAN/ULC S104, NFPA 252 and listed by nationally recognized agency having factory inspection services.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Provide product data:
 - .1 Provide manufacturer's printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Provide shop drawings:
 - .1 Indicate each type of door, material, steel core thicknesses, mortises, reinforcements, location of exposed fasteners, openings, glazed, louvred, arrangement of hardware fire rating and finishes.
 - .2 Indicate each type frame material, core thickness, reinforcements, glazing stops, location of anchors and exposed fastenings reinforcing, fire rating finishes.
 - .3 Include schedule identifying each unit, with door marks and numbers relating to numbering on drawings and door schedule.
 - .4 Submit test and engineering data, and installation instructions.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 10 - Product Requirements.

1.6 WASTE MANAGEMENT AND DISPOSAL

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

Part 2

Products

2.1 MATERIALS

- .1 Hot dipped galvanized steel sheet: to ASTM A653M, ZF75, minimum base steel thickness in accordance with CSDMA Table 1 - Thickness for Component Parts.
- .2 Composites: balance of core materials used in conjunction with lead: in accordance with manufacturers' proprietary design.

2.2 DOOR CORE MATERIALS

- .1 Honeycomb construction:
 - .1 Structural small cell, 24.5 mm maximum kraft paper 'honeycomb', weight: 36.3 kg per ream minimum, density: 16.5 kg/m³ minimum sanded to required thickness.

2.3 ADHESIVES

- .1 Honeycomb cores and steel components: heat resistant, spray grade, resin reinforced neoprene/rubber (polychloroprene) based, low viscosity, contact cement.
- .2 Lock-seam doors: fire resistant, resin reinforced polychloroprene, high viscosity, sealant/adhesive.

2.4 PRIMER

- .1 Touch-up prime CAN/CGSB-1.181.
 - .1 Maximum VOC limit 50 g/L to GC-03.

2.5 PAINT

- .1 Field paint steel doors and frames in accordance with Section 09 91 99 Painting for Minor Works. Protect weatherstrips from paint. Provide final finish free of scratches or other blemishes.

2.6 ACCESSORIES

- .1 Door silencers: single stud rubber/neoprene type.
- .2 Fabricate glazing stops as formed channel, minimum 16 mm height, accurately fitted, butted at corners and fastened to frame sections with counter-sunk oval head sheet metal screws.
- .3 Metallic paste filler: to manufacturer's standard.
- .4 Fire labels: metal rivited.
- .5 Glazing: as specified in Section 08 80 50.

2.7 FRAMES FABRICATION GENERAL

- .1 Fabricate frames in accordance with CSDMA specifications.

- .2 Fabricate frames to profiles and maximum face sizes as indicated.
- .3 Fabricate frames to incorporate glazing configurations specified in Section 08 80 50.
- .4 Interior frames: 1.2 mm welded type construction.
- .5 Blank, reinforce, drill and tap frames for mortised, templated hardware, electronic hardware using templates provided by finish hardware supplier. Reinforce frames for surface mounted hardware.
- .6 Prepare frame for door silencers, 3 for single door, 2 at head for double door.
- .7 Manufacturer's nameplates on frames and screens are not permitted.
- .8 Conceal fastenings except where exposed fastenings are indicated.
- .9 Provide factory-applied touch up primer at areas where zinc coating has been removed during fabrication.

2.8 FRAME ANCHORAGE

- .1 Provide appropriate anchorage to floor and wall construction.
- .2 Locate each wall anchor immediately above or below each hinge reinforcement on hinge jamb and directly opposite on strike jamb.
- .3 Provide 2 anchors for rebate opening heights up to 1520 mm and 1 additional anchor for each additional 760 mm of height or fraction thereof.
- .4 Locate anchors for frames in existing openings not more than 150 mm from top and bottom of each jambs and intermediate at 660 mm on centre maximum.

2.9 FRAMES: WELDED TYPE

- .1 Welding in accordance with CSA W59.
- .2 Accurately mitre or mechanically joint frame product and securely weld on inside of profile.
- .3 Cope accurately and securely weld butt joints of mullions, transom bars, centre rails and sills.
- .4 Grind welded joints and corners to a flat plane, fill with metallic paste and sand to uniform smooth finish.
- .5 Securely attach floor anchors to inside of each jamb profile.
- .6 Weld in 2 temporary jamb spreaders per frame to maintain proper alignment during shipment.

2.10 DOOR FABRICATION GENERAL

- .1 Doors: swing type, flush, with provision for glass and/or louvre openings as indicated.
- .2 Interior doors: honeycomb construction.
- .3 Fabricate doors with longitudinal edges fully welded and ground smooth.

- .4 Blank, reinforce, drill doors and tap for mortised, templated hardware electronic hardware.
- .5 Factory prepare holes 12.7 mm diameter and larger except mounting and through-bolt holes, on site, at time of hardware installation.
- .6 Provide factory-applied touch-up primer at areas where zinc coating has been removed during fabrication.
- .7 Provide fire labelled doors for those openings requiring fire protection ratings, as scheduled. Test such products in conformance with CAN/ULC-S104 NFPA 252 and list by nationally recognized agency having factory inspection service and construct as detailed in Follow-Up Service Procedures/Factory Inspection Manuals issued by listing agency to individual manufacturers.

2.11 DOORS: HONEYCOMB CORE CONSTRUCTION

- .1 Form face sheets for interior doors from 1.2 mm sheet steel with honeycomb core laminated under pressure to face sheets.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION GENERAL

- .1 Install labelled steel fire rated doors and frames to NFPA 80 except where specified otherwise.
- .2 Install doors and frames to CSDMA Installation Guide.

3.3 FRAME INSTALLATION

- .1 Set frames plumb, square, level and at correct elevation.
- .2 Secure anchorages and connections to adjacent construction.
- .3 Brace frames rigidly in position while building-in. Install temporary horizontal wood spreader at third points of door opening to maintain frame width. Provide vertical support at centre of head for openings over 1200 mm wide. Remove temporary spreaders after frames are built-in.
- .4 Make allowances for deflection of structure to ensure structural loads are not transmitted to frames.
- .5 Seal perimeter of frames between frame and adjacent material with acrylic sealant specified in Section 07 92 00.

3.4 DOOR INSTALLATION

- .1 Install doors and hardware in accordance with hardware templates and manufacturer's instructions and Section 08 71 00 - Door Hardware.
- .2 Install metal door frames in accordance with HMMA 840, part 3 A, B, C, D and E, except provide steel rivets instead screws. Refer to framing requirements in Section 09 22 00.
- .3 Provide even margins between doors and jambs and doors and finished floor and thresholds as follows.
 - .1 Hinge side: 1.0 mm.
 - .2 Latchside and head: 1.5 mm.
 - .3 Finished floor: 13 mm.
- .4 Adjust operable parts for correct function.

3.5 FINISH REPAIRS

- .1 Touch up with primer finishes damaged during installation.
- .2 Fill exposed frame anchors surfaces with imperfections with metallic paste filler and sand to a uniform smooth finish.

3.6 GLAZING

- .1 Install glazing for doors, sidelights and frames in accordance with Section 08 80 50 - Glazing.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 08 11 00 – Metal Doors and Frames
- .2 Section 08 71 00 - Hardware

1.2 REFERENCES

- .1 Architectural Woodwork Manufacturers Association of Canada (AWMAC).
 - .1 Architectural Woodwork Standards (AWS), Edition 1, 2009
- .2 Canadian Standards Association (CSA International).
 - .1 CSA O115-M1982(R2001), Hardwood and Decorative Plywood.
- .3 Forest Stewardship Council (FSC)
 - .1 FSC-STD-01-001, FSC Principle and Criteria for Forest Stewardship.
- .4 National Fire Protection Association (NFPA)
 - .1 NFPA Fire 80, Standard for Fire Doors and Other Opening Protectives, 2010 Edition.
 - .2 NFPA Fire 252, Standard Methods of Fire Tests of Door Assemblies, 2008 Edition.
- .5 South Coast Air Quality Management District (SCAQMD), California State (SCAQMD)
 - .1 SCAQMD Rule 1113, Architectural Coatings, June 9, 2006 Amendment, Effective date July 1, 2008.
 - .2 SCAQMD Rule 1168, Adhesives and Sealants, January 5, 2005 amendment, effective date July 1, 2005.
- .6 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC S104-15, Fire Tests of Door Assemblies
- .7 Wood Door Manufacturer's Association (WDMA)
 - .1 ANSI/WDMA I.S. 1A-04, Industry Standard for Architectural Wood Flush Doors.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheets.
 - .2 Submit WHMIS MSDS - Material Safety Data Sheets. Indicate VOC's:
 - .1 For sealant materials during application and curing.
 - .2 For door materials and adhesives.

- .3 Shop Drawings:
 - .1 Indicate door types and cutouts for lights, louvres, sizes, core construction, transom panel construction and cutouts.
- .4 Manufacturer's Instructions:
 - .1 Submit manufacturer's installation instructions.

1.4 QUALITY ASSURANCE

- .1 Regulatory Requirements:
 - .1 Wood fire rated doors: labelled and listed by an 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.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Storage and Protection:
 - .1 Protect doors from dampness. Arrange for delivery after work causing abnormal humidity has been completed.
 - .2 Store doors in well ventilated room, off floor, in accordance with manufacturer's recommendations.
 - .3 Protect doors from scratches, handling marks and other damage. Wrap doors.
 - .4 Store doors away from direct sunlight.

1.6 WASTE MANAGEMENT AND DISPOSAL

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

Part 2 Products

2.1 FIRE RATED WOOD DOORS

- .1 Wood doors: tested in accordance with CAN4-S104 /NFPA 252 and NFPA 80 to achieve rating as scheduled.

2.2 WOOD FLUSH DOORS

- .1 Commercial Doors to ANSI/WDMA I.S. 1A, AWS Premium Grade.
- .2 Dry lumber to an average moisture content of between 6 and 12% maximum at time of manufacture.
- .3 Solid Core Construction:

- .1 Non-rated Flat panel doors: particle board core bonded to solid wood stile and rail and lock blocks, 7 ply.
- .2 Fire Rated Flat panel doors: mineral core bonded to solid wood stile and rail and lock blocks, 7 ply, with permanently fixed rating label.
- .3 Face veneer for clear finished and stained doors:
 - .1 Grade: AA
 - .2 Species: Birch
 - .3 Cut: quarter sliced.
 - .4 Match between veneer leaves: random matched.
 - .5 Minimum thickness: 0.5 mm.
 - .6 Door Thickness: as scheduled.
 - .7 Finish: Stain and Clear finish; Factory finish doors in accordance with AWS Section 5 – Finishing, System 9 UV-Curable, Acrylated Epoxy, Polyester or Urethane as a minimum.
 - .8 Stain colour: colour will be selected by Departmental Representative.
- .4 Face for painted doors:
 - .1 Hardboard: minimum density 500 kg/m³, 6 mm nominal thickness one face smooth finish suitable for painted finish.
 - .2 Finish: as specified in Section 09 91 99.

2.3 FABRICATION

- .1 Fabrication to ANSI/WDMA I.S. 1A.
- .2 Vertical edge strips to match face veneer.
- .3 Adhesive: Type II (water resistant).
- .4 Bevel vertical edges of single acting doors 3 mm in 50 mm on lock side and 1.5 mm in 50 mm on hinge side.

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 instructions, and data sheets.

3.2 INSTALLATION

- .1 Unwrap and protect doors in accordance with CAN/CSA-O132.2 Series, Appendix A.
- .2 Install labelled fire rated doors to NFPA 80.
- .3 Install doors and hardware in accordance with manufacturer's printed instructions and CAN/CSA-O132.2 Series, Appendix A.

- .4 Adjust hardware for correct function.

3.3 ADJUSTMENT

- .1 Re-adjust doors and hardware just prior to completion of building to function freely and properly.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 11 55 – General Instructions.
 - .1 Leave Work area clean at end of each shift.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 11 55 – General Instructions.
- .3 Perform cleaning as soon as possible after installation to remove construction and accumulated environmental dirt.
- .4 Remove traces of primer, caulking; clean doors and frames.
- .5 Clean glass and glazing materials with approved non-abrasive cleaner.
- .6 On completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 08 11 00 – Metal Doors and Frames
- .2 Section 08 14 16 – Flush Wood Doors

1.2 REFERENCES

- .1 American National Standards Institute (ANSI) / Builders Hardware Manufacturers Association (BHMA)
 - .1 ANSI/BHMA A156.1-2000, American National Standard for Butts and Hinges.
 - .2 ANSI/BHMA A156.2-2003, Bored and Preamsembled Locks and Latches.
 - .3 ANSI/BHMA A156.4-2000, Door Controls - Closers.
 - .4 ANSI/BHMA A156.5-2001, Auxiliary Locks and Associated Products.
 - .5 ANSI/BHMA A156.6-2005, Architectural Door Trim.
 - .6 ANSI/BHMA A156.8-2005, Door Controls - Overhead Stops and Holders.
 - .7 ANSI/BHMA A156.12-2005, Interconnected Locks and Latches.
 - .8 ANSI/BHMA A156.13-2002, Mortise Locks and Latches Series 1000.
 - .9 ANSI/BHMA A156.15-2006, Release Devices - Closer Holder, Electromagnetic and Electromechanical.
 - .10 ANSI/BHMA A156.16-2002, Auxiliary Hardware.
 - .11 ANSI/BHMA A156.18-2006, Materials and Finishes.
 - .12 ANSI/BHMA A156.19-2007, Power Assist and Low Energy Power Operated Doors.
- .2 Canadian Steel Door and Frame Manufacturers' Association (CSDMA)
 - .1 CSDMA Recommended Dimensional Standards for Commercial Steel Doors and Frames - 2009.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

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

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 30 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for door hardware for incorporation into manual.

1.5 MAINTENANCE MATERIALS SUBMITTALS

- .1 Extra Stock Materials:
 - .1 Supply maintenance tools.

1.6 QUALITY ASSURANCE

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

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 10 - Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Package items of hardware including fastenings, separately or in like groups of hardware, label each package as to item definition and location.
- .4 Storage and Handling Requirements:
 - .1 Store and protect door hardware from nicks, scratches, and blemishes.
 - .2 Protect prefinished surfaces with strippable coating.
 - .3 Replace defective or damaged materials with new.
- .1 Separate and recycle waste materials in accordance with Section 01 74 19 –Waste Management and Disposal.

Part 2 Products

2.1 HARDWARE ITEMS

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

2.2 DOOR HARDWARE

- .1 Locks and latches:
 - .1 Mortise locks to ANSI/BHMA A156.13, Grade 1.
 - .1 Acceptable products:
 - .1 Schlage 9000 Series.
 - .2 Sargent 8200 Series.
 - .3 Corbin ML2000 Series.
 - .2 Bored and preassembled locks and latches: to ANSI/BHMA A156.2, Grade 1.
 - .1 Acceptable products:
 - .1 Schlage ND Series.
 - .2 Sargent 10-Line Series with -30 prefix cylinder preparation.
 - .3 Corbin CL3300 Series with M06 cylinder tailpiece.
 - .2 Electric Strikes:
 - .1 Acceptable products:
 - .1 HES 1006.
 - .2 Von Duprin 6216.
 - .3 RCI 2164.
 - .3 Butts and hinges: to ANSI/BHMA A156.1, acceptable products as manufactured by:
 - .1 Ives.
 - .2 McKenney.
 - .3 Stanley.
 - .4 Door controls (closers): to ANSI/BHMA A156.4.
 - .1 Acceptable products:
 - .1 LCN 4041 Series.
 - .2 Norton 7501/8501 Series.
 - .3 Sargent 381/1431 Series.
 - .5 Door Closers; acceptable products as manufactured by:
 - .1 Rockwood.
 - .2 Gallery.
 - .3 Hager.
 - .6 Thresholds, Seals, Astragals, Door Bottoms; acceptable products as manufactured by:
 - .1 Pemko.
 - .2 DraftSeal.
 - .3 Anemostat.
 - .7 Power Supplies; acceptable products as manufactured by:
 - .1 Schlage.

- .2 Securitron.
- .3 Asterisk.
- .8 Automatic Door Operators, to ANSI/BHMA A156.19; acceptable products as manufactured by:
 - .1 Besam.
 - .2 Stanley.
 - .3 Horton.

2.3 FASTENINGS

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

2.4 KEYING

- .1 At Project completion turn over construction cores and keys to Departmental Representative.

Part 3 Execution

3.1 INSTALLATION

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

3.2 ADJUSTING

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

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 11 55 – General Instructions.
 - .1 Leave Work area clean at end of each day.
 - .2 Clean hardware with damp rag and approved non-abrasive cleaner, and polish hardware in accordance with manufacturer's instructions.
 - .3 Remove protective material from hardware items where present.
 - .4 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 11 55 – General Instructions.

3.4 DEMONSTRATION

- .1 Maintenance Staff Briefing:
 - .1 Brief maintenance staff regarding:
 - .1 Proper care, cleaning, and general maintenance of projects complete hardware.
 - .2 Description, use, handling, and storage of keys.
 - .3 Use, application and storage of wrenches for door closers, locksets.
- .2 Demonstrate operation, operating components, adjustment features, and lubrication requirements.

3.5 PROTECTION

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

3.6 HARDWARE SCHEDULE

- .1 Brand names and model numbers scheduled are for convenience and for expressing quality and functions required. Products of other manufacturers may be considered if they meet the quality and function of those named products.
- .2 Schedule as follows:

DOOR INDEX

Dr. #	Set #	Dr. #	Set #	Dr. #	Set #	Dr. #	Set #	Dr. #	Set #
701	OF08d	716	OF05d	801	OF09b	809	OF05d	821A-b	OF04j
702	OF08e	717	OF05d	802-a	OF01c	815	OF01d	822A-a	OF02b
703	OF06a	719-a	OF01d	802-b	OF04j	816	OF05c	822A-b	OF04j
704	OF06a	719-b	OF01d	803	OF07b	818	OF06b	823A	OF05c
709	BR01e	720	OF01c	804	OF04h	819	OF04g	824A	OF10a
710	OF01c	722	OF07b	805	OF04h	820a	OF02b	825A	BR03c
711	OF01d	724	BR01e	807	OF08f	820b	OF04j	826A	OF01d
715	OF05d	725	OF01c	808	OF05d	821A-a	OF02b		

Hardware Set BR01e

5	Ea.	Hinges	Ives	5BB1HW-114mm x 114mm x NRP	630
1	Ea.	Hinge	Ives	5BB1HW-114mm x 114mm x TW4	630
1	Ea.	Lock Set	Schlage	L9480 x L-06	626
1	Ea.	Cylinder		Type x Length x Cam to suit	626
1	Ea.	Strike	HES	1006CDB	630
1	Pr.	Flush Bolt	Rockwood	2842	630
1	Ea.	DP Strike	Rockwood	570	
2	Ea.	Closer	LCN	4041- PA- DEL x SN	626
1	Ea.	Coordinator	Rockwood	1700	
2	Ea.	W/F Stop	Gallery	GSH 218/240	630
1	Ea.	Stile Seal	Pemko	S771 x 6C x length	
1	Ea.	Threshold	Pemko	173A x width	

Note: -Cylinder to be keyed as required by Client locksmith.
 -Inactive leaf to be drilled at factory for cable to electric strike.
 -Power Supply, DPS and REX to be supplied through Chubb Edwards.
 -Prep door and frame for Sentrol 1076D DPS.

Hardware Set BR03c

6	Ea.	Hinges	Ives	5BB1HW-114mm x 114mm x NRP	630
1	Ea.	Lock Set	Schlage	ND50PD x RHO	626
1	Ea.	Cylinder		Type x Length x Cam to suit	626
1	Pr.	Flush Bolt	Rockwood	1942	630
1	Ea.	DP Strike	Rockwood	570	
1	Ea.	Coordinator	Rockwood	1700	
2	Ea.	W/F Stop	Gallery	GSH 218/240	630
1	Ea.	Gasketing	Pemko	312CR x width x 2-height	628
2	Ea.	Door Bottom	Pemko	412CPKL x width	628
1	Ea.	Threshold	Pemko	173A x width	

Note: -Cylinder to be keyed as required by Client locksmith.

Hardware Set OF01c

3	Ea.	Hinges	Ives	5BB1HW-114mm x 114mm x NRP	630
1	Ea.	Lock Set	Schlage	L9480 x L-06	626
1	Ea.	Cylinder		Type x Length x Cam to suit	626
1	Ea.	Strike	HES	1006CDB	630
1	Ea.	W/F Stop	Gallery	GSH 218/240	630
1	Ea.	Gasketing	Pemko	312CR x width x 2-height	628
1	Ea.	Door Bottom	Pemko	PDB411AE x width	628
1	Ea.	Threshold	Pemko	173A x width	

Note: -Cylinder to be keyed as required by Client locksmith.
 -Power Supply, DPS and REX to be supplied through Chubb Edwards.
 -Prep door and frame for Sentrol 1076D DPS.

Hardware Set OF01d

3	Ea.	Hinges	Ives	5BB1HW-114mm x 114mm x NRP	630
1	Ea.	Lock Set	Schlage	L9480 x L-06	626
1	Ea.	Cylinder		Type x Length x Cam to suit	626
1	Ea.	Strike	HES	1006CDB	630
1	Ea.	Closer	LCN	4041- PA- DEL x SN	626
1	Ea.	W/F Stop	Gallery	GSH 218/240	630
1	Ea.	Latch Guard	Don-Jo	MLP-111-EBF	630
1	Ea.	Threshold	Pemko	173A x width	

Note: -Cylinder to be keyed as required by Client locksmith.
 -Power Supply, DPS and REX to be supplied through Chubb Edwards.
 -Prep door and frame for Sentrol 1076D DPS.

Hardware Set OF02b

3	Ea.	Hinges	Ives	5BB1HW-114mm x 114mm x NRP	630
1	Ea.	Lock Set	Schlage	L9480 x L-06	626
1	Ea.	Cylinder		Type x Length x Cam to suit	626
1	Ea.	Strike	HES	1006CDB	630
1	Ea.	Closer	LCN	4041- PA- DEL x SN	626
1	Ea.	W/F Stop	Gallery	GSH 218/240	630
1	Ea.	Gasketing	Pemko	312CR x width x 2-height	628
1	Ea.	Door Bottom	Pemko	4131CRL x width	628
1	Ea.	Threshold	Pemko	173A x width	

Note: -Cylinder to be keyed as required by Client locksmith.
 -Power Supply, DPS and REX to be supplied through Chubb Edwards.
 -Prep door and frame for Sentrol 1076D DPS.

Hardware Set OF04g

3	Ea.	Hinges	Ives	5BB1HW-114mm x 114mm x NRP	630
1	Ea.	Lock Set	Schlage	L9080 x L-06	626
1	Ea.	Cylinder		Type x Length x Cam to suit	626
1	Ea.	Strike	HES	1006CLB	630
1	Ea.	Closer	LCN	4041- PA- DEL x SN	626
1	Ea.	W/F Stop	Gallery	GSH 218/240	630
1	Ea.	Gasketing	Pemko	312CR x width x 2-height	628
1	Ea.	Door Bottom	Pemko	PDB411AE x width	628
1	Ea.	Threshold	Pemko	173A x width	

Note: -Cylinder to be keyed as required by Client locksmith.
 -Power Supply, DPS and REX to be supplied through Chubb Edwards.
 -Prep door and frame for Sentrol 1076D DPS.

Hardware Set OF04h

3	Ea.	Hinges	Ives	5BB1HW-114mm x 114mm x NRP	630
1	Ea.	Lock Set	Schlage	ND50PD x RHO	626
1	Ea.	Cylinder		Type x Length x Cam to suit	626
1	Ea.	Strike	HES	1006JLB	630
1	Ea.	Closer	LCN	4041- PA- DEL x SN	626
1	Ea.	W/F Stop	Gallery	GSH 218/240	630
1	Ea.	Gasketing	Pemko	312CR x width x 2-height	628
1	Ea.	Door Bottom	Pemko	PDB411AE x width	628
1	Ea.	Threshold	Pemko	173A x width	

Note: -Cylinder to be keyed as required by Client locksmith.
 -Power Supply, DPS and REX to be supplied through Chubb Edwards.
 -Prep door and frame for Sentrol 1076D DPS.

Hardware Set OF04j

3	Ea.	Hinges	Ives	5BB1HW-114mm x 114mm x NRP	630
1	Ea.	Lock Set	Schlage	L9080 x L-06	626
1	Ea.	Cylinder		Type x Length x Cam to suit	626
1	Ea.	Strike	HES	1006CLB	630
1	Ea.	Closer	LCN	4041- PA- DEL x SN	626
1	Ea.	W/F Stop	Gallery	GSH 218/240	630
1	Ea.	Latch Guard	Don-Jo	MLP-111-EBF	630
1	Ea.	Gasketing	Pemko	312CR x width x 2-height	628
1	Ea.	Door Bottom	Pemko	PDB411AE x width	628
1	Ea.	Threshold	Pemko	173A x width	

Note: -Cylinder to be keyed as required by Client locksmith.
 -Power Supply, DPS and REX to be supplied through Chubb Edwards.
 -Prep door and frame for Sentrol 1076D DPS.

Hardware Set OF05c

3	Ea.	Hinges	Ives	5BB1HW-114mm x 114mm x NRP	630
1	Ea.	Lock Set	Schlage	L9480 x L-06	626
1	Ea.	Cylinder		Type x Length x Cam to suit	626
1	Ea.	Strike	HES	1006CDB	630
1	Ea.	Closer	LCN	4041- PA- DEL x SN	626
1	Ea.	W/F Stop	Gallery	GSH 218/240	630
1	Ea.	Gasketing	Pemko	312CR x width x 2-height	628
1	Ea.	Door Bottom	Pemko	420APKL x width	628
1	Ea.	Threshold	Pemko	173A x width	

Note: -Cylinder to be keyed as required by Client locksmith.
 -Power Supply, DPS and REX to be supplied through Chubb Edwards.
 -Prep door and frame for Sentrol 1076D DPS.

Hardware Set OF05d

3	Ea.	Hinges	Ives	5BB1HW-114mm x 114mm x NRP	630
1	Ea.	Lock Set	Schlage	L9480 x L-06	626
1	Ea.	Cylinder		Type x Length x Cam to suit	626
1	Ea.	Strike	HES	1006CDB	630
1	Ea.	Closer	LCN	4041- PA- DEL x SN	626
1	Ea.	W/F Stop	Gallery	GSH 218/240	630
1	Ea.	Threshold	Pemko	173A x width	

Note: -Cylinder to be keyed as required by Client locksmith.
 -Power Supply, DPS and REX to be supplied through Chubb Edwards.
 -Prep door and frame for Sentrol 1076D DPS.

Hardware Set OF06a

3	Ea.	Hinges	Ives	5BB1HW-114mm x 114mm x NRP	630
1	Ea.	Lock Set	Schlage	ND50 x RHO	626
1	Ea.	Cylinder		Type x Length x Cam to suit	626
1	Ea.	W/F Stop	Gallery	GSH 218/240	630
1	Ea.	Gasketing	Pemko	312CR x width x 2-height	628
1	Ea.	Door Bottom	Pemko	PDB411AE x width	628
1	Ea.	Threshold	Pemko	173A x width	

Note: -Cylinder to be keyed as required by Client locksmith.

Hardware Set OF06b

3	Ea.	Hinges	Ives	5BB1HW-114mm x 114mm x NRP	630
1	Ea.	Lock Set	Schlage	ND50 x RHO	626
1	Ea.	Cylinder		Type x Length x Cam to suit	626
1	Ea.	W/F Stop	Gallery	GSH 218/240	630

Note: -Cylinder to be keyed as required by Client locksmith.

Hardware Set OF07b

3	Ea.	Hinges	Ives	5BB1HW-114mm x 114mm x NRP	630
1	Ea.	Lock Set	Schlage	ND50PD x RHO	626
1	Ea.	Cylinder		Type x Length x Cam to suit	626
1	Ea.	Closer	LCN	4041- PA- DEL x SN	626
1	Ea.	W/F Stop	Gallery	GSH 218/240	630

Note: -Cylinder to be keyed as required by Client locksmith.
 -DPS to be supplied through Chubb Edwards.
 -Prep door and frame for Sentrol 1076D DPS.

Hardware Set OF08d

3	Ea.	Hinges	Ives	5BB1HW-114mm x 114mm x NRP	630
1	Ea.	Lock Set	Schlage	L9480 x L-06	626
1	Ea.	Cylinder		Type x Length x Cam to suit	626
1	Ea.	Strike	HES	1006CDB	630
1	Ea.	Operator	Besam	Power Swing series with full header	
2	Ea.	Push Button	Securitron	PB5	
1	Ea.	Sensor	BEA	10SSII42 Superscan SMR	
1	Ea.	Network	Besam	ES10	630
1	Ea.	Key Switch	Besam	SL-1701	630
1	Ea.	Network	Besam	Sequential	
1	Ea.	W/F Stop	Gallery	GSH 218/240	630
1	Ea.	Gasketing	Pemko	312CR x width x 2-height	628
1	Ea.	Door Bottom	Pemko	PDB411AE x width	628
1	Ea.	Threshold	Pemko	173A x width	

Note: -Cylinder to be keyed as required by Client locksmith.
 -Power Supply, DPS and REX to be supplied through Chubb Edwards.
 -Prep door and frame for Sentrol 1076D DPS.

Hardware Set OF08e

3	Ea.	Hinges	Ives	5BB1HW-114mm x 114mm x NRP	630
1	Ea.	Lock Set	Schlage	L9480 x L-06	626
1	Ea.	Cylinder		Type x Length x Cam to suit	626
1	Ea.	Strike	HES	1006CDB	630
1	Ea.	Operator	Besam	Power Swing series with full header	
2	Ea.	Push Button	Securitron	PB5	
1	Ea.	Sensor	BEA	10SSII42 Superscan SMR	
1	Ea.	Network	Besam	ES10	630
1	Ea.	Key Switch	Besam	SL-1701	630
1	Ea.	Network	Besam	Sequential	
1	Ea.	W/F Stop	Gallery	GSH 218/240	630
1	Ea.	Latch Guard	Don-Jo	MLP-111-EBF	630
1	Ea.	Threshold	Pemko	173A x width	

Note: -Cylinder to be keyed as required by Client locksmith.
 -Power Supply, DPS and REX to be supplied through Chubb Edwards.
 -Prep door and frame for Sentrol 1076D DPS.

Hardware Set OF08f

3	Ea.	Hinges	Ives	5BB1HW-114mm x 114mm x NRP	630
1	Ea.	Lock Set	Schlage	L9480 x L-06	626
1	Ea.	Cylinder		Type x Length x Cam to suit	626

1	Ea.	Strike	HES	1006CDB	630
1	Ea.	Operator	Besam	Power Swing series with full header	
2	Ea.	Push Button	Securitron	PB5	
1	Ea.	Sensor	BEA	10SSII42 Superscan SMR	
1	Ea.	Network	Besam	ES10	630
1	Ea.	Key Switch	Besam	SL-1701	630
1	Ea.	Network	Besam	Sequential	
1	Ea.	W/F Stop	Gallery	GSH 218/240	630
1	Ea.	Threshold	Pemko	173A x width	

Note: -Cylinder to be keyed as required by Client locksmith.
 -Power Supply, DPS and REX to be supplied through Chubb Edwards.
 -Prep door and frame for Sentrol 1076D DPS.

Hardware Set OF09b

3	Ea.	Hinges	Ives	5BB1HW-114mm x 114mm x NRP	630
1	Ea.	Lock Set	Schlage	L9480 x L-06	626
1	Ea.	Cylinder		Type x Length x Cam to suit	626
1	Ea.	Strike	HES	1006CDB	630
1	Ea.	Operator	Besam	Power Swing series with full header	
2	Ea.	Push Button	Securitron	PB5	
1	Ea.	Sensor	BEA	10SSII42 Superscan SMR	
1	Ea.	Network	Besam	ES10	630
1	Ea.	Key Switch	Besam	SL-1701	630
1	Ea.	Network	Besam	Sequential	
1	Ea.	W/F Stop	Gallery	GSH 218/240	630
1	Ea.	Gasketing	Pemko	312CR x width x 2-height	628
1	Ea.	Door Bottom	Pemko	420APKL x width	628
1	Ea.	Threshold	Pemko	173A x width	

Note: -Cylinder to be keyed as required by Client locksmith.
 -Power Supply, DPS and REX to be supplied through Chubb Edwards.
 -Prep door and frame for Sentrol 1076D DPS.

Hardware Set OF10a

3	Ea.	Hinges	Ives	5BB1HW-114mm x 114mm x NRP	630
1	Ea.	Lock Set	Schlage	L9480 x L-06	626
1	Ea.	Cylinder		Type x Length x Cam to suit	626
1	Ea.	Strike	HES	1006CDB	630
1	Ea.	Closer	LCN	4041- PA- DEL x SN	626
1	Ea.	W/F Stop	Gallery	GSH 218/240	630

Note: -Cylinder to be keyed as required by Client locksmith.
 -Power Supply, DPS and REX to be supplied through Chubb Edwards.
 -Prep door and frame for Sentrol 1076D DPS.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 07 92 00 – Joint Sealing
- .2 Section 08 11 00 – Metal Doors and Frames

1.2 REFERENCES

- .1 ASTM International
 - .1 ASTM C542-05, Standard Specification for Lock-Strip Gaskets.
 - .2 ASTM D2240-05, Standard Test Method for Rubber Property - Durometer Hardness.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-12.1-M90, Tempered or Laminated Safety Glass.
 - .2 CAN/CGSB-12.6-M91, Transparent (One-Way) Mirrors.
 - .3 CAN/CGSB-12.11-M90, Wired Safety Glass.
- .3 Glass Association of North American (GANA)
 - .1 GANA Glazing Manual.
 - .2 GANA Laminated Glazing Reference Manual.
- .4 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
 - .1 SCAQMD Rule 1168, Adhesives and Sealants, January 5, 2005 amendment, effective date July 1, 2005.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for glass, sealants, and glazing accessories and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Samples:
 - .1 Submit for review and acceptance of each unit.

1.4 DELIVERY, STORAGE AND HANDLING

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

- .1 Store materials off ground, protected and in accordance with manufacturer's recommendations.
- .2 Store and protect glazing and frames from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

1.5 WASTE MANAGEMENT AND DISPOSAL

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

Part 2 Products

2.1 MATERIALS

- .1 Flat Glass:
 - .1 Float glass: to CAN/CGSB-12.3.
 - .2 Safety glass: to CAN/CGSB-12.1, clear, 6 mm thick.
 - .1 Type 2-tempered.
 - .2 Class B-float.
 - .3 Edge treatment:
 - .1 Concealed edges: factory standard
 - .2 Exposed edges arrised and polished.
 - .2 Frosted Glazing Film: 20 mil thick plastic, pattern and finishes to be specified by Architect and approved by Departmental Representative.
 - .3 Sealant: in accordance with Section 07 92 00 - Joint Sealants.
 - .1 VOC limit 250 g/L maximum to SCAQMD Rule 1168.

2.2 MATERIALS: SEALED INSULATING GLASS

- .1 Double Pane Insulating Glass Units: meet or exceed requirements of CAN/CGSB-12.8. Units shall be certified by the Insulated Glass Manufacturers Alliance (IGMA).
- .2 One way viewing unit; two sets of Double Glazing as follows:
 - .1 12 mm clear laminated annealed glass with min. 0.76 mm PVB interlayer.
 - .2 12 mm airspace.
 - .3 6 mm clear annealed glass.
 - .4 80 mm airspace.
 - .5 6 mm clear annealed glass.
 - .6 12 mm airspace.
 - .7 12 mm clear laminated annealed glass with min. 0.76 mm PVB interlayer.
 - .1 Unidirectional viewing glass visible from Room 819 only: to CAN/CGSB-12.6.

- .1 On-Line coating process.
- .2 One-way mirror properties providing undetected surveillance and high quality one-way vision.
- .3 Type 2-metallic coating applied to tinted glass.
- .3 Two sets of Double Glazing for Sidelight configuration:
 - .1 12 mm clear laminated annealed glass with min. 0.76 mm PVB interlayer.
 - .2 12 mm airspace.
 - .3 6 mm clear annealed glass.
 - .4 80 mm airspace.
 - .5 6 mm clear annealed glass.
 - .6 12 mm airspace.
 - .7 12 mm clear laminated annealed glass with min. 0.76 mm PVB interlayer.
- .4 Other Glazing Accessories: setting blocks to CAN/CSA-A440.

2.3 ACCESSORIES

- .1 Corner Blocks and Setting blocks: neoprene EPDM silicone, 80-90 Shore A durometer hardness to ASTM D2240, to suit glazing method, glass light weight and area.
- .2 Glazing tape:
 - .1 Closed cell polyvinyl chloride foam, coiled on release paper over adhesive on two sides.
- .3 Glazing splines: resilient EPDM, extruded shape to suit glazing channel retaining slot, black.
- .4 Glazing clips: manufacturer's standard type.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for glazing installation in accordance with manufacturer's written instructions.
 - .1 Verify that openings for glazing are correctly sized and within tolerance.
 - .2 Verify that surfaces of glazing channels or recesses are clean, free of obstructions, and ready to receive glazing.

3.2 PREPARATION

- .1 Clean contact surfaces with solvent and wipe dry.
- .2 Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- .3 Prime surfaces scheduled to receive sealant.

3.3 INSTALLATION: INTERIOR - DRY METHOD (TAPE AND TAPE)

- .1 Perform work in accordance with GANA Glazing Manual for glazing installation methods.
- .2 Cut glazing tape to length and set against permanent stops, projecting 1.6 mm above sight line.
- .3 Place setting blocks at 1/4 points, with edge block maximum 150 mm from corners.
- .4 Rest glazing on setting blocks and push against tape for full contact at perimeter of light or unit.
- .5 Place glazing tape on free perimeter of glazing in same manner described.
- .6 Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.
- .7 Knife trim protruding tape.

3.4 INSTALLATION: PLASTIC FILM

- .1 Install plastic film with adhesive, applied in accordance with film manufacturer's instructions.
- .2 Place without air bubbles, creases or visible distortion.
- .3 Fit tight to glass perimeter with razor cut edge.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 11 55 – General Instructions.
 - .1 Leave Work area clean at end of each shift.
 - .1 Remove traces of primer, caulking.
 - .2 Remove glazing materials from finish surfaces.
 - .3 Remove labels.
 - .4 Clean glass using approved non-abrasive cleaner in accordance with manufacturer's instructions.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 11 55 – General Instructions.

3.6 PROTECTION

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 09 22 16 – Non-Structural Metal Framing

1.2 REFERENCES

- .1 ASTM International
 - .1 ASTM C475-02(2007), Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
 - .2 ASTM C840-08, Standard Specification for Application and Finishing of Gypsum Board.
 - .3 ASTM C954-07, Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness.
 - .4 ASTM C1002-07, Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
 - .5 ASTM C1047-09, Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
 - .6 ASTM C1396/C1396M-09a, Standard Specification for Gypsum Wallboard.
- .2 Association of the Wall and Ceilings Industries International (AWCI)
 - .1 AWCI Levels of Gypsum Board Finish-97.
- .3 Green Seal Environmental Standards (GS)
 - .1 GS-11-2008, 2nd Edition, Paints and Coatings.
- .4 South Coast Air Quality Management District (SCAQMD), California State (SCAQMD)
 - .1 SCAQMD Rule 1113, Architectural Coatings, June 9, 2006 Amendment, Effective date July 1, 2008.
 - .2 SCAQMD Rule 1168, Adhesives and Sealants, January 5, 2005 amendment, effective date July 1, 2005.
- .5 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-07, Standard Method of Test of Surface Burning Characteristics of Building Materials and Assemblies.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product Data:

- .1 Submit manufacturer's instructions, printed product literature and data sheets for gypsum board assemblies and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 10 - Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store gypsum board assemblies materials level indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect gypsum board assemblies from nicks, scratches, and blemishes.
 - .3 Protect from weather, elements and damage from construction operations.
 - .4 Handle gypsum boards to prevent damage to edges, ends or surfaces.
 - .5 Replace defective or damaged materials with new.

1.5 WASTE MANAGEMENT AND DISPOSAL

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

1.6 AMBIENT CONDITIONS

- .1 Maintain temperature 10 degrees C minimum, 21 degrees C maximum for 48 hours prior to and during application of gypsum boards and joint treatment, and for 48 hours minimum after completion of joint treatment.
- .2 Apply board and joint treatment to dry, frost free surfaces.
- .3 Ventilation: ventilate building spaces as required to remove excess moisture that would prevent drying of joint treatment material immediately after its application.

Part 2 Products

2.1 MATERIALS

- .1 Standard board: to ASTM C1396/C1396M regular, 16 mm thick Type X, 1200 mm wide x maximum practical length, ends square cut, edges bevelled.
- .2 Steel drill screws: to ASTM C1002.
- .3 Laminating compound: as recommended by manufacturer, asbestos-free.
- .4 Casing beads, corner beads, control joints and edge trim: to ASTM C1047, metal, zinc-coated, 0.5 mm base thickness, perforated flanges, one piece length per location.
- .5 Sealants: in accordance with Section 07 92 00 - Joint Sealants.

- .1 Acoustic sealant: in accordance with Section 07 92 00 - Joint Sealants.
- .6 Polyethylene: to CAN/CGSB-51.34, Type 2.
- .7 Insulating strip: rubberized, moisture resistant, 3 mm thick closed cell neoprene strip, 12 mm wide, with self sticking permanent adhesive on one face, lengths as required.
- .8 Joint compound: to ASTM C475, asbestos-free.

Part 3 Execution

3.1 EXAMINATION

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

3.2 ERECTION

- .1 Perform application and finishing of gypsum board to ASTM C840 except where specified otherwise.
- .2 Erect hangers and runner channels for suspended gypsum board ceilings to ASTM C840 except where specified otherwise.
- .3 Install work level to tolerance of 1:1200.
- .4 Frame with furring channels, perimeter of openings for access panels, light fixtures, diffusers, grilles.
- .5 Install 19 x 64 mm furring channels parallel to, and at exact locations of steel stud partition header track.
- .6 Furr for gypsum board faced vertical bulkheads within and at termination of ceilings.
- .7 Furr above suspended ceilings for gypsum board fire and sound stops and to form plenum areas as indicated.
- .8 Install wall furring for gypsum board wall finishes to ASTM C840, except where specified otherwise.
- .9 Furr openings and around built-in equipment, cabinets, access panels, on four sides. Extend furring into reveals. Check clearances with equipment suppliers.
- .10 Furr duct shafts, beams, columns, pipes and exposed services where indicated.

3.3 APPLICATION

- .1 Apply gypsum board after bucks, anchors, blocking, sound attenuation, electrical and mechanical work have been approved.

- .2 Apply gypsum board to metal furring or framing using screw fasteners. Maximum spacing of screws 300 mm on centre.
 - .1 Single-Layer Application:
 - .1 Apply gypsum board on ceilings prior to application of walls to ASTM C840.
- .3 Apply 12 mm diameter bead of acoustic sealant continuously around periphery of each face of partitioning to seal gypsum board/structure junction where partitions abut fixed building components. Seal full perimeter of cut-outs around electrical boxes, ducts in partitions where perimeter sealed with acoustic sealant.
- .4 Install ceiling boards in direction that will minimize number of end-butt joints. Stagger end joints at least 250 mm.
- .5 Install gypsum board on walls vertically to avoid end-butt joints.
- .6 Install gypsum board with face side out.
- .7 Do not install damaged or damp boards.
- .8 Locate edge or end joints over supports. Stagger vertical joints over different studs on opposite sides of wall.

3.4 INSTALLATION

- .1 Erect accessories straight, plumb or level, rigid and at proper plane. Use full length pieces where practical. Make joints tight, accurately aligned and rigidly secured. Mitre and fit corners accurately, free from rough edges. Secure at 150 mm on centre.
- .2 Install casing beads where gypsum board butts against surfaces having no trim concealing junction and where indicated. Seal joints with sealant.
- .3 Install insulating strips continuously at edges of gypsum board and casing beads abutting metal window and exterior door frames, to provide thermal break.
- .4 Splice corners and intersections together and secure to each member with 3 screws.
- .5 Install access doors to electrical and mechanical fixtures specified in respective sections.
 - .1 Rigidly secure frames to furring or framing systems.
- .6 Finish face panel joints and internal angles with joint system consisting of joint compound, joint tape and taping compound installed according to manufacturer's directions and feathered out onto panel faces.
- .7 Gypsum Board Finish: finish gypsum board walls and ceilings to following levels in accordance with AWCI Levels of Gypsum Board Finish:
 - .1 Levels of finish:
 - .1 Level 2; to walls above finished ceiling level: embed tape for joints and interior angles in joint compound and apply one separate coat of joint compound over joints, angles, fastener heads and accessories; surfaces free of excess joint compound; tool marks and ridges are acceptable.

- .2 Level 4; to walls exposed to view: embed tape for joints and interior angles in joint compound and apply three separate coats of joint compound over joints, angles, fastener heads and accessories; surfaces smooth and free of tool marks and ridges.
- .8 Finish corner beads, control joints and trim as required with two coats of joint compound and one coat of taping compound, feathered out onto panel faces.
- .9 Fill screw head depressions with joint and taping compounds to bring flush with adjacent surface of gypsum board so as to be invisible after surface finish is completed.
- .10 Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surface of board.
- .11 Completed installation to be smooth, level or plumb, free from waves and other defects and ready for surface finish.
- .12 Mix joint compound slightly thinner than for joint taping.
- .13 To walls receiving semi-gloss paint apply thin coat to entire surface using trowel or drywall broad knife to fill surface texture differences, variations or tool marks.
- .14 Allow skim coat to dry completely.
- .15 Remove ridges by light sanding or wiping with damp cloth.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 11 55 – General Instructions.
 - .1 Leave Work area clean at end of each shift.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 11 55 – General Instructions.

3.6 PROTECTION

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

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

1.2 REFERENCES

- .1 ASTM International
 - .1 ASTM C645-14, Standard Specification for Non-structural Steel Framing Members.
 - .2 ASTM C754-15, Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
 - .3 ASTM C1002-14, Standard Specification for Steel Self Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
- .2 Hollow Metal Manufacturers Association (HMMA) & National Association of Architectural Metal Manufacturers
 - .1 HMMA 840-07, Guide Specification for Installation and Storage of Hollow Metal Doors and Frames
- .3 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
 - .1 SCAQMD Rule 1168, Adhesives and Sealants, January 5, 2005 amendment, effective date July 1, 2005.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit to Departmental Representative submittals listed for review in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for metal framing and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 QUALITY ASSURANCE

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

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 10 - Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.

1.6 WASTE MANAGEMENT AND DISPOSAL

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

Part 2 Products

2.1 MATERIALS

- .1 Non-load bearing channel stud framing: to ASTM C645, roll formed from 0.455 mm (25 Ga.) base thickness hot dipped galvanized steel sheet, for screw attachment of gypsum board.
 - .1 Size as indicated on drawings.
 - .2 Knock-out service holes at 460 mm centres.
- .2 Heavy gauge studs: roll formed from 0.91 mm thickness hot dipped galvanized steel sheet, for screw attachment of gypsum board.
- .3 Floor and top tracks: to ASTM C645, in widths to suit stud sizes, 32 mm flange height.
- .4 Channel track: 50 mm leg x 0.91 mm thick.
- .5 Security mesh: 19 mm, ten (10) gauge rolled and flattened steel, rippled diamond design with no openings larger than fifty (50) mm.
- .6 Fasteners for framing:
 - .1 Wafer head self-tapping screws, of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates in accordance with ASTM C1002.
 - .2 Security fasteners: steel rivets.
- .7 Fasteners for security mesh: flat washers and non-removable or protected screws.
- .8 Metal channel stiffener: 1.4 mm thick cold rolled steel, coated with rust inhibitive coating.
- .9 Acoustical sealant: in accordance with Section 07 92 00 - Joint Sealants.
- .10 Sealants: in accordance with Section 07 92 00 - Joint Sealants.

- .11 Insulating strip: rubberized, moisture resistant 3 mm thick foam strip, 12 mm wide, with self sticking adhesive on one face, lengths as required.

Part 3 Execution

3.1 EXAMINATION

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

3.2 ERECTION

- .1 Align partition tracks at floor and ceiling and secure at 600 mm on centre maximum.
- .2 Place studs vertically and not more than 50 mm from abutting walls, and at each side of openings and corners. Spacing of studs as indicated on drawings.
 - .1 Install studs from floor to nested top track on underside of floor assembly above.
 - .2 Position studs in tracks at floor and ceiling. Cross brace steel studs as required to provide rigid installation to manufacturer's instructions.
- .3 Erect metal studding to tolerance of 1:1000.
- .4 Attach studs to bottom track using screws.
- .5 Co-ordinate simultaneous erection of studs with installation of service lines. When erecting studs ensure web openings are aligned.
- .6 Co-ordinate erection of studs with installation of door/window frames and special supports or anchorage for work specified in other Sections.
- .7 Window Openings: Provide two studs extending from floor to underside of structure at each side of window openings wider than stud centres specified.
 - .1 Secure studs together, 50 mm apart using column clips or other approved means of fastening placed alongside frame anchor clips.
- .8 Door Openings:
 - .1 Install heavy gauge double jamb studs at door openings.
 - .2 Install anti-spread bracing on each side of double steel studs at approximately 2040 mm height from floor and anti-spread bracing on each side of the double steel studs above door header framing.
 - .3 Install metal door frames in accordance with HMMA 840, part 3 A, B, C, D and E, except provide steel rivets instead screws.

- .9 Erect track at head of door/window openings and sills of sidelight/window openings to accommodate intermediate studs.
 - .1 Secure track to studs at each end, in accordance with manufacturer's instructions.
 - .2 Install intermediate studs above and below openings in same manner and spacing as wall studs.
- .10 Corners: install double stud framing at corners.
- .11 Frame openings and around built-in equipment, cabinets, access panels, on four sides. Extend framing into reveals. Check clearances with equipment suppliers.
- .12 Refer to Section 06 08 99 – Rough Carpentry for Minor Works for blocking in walls for wall mounted items.
- .13 Installation of security mesh: fasten on exterior (attack) side of studs at least every 600 mm vertically, every stud horizontally and at least every 300 mm horizontally along top and bottom plates.
- .14 Install steel studs or furring channel between studs for attaching electrical and other boxes.
- .15 Extend partitions to underside of structural slab above except where noted otherwise on drawings.
- .16 Maintain clearance under beams and structural slabs to avoid transmission of structural loads to studs.
 - .1 Use double track slip joint; 50 mm leg channel and 32 mm leg top track.
- .17 Install continuous insulating strips to isolate studs from uninsulated surfaces.
- .18 Install insulating strip under studs and tracks around perimeter of sound control partitions. Install to tracks and studs, not surrounding finishes.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 11 55 – General Instructions.
 - .1 Leave Work area clean at end of each shift.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 11 55 – General Instructions.

3.4 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by non-structural metal framing application.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM E 580/E580M-14, Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions.
 - .2 ASTM A641/A641M-09a(2014), Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
 - .3 ASTM C635/C635M-13a, Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
 - .4 ASTM C636/C636M-13, Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.
 - .5 ASTM E1264-14, Standard Classification for Acoustical Ceiling Products.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet, for Use in Building Construction
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .4 Underwriter's Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-10, Surface Burning Characteristics of Building Materials and Assemblies.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product Data: submit WHMIS MSDS.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 10 - Product Requirements.
- .2 Protect on site stored or installed absorptive material from moisture damage.
- .3 Store extra materials required for maintenance, where directed by Departmental Representative.

1.4 WASTE MANAGEMENT AND DISPOSAL

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

1.5 ENVIRONMENTAL REQUIREMENTS

- .1 Permit wet work to dry before beginning to install.
- .2 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 Ensure extra materials are 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.

Part 2 Products

2.1 PERFORMANCE REQUIREMENTS

- .1 Suspension System: Rigidly secure acoustic ceiling system including integral mechanical and electrical components with maximum deflection of 1:240 and meeting the requirements of ASTM C636 and ASTM E580 for seismic design category D,E & F.

2.2 MATERIALS

- .1 Materials shall be from same manufacturer.
- .2 Acoustic units for suspended ceiling system: to ASTM E1264 and to match existing in building.
- .3 Acoustical Suspension: Heavy duty system to ASTM C635.
 - .1 Heavy duty system to ASTM C635.
 - .2 Basic materials for suspension system: commercial quality cold rolled steel, zinc coated.
 - .3 Suspension system: non fire rated, two directional exposed tee bar grid.
 - .4 Size: 15/16" face for square edge tile.
 - .5 Exposed tee bar grid components: shop painted satin sheen, white colour. Components die cut. Main tee with double web, rectangular bulb and 25 mm rolled cap on exposed face. Cross tee with rectangular bulb; web extended to form positive interlock with main tee webs; lower flange extended and offset to provide flush intersection.
 - .6 Hanger wire: galvanized soft annealed steel wire, 3.6 mm diameter for access tile ceilings.
 - .7 Hanger inserts: purpose made.

- .8 Accessories: splices, clips, wire ties, retainers and wall moulding flush or reveal as required to complement suspension system components, as recommended by system manufacturer.
- .9 Hold down clips: provide to ceiling in Server Room.
- .4 Performance/Design Criteria:
 - .1 Maximum deflection: 1/360th of span to ASTM C635 deflection test.

Part 3 Execution

3.1 EXAMINATION

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

3.2 INSTALLATION

- .1 Installation: in accordance with ASTM E 580/E580M and ASTM C636 except where specified otherwise.
- .2 Suspension System:
 - .1 Erect ceiling suspension system after work above ceiling has been inspected by Departmental Representative.
 - .2 Install hangers spaced at maximum 1200 mm centres and within 150 mm from ends of main tees.
 - .3 Completed suspension system to support super-imposed loads, such as lighting fixtures, diffusers, grilles, and speakers.
 - .4 Support at light fixtures diffusers with additional ceiling suspension hangers within 150 mm of each corner and at maximum 600 mm around perimeter of fixture.
 - .5 Interlock cross member to main runner to provide rigid assembly.
 - .6 Ensure finished ceiling system is square with adjoining walls and level within 1:1000.
- .3 Acoustic Panels:
 - .1 Install acoustical panels and tiles in ceiling suspension system.
 - .2 Co-ordinate ceiling work with work of other sections such as interior lighting, fire protection communication, and intrusion and detection systems.
- .4 Install fibrous acoustical media over entire area.

3.3 APPLICATION

- .1 General: Install acoustical units parallel to building lines with edge unit not less than 50% of unit width with directional pattern running in same direction.
- .2 Refer to reflected ceiling plan.

- .3 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.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 11 55 – General Instructions.
 - .1 Leave Work area clean at end of each shift.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 11 55 – General Instructions.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 06 40 00 - Architectural Woodwork
- .2 Section 07 92 00 – Sealants
- .3 Section 09 68 00 – Carpeting

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM E648-15e1, Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
 - .2 ASTM F710-11, Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
 - .3 ASTM F1303-04(2009), Standard Specification for Sheet Vinyl Floor Covering with Backing.
 - .4 ASTM F1516-08, Standard Practice for Sealing Seams of Resilient Flooring Products by the Heat Weld Method (when Recommended).
 - .5 ASTM F1861-08(2012), Standard Specification for Resilient Wall Base.
 - .6 ASTM F1913-04(2010), Standard Specification for Vinyl Sheet Floor Covering Without Backing.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .3 South Coast Air Quality Management District (SCAQMD), California State
 - .1 SCAQMD Rule 1168-05, Adhesives and Sealants Applications.
- .4 Underwriters Laboratories of Canada (ULC):
 - .1 CAN/ULC S102.2-10, Method of Test for Surface Burning Characteristics of Flooring, Floor Covering and Miscellaneous Materials and Assemblies.

1.3 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
 - .1 Documentation identifying resilient flooring products are certified as compliant with the FloorScore standard by an independent third-party.
 - .2 Submit one copy of product data for each type of product specified.
 - .3 Submit WHMIS Material Safety Data Sheets (MSDS) for flooring adhesive and seam welding. Indicate VOC content.
- .2 Provide samples:
 - .1 Provide samples of standard colours for selection by Departmental Representative.
 - .2 Submit duplicate 300 x 300 mm sample pieces of sheet material, 300 mm long base.

- .3 Submit samples of welding rod for selection by Departmental Representative.
- .4 Transition strips; 300 mm long, for selection by Departmental Representative.
- .3 Closeout Submittals:
 - .1 Provide manufacturer's printed recommendations for general maintenance, including cleaning instructions and guidelines for use of waxes and other protective coatings and appearance enhancers in accordance with Section 01 78 00 – Closeout Submittals.

1.4 EXTRA MATERIALS

- .1 Extra stock materials: deliver to Departmental Representative extra materials from same production run as products installed. Package products with protective covering and identify with descriptive labels. Comply with Section 01 78 30 - Closeout Submittals.
- .2 Provide 5 m² of each colour, pattern and type flooring material required for project for maintenance use.
- .3 Extra materials one piece and from same production run as installed materials.
- .4 Clearly identify each roll of sheet flooring and each container of adhesive.
- .5 Deliver to Consultant upon completion of the work of this section.

1.5 QUALITY ASSURANCE

- .1 Regulatory Requirements: Provide products that meet requirements of ULC S102.2 as applicable for required flame spread ratings; labelled and listed by Underwriters Laboratories of Canada (ULC), or another testing and inspecting agency acceptable to authorities having jurisdiction.
- .2 Qualifications: Provide proof of qualifications:
 - .1 Resilient Flooring Installer:
 - .1 Installer who is competent in heat welding and have a minimum of three (3) years documented experience in the installation of resilient sheet flooring and seams in accordance with manufacturer's training or certification program.
 - .2 Source Limitations: Obtain each type, colour, and pattern of flooring or accessories specified from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 10 - Product Requirements.
- .2 Deliver materials in good conditions to the jobsite in the manufacturer's original unopened containers that bear the name and brand of the manufacturer, project identification, and shipping and handling instructions.
- .3 Store materials in a clean, dry, enclosed space off the ground, and protect from the weather and from extremes of heat and cold. Protect adhesive from freezing. Store

flooring, adhesives and accessories in the spaces where they will be installed for at least 48 hours before beginning installation.

- .4 Install flooring and accessories after the other finishing operations, including painting, have been completed. Close spaces to traffic during the installation of the flooring. Do not install flooring over concrete slabs until they are sufficiently dry to achieve a bond with the adhesive, in accordance with the manufacturer's recommended bond and moisture tests.

1.7 WASTE MANAGEMENT AND DISPOSAL

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

1.8 ENVIRONMENTAL REQUIREMENTS

- .1 Moisture:
 - .1 Ensure substrate is within moisture limits and alkalinity limits prescribed by manufacturer.
 - .2 Alkalinity: for concrete substrates conduct testing for alkalinity values and submit report to Consultant. Acceptable values are between 5.0 and 12.0.
 - .3 Ambient Conditions:
 - .1 Temperature: maintain ambient temperature of not less than 18 degrees C from 48 hours before installation to at least 48 hours after completion of work.
 - .2 Relative humidity: maintain between 10% and 65% for 48 hours before, during and 48 hours after installation.
 - .3 Ventilation:
 - .1 Co-ordinate operation of ventilation system during installation of carpet with BGIS. Also refer to Appendix B
 - .2 Ventilate enclosed spaces in accordance with Section 01 47 18 – Indoor Air Quality.

1.9 WARRANTY

- .1 Provide Manufacturers Warranty for product to be free from manufacturers defects for a period of five (5) years from date of substantial performance.

Part 2 Products

2.1 MATERIALS

- .1 Certified as compliant with the FloorScore standard by an independent third-party.

2.2 SHEET FLOORING

- .1 Static Dissipative Sheet vinyl without backing: to ASTM F1913, commercial.
 - .1 Minimum width: 2.0 meters.
 - .2 Total Thickness: nominal 2mm.

- .3 Texture: smooth.
- .4 Pattern: speckled.
- .5 Colour: to be selected by Departmental Representative from manufacturer's standard range.
- .6 Recycled Content: 25% pre-consumer content.
- .7 ASTM E 648, Standard Test method for Critical Radiant Flux of 0.45 watts/cm² or greater, Class I.
- .8 ANSI/ESD S7.1: 7.5 x 108, 12% RH, tested surface to ground
- .9 Meet OSHA/NFPA (> 2.5 x 10⁴ ohms): 6.2 x 10⁷ ohms
- .10 Meet ASTM F 150, 106 to 109 ohms (50% RH, 100v): 6.2 x 10⁷ ohms
- .11 ESD-approval (IEC 61340 / 100v): 107
- .2 Sheet vinyl without backing: commercial, PVC and phthalate free.
 - .1 Minimum width: 1450 mm.
 - .2 Total Thickness: nominal 2mm.
 - .3 Texture: smooth.
 - .4 Pattern: to be selected by Departmental Representative from manufacturer's standard range
 - .5 Colour: to be selected by Departmental Representative from manufacturer's standard range.
 - .6 Recycled Content: greater than 25%.
 - .7 Warranty: 15 years.

2.3 RESILIENT BASE

- .1 Resilient Base: to ASTM F1861, and as follows:
 - .1 Type: rubber.
 - .2 Style: Cove.
 - .3 Thickness: 3.17 mm.
 - .4 Height: 101 mm.
 - .5 Length: 36.5 meter rolls.
 - .6 Colour: as selected by Departmental Representative from manufacturer's full range.

2.4 ACCESSORIES

- .1 Metal edge strips:
 - .1 Extruded, smooth, stainless steel with lip to extend under floor finish, shoulder flush with top of adjacent floor finish.
- Sub-floor filler and leveller: white premix latex requiring water only to produce cementitious paste.
- .2 Transition strips: provide resilient transitions; colour to be selected by Departmental Representative.

- .3 Primers and adhesives: of types recommended by resilient flooring manufacturer for specific material on applicable substrate, above, on or below grade.
 - .1 Sheet flooring adhesive: as recommended by manufacturer.
 - .2 Static Dissipation flooring adhesive: as recommended by manufacturer.
- .4 Static Dissipative Installation System:
 - .1 Adhesive: Static dissipative, water based resin as recommended by flooring manufacturer to obtain required performance requirements.
 - .2 Grounding Strips: 50 mm wide x maximum length copper ground connection strips as recommended by flooring manufacturer to obtain required performance requirements.
- .5 Welding rod: designed to weld seams of sheet flooring, as recommended by flooring manufacturer, colour to be selected by Departmental Representative.

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 SITE VERIFICATION OF CONDITIONS

- .1 Ensure concrete floors have maximum 2.5% moisture content, exhibit normal alkalinity and no carbonization or dusting.
- .2 Ensure concrete floors are clean, smooth, and flat to plus or minus 3 mm over 3 meters.

3.3 PREPARATION

- .1 Remove existing flooring.
- .2 Remove old adhesives.
- .3 Prepare substrate in accordance with ASTM F710.
- .4 Clean floor and apply filler; trowel and float to leave smooth, flat hard surface. Prohibit traffic until filler cured and dry.
- .5 Remove sub-floor ridges and bumps. Fill low spots, cracks, joints, holes and other defects with sub-floor filler.

3.4 INSTALLATION: GENERAL

- .1 Apply adhesive uniformly using recommended trowel in accordance with flooring manufacturer's instructions. Do not spread more adhesive than can be covered by flooring before initial set takes place. Do not use worn trowels that inhibit correct distribution and spreading of adhesive.
- .2 Cut flooring around fixed objects.
- .3 Install feature strips and floor markings where indicated. Fit joints tightly.

- .4 Install flooring in pan type floor access covers. Maintain floor pattern.
- .5 Continue flooring over areas which will be under built-in furniture.
- .6 Continue flooring through areas to receive movable type partitions without interrupting floor pattern.
- .7 Terminate flooring at centreline of door in openings where adjacent floor finish or colour is dissimilar.
- .8 Install metal edge strips at unprotected or exposed edges where flooring terminates.

3.5 INSTALLATION: SHEET FLOORING

- .1 Install in accordance with manufacturer's written instructions.
- .2 Install static dissipative flooring with manufacturer's recommended adhesive and procedures.
- .3 Install static dissipative flooring with manufacturer's copper grounding strips.
- .4 Static dissipative flooring shall be cold or heat welded.
- .5 Lay flooring with seams parallel to building line or as indicated on drawings to produce a minimum number of seams. Border widths minimum 1/3 width of full material.
- .6 Provide seams in strict accordance with manufacturer's recommendations. Heat weld seams with welding rod when heat welded seams are a permitted option by manufacturer.
- .7 As installation progresses and after installation is complete, roll resilient sheet flooring in accordance with manufacture's instructions.

3.6 INSTALLATION: BASE

- .1 Lay out base to keep number of joints at minimum.
- .2 Do not make joints on straight sections.
- .3 Clean substrate and prime with one coat of adhesive.
- .4 Apply adhesive to back of base.
- .5 Set base against wall and floor surfaces tightly by using 3 kg hand roller.
- .6 Install straight and level to variation of 1:1000.
- .7 Scribe and fit to door frames and other obstructions. Use premoulded end pieces at flush door frames.
- .8 Cope internal corners. Use formed straight base material for external corners.

3.7 INSTALLATION: ACCESSORIES

- .1 Install feature strips and floor markings where indicated. Fit joints tightly.
- .2 Install metal edge strips at unprotected and exposed edges where flooring terminates.
- .3 Install flooring transition strips.

3.8 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 11 55 – General Instructions.

- .1 Leave Work area clean at end of each shift.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 11 55 – General Instructions.
- .3 Remove excess adhesive from floor, base and wall surfaces without damage.
- .4 Clean floor and base surface to flooring manufacturer's printed instructions.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 09 65 00 - Resilient Flooring

1.2 REFERENCES

- .1 Carpet and Rug Institute (CRI)
 - .1 CRI Carpet Installation Standard.
 - .2 CRI Green Label Indoor Air Quality Testing Program.
 - .3 CRI Green Label Plus Indoor Air Quality Testing Program.
- .2 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .3 National Floor Covering Association (NFCA)
 - .1 National Floor Covering Specification Manual - on line version.
- .4 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
 - .1 SCAQMD Rule 1168, Adhesives and Sealants, January 5, 2005 amendment, effective date July 1, 2005.
- .5 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S102.2-10, Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings and Miscellaneous Materials and Assemblies.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Sequencing: sequence with other work. Comply with manufacturer's written recommendations for sequencing construction operations.
- .2 Scheduling: schedule with other work.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Manufacturer's Instructions: submit manufacturer's installation storage instructions.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 30 - Closeout Submittals.

- .2 Operation and Maintenance Data: submit operation and maintenance data for installed products for incorporation into manual.
- .3 Warranty Documentation: submit warranty documents specified.

1.6 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Manufacturer: capable of providing field service representation during construction and approving application method.
 - .2 Flooring Installer:
 - .1 Experienced, minimum five (5) years in performing work of this Section who has specialized in installation of work similar to that required for this project.
 - .2 Certified by carpet manufacturer.
 - .3 Must not sub-contract labour without written approval of Departmental Representative.
 - .4 Responsible for proper product installation, including floor testing and preparation as specified and in accordance with carpet manufacturer's written instructions.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 10 - Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store materials protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.
 - .3 Store and protect materials in original containers or wrapping with manufacturer's seals and labels intact.
 - .4 Store carpet and adhesive at minimum temperature of 18 degrees C and relative humidity of maximum 65% for minimum of 48 hours before installation.
 - .5 Prevent damage to materials during handling and storage. Keep materials under cover and free from dampness.
 - .6 Safety: comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials.
 - .7 Replace defective or damaged materials with new.

1.8 WASTE MANAGEMENT AND DISPOSAL

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

1.9 SITE CONDITIONS

- .1 Ambient Conditions:
 - .1 Temperature: maintain ambient temperature of not less than 18 degrees C from 48 hours before installation to at least 48 hours after completion of work.
 - .2 Relative humidity: maintain between 10% and 65% for 48 hours before, during and 48 hours after installation.
 - .3 Ventilation:
 - .1 Departmental Representative will co-ordinate operation of ventilation system during installation of carpet.
 - .2 Ventilate enclosed spaces in accordance with Section 01 47 18 – Indoor Air Quality.
 - .4 Install carpet after space is enclosed and weatherproof, wet-work in space is completed and nominally dry, work above ceilings is complete.

1.10 WARRANTY

- .1 Manufacturer's warranty: submit, for Departmental Representative's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to and does not limit other rights Owner may have under Contract Documents.

Part 2 Products

2.1 MATERIALS

- .1 Carpet: provided by BGIS and installed under the Work of this Section.
- .2 Adhesive:
 - .1 Provide Pressure Sensitive Type: recommended by carpet tile manufacturer for direct glue down installation of speciality backed carpet tiles.
 - .2 On site application VOC limit: 50 g/L maximum to SCAQMD Rule 1168.
- .3 Transition Mouldings:
 - .1 Carpet edge / reducer strip: rubber, colour to suit colour schedule and as selected by Departmental Representative.

Part 3 Execution

3.1 INSTALLERS

- .1 Use experienced and qualified technicians to carry out assembly and installation of tile carpet.

3.2 EXAMINATION

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

3.3 PREPARATION

- .1 Subfloor Preparation:
 - .1 Inspect concrete and determine special care required to make it a suitable for carpet.
 - .2 Comply with manufacturer's written recommendations for maximum patch thickness.
 - .3 Prime large patch areas with compatible primer.
 - .4 Ensure concrete substrates are cured, clean and dry.
 - .5 Ensure concrete substrates are free of paint, dirt, grease, oil, curing or parting agents, and other contaminants, including sealers, that interfere with the bonding of adhesive.
 - .6 Where powdery or porous concrete surface is encountered, apply primer compatible with adhesive to provide a suitable surface for glue-down installation.
 - .7 Prepare floor surfaces in accordance with CRI Carpet Installation Standard.
- .2 Tile Carpeting Preparation:
 - .1 Pre-condition carpeting: following manufacturer's written instructions.

3.4 INSTALLATION

- .1 Install in accordance with manufacturer's written instructions, and CRI Carpet Installation Standard.
- .2 Co-ordinate carpeting work with work of other trades, for proper time and sequence to avoid construction delays.
- .3 Install carpet after finishing work is completed but before demountable office partitions and telephone and electrical pedestal outlets are installed.
- .4 Install carpet as per manufacturer's recommendation.
- .5 Pattern: pattern shall be same as in other suites.

- .6 Snugly join carpet tiles in completed installation.
 - .1 Measure distance covered by 11 carpet tiles (10 joints) and ensure distance is in compliance with manufacturer specifications.
 - .2 Do not trap yarn between carpet tiles.
- .7 Apply thin film of pressure-sensitive adhesive according to manufacturer's recommendations.
- .8 Ensure finished installation presents smooth wearing surface free from conspicuous seams, burring and other faults.
- .9 Use material from same dye lot.
 - .1 Ensure colour, pattern and texture match within visual areas.
 - .2 Maintain constant pile direction.
- .10 Fit around architectural, mechanical, electrical and telephone outlets, and furniture fitments, around perimeter of rooms into recesses, and around projections.
- .11 Install carpet tiles to underfloor duct system and to access covers.
- .12 Install carpeting in pan type floor access covers.
- .13 Extend carpet tiles into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- .14 Install carpet tiles smooth and free from bubbles, puckers, and other defects.
- .15 Protect exposed carpet tile edges at transition to other flooring materials with suitable transition strips.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 11 55 – General Instructions.
 - .1 Leave Work area clean at end of each shift.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 11 55 – General Instructions.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 09 21 16 - Gypsum Board Assemblies
- .2 Section 09 91 00 - Painting

1.2 REFERENCES

- .1 Canadian General Standards Board (CGSB)
 - .1 CGSB 41-GP-30M-82, Wall Coverings, Vinyl-Coated Fabrics.
- .2 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-10, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Provide product data:
 - .1 Submit WHMIS MSDS - Material Safety Data Sheets. WHMIS MSDS acceptable to Labour Canada and Health and Welfare Canada for vinyl-coated fabric wall coverings. Indicate VOC content.
 - .2 Submit complete written description, including total fabric weight, name of fabric backing, tensile strength, tear strength and fire rating characteristics.
- .3 Provide samples:
 - .1 Due to product lead times, order material immediately upon approval of wall covering from Departmental Representative.
 - .2 Submit duplicate 300 x 300 mm samples of colours and textures of wall coverings.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 30 - Closeout Submittals.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 10 - Product Requirements.

1.6 WASTE MANAGEMENT AND DISPOSAL

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

1.7 AMBIENT CONDITIONS

- .1 Temperature: maintain air temperature and structural base temperature at wall covering installation area above 20 degrees C and relative humidity below 55% for 72 hours before, during and 72 hours after installation.
- .2 Ventilation:
 - .1 Ventilate enclosed spaces.
 - .2 Provide continuous ventilation during and after coating application.

Part 2 Products

2.1 MATERIALS

- .1 Wall covering: to CGSB 41-GP-30M and to match existing material.
- .2 Sealer: type recommended by covering manufacturer.
 - .1 Sealer: maximum VOC limit 250 g/L.
- .3 Sizing: type recommended by covering manufacturer.
- .4 Adhesive: as recommended by covering manufacturer.
 - .1 Adhesives: maximum VOC limit 50 g/L.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 PREPARATION

- .1 Unwrap wall covering when ventilation conditions are accelerated. Allow 24 hours acclimation in installation before application.
- .2 Prepare surfaces according to covering manufacturer's instructions.
- .3 Work penetrating substrate to be completed before installing covering.
- .4 Seal and size surfaces to receive covering.

3.3 INSTALLATION

- .1 Installation sequence:
 - .1 Use rolls in consecutive numerical sequence of manufacture.
 - .2 Place strips and panels consecutively in exact order they are cut from roll; including spaces above or below windows, doors or similar penetrations.
 - .3 Reverse alternate strips except on match patterns.
- .2 Apply adhesive as recommended by manufacturer.

- .3 Wrap fabric 150 mm beyond inside and outside corners. No cutting at corners permitted, unless pattern or colour changes.
- .4 No horizontal seams permitted.
- .5 Remove excess adhesive along finished seams immediately after strips of wall covering is applied. As work progresses ensure clean warm water is used for final rinsing of wall covering and leave clean.
- .6 Leave completed work smooth, clean, without wrinkles, gaps, overlaps or air pockets.

3.4 CLEANING

- .1 Clean surfaces to covering manufacturer's written instructions.

3.5 PROTECTION

- .1 Protect finished surfaces and exterior corners from damage until final inspection.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 08 11 00 – Metal Doors and Frames
- .2 Section 08 14 16 – Flush Wood Doors
- .3 Section 09 21 16 – Gypsum Board Assemblies

1.2 REFERENCES

- .1 Green Seal (GS)
 - .1 Green Seal Standards GC-03, Anti-Corrosive Paints, Second Edition, January 7, 1997
 - .2 Green Seal Standards GS-11, Paints, First Edition, May 20, 1993.
 - .3 Green Seal Standard GS-36, Aerosol Adhesives, October 19, 2000.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .3 The Master Painters Institute (MPI)
 - .1 Architectural Painting Specification Manual - current edition.
 - .2 Maintenance Repainting Manual - current edition.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for paint and coating products and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit WHMIS MSDS.
- .3 Samples:
 - .1 Submit duplicate 200 x 300 mm sample panels of each paint special finish with specified paint or coating in colours, gloss/sheen and textures required to MPI Painting Specification Manual standards.
- .4 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 10 - Product Requirements.

- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Provide and maintain dry, temperature controlled, secure storage.
 - .2 Store painting materials and supplies away from heat generating devices.
 - .3 Store materials and equipment in well ventilated area within temperature as recommended by manufacturer.

1.5 WASTE MANAGEMENT AND DISPOSAL

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

1.6 SITE CONDITIONS

- .1 Heating, Ventilation and Lighting:
 - .1 Ventilate enclosed spaces in accordance with Section 01 11 55 – General Instructions and Section 01 47 18 – Indoor Air Quality.
 - .1 Co-ordinate use of existing ventilation system with Departmental Representative and ensure its operation during and after application of paint as required.
 - .2 Provide minimum lighting level of 323 Lux on surfaces to be painted.
 - .2 Temperature, Humidity and Substrate Moisture Content Levels:
 - .1 Apply paint finishes when ambient air and substrate temperatures at location of installation can be satisfactorily maintained during application and drying process, within MPI and paint manufacturer's prescribed limits.
 - .2 Test concrete, masonry and plaster surfaces for alkalinity as required.
 - .3 Apply paint to adequately prepared surfaces, when moisture content is below paint manufacturer's prescribed limits.
 - .3 Additional application requirements:
 - .1 Apply paint finish in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.
 - .2 Apply paint in occupied facilities during silent hours only. Schedule operations to approval of Departmental Representative such that painted surfaces will have dried and cured sufficiently before occupants are affected.

Part 2 Products

2.1 MATERIALS

- .1 Supply paint materials for paint systems from single manufacturer.
- .2 Conform to latest MPI requirements for painting work including preparation and priming.

- .3 Materials in accordance with MPI - Architectural Painting Specification Manual and MPI - Maintenance Repainting Manual "Approved Product" listing.
 - .1 Use MPI listed materials having E2 or E3 rating where indoor air quality requirements exist.
- .4 Maximum VOC limits as follows:
 - .1 Anti-Corrosive and Anti-Rust Paints: Maximum VOC Limit: 250g/l.
 - .2 Paint - Non-Flat: Maximum VOC Limit: 150 g/l.
 - .3 Flat: Maximum VOC Limit: 50 g/l.
- .5 Colours:
 - .1 Base colour schedule on selection of 3 base colours and 2 accent colours.
- .6 Mixing and tinting:
 - .1 Perform colour tinting operations prior to delivery of paint to site, in accordance with manufacturer's written recommendations. Obtain written approval from Departmental Representative for tinting of painting materials.
 - .2 Use and add thinner in accordance with paint manufacturer's recommendations.
 - .1 Do not use kerosene or similar organic solvents to thin water-based paints.
 - .3 Thin paint for spraying in accordance with paint manufacturer's written recommendations.
 - .4 Re-mix paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity.
- .7 Gloss/sheen ratings:
 - .1 Paint gloss is defined as sheen rating of applied paint, in accordance with following values:

Gloss Level-Category	Gloss @ 60 degrees	Sheen @ 85 degrees
Gloss Level 1 - Matte Finish	Max. 5	Max. 10
Gloss Level 2 - Velvet	Max.10	10 to 35
Gloss Level 3 - Eggshell	10 to 25	10 to 35
Gloss Level 4 - Satin	20 to 35	min. 35
Gloss Level 5 - Semi-Gloss	35 to 70	
Gloss Level 6 - Gloss	70 to 85	
Gloss Level 7 - High Gloss	More than 85	

- .2 Gloss level ratings of painted surfaces as indicated as noted below.
- .8 Interior painting:
 - .1 Galvanized Metal and Miscellaneous Metal: high contact/high traffic areas (doors, frames, railings and handrails, pipes, etc.).
 - .1 INT 5.3J – G5: High Performance Architectural Latex (over w.b. galvanized primer).
 - .2 Dressed Lumber: doors, door and window frames, casings, mouldings, etc.:

- .1 INT 6.3A – G5: High Performance Architectural Latex (over latex primer).
- .3 Plaster and gypsum board: gypsum wallboard, drywall, "sheet rock" type material, etc.
 - .1 INT 9.2B – G3: High Performance Latex finish (over latex sealer).
- .9 Interior re-painting:
 - .1 Galvanized Metal: high contact/high traffic areas (doors, frames, railings and handrails, etc.).
 - .1 RIN 5.3A – G5: Latex.
 - .2 Dressed Lumber: doors, door and window frames, casings, mouldings, etc.:
 - .1 RIN 6.3A – G5: High Performance Architectural Latex (over latex primer). Provide same MPI # product as INT 6.3A
 - .3 Plaster and Gypsum Board: gypsum wallboard, drywall, "sheet rock" type material, etc.
 - .1 RIN 9.2A – G3: Latex. Provide same MPI# product as INT 9.2B.

Part 3 Execution

3.1 GENERAL

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheets.
- .2 Perform preparation and operations for interior painting in accordance with MPI - Architectural Painting Specifications Manual and MPI - Maintenance Repainting Manual except where specified otherwise.

3.2 EXAMINATION

- .1 Investigate existing substrates for problems related to proper and complete preparation of surfaces to be painted. Report to Departmental Representative damages, defects, unsatisfactory or unfavourable conditions before proceeding with work.
- .2 Conduct moisture testing of surfaces to be painted using properly calibrated electronic moisture meter, except test concrete floors for moisture using simple "cover patch test". Do not proceed with work until conditions fall within acceptable range as recommended by manufacturer.

3.3 PREPARATION

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

- .2 Protect items that are permanently attached such as Fire Labels on doors and frames.
- .3 Protect factory finished products and equipment.
- .2 Surface Preparation:
 - .1 Remove electrical cover plates, light fixtures, surface hardware on doors, bath accessories and other surface mounted equipment, fittings and fastenings prior to undertaking painting operations. Identify and store items in secure location and re-installed after painting is completed.
 - .2 Move and cover furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.
 - .3 Place "WET PAINT" signs in occupied areas as painting operations progress. Signs to approval of Departmental Representative.
 - .4 Clean and prepare surfaces in accordance with MPI - Architectural Painting Specification Manual and MPI - Maintenance Repainting Manual specific requirements and coating manufacturer's recommendations.
 - .5 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats. Apply primer, paint, or pretreatment as soon as possible after cleaning and before deterioration occurs.
 - .6 Where possible, prime non-exposed surfaces of new wood surfaces before installation. Use same primers as specified for exposed surfaces.
 - .1 Apply vinyl sealer to MPI #36 over knots, pitch, sap and resinous areas.
 - .2 Apply wood filler to nail holes and cracks.
 - .3 Tint filler to match stains for stained woodwork.
 - .7 Sand and dust between coats as required to provide adequate adhesion for next coat and to remove defects visible from a distance up to 1000 mm.
 - .8 Clean metal surfaces to be painted by removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with MPI requirements.
 - .9 Touch up of shop primers with primer as specified.

3.4 APPLICATION

- .1 Apply coats of paint in continuous film of uniform thickness.
 - .1 Repaint thin spots or bare areas before next coat of paint is applied.
- .2 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.
- .3 Sand and dust between coats to remove visible defects.
- .4 Finish surfaces both above and below sight lines as specified for surrounding surfaces, including such surfaces as tops of interior cupboards and cabinets and projecting ledges.
- .5 Finish inside of cupboards and cabinets as specified for outside surfaces.
- .6 Finish closets and alcoves as specified for adjoining rooms.

- .7 Finish top, bottom, edges and cutouts of doors after fitting as specified for door surfaces.
- .8 Mechanical/Electrical Equipment:
 - .1 Paint conduits, piping, hangers, ductwork and other mechanical and electrical equipment exposed in finished areas, to match adjacent surfaces, except as indicated. Paint exposed piping and tanks for clean agent systems to match ceiling.
 - .2 Do not paint over nameplates.
 - .3 Keep sprinkler heads free of paint.
 - .4 Paint both sides and edges of backboards for telephone and electrical equipment before installation.
 - .5 Leave equipment in original finish except for touch-up as required, and paint conduits, mounting accessories and other unfinished items.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 11 55 – General Instructions.
 - .1 Leave Work area clean at end of each shift.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 11 55 – General Instructions.
- .3 Place paint, stains and primers defined as hazardous or toxic waste, including tubes and containers, in containers or areas designated for hazardous waste.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 09 21 16 - Gypsum Board Assemblies

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 10 - Product Requirements.

Part 2 Products

2.1 MATERIALS

- .1 Provide single fold paper towel dispenser to match existing base building dispensers.

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 drywall finish. Provide plate with threaded studs or plugs.

3.2 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 11 55 – General Instructions.
 - .1 Leave Work area clean at end of each shift.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 09 68 00 - Carpeting

1.2 REFERENCES

- .1 Definitions:
 - .1 Bay: single shelving section of unit.
 - .2 Unit: assembly of one or more bays.
 - .3 Module: grouping of units with one or more access.
 - .4 System: complete system including units, and track.
- .2 Reference Standards:
 - .1 Aluminum Association (AA)
 - .1 AA DAF 45-03(R2009), Designation System for Aluminum Finishes.
 - .1 AA-A31, Clear Anodized Finish.
 - .2 AA-A41, Clear Anodized Finish.
 - .2 American National Standards Institute (ANSI)
 - .1 ANSI A208.1-09, Particleboard.
 - .3 ASTM International
 - .1 ASTM A490M-14a, Standard Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints Metric.
 - .2 ASTM D523-14, Standard Test Method for Specular Gloss.
 - .3 ASTM D968-15, Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive.
 - .3 Canadian Standards Association (CSA International)
 - .1 CSA-G40.20/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel, Includes Update No. 1 (2014)
 - .2 CSA W59-13, Welded Steel Construction (Metal Arc Welding), Includes Update No. 1 (2014), Update No. 3 (2015).

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Sequencing: Coordinate storage shelving system installation with other work to minimize possibility of damage and soiling during remainder of construction period.
- .2 Scheduling: Plan installation to commence after finishing operations, including painting have been completed.
- .3 Built-In Items: Provide components which must be built in at a time which causes no delays general progress of the Work.

- .4 Pre-installation Conference: Schedule and conduct conference on project site to review methods and procedures for installing mobile storage units including, but not limited to, the following:
 - .1 Review project conditions and levelness of flooring and other preparatory work performed under other contracts.
 - .2 Review and verify structural loading limitations.
 - .3 Recommended attendees include:
 - .1 Departmental Representative.
 - .2 Owner's Representative.
 - .3 Prime Contractor or representative.
 - .4 Consultant.
 - .5 Manufacturer's representative.
 - .6 Subcontractors or installers whose work may affect, or be affected by, the work of this section.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for mobile storage shelving and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Design Data:
 - .1 Submit floor loading calculations including floor loading diagram.
 - .2 Provide installation details.
- .4 Shop Drawings: Show fabrication, assembly, and installation details including descriptions of procedures and diagrams. Show complete extent of installation layout including clearances, spacings, and relation to adjacent construction in plan, elevation, and sections. Indicate clear exit and access aisle widths; access to concealed components; assemblies, connections, attachments, reinforcement, and anchorage; and deck details, edge conditions, and extent of finish flooring within area where units are to be installed.
 - .1 Show installation details at non-standard conditions. Furnish floor layouts, technical and installation manuals for every unit shipment with necessary dimensions for rail layout and system configuration at the project site. Include installed weight, load criteria, furnished specialties, and accessories.
 - .2 Provide layout, dimensions, and identification of each unit corresponding to sequence of installation and erection procedures. Specifically include the following:
 - .1 Location, position and configuration of tracks on all floors.
 - .2 Plan layouts of positions of carriages, including all required clearances.
 - .3 Details of shelving, indicating method and configuration of installation in carriages.

- .3 Provide location and details of anchorage devices to be embedded in or fastened to other construction.
- .4 Provide installation schedule and complete erection procedures to ensure proper installation.
- .5 Samples: Provide minimum 76 mm square example of each color and texture on actual substrate for each component to remain exposed after installation.
- .6 Selection Samples: For initial selection of colors and textures, submit manufacturer's color charts consisting of actual product pieces, showing full range of colors and textures available.
- .7 Warranty: Submit draft copy of proposed warranty for review by Departmental Representative.
- .8 Maintenance Data: Provide in form suitable for inclusion in maintenance manuals for mobile storage units. Data shall include operating and maintenance instructions, parts inventory listing, purchase source listing, emergency instructions, and related information.
 - .1 Submit manufacturer's instructions for proper maintenance materials and procedures.
 - .2 Submit manufacturer's printed instructions for maintenance of installed work, including methods and frequency recommended for maintaining optimum condition under anticipated use conditions. Include precautions against using materials and methods which may be detrimental to finishes and performance.
- .9 Reference List: Provide a list of recently installed mobile storage units to be visited by owner, architect, and contractor. Intent of list is to aid in verifying the suitability of manufacturer's products and comparison with materials and product specified in this section.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 30 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.

1.6 QUALITY ASSURANCE

- .1 Manufacturer Qualifications: Engage an experienced manufacturer who is ISO 9001 certified for the design, production, installation and service of carriage mounted high-density mobile storage units and support rails. Furnish certificate attesting manufacturer's ISO 9001 quality system registration
- .2 Installer Qualifications: Engage an experienced installer who is a manufacturer's authorized representative for the specified products for installing carriages and anchoring shelving units to carriages.
 - .1 Minimum Qualifications: 1-year experience installing systems of comparable size and complexity to specified project requirements.
 - .2 Guaranteed 24-hour service response time.

- .3 Qualifications: installation by factory trained, authorized installer, with experience installing mobile systems on regular basis and approved by manufacturer.
- .4 Site Meetings: as part of Manufacturer's Services described in PART 3 - FIELD QUALITY CONTROL, schedule site visits, to review Work, at stages listed.
 - .1 After delivery and storage of products, and when preparatory Work is complete but before installation begins.
 - .2 Upon completion of Work, after cleaning is carried out.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 10 - Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Separate and recycle waste materials in accordance with Section 01 74 19 –Waste Management and Disposal.

1.8 WARRANTY

- .1 Provide a written warranty, executed by Contractor, Installer, and Manufacturer, agreeing to repair or replace units which fail in materials or workmanship within the established warranty period. This warranty shall be in addition to, and not a limitation of, other rights the Owner may have under General Conditions provisions of the Contract Documents.
- .2 Warrant the entire movable compact shelving installation against defects in materials and workmanship for a period of five years from date of acceptance by the Departmental Representative.

Part 2 Products

2.1 SYSTEM DESCRIPTION

- .1 General: manufactured storage units mounted on manufacturer's track-guided carriages to form a compact storage system. System design permits access to any single aisle by manually moving units until desired aisle is opened. Carriage/rail system provides uniform carriage movement along total length of travel, even with unbalanced loads.
- .2 Carriage System Design and Features: carriage system consists of a formed structural steel frame with machined and balanced wheels riding on steel rails mounted to floor. Rails shall be types selected by manufacturer to ensure smooth operation and self-

centering of mobile storage units during travel without end play or binding. Rail types, quantities and spacing shall be selected by manufacturer to suit installation conditions and requirements. All bearings used in the drive mechanism shall be permanently shielded and lubricated.

- .3 Movement Controls: Triple arm operating wheels with rotating hand knobs shall be provided on the accessible (drive) ends of shelf units, centered on the end panel, located 1051 mm from the base of each unit to permit units to be moved to create a single aisle opening. Turning the handle transmits power through chain drive to drive wheels on each carriage.
- .4 Drive System: shall be designed with a positive type mechanically-assisted drive which minimizes end play, ensures there is no play in the drive handle, and that carriages will stop without drifting.
- .5 System shall include a chain sprocket drive system for each movable carriage to ensure that carriages move uniformly along the total length of travel, even with unbalanced loads. All system components shall be selected to ensure a smooth, even movement along the entire carriage length. Drive system gearing shall be designed to permit 1 lb. of force applied to the drive handle to move a minimum of 4,000 lbs. of load.
 - .1 A tensioning device shall be provided on each chain drive with provision for adjusting tension without removing end panels.
 - .2 All bearings used in drive mechanism shall be permanently shielded and lubricated.
- .6 Safety Features:
 - .1 Color-coded visual indicators shall provide verification that carriages are in a locked or unlocked mode.
 - .2 A single safety lock button, mounted on each operating wheel hub, will permit moving a carriage in either direction to create a new access aisle when pulled out (unlocked), or locking the carriage when pushed in.
- .7 Finishes:
 - .1 Fabricated Metal Components And Assemblies: Manufacturer's standard powder coat paint finish.
 - .2 End Panels, Accessible Ends: [Plastic laminate, manufacturer's standard textures and patterns.] [Manufacturer's standard powder coat paint finish.]
- .8 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

2.2 DESIGN REQUIREMENTS

- .1 Maximum allowable loading: mobile shelving system shall not exceed 659kg/m².
- .2 Slab deflection: floor slab deflection under the HDMS loads shall not be greater than L/480.

- .3 Design and construct metal storage shelving to support uniform load of 18kg/305mm of shelf length with maximum deflection of L/140. Shelves shall exhibit no permanent deflection under fully loaded conditions.
- .4 Design shelving to accommodate vertical adjustment of shelves in 50 mm increments and to permit easy assembly, expansion, dismantling and re-use of shelving component parts.

2.3 MATERIALS

- .1 Provide materials and quality of workmanship which meet or exceed established industry standards for products specified. Material thicknesses/gauges are manufacturer's option unless indicated otherwise.
- .2 Plastic Laminates: NEMA LD-3, GP-28, Vertical Grade.
- .3 Grout:
 - .1 Provide non-shrink, non-staining hydraulic cement compound conforming to the following requirements, based on the performance of the test specimens at room temperature and in laboratory air.
 - .2 Linear Movement: No shrinkage while setting; maximum expansion limited to .051 mm per linear 25 mm.
 - .3 Compressive Strength: Based on two inch cubes made following ASTM standards, tested on a Balding-Southward machine of 27,272 kg capacity, meet or exceed the following:
 - .1 Age: 1 hour 4,500 psi
 - .2 7 days 8,000 psi
- .4 Steel sections and plates: to CSA G40.20/G40.21, type 400W.
- .5 Steel: to CSA G40.20/G40.21, Grade 300W.
- .6 Hollow Structural Sections (HSS): to CSA G40.20/G40.21, Grade 350W, Class H.
- .7 Steel bolts, nuts and washers: to ASTM A490M.
- .8 Welding materials: to CSAW59.

2.4 PRODUCT

- .1 Minimum Standard Acceptable Product: Spacesaver.
 - .1 Product specified as minimum standard does not exclude any other products. Specifications for specified product will be used as base for minimum acceptable standards during shop drawings review. All products must meet or exceed minimum standards.

2.5 MANUFACTURED COMPONENTS

- .1 Rails:
 - .1 Material: ASTM/AISI Type 1035 or 1045 steel, manufacturer's selection.
 - .2 Capacity: 1385kg/m of carriage.
 - .3 Minimum Contact Surface: 16mm wide.

- .4 Provide rail sections in minimum 1.83m lengths.
- .5 Rail configuration shall permit attachment to top of structural floor system with provision for leveling rails to compensate for variations in floor surface level.
- .6 Provide rail connections designed to provide horizontal and vertical continuity between rail sections, to gradually transfer the concentrated wheel point load to and from adjoining rail sections. Butt joints are not permitted.
- .2 Floor / Ramp:
 - .1 Floor/Ramp Sheathing: Minimum 19 mm, 5-ply underlayment grade plywood. Particle board sheathing materials are not permitted.
- .3 Carriages:
 - .1 Provide manufacturer's design movable carriages fabricated of welded or bolted steel construction. Galvanized structural components and/or riveted carriages are unacceptable.
 - .2 Provide fixed carriages of same construction and height as the movable carriages, anchored to rails. Setting fixed shelving directly on floors is not permitted.
 - .3 When required, provide bolted carriage splices designed to maintain proper unit alignment and weight load distribution.
 - .4 Provide each carriage with two wheels per rail.
 - .5 Provide carriage bumpers and extensions designed to provide 100mm (4") flue spacing between all shelving on carriages and platforms
 - .6 System design should allow for a minimum of 36" aisles within mobile system.
- .4 Drive / Guide System:
 - .1 Design: Provide drive system which prevents carriage whipping, binding and excessive wheel/rail wear under normal operation.
 - .1 If line shafts are used, all wheels on one side of carriage shall drive.
 - .2 If synchronized drives are used, a minimum of one wheel assembly driving both sides of carriage at center location required. Drive shaft shall exhibit no play or looseness over the entire length of that assembly.
 - .2 Shaft Connections: Secured couplings.
 - .3 Bearing Surfaces: Provide rotating load bearing members with ball or roller bearings. Provide shafts with pillow block or flanged self-aligning type bearings.
- .5 Wheels:
 - .1 Capacity: Minimum load capacity per wheel: 1455 kg.
 - .2 Size: Minimum 127 mm, outside diameter drive wheels.
 - .3 Guides: Determined by manufacturer; minimum 2 locations.
- .6 Face Panels:
 - .1 Materials: Plastic laminate clad particle board with plastic edging on vertical edges.
 - .2 Finishes: Selected from manufacturer's standard available colors and patterns by Departmental Representative.

- .7 Four Post Shelving:
 - .1 Design: Wedge-lock type consisting of uprights, shelves, and shelf supports, designed to be assembled without fasteners or clips. Shelves shall not have any holes on exposed surfaces. Front and back flanges shall be flush with outside faces of posts. Design shall permit individual shelf adjustment and/or removal anywhere along the entire height of uprights.
 - .2 Materials and Workmanship: Fabricate units from Class 1, cold-rolled steel sheet with all bends sharp and true and no exposed “knife” edges.
 - .1 All units shall be free of burrs, sharp edges and projecting hardware with smooth, non-abrasive surfaces and edges.
 - .2 After fabrication, shelving shall exhibit no dents, “oil canning”, buckling or other surface irregularities.
 - .3 Uprights: Formed from steel sheet to a hollow “tee” shape for intermediate supports and formed angles for end supports. Uprights shall have keyhole slots on inner wall only. Provide with sheet steel panels full height and depth of end uprights. Provide intermediate “tee” uprights between adjacent units.
 - .4 Shelves: Form from sheet steel with flanges on all sides and return hem on front and back flanges. Ends shall be formed to clear inside of upright offset panels. Shelves shall be independently adjustable. Provide all shelves with slots for file dividers.
 - .5 Canopy Tops: Same construction as shelf units.
 - .6 Shelf Supports: Form from heavy gauge steel sheet with four solid steel shoulder rivets, two per ear, that interlock with inner wall of uprights.
 - .7 Nominal Shelf Dimensions:
 - .1 Standard Width: 914 mm, with 762, 1067, or 1219 mm sections used to meet project requirements.
 - .2 Shelf Edge Vertical Profile: 9 mm maximum.
 - .3 Vertical Adjustment Increment: 38 mm.
 - .4 Width Of Intermediate Uprights: 51 mm.
 - .5 Clearance Between Uprights: Nominal shelf section width minus 51 mm.
 - .6 Levelness Of Completed Shelf Units: Maximum 3.2 mm between bottom shelf and canopy top, measured along the edge of any upright in any direction.
 - .7 Number of Vertical Shelf Spaces: As indicated on drawings.
 - .8 Vertical Shelf-To-Shelf Spacing: As indicated on drawings.
 - .8 Load Carrying Capabilities: Provide shelf units capable of supporting 18kg/30 mm with maximum deflection of L/140. Shelves shall exhibit no permanent deflection under fully loaded conditions.
 - .9 Accessories: Provide 8 file dividers per shelf.
 - .10 Powder Coat Paint Finish: colour to be selected by Departmental Representative.

2.6 FABRICATION

- .1 General: Coordinate fabrication and delivery to ensure no delay in progress of the Work.
- .2 Wheels: Provide precision machined and balanced units with permanently shielded and lubricated bearings.
- .3 Carriages: Fabricate to ensure no more than 6 mm maximum deviation from a true straight line. Splice and weld to ensure no permanent set or slippage in any spliced or welded joint when exposed to forces encountered in normal operating circumstances.
- .4 Shelving, Supports and Accessories: See individual descriptions in “Shelving” paragraphs.

2.7 FINISH

- .1 Finish metal shelving in colour selected by Departmental Representative from manufacturer's standard range.
- .2 Paint Finish: Provide factory applied electrostatic powder coat paint. Meet or exceed specifications of the American Library Association.
- .3 Laminate Finish: Provide factory applied laminate panels at locations indicated on approved shop drawings.
- .4 Edgings: Provide preformed edging, color-matched to unit colors selected.

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 manual mobile storage shelving 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.
- .2 Examine floor surfaces with Installer present for compliance with requirements for installation tolerances and other conditions affecting performance of mobile storage units.
- .3 For installations on existing floors, ensure that rail spacings indicated on shop drawings are in proper locations so existing load-bearing structural members are not over stressed.
- .4 Verify that intended installation locations of mobile storage units will not interfere with nor block established required exit paths or similar means of egress once units are installed.
- .5 Prepare written report, endorsed by Installer, listing conditions detrimental to proper performance of mobile storage units, once installed.

3.2 INSTALLATION

- .1 Rails:
 - .1 Lay out rails using full length units to the maximum extent possible. Use cut lengths only at ends to attain total length required. Locate and position properly, following dimensions indicated on approved shop drawings. Verify thickness of finished floor materials to be installed (by others) and install level 1/16 inch (0.6MM) above finished floor surfaces.
 - .2 Verify level, allowing for a minimum 6 mm of grout under high points. Position and support rails so that no movement occurs during grouting.
 - .3 Set rails in full grout bed, completely filling any voids entire length of all rails including rail connectors. Trim up sides flush with rails to ensure proper load transfer from rail to supporting floor. Using shims in lieu of full grouting is not permitted.
 - .4 Installation Tolerances: Do not exceed levelness of installed rails listed below:
 - .1 Maximum Variation From True Level Within Any Module: 2.4 mm.
 - .2 Maximum Variation Between Adjacent (Parallel) Rails: 1.6 mm, perpendicular to rail direction.
 - .3 Maximum Variation In Height: 0.8 mm, measured along any 3.05 m rail length.
 - .5 Verify rail position and level; anchor to structural floor system with anchor type and spacings indicated on approved shop drawings.
 - .6 Existing floor slab is post tensioned concrete. Verify location of post-tensioning with GPR scanning. Install anchors to avoiding post-tensioning cables or other materials such as in-floor conduit and reinforcing steel.
- .2 Floors/Ramps:
 - .1 General: Finished elevation shall be 1.6 mm below top of rails.
 - .2 Place floors and ramps to the extent indicated on approved shop drawings. Extend ramps under all movable ranges. Extend under stationary ranges if dual control access is required. Provide ramp at both ends of mobile system. Do not extend ramps beyond the ends of carriages.
 - .3 Construct floors and ramps to prevent warping or deformation of floor panels in a normal operating environment. Support panels on levelers at maximum 450 mm on center.
- .3 Shelving Units Installation:
 - .1 General: Follow layout and details shown on approved shop drawings and manufacturer's printed installation instructions. Position units level, plumb; at proper location relative to adjoining units and related work.
 - .2 Carriages:
 - .1 Place movable carriages on rails. Ensure that all wheels track properly and centering wheels are properly seated on centering rails. Fasten multiple carriage units together to form single movable base where required.

- .2 Position fixed carriage units to align with movable units.
- .3 Shelving Units:
 - .1 Permanently fasten shelving units to fixed and movable carriages with vibration-proof fasteners.
 - .2 Stabilize shelving units following manufacturer's written instructions. Reinforce shelving units to withstand the stress of movement where required and specified.
- .4 Make good finished surfaces damaged during shipment or installation.

3.3 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.
- .2 Verify shelving unit alignment and plumb after installation. Correct if required following manufacturer's instructions.
- .3 Remove components which are chipped, scratched, or otherwise damaged and which do not match adjoining work. Replace with new matching units, installed as specified and in manner to eliminate evidence of replacement.

3.4 ADJUSTING

- .1 Adjust components and accessories to provide smoothly operating, visually acceptable installation.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 11 55 – General Instructions.
 - .1 Leave Work area clean at end of each shift.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 11 55 – General Instructions.

3.6 DEMONSTRATION AND TRAINING

- .1 Schedule and conduct demonstration of installed equipment and features with Departmental Representative.

- .2 Schedule and conduct maintenance training with Departmental Representative's maintenance personnel. Training session should include lecture and demonstration of all maintenance and repair procedures that end user personnel would normally perform.

END OF SECTION

Part 1 General

1.1 INTENT

- .1 Contractor to retain and pay for the service of a seismic engineer registered in the Province of British Columbia to provide and submit to the Departmental Representative Assurance of Professional Design and Commitment for Field Review Schedule B and Assurance of Professional Field Review and Compliance Schedule C-B for seismic restraints
- .2 Provide complete, fully tested and operational mechanical 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 and are not detailed installation instructions.
- .4 Follow manufacturers' recommended installation details and procedures for equipment, supplemented by requirements of Contract Documents.
- .5 Install equipment generally in locations and routes shown. Run piping and ductwork 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 satisfaction of the Departmental Representative at no extra cost.
- .6 Install equipment to provide access and ease of maintenance.
- .7 Connect to equipment specified in other Sections. 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 ducts, furnished by Controls Contractor.
- .9 Provide seismic restraints for all required equipment, piping and ductwork.
- .10 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.
- .11 If the equipment is used during construction, the guarantee or guarantee period shall not be shortened or altered.
- .12 'Provide' shall mean; supply and install'.

1.2 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.
- .5 Any areas indicated as space for future materials or equipment shall be left clear.

1.3 ALTERNATE MATERIALS AND EQUIPMENT

- .1 Approved equivalents and/or alternatives to specified products shall be equal to the specified product in every respect, operate as intended, meet the space, capacity, and noise requirements outlined.
- .2 The Contractor shall be fully responsible for any additional work or materials required by the trades or other Contractors to accommodate use of other than specified materials or equipment. Extras will not be approved to cover such work.

1.4 DRAWINGS AND SPECIFICATIONS

- .1 Drawings and specifications are complementary each to the other, and what is called for by one shall be binding as if called for by both.
- .2 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.

1.5 EQUIPMENT PROTECTION & CLEANUP

- .1 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 and duct systems.
- .2 Protect equipment with polyethylene covers and crates.
- .3 Operate, drain and flush out unsealed bearings and refill with new change of oil, before final acceptance.
- .4 Thoroughly clean piping, ducts and equipment of dirt, cuttings and other foreign substances.
- .5 Protect bearings and shafts during installation. Grease shafts and sheaves to prevent corrosion. Supply and install necessary extended nipples for lubrication purposes.
- .6 Ensure that existing equipment is carefully dismantled and not damaged or lost. Do not reuse existing materials and equipment unless specifically indicated.

1.6 SUBSTANTIAL & 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:
 - .1 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 The necessary tests on equipment and systems including those required by authorities have been completed with certificates of approval.
 - .3 Valve tagging and equipment identification is complete.
 - .4 Warranty forms have been mailed to the manufacturer. Provide copy of original warranty for equipment which has warranty period longer than one year.
 - .5 Systems have been chemically cleaned. Flush and initiate water treatment. Provide report from manufacturer's representative to confirm status of treatment.
 - .6 Draft Operating/Maintenance Manuals have been submitted.
 - .7 Operating and Maintenance demonstrations have been provided to the Departmental Representative.
 - .8 Record drawings have been submitted.
 - .9 All seismic restraint devices have been installed.
 - .10 All previously identified deficiencies have been corrected.
- .3 The following shall be an outline checklist of the minimum requirements to be met by the contractor prior to the Departmental Representatives' Substantial Performance by the contractor.
 - .1 Inspection:
 - .1 Final Sprinkler Materials and Test Certificate
 - .2 Fire alarm test certificate (via DIV.26)
 - .3 Fire stopping and Fire Damper test certificate.
 - .4 Seismic Engineers inspection of all Seismic restraints and schedule B and C letters of assurance
 - .5 Sprinkler Contractors Engineer of record inspection and Schedule B and C letters of assurance
 - .6 Final As-Built Drawings ready for review
 - .7 Maintenance and operation manuals, ready for review

1.7 MAINTENANCE

- .1 Furnish spare parts in accordance with Section 01 78 30 - Closeout Submittals and as follows:
- .2 Additional spare parts shall also be included as outlined in their appropriate sections.

1.8 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Shop Drawings, Product Data and Samples.
 - .1 As-Built drawings:
 - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
 - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
 - .3 Submit to the Departmental Representative for approval and make corrections as directed.
 - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
 - .5 Submit PDF copies of as-built drawings for inclusion in final TAB report. The PDF shall be saved in a USB flash memory.
 - .6 Provide one (1) full scale hard copy of as-built drawings to the Departmental Representative.
 - .7 Refer to Section 01 78 30.

1.9 HEALTH AND SAFETY

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

1.10 DELIVERY, STORAGE, AND HANDLING

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

1.11 WASTE MANAGEMENT

- .1 Refer to the requirements in Section 01 74 19 – Waste Management & Disposal.

Part 2 Products

2.1 OPERATING AND MAINTENANCE MANUALS

- .1 Refer to Division 1 and Section 22 05 00 – 2.1 Fire Protection O&M information to be inserted into this volume.

Part 3 Execution

3.1 RECORD DRAWINGS:

- .1 Refer to Section 01 78 30.

3.2 PROTECTION

- .1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Supply and installation of portable fire extinguishers, extinguisher cabinets and fire safety blankets.
- .2 Related Sections:
 - .1 This section shall be read in conjunction with all other mechanical specification sections (Division 21, 22, 23).

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)
 - .1 ANSI/NFPA 10 [1998], Portable Fire Extinguishers.
- .2 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC S508 [M90 (R1995)], Rating and Fire Testing of Fire Extinguishers and Class "D" Extinguishing Media
- .3 National Building Code 2010
- .4 Vancouver Building Bylaw 2014

1.3 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 - Shop Drawings, Product Data and Samples and Section 21 – Fire Protection–General Requirements.

Part 2 Products

2.1 MANUFACTURERS

- .1 Provide equipment that meets or exceeds the performance specification.

2.2 FE-1 SEMI-RECESSED CABINET WITH EXTINGUISHER:

- .1 203 mm wide x 432 mm high x 127 mm deep cabinet
- .2 Semi-recessed steel cabinet with turnback frame for 100 mm wall thickness
- .3 Full length semi-concealed piano hinges for 180 degree swing
- .4 Flush stainless steel door latch with no exposed fasteners
- .5 22 gauge steel tub
- .6 16 gauge steel door and trim with optional 5 mm clear tempered glass (-G-T)
- .7 White baked enamel finish

- .8 2.3 kg ABC dry chemical multipurpose fire extinguisher

2.3 FE-2 SURFACE MOUNTED CABINET WITH EXTINGUISHER:

- .1 216 mm wide x 521 mm high x 152 mm deep cabinet
- .2 Surface mount steel cabinet
- .3 Cylinder lock with key (provide same keying throughout the facility and turn keys over to the Departmental representative at time of demonstration)
- .4 18 gauge steel tub
- .5 Plexus glass panel, break glass hammer and instruction decal
- .6 White baked enamel finish
- .7 2.3 kg ABC dry chemical multipurpose fire extinguisher

2.4 EXTINGUISHER BRACKETS

- .1 Type recommended by extinguisher manufacturer.

2.5 CABINETS

- .1 Type as indicated above, constructed of 1.6 mm thick steel, 180° opening door of 2.5 mm thick steel with latching device.
- .2 Cabinets to maintain fire resistive rating of construction in which they occur.
- .3 Cabinet door: with 5 mm full glass panel.

Part 3 Execution

3.1 INSTALLATION

- .1 Install fire extinguishers in cabinets at locations as indicated on the drawings.
- .2 Coordinate locations of fire extinguisher cabinets with the framing trades in order to facilitate recessed and semi-recessed installations.
- .3 Mount fire extinguishers and cabinets such that the top of the extinguisher is at 1220 mm above the floor.
- .4 Install fire extinguisher cabinet doors, glazing panels and fire extinguishers in the cabinets prior to the project substantial completion review by the Departmental Representative.

3.2 IDENTIFICATION

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

END OF SECTION

Part 1 General

1.1 INTENT

- .1 Provide complete, fully tested and operational wet sprinkler systems to meet the requirements described herein and in complete accord with applicable codes and ordinances. Materials and installation for wet pipe fire protection and sprinkler systems for heated areas.
- .2 Sustainable requirements for construction and verification.

1.2 RELATED SECTIONS

- .1 Section 01 78 30 – Closeout Submittals.
- .2 Section 21 05 01 – Common Work Results

1.3 REFERENCES

- .1 American National Standards Institute/National Fire Prevention Association (ANSI/NFPA) ANSI/NFPA 13, Installation of Sprinkler Systems.
 - .1 ANSI/NFPA 24, Installation of Private Fire Service Mains and Their Appurtenances.
 - .2 ANSI/NFPA 25, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.

1.4 SUBMITTALS

- .1 Provide submittals in accordance with Section 21 05 01 – Common Work Results, and as specified in this section.
 - .1 Manufacturer's Field Reports: manufacturer's field reports specified.

1.5 COORDINATION OF WORK

- .1 Cooperate and coordinate with other trades on the project.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Provide delivery, storage and handling in accordance with Section 21 05 01 – Common Work Results, and as specified in this section.

1.7 WASTE MANAGEMENT AND DISPOSAL

- .1 Refer to the requirements in Section 01 74 19 – Waste Management & Disposal.

1.8 EQUIPMENT PROTECTION & CLEANUP

- .1 Protect equipment and materials in accordance with Section 21 05 01 – Common Work Results, and as specified in this section.

Part 2 Products

2.1 PIPE, FITTINGS AND VALVES

- .1 Pipe
 - .1 Ferrous: to ANSI/NFPA 13.
 - .2 Copper tube: to ANSI/NFPA 13.
- .2 Fittings and joints to ANSI/NFPA 13
 - .1 Ferrous: screwed welded flanged or roll grooved.
 - .2 Copper tube: screwed soldered or brazed.
- .3 Pipe hangers
 - .1 ULC listed for fire protection services.

2.2 SPRINKLER HEADS

- .1 Temperature rating on fusible links shall suit specific hazard area with minimum margin of safety 10°C.
- .2 All sprinkler heads shall be of quick response type, having a response time between 30 to 90 seconds.
- .3 For suspended ceilings, provide semi-recessed pendant type with white powder coated finish and escutcheon.
- .4 For Rooms 709, 724, 808, 809, provide concealed sprinklers with white powder coated cover.
- .5 Provide high temperature sprinkler heads for Room 809.

Part 3 Execution

3.1 INSTALLATION

- .1 Install, inspect and test to acceptance in accordance with ANSI/NFPA 13.
- .2 Protect sprinkler heads against mechanical injury with standard guards when necessary.
- .3 Centre heads in two directions in ceiling tile. Maintain code-required spacing.
- .4 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.
- .5 All sprinkler head locations shall be coordinated with the lighting, audio equipment, and all other obstacles on the ceilings.
- .6 Adjust sprinkler piping up or down if conflicts occur between structure, lighting, electrical, plumbing piping or ductwork.
- .7 Do not install any sprinkler heads until all piping systems have been flushed of all contaminants such as cutting oil.

- .8 All off site prefabrication of sprinkler piping shall be at the contractor's own risk.

3.2 TESTING

- .1 All tests required by this standard for the work shall be performed by this Contractor. When the authority having jurisdiction desires to be present during the conduct of tests, the Contractor shall give the Authority Having Jurisdiction advance notice of the time tests are to be performed.
- .2 All tests to be witnessed by the Departmental Representative or Departmental Representative appointed individual.
- .3 The sprinkler system is subject to final inspection test, and approval by the Departmental Representative or Departmental Representative appointed individual.
- .4 All systems and piping shall be tested hydrostatically at not less than 1380 kPa pressure for two (2) hours, or at 345 kPa in excess of the maximum static pressure when the maximum static pressure is in excess of 1034 kPa.
- .5 The hydrostatic test pressure shall be measured at the low point of the individual system or zone being tested.
- .6 No substance to stop leaks shall be introduced to any sprinkler system.

3.3 FINAL APPROVAL

- .1 Before asking final approval of the wet sprinkler system by the authority having jurisdiction, the installing company shall furnish a written statement to the effect that the work covered by its contract has been completed and tested in accordance with the approved specifications and plans.
- .2 Contractor's Certificate - NFPA Testing Contractor's Certificate is to be completed and forwarded to the authority having jurisdiction and the Departmental Representative as evidence that the necessary tests and materials have been provided. It is stressed that all sections of the certificate are to be completed.

END OF SECTION

Part 1 General

1.1 SCOPE

- .1 Design and installation of an engineered fire detection and inert gas total flooding agent IG-541. Chemical based clean agents are not acceptable. The scope of the clean agent fire extinguishing system is to provide a standalone system for Room 809. Contractor to provide a design build installation for the room which includes all electrical work, testing of HVAC equipment, letters of assurance (Fire Protection and Seismic) to provide a code compliant fully operational system.
- .2 The design of the clean agent fire extinguishing system shall be by a Professional Engineer registered in the Province of British Columbia.
- .3 The Fire Alarm System shall consist of all necessary hardware equipment and software programming to perform the following functions:
 - .1 Fire alarm system detection and notification operations.
 - .2 Control and monitoring of fire suppression systems and other equipment as indicated in the drawings and specifications.
- .4 The fire suppression control panel shall utilize a Vesda Air Sampling system. The new Fire Suppression control panel shall include new dedicated horns and strobes, blue dump station, abort station, monitoring of clean agent pressure switches and control of any HVAC/Damper required to seal the room.

1.2 RELATED REQUIREMENTS

- .1 Section 21 05 01 – Common Work Results
- .2 Section 26 05 00 – Common Work Results – Electrical
- .3 Section 26 05 20 – Wire and box Connectors 0-1000V
- .4 Section 26 27 26 – Wiring Devices
- .5 Section 28 31 00 – Fire Alarm Systems

1.3 REFERENCES

- .1 American National Standards Institute (ANSI)
 - .1 ANSI/ASME B1.20.1-[83(R2001)], Standard for Pipe Threads, General Purpose.
 - .2 ANSI/ASME B16.3-[2006], Malleable Iron Threaded Fittings Classes 150 and 300.
 - .3 ANSI/ASME B16.9-[01], Factory Made Wrought Buttwelding Fittings.
 - .4 ANSI/ASME 2004 Boiler and Pressure Vessel Code - Section IX, Welding and Brazing Qualifications.
- .2 American Society of Mechanical Engineers (ASME)
 - .1 ASME B31.1-[04], Power Piping.

- .3 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A53/A53M-[07], Standard Specification for Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
 - .2 ASTM A106/A106M-[06a], Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
 - .3 ASTM A197/A197M-[00(R2006)], Standard Specification for Cupola Malleable Iron.
 - .4 ASTM A234/A234M-[07], Standard Specification for Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
- .4 National Fire Protection Association (NFPA)
 - .1 NFPA 2001-[2008], Standard on Clean Agent Fire Extinguishing Systems.
 - .2 NFPA 70-[2008], National Electrical Code.
 - .3 NFPA 72 National Fire Alarm Code
 - .4 NFPA 75 Protection of Information Technology Equipment
 - .5 NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems, 2009 Edition
- .5 Underwriters' Laboratories Inc. (UL) - Fire Protection Equipment Directory-2002
 - .1 UL 1058-[2006], Standard for Halogenated Agent Extinguishing System Units.
 - .2 UL 2166-[99], Standard for Halocarbon Clean Agent Extinguishing Systems Units.
 - .3 CAN/ULC-S524-06 Installation of Fire Alarm Systems
 - .4 C22.1-12, Canadian Electrical Code, Part 1 - 2012
 - .5 CAN/ULC-S527-11, Control Units for Fire Alarm Systems

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Shop Drawings, Product Data and Samples.
- .2 Provide product data in accordance with Section 01 33 00 - Shop Drawings, Product Data and Samples.
 - .1 Submit product data for the following:
 - .1 Storage cylinders.
 - .2 Control valves and pilot controls.
 - .3 Control panels.
 - .4 Nozzles.
 - .5 Push button stations.
 - .6 Detectors.
 - .7 Alarm bells or horns.
 - .8 Switches.
 - .9 Annunciators.

- .2 Submit one (1) pdf copy of WHMIS MSDS - Material Safety Data Sheets.
- .3 Provide shop drawings in accordance with Section 01 33 00 - Shop Drawings, Product Data and Samples.
 - .1 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in the Province of British Columbia, Canada.
 - .1 Submit shop drawings indicating:
 - .1 Detailed layout of system.
 - .2 Component descriptions and locations.
 - .3 Control diagrams.
 - .4 Wiring diagrams.
 - .5 Written sequence of operations.
 - .2 Submit electrical schematics and piping diagrams describing complete suppression system.
- .4 Submit test reports for the following:
 - .1 Room integrity test[s].
 - .2 Pressure test.
 - .3 Flow test.
- .5 Provide samples in accordance with Section 01 33 00 - Shop Drawings, Product Data and Samples.
 - .1 Nozzle.
 - .2 Signs and valve tags.
- .6 Quality Control Submittals:
 - .1 Manufacturer's Instructions: manufacturer's installation instructions.
 - .2 Manufacturer's Field Reports: manufacturer's field reports specified.
- .7 Closeout Submittals:
 - .1 Electrical schematic of circuits.
 - .2 Written description of system design.
 - .3 Drawings illustrating control logic and equipment location.
 - .4 One hardcopy and one PDF of the as-built drawings shall be provided indicating the installation details, all routing of the piping, electrical conduit, and accessories shall be noted.
 - .5 Written documentation for:
 - .1 Emergency procedures.
 - .2 Abort functions.
 - .3 System control panel operation.
 - .4 Trouble procedures.
 - .5 Safety requirements.
 - .6 Detectors

- .7 Manual release switches
- .8 Control panel
- .9 Releasing devices
- .10 Alarm devices
- .11 Agent storage containers
- .12 Mounting brackets
- .13 Discharge nozzles
- .14 Abort switches

1.5 WASTE MANAGEMENT

- .1 Refer to the requirements in Section 01 74 19 – Waste Management & Disposal.

1.6 SYSTEM DESCRIPTION

- .1 Clean Agent Fire Extinguisher System Design Requirements:
 - .1 Design system in accordance with NFPA 2001 using following parameters:
 - .1 Hazard: to suit light hazard occupancy.
 - .2 Submit design calculations for following:
 - .1 System terminal pressures.
 - .2 Nozzle flow rates.
 - .3 Orifice code number.
 - .4 Piping pressure losses.
 - .5 Component flow data.
 - .6 Pipe sizes.
 - .7 Minimum design concentration.
 - .8 Minimum design agent quantity.
 - .9 Actual agent quantity.
 - .10 Highest expected actual concentration.
 - .11 Discharge time.
 - .12 Concentration hold time.
 - .13 Enclosure pressure venting requirements.
 - .3 Submit schematics and diagrams describing suppression system and interface with building system.
- .2 Vesda Air Sampling System Design Requirements:
 - .1 General: Provide a complete, non-coded addressable microprocessor-based fire alarm system with initiating devices, notification appliances, and monitoring and control devices.

- .2 Power Requirements
 - .1 The system shall be provided with sufficient battery capacity to operate the entire system upon loss of normal AC power in a normal supervisory mode for a period of 24 hours with 30 minutes of alarm operation at the end of this period. The system shall automatically transfer to battery standby upon power failure. All battery charging and recharging operations shall be automatic.
 - .2 All circuits requiring system-operating power shall be 24 VDC nominal voltage and shall be individually fused at the control unit.
 - .3 The incoming power to the system shall be supervised so that any power failure will be indicated at the control unit. A green "power on" LED shall be displayed continuously at the user interface while incoming power is present.
 - .4 The system batteries shall be supervised so that a low battery or a depleted battery condition, or disconnection of the battery shall be indicated at the control unit and displayed for the specific fault type.
 - .5 The system shall support shutdown operation as defined by CAN/ULC-S527 standard after a Depleted Battery condition occurs.
 - .6 The system shall support 100% of addressable devices in alarm or operated at the same time, under both primary (AC) and secondary (battery) power conditions.
 - .7 Loss of primary power shall sound a trouble signal at the FACP. FACP shall indicate when the system is operating on an alternate power supply.
- .3 Software: The fire alarm system shall allow for loading and editing instructions and operating sequences as necessary.
 - .1 The system shall be capable of on-site programming to accommodate system expansion and facilitate changes in operation.
 - .2 All software operations shall be stored in a non-volatile programmable memory within the fire alarm control unit. Loss of primary and secondary power shall not erase the instructions stored in memory.
 - .3 Panels shall be capable of full system operation during new site specific configuration download, master exec downloads, and slave exec downloads.
 - .4 Panels shall automatically store all program changes to the panel's non-volatile memory each time a new program is downloaded. Panels shall be capable of storing the active site-specific configuration program and no less than 9 previous revisions in reserve. A compare utility program shall also be available to authorized users to compare any two of the saved programs. The compare utility shall provide a deviation report highlighting the changes between the two compared programs.
 - .5 Panels shall provide electronic file storage with a means to retrieve a record copy of the site-specific software and up to 9 previous revisions. Sufficient file storage shall be provided for other related system documentation such as record drawings, record of completion, manuals, testing and maintenance records, etc.

- .6 The media used to store the record copy of site-specific software and other related system documentation shall be electrically supervised. If the media is removed a trouble shall be reported on the fire alarm control panel.
- .4 History Logs: The system shall provide a means to recall alarms and trouble conditions in chronological order for the purpose of recreating an event history. A separate alarm and trouble log shall be provided.
- .5 Wiring/Signal Transmission:
 - .1 Transmission shall be hard-wired using separate individual circuits for each zone of alarm operation, as required or addressable signal transmission, dedicated to fire alarm service only.
 - .2 System connections for in/out circuits shall be Class B, data communication links shall be Class B, Style 4 and signaling circuits shall be Class B, Style Y.
 - .3 Circuit Supervision: Circuit faults shall be indicated by a trouble signal at the FACP. Provide a distinctive indicating audible tone and alphanumeric annunciation.
- .6 Required Functions: The following are required system functions and operating features:
 - .1 System to be monitored by site wide fire alarm system utilizing addressable inputs. Each of the following conditions shall be individually monitored: Fault, Clean Agent Low pressure, Fire, Discharge.
 - .2 System Reset
 - .1 The "System Reset" button shall be used to return the system to its normal state. Display messages shall provide operator assurance of the sequential steps ("IN PROGRESS", "RESET COMPLETED") as they occur. The system shall verify all circuits or devices are restored prior to resetting the system to avoid the potential for re-alarming the system. The display message shall indicate "ALARM PRESENT, SYSTEM RESET ABORTED."
 - .2 Should an alarm condition continue, the system will remain in an alarmed state.
- .7 Audible Alarm Notification: By horns in areas as indicated on drawings and as specified herein.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle materials in accordance with Section 01 61 10 - Product Requirements.
 - .2 Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

- .3 Store materials protected from weather conditions and at temperature conditions recommended by manufacturer.
- .2 Waste Management and Disposal:
 - .1 Separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

1.8 WARRANTY

- .1 Warranty system for parts and labour for not less than a period of 12 months from date of substantial completion.
- .2 False Discharge Warranty: Warranty replacement and associated costs of clean agent in event of false discharge attributable to defects in installation or parts for period of 12 months from date of substantial completion.
- .3 Warranty capability to recondition complete system within 24 hours in event of system activation.
- .4 Environmental: The manufacturer shall offer a 20 year warranty covering regulations banning or restricting use of the Clean Agent due to environmental issues.
- .5 Evergreen Discharge: Replacement cost for the Clean Agent agent shall be covered in a 20 year discharge warranty, except for the system commissioning discharge test, regardless of the cause of the fire suppression system discharge.

1.9 COMMISSIONING

- .1 Upon acceptance, system shall be conditions and placed in operation.

1.10 MAINTENANCE

- .1 Extra Materials:
 - .1 Provide maintenance data for system and components for incorporation into manual specified in Section 01 78 30 - Closeout Submittals.
- .2 Maintenance Service:
 - .1 Provide regular maintenance service to system in accordance with clean agent manufacturer's written recommendations and maintenance manual for period of 12 months.
 - .2 Inspection personnel: authorized by clean agent manufacturer.
 - .3 Inspect system 6 months and 12 months after installation.
 - .4 Conduct inspections in accordance with manufacturer's guidelines and recommendations of NFPA 2001.
 - .5 Inspections include but are not necessarily limited to:
 - .1 Determination of clean agent contents and pressure.
 - .2 Proper working order of control, detection and alarm systems.
 - .3 Modifications have not been made to the server room (room 809) that could prevent system function ie baffles, changes to room integrity.

- .4 Clearance is maintained around tank(s) for inspections.
- .6 Submit documents certifying satisfactory system conditions after inspections.

Part 2 Products

2.1 SUPPRESSION AGENT

- .1 Suppression Agent: The agent shall be inert in nature and not chemical based.
 - .1 NFPA-541: Inergen (52% Nitrogen, 40% Argon, 8% Carbon dioxide)
 - .2 NFPA-HFC-227ea: Fm200 Hepta + Mono Propane.
 - .3 NFPA-HFC-23: FE-13, Trifluoromethane.

2.2 AGENT STORAGE

- .1 Capacity: 300 bar high pressure seamless steel alloy cylinders to suit room volume.
- .2 Cylinder charging pressure: As required at 21.1 degrees C.
- .3 Quantity: Provide cylinders as required.
- .4 Standard:
 - .1 In accordance with Listed suppression agent manufacturer.
- .5 Cylinder assemblies shall be of steel construction certified to UN ISO standards and acceptable to the Department of Transportation (DOT) with a standard RED enamel paint finish. Each cylinder shall be equipped with a nominal 60 bar pressure regulating valve and a gauge. The system shall be utilize listed valve assemblies for this purpose. Each valve shall be constructed of forge brass and shall attach to the container providing a leak-tight seal. The valve design must fail safe (closed) to prevent pressure from exceeding a nominal 60 bar in the event of a blocked pipe.
- .6 Cylinder Assembly:
 - .1 Pressure seat type valve equipped with gauge.
 - .2 Cylinder pressure supervisor switch to provide a signal at the control panel if the pressure in the cylinder drops to 2206 kPa.
 - .3 Protective cap: threaded steel anti-recoil.
 - .4 Installation: free standing steel racks or on solid walls.
 - .5 Lifting lugs: cylinders larger than 97 kg with lifting lugs.
 - .6 Brackets: integral brackets to be provided for secure mounting.
 - .7 First filling of the container assembly shall be by a listed clean agent manufacturer.
 - .8 Cylinder brackets shall be ULC Listed for use with clean agent fire suppression system.
 - .9 Discharge Valve:
 - .1 Material: machined brass forging.

- .2 Design: pressure seated, high flow rate design incorporating brass piston with seal, pressure releasing for valve operation, safety disc assembly, pressure actuation outlet port and pressure gauge.
- .3 Each valve shall include a safety pressure relief device, which provides relief at 400 to 430 bar per CGA test methods.

2.3 RELEASING DEVICE

- .1 Detection: to signal automatic release and alarm type smoke detectors and/or heat (rate compensated) detectors signalling control panel.
- .2 No electro-explosive devices may be used to actuate the valve assembly.
- .3 Electric actuators shall be a continuous duty type for 24 VDC operations.
- .4 Actuation devices shall be ULC Listed for use with the clean agent fire suppression system.
- .5 Alarms:
 - .1 Quantity: 1.
 - .2 Type: horn/strobe.
 - .3 Locations:
 - .1 To alert personnel located in protected areas.
 - .2 At entrance(s) and exit(s) of the protected area.
- .6 Operation:
 - .1 Automatic release solenoid-operated valve on cylinder valve that causes discharge of agent storage containers in system.
 - .2 Manual release
 - .3 Program control panel to provide adequate pre-discharge alarm period at time of system test to ensure personnel safety.
- .7 Supervision: each releasing device separately series supervised and activated by output directly from control panel.
- .8 Features:
 - .1 Releasing device: removable from container valve without emptying container.
 - .2 While removed from container valve, releasing device capable of being operated, with no replacement of parts required after this operation.

2.4 MANUAL OVERRIDE

- .1 Manual lever actuator for override applications.

2.5 DISCHARGE HOSE / CHECK VALVE

- .1 Quantity: 1, for each cylinder connected to common manifold.
- .2 When manifolding, all cylinder assemblies shall include the matrix bracketing system, flexible discharge hose, and horizontal check valve for connection to the manifold inlet.

- .3 All hose / check valves shall be ULC Listed for use with the clean agent valve as manufactured by Manufacturer.

2.6 PRESSURE REDUCER

- .1 Provide pressure reducer as required by the successful clean agent supplier.
- .2 Orifice plate:
 - .1 Stainless steel.
 - .2 Orifice size shall be determined by a ULC Listed flow calculation program.

2.7 AUXILIARY SWITCHES

- .1 General: to ANSI/NFPA 13 and ULC listed for fire service.
- .2 Quantity:
 - .1 Type:
 - .1 Normally open and normally closed contacts with supervisory capability, pressure operated upon release of clean agent into discharge piping.
 - .2 Heavy duty, double pole, single throw, two to unit.
 - .3 Complete with manual operator for test and reset.
 - .2 Signal:
 - .1 Shut down of electric power to ventilation system.
 - .2 Shut down of electric powered equipment within hazard.
 - .3 Alarm.

2.8 PRESSURE OPERATED RELEASES

- .1 Co-ordinate with the overall fire alarm system the supply and installation of pressure operated switches, operating upon release of the clean agent into the discharge piping.
- .2 To insure the integrity of containment of the clean agent to the hazard area, opening to, from and perhaps in the area must be closed. Devices used must be self-closing and capable of being held open by a cable or chain hooked to the release.
- .3 Function: to release self-closing devices operating doors.

2.9 DISCHARGE NOZZLES

- .1 Coverage: in accordance with NFPA 2001.
- .2 Size: as per supplier design standards.
- .3 Dispersion pattern: 360 degrees.
- .4 Material: brass construction and specifically designed for specified clean agent application.
- .5 Markings: permanently marked as to part number and orifice size.
- .6 Pipe thread: standard thread corresponding to nozzle size for attachment to discharge piping.

- .7 A nozzle inlet orifice plate shall be included. The orifice size shall be determined by a ULC Listed flow calculation program.
- .8 Standards: UL listed.

2.10 DISTRIBUTION PIPE AND FITTINGS

- .1 System piping shall be of non-combustible material having physical and chemical characteristics such that its integrity under stress can be predicted with reliability.
- .2 Pipe wall thickness: to ASME B31.1.
- .3 As a minimum, piping materials shall be black pie conforming to ASTM A-53A ERW or ASTM A-106A seamless.
- .4 DO NOT USE ordinary cast iron pipe, steel pipe conforming to ASTM A-120 or ASTM A-53/A-120.
- .5 All piping and fittings shall comply with NFPA 2001.
- .6 Pipe junctions:
 - .1 50 mm and smaller: threaded.
 - .2 Greater than 50 mm: welded.
 - .3 Piping joints shall be suitable for the design conditions, and shall be selected with consideration of joint tightness and mechanical strength.
 - .4 As a minimum, fittings beyond the pressure reducing valve shall be class 300 M.I. fittings conforming to ANSI B-16.3. Distribution piping downstream of pressure regulating container valve shall be a minimum of schedule 40.
- .7 Piping design:
 - .1 To NFPA 2001.
 - .2 Routing: layout piping to give maximum flow and to avoid possible mechanical, chemical or other damage.
- .8 Pipe threads: to ANSI B1.20.1.
- .9 Pipe reductions: butt weld concentric reducers.
- .10 Screwed pipe reductions: screwed concentric reducing fittings.
- .11 Non-corrosive pipe: hot-dipped galvanized inside and out.
- .12 Multi-outlet fittings, other than tees, shall not be permitted.
- .13 Assembly all joints shall conform to the appropriate standards.
- .14 Threaded pipe joints shall utilize Teflon tape or pipe sealant applied to the male thread only.

2.11 PIPE SLEEVES

- .1 Sleeve piping through building walls, partitions, floor slabs, roof slabs.
- .2 Material: schedule 40 steel pipe at 50 mm (minimum) greater than pipe being sleeved.

- .3 Extend sleeves through floor slabs minimum 50 mm above floor.
- .4 Extend sleeves through roof slabs to permit clearance for roofing and flashing material.

2.12 PIPE HANGERS AND SUPPORTS

- .1 To ASME B31.1.
- .2 Hanger material: steel.

2.13 ACCESSORIES

- .1 Cylinder weighing:
 - .1 Provide rack uprights with weigh bar spanning rack for support of portable weighing device.
 - .2 Provide portable direct reading beam scale for weighing cylinders in place by loosening cylinder clamps and disconnecting discharge heads without disconnecting control components.
- .2 Cylinders: fit cylinders with capacity of 97 kg or more with liquid level indicating device.
 - .1 Provide graph to translate device reading to pounds of clean agent at cylinder temperature.

2.14 VESDA AIR SAMPLING PROUDCT

- .1 Local Fire Alarm Control Panel
 - .1 General: Comply with CAN/ULC-S527-11, "Control Units for Fire Alarm Systems".
 - .2 The following FACP hardware shall be provided:
 - .1 Base panel with red cabinet and door, 120 VAC input power.
 - .2 8 Amp Power Supply with 3.3 Amp, temperature compensated, dual-rate battery charger. Battery charger voltage and amperage values shall be accessible on the FACP LCD display.
 - .3 2 Amp Auxiliary Power output with electronic overload protection, automatic restoral, and programmable operation for four-wire detector reset operation.
 - .4 Panel shall be capable of adding 8 conventional zone circuits to connect to existing system devices for ease in retrofit applications.
 - .5 One Auxiliary Relay with Form C contact rated for 2A @32VDC, programmable as a trouble relay, either as normally energized or de-energized, or as an auxiliary control.
 - .6 Four (4) Class B or A Notification Appliance Circuits (NAC; rated 3A@24VDC, resistive). As an option, each NAC shall be configurable for use as auxiliary power taps to control non-reverse polarity devices. Maximum current rating is 2 Amps when used to control auxiliary devices powered from the 24 VDC auxiliary power output.

- .7 Four (4) form "C" Auxiliary Relay Circuits (Form C contacts rated 2A @ 24VDC, resistive), operation is programmable for trouble, alarm, supervisory of other fire response functions. Relays shall be capable of switching up to ½ A @ 120VAC, inductive.
- .3 Cabinet: Lockable steel enclosure. Arrange unit so all operations required for testing or for normal care and maintenance of the system are performed from the front of the enclosure. If more than a single unit is required to form a complete control unit, provide exactly matching modular unit enclosures.
- .4 Alphanumeric Display and System Controls: Panel shall include an 40 character LCD display to indicate alarm, supervisory, and component status messages and shall include a keypad for use in entering and executing control commands.
- .2 Emergency Power Supply
 - .1 General: Components include battery, charger, and an automatic transfer switch.
 - .2 Battery: Sealed lead-acid or nickel cadmium type. Provide sufficient capacity to operate the complete alarm system in normal or supervisory (non-alarm) mode for a period of 24 hours. Following this period of operation on battery power, the battery shall have sufficient capacity to operate all components of the system, including all alarm notification devices in alarm mode for a period of 30 minutes.
- .3 Addressable Initiating
 - .1 Addressable Manual Pull Stations
 - .1 Description: Addressable BLUE double-action type, blue LEXAN, with molded, raised-letter operating instructions of contrasting color. Station will mechanically latch upon operation and remain so until manually reset by opening with a key common with the control units. All Manual Stations will be listed to CAN/ULC-S528, Manual Stations for Fire Alarm Systems. Station must clearly indicate "Agent Release".
 - .2 Description: Provide conventional Abort Stations c/w individual addressable input modules to prevent unwanted release of agent.
 - .2 Addressable Circuit Interface Modules
 - .1 Addressable Circuit Interface Modules: Arrange to monitor or control one or more system components that are not otherwise equipped for addressable communication. Modules shall be used for monitoring of clean agent low pressure or clean agent discharge.
 - .2 Addressable Circuit Interface Modules will be capable of mounting in a standard electric outlet box. Modules will include cover plates to allow surface or flush mounting. Modules will receive their operating power from the signaling line circuit or a separate two wire pair running from an appropriate power supply, as required.
 - .3 Provide ULC listed air sampling smoke detection system that communicates directly to the fire alarm control panel over addressable communication. Air sampling system shall be able to provide a minimum of three obscuration levels of alarm.
 - .4 There shall be the following types of modules:

- .4 Conventional Notification
 - .1 Standard Alarm Notification Appliances
 - .1 Audible/Visible: Combination Audible/Visible (A/V) Notification Appliances shall be listed to ULC. The blue strobe light shall consist of a led or xenon flash tube and associated lens/reflector system. Provide a label inside the strobe lens to indicate the listed candela rating of the specific strobe. The horn shall have a minimum sound pressure level of 85 dBA @ 24VDC. The audible/visible enclosure shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings. The horn shall have two modes of operation, intermittent horn for agent pre-discharge indication and steady horn for agent discharged status. The strobe shall flash continuously from the first detection of alarm.

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 INSTALLERS

- .1 System components and accessories installed by personnel trained and certified by clean agent specified manufacturer.
- .2 Install, inspect and test to acceptance in accordance with NFPA Standard 2001 and NFPA 70.

3.3 INSTALLATION

- .1 General: to NFPA Standard 2001.
- .2 In accordance with clean agent manufacturer's written instructions.
- .3 Install cylinders with service aisle for cylinder removal and cylinder weighing.
- .4 Furnish and install a complete Fire Alarm System as described herein and as shown on the plans. Include sufficient control unit(s), annunciator(s), manual stations, automatic fire detectors, smoke detectors, audible and visible notification appliances, wiring, terminations, electrical boxes, ethernet drops, and all other necessary material for a complete operating system.
- .5 Install manual station with operating handle 1100 mm above floor. Install wall mounted audible and visual notification appliances not less than 2300 mm above floor to top of device and not less than 150 mm from ceiling to top of device.
- .6 Mount outlet box for electric door holder to withstand 80 pounds pulling force.
- .7 Make conduit and wiring connections to field devices.

- .8 Automatic Detector Installation: Conform to CAN/ULC-S524

3.4 PIPING

- .1 All piping shall be reamed, blown clear, and swabbed with appropriate solvent to remove mill varnish, debris, oils, and any other contaminants before assembly.
- .2 Clean pipe before installation to remove foreign matter and oil from pipe.
 - .1 Pull wire brush through pipe lengths several times.
 - .2 Follow with clean cloth rags treated with a non-combustible metal cleaner designed for purpose.
- .3 Install piping in accordance with layout design to provide maximum flow and to avoid possible mechanical, chemical or other damage.
- .4 Piping shall be installed in accordance with good commercial practice to the appropriate codes, securely supported with ULC Listed hangers.
- .5 Piping shall be bracketed within 305 mm of all discharge nozzles.
- .6 Report deviations from pipe routing design to Departmental Representative.
- .7 Pipe reductions: install reductions to permit full flow. Entrance holes from main pipe run to fitting to be of proper size and free of sharp edges, ridges or burrs.
- .8 Valve and Equipment Connections:
 - .1 Connect check valves with union immediately downstream.
 - .2 Connect equipment such as discharge delay devices with union adjacent to equipment.
- .9 Pressure release piping and fittings: locate take-offs for pressure release piping from top of discharge piping.

3.5 PIPE HANGERS AND SUPPORTS

- .1 Fasten piping within 300 mm of the nozzles to prevent pipe movement due to reaction force during discharge.
- .2 Install piping supports to prevent disengagement of supports by movement of supported pipe.
- .3 Solidly anchor pipe to structural members where longitudinal or lateral movements is possible.
- .4 Install rigid hangers wherever change in direction or change in elevation in piping system occurs.
- .5 Every other hanger: rigid on long straight runs.
- .6 Attach piping to rigid hangers by means of U-bolts locked with double nuts, one on each side of hanger.
- .7 Allow for longitudinal movement of pipe within U-bolt except where piping design requires pipe to be anchored.

- .8 Do not support pipe using other pipeline.
- .9 Arrange piping supports to prevent bending stresses from concentrated loads between supports.
- .10 The pipe hangers and pipe support system must consider the stresses induced due to the temperature change caused by the discharge of the clean agent.

3.6 WIRING INSTALLATION

- .1 System Wiring: Wire and cable shall be a type listed for its intended use by an approval agency acceptable to the Authority Having Jurisdiction and shall be installed in accordance with the appropriate articles from the current approved edition of the Canadian Electrical Code and BC Building Code 2012 of Canada and VBBL 2014.
- .2 Contractor shall obtain from the Fire Alarm System Manufacturer written instruction regarding the appropriate wire/cable to be used for this installation. No deviation from the written instruction shall be made by the Contractor without the prior written approval of the Fire Alarm System Manufacturer.
- .3 Color Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color code for alarm initiating device circuits wiring and a different color code for supervisory circuits. Color-code signal circuits differently from alarm-initiating circuits. Paint fire alarm system junction boxes and covers red.
- .4 Mount end-of-line device in box with last device or separate box adjacent to last device for Class "B" supervision.

3.7 FIELD QUALITY CONTROL

- .1 Site Tests:
 - .1 Test installation for correct operation and function.
 - .2 The completed installation shall be inspected by factory authorized and trained personnel. The inspection shall include a full operation test of all components per the manufacturer's recommendations.
 - .3 Inspection shall be performed in the presence of the Departmental Representative and /or Authority Having Jurisdiction.
 - .4 All mechanical and electrical components shall be tested according to the manufacturer's recommended procedure to verify system integrity.
 - .5 Inspection shall include a complete checkout of the detection / control system and certification of cylinder pressure. Provide written reports of results.
 - .6 Testing of the system includes verification of the room integrity to ensure that all required dampers, door bottom seals, weather stripping, sealants have been installed correctly.
 - .7 Perform operational system tests of the Vesda Air Sampling System to verify conformance with specifications:
 - .1 Each alarm initiating device installed shall be operationally tested as described in CAN/ULC-S537 Verification of Fire Alarm Systems. Each device shall be tested for alarm and trouble conditions. Contractor shall

- submit a written certification that the Fire Alarm System installation is complete including all punch-list items. Test battery operated emergency power supply. Test emergency power supply to minimum durations specified. Test connection to base building fire alarm system.
- .2 Test each Signal device installed for proper operation. Submit written report indicating sound pressure levels at specified distances following device listing form as shown in the Appendix of CAN/ULC-S537.
 - .3 Test Fire Alarm Control Panel and Remote Annunciator.
 - .8 Retesting: Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify by the system test that the total system meets the Specifications and complies with applicable standards.
 - .9 Report of Tests and Inspections: Provide a written record of inspections, tests, and detailed test results in the form of a test log. Use CAN/ULC-S537 Forms for documentation.
 - .10 Final Test, Record of Completion, and Certificate of Occupancy:
 - .1 Test the system as required by the Authority Having Jurisdiction in order to obtain a certificate of occupancy. Provide completed CAN/ULC-S537 Report to Departmental Representative and Authority Having Jurisdiction.
 - .11 Room Integrity:
 - .1 Standard: to NFPA 2001.
 - .2 Test room integrity in accordance with clean agent's testing requirement using door fan method of room pressurization to determine leakage.
 - .3 Provide written test report to Departmental Representative of results.
 - .4 Correct deficiencies and retest.
 - .12 Pressure Test:
 - .1 Pneumatically test system discharge piping in closed circuit for period of ten minutes at 276 kPa.
 - .2 Pressure drop not exceed 20% of test pressure.
 - .2 Manufacturer's Field Services:
 - .1 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.8 CLEANING

- .1 Proceed in accordance with Section 01 74 19 - Waste Management and Disposal.

3.9 DEMONSTRATION

- .1 Upon completion of installation provide 'hand-on' site review of system components and operation.

- .2 Functionally test system to demonstrate system components, system functions and recommended procedures for the Departmental Representatives. The contractor shall provide operational training in all aspects of the system which shall consist of:
 - .1 Control system operations
 - .2 Trouble procedures
 - .3 Abort switches procedures
 - .4 Emergency procedures
 - .5 Safety requirements
 - .6 Demonstration of the system
- .3 Training to include but not necessarily limited to training for emergency procedures, abort functions, system control panel operation, trouble procedures and safety requirements.
- .4 Duration of training to the Departmental representative and their maintenance staff: 2 shifts of 2 hours.

END OF SECTION

Part 1 General

1.1 INTENT

- .1 Provide complete, fully tested and operational mechanical and plumbing systems to meet the requirements described herein and in complete accord with applicable codes and ordinances.
- .2 Contract documents and drawings of this Division are diagrammatic and approximately to scale unless detailed otherwise. They establish scope, material and installation quality and are not detailed installation instructions.
- .3 Follow manufacturers' recommended installation details and procedures for equipment, supplemented by requirements of Contract Documents.
- .4 Install equipment generally in locations and routes shown. Run piping and ductwork 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 satisfaction of the Departmental Representative at no extra cost.
- .5 Install equipment to provide access and ease of maintenance.
- .6 Connect to equipment specified in other Sections. Uncrate equipment, move in place and install complete; start up and test.
- .7 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.
- .8 If the equipment is used during construction, the guarantee or guarantee period shall not be shortened or altered.
- .9 'Provide' shall mean; supply and install'.

1.2 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 Any areas indicated as space for future materials or equipment shall be left clear.

1.3 PERMITS

- .1 All work shall comply with national, municipal, bylaws and authorities having jurisdiction.
- .2 Obtain all permits and pay all fees applicable to the work.
- .3 Contractor shall arrange for inspections of the work by the authorities having jurisdiction and shall provide certificates indicating Final Approval.
- .4 Contractor shall provide schedule B1/B2 letters of assurance for seismic engineering and for fire protection/sprinkler system engineer.

1.4 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Shop Drawings, Product Data and Samples.
- .2 Shop drawings to show:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances.
- .3 Shop drawings and product data accompanied by:
 - .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 Manufacturer to certify current model production.
 - .3 Certification of compliance to applicable codes.
- .4 Mechanical Contractor's Association of Canada "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.
- .5 Closeout Submittals:
 - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 30 - Closeout Submittals.
 - .2 Operation and maintenance manual approved by, and final copies deposited with, the Departmental Representative before final inspection.
 - .3 Operation data to include:
 - .1 Operation instruction for systems and component.
 - .2 Description of actions to be taken in event of equipment failure.
 - .3 Valves schedule and flow diagram.
 - .4 Colour coding chart.
 - .4 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.
 - .5 Performance data to include:
 - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.

- .2 Equipment performance verification test results.
- .3 Special performance data as specified.
- .6 Approvals:
 - .1 Submit one (1) hard copy and one (1) PDF of draft Operation and Maintenance Manual to the Departmental Representative for approval. Submission of individual data will not be accepted unless directed by the Departmental Representative.
 - .2 Make changes as required and re-submit as directed by the Departmental Representative.
- .7 Additional data:
 - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .8 As-built drawings:
 - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
 - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (date).
 - .3 Submit to the Departmental Representative for approval and make corrections as directed.
 - .4 Provide one (1) full scale hard copy of as-built drawings in a USB flash memory to the Departmental Representative.
 - .5 Refer to Section 01 78 30.
- .9 Submit copies of as-built drawings for inclusion in final TAB report.

1.5 HEALTH AND SAFETY

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

1.6 DELIVERY, STORAGE, AND HANDLING

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

1.7 EXISTING PIPING TO BE REMOVED

- .1 Reference Standards
 - .1 Unless otherwise specified, carry out demolition work in accordance with CSA S350-M1980, Code of Practice for Safety in Demolition of Structures.
- .2 Existing Conditions

- .1 Visit and examine the site and note all characteristics and irregularities affecting the work of this Section.
- .3 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 Departmental Representative 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
- .4 Salvageable Materials
 - .1 Except as otherwise stated, salvageable materials from area of demolition shall become the property of the Contractor. All material shall be removed off from this site and disposed of as required by any applicable disposal regulations.
- .5 All existing plumbing piping systems that become abandoned as a result of the work or depicted on the drawings for abandonment shall be removed, and/ or disposed of in the following situations:
 - .1 Where specifically noted on the drawings for removal.
 - .2 Where plumbing piping systems are exposed.
 - .3 Where ceilings are opened-up for any reason that would permit such removal to be implemented. In such a case only those portions of the plumbing system that can be removed without taking down more ceiling shall be removed.

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 QUALITY OF WORK

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

1.10 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	65	2-1/2	375	15
6	1/4	75	3	450	18
10	3/8	100	4	500	20
15	1/2	125	5	600	24
20	3/4	150	6	750	30
25	1	200	8		
30	1-1/4	250	10		
40	1-1/2	300	12		
50	2				

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

1.11 ALTERNATE MATERIALS AND EQUIPMENT

- .1 Approved equivalents and/or alternatives to specified products shall be equal to the specified product in every respect, operate as intended, meet the space, capacity, and noise requirements outlined.
- .2 The Contractor shall be fully responsible for any additional work or materials required by the trades or other Contractors to accommodate use of other than specified materials or equipment. Extras will not be approved to cover such work.

1.12 DRAWINGS AND SPECIFICATIONS

- .1 Drawings and specifications are complementary each to the other, and what is called for by one shall be binding as if called for by both.
- .2 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.

1.13 SALVAGE

- .1 Remove from site all equipment, ducting or piping which is no longer required because of work under this Contract.
- .2 Refer to the requirements in Section 01 74 19 – Waste Management & Disposal.

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 Prior to drilling for expansion bolts, hanger rods, brackets, and support, obtain GPR scan of proposed location to ensure drilled anchor will avoid any existing post-tensioning cable or reinforcing steel. Advise the Departmental Representative of any conflicts.
- .3 Do not cut or burn existing structural members.
- .4 Patch building where damaged from equipment installation, improperly located holes etc. Use matching materials as specified in the respective section.

1.15 CONNECTIONS TO EXISTING SERVICES

- .1 Refer to Appendix B for requirements with regards to access, and any interruptions and shutdowns of existing building services.

1.16 ACCESS DOORS

- .1 Provide access doors for maintenance or adjustment purposes for all mechanical system components including:
 - .1 Valves;
 - .2 Cleanouts and traps;
 - .3 Controls, coils and terminal units;
 - .4 Filters
 - .5 Strainers
- .2 Mark removable ceiling tiles used for access with colour coded dots.
- .3 Provide ULC-listed fire rated access doors installed in rated wall and ceilings.
- .4 Refer to Section 23 05 00 for additional requirements.

1.17 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.

1.18 PIPE SLEEVES

- .1 Pipe sleeves shall be provided for piping passing through walls and floors. Minimum schedule 40 steel pipes. Sleeves shall extend 25 mm on either side of the wall.
- .2 Pipe sleeves are not required where pipes pass through cored concrete walls or floors.

1.19 ESCUTCHEON AND PLATES

- .1 Provide escutcheon and plates on piping and ductwork passing through finished walls, floors and ceilings.
- .2 Escutcheons shall be split type, stainless or chrome plated steel.

1.20 SUBSTANTIAL PERFORMANCE

- .1 Refer to requirements with Section 01 33 00.

1.21 ACCEPTABLE MANUFACTURERS

- .1 Refer to requirements within Section 01 33 00

Part 2 Products

2.1 OPERATING AND MAINTENANCE MANUALS

- .1 Secure and assemble all necessary literature describing the operation and maintenance of all equipment provided. Complete and transmit documentation for review to the Departmental Representative two (2) months prior to final inspection.
- .2 Provide one (1) 216 mm x 280 mm capacity, expanding spine catalogue binder, bound with heavy fabric, hot stamped lettering front and spine. Provide one (1) PDF copy as well.
- .3 Index binder according to the following system:
 - .1 Tab-1.0 Mechanical Systems:
 - .1 Title page with clear plastic protection cover.
 - .2 Tab-1.1 List of Mechanical Drawings:
 - .3 Tab-1.2 System Descriptions:
 - .1 Provide complete description of the operating sequence for all systems. Include detailed system description, with individual components described, explanation of how components interface with others and to the complete system, location of thermostats, controllers or operating variances, and controller operating setpoints.
 - .4 Tab-1.3 Operating Division:
 - .1 Provide complete and detailed operation of major components and systems. Provide information on location of components, how to energize switches and controls, how components interface with other components, operation of controls including operational sequence, operational changes for summer of winter operation, how to accomplish the changeover, complete trouble shooting sequence, emergency operating sequences in event of major component failure, and safeguards to indicate if equipment goes off-line.
 - .5 Tab-1.4 Maintenance and Lubrication Division:

- .1 Provide general maintenance and lubrication schedule for major components to include daily, weekly, monthly, semi-annual and yearly checks and tasks. Explain how to execute maintenance tasks required for typical equipment such as bearings, drives, motors, and filters. Compile this information for equipment and separate from shop drawings.
- .6 Tab-1.5 List of Equipment Suppliers and Contractors:
 - .1 Provide list of equipment suppliers and contractors, including address and telephone number. Outline procedures for purchasing parts and equipment.
- .7 Tab-Certification (2.0, 2.1, ...):
 - .1 Include copy of test data on degreasing and flushing of heating system, analysis of system water taken at time system was put into operation, hydrostatic or air tests performed on piping systems, equipment alignment certificates, copy of balancing data for air and water systems, copy of valve tag identification and pipe colour code, inspection approval certificates for plumbing system, heating and ventilation systems and operational tests on oil-fired equipment.
- .8 Tab-Shop Drawings and Maintenance Bulletins (3.0, 3.1, ...):
 - .1 Provide materials received in compliance with clause "Shop Drawings".
- .4 The divider tabs shall be laminated mylar plastic and coloured according to Section. The colouring is as follows: Mechanical Systems - 1.0 - 1.5 Orange; Certification - 2.0 - 2.4 Green; Shop Drawings & Maintenance - 3.0 - 3.17 Yellow. Plastic tabs with typewritten card insertions will not be accepted.

Part 3 Execution

3.1 RECORD DRAWINGS:

- .1 Refer to Section 01 78 30 – Closeout Submittals.

3.2 CLEANING

- .1 Clean interior and exterior of all systems including strainers.

3.3 PROTECTION

- .1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

3.4 EXISTING SERVICES

- .1 Disconnect and cap all mechanical services in accordance with requirements of local 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 all building services during demolition/removal of existing.

- .3 Maintain all trap seals and ensure no sewer gas enters the building during renovations or demolition work. Maintain all existing sewer piping in a wet condition daily.

3.5 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 possible. Co-ordinate this activity with the Departmental Representative.
- .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 Departmental Representative.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Section, apply to work specified in this section.
- .2 Division 21 – Fire Suppression
- .3 Division 22 – Plumbing
- .4 Division 23 – Heating, Ventilation & Air Conditioning

1.2 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Shop Drawings, Product Data and Samples.
- .2 Shop drawings to show:
 - .1 Material Specification including CSA or ULC reference numbers.
 - .2 Installation details for various types of piping materials.
 - .3 Operating and maintenance requirements.
- .3 Shop drawings and product data accompanied by:
 - .1 Manufacturer to certify current model production.
 - .2 Certification of compliance to applicable codes.
- .4 Material Safety Data Sheets (MSDS)
 - .1 Submit Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Shop Drawings, Product Data and Samples 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.
- .5 Closeout Submittals:
 - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 30 - Closeout Submittals.
 - .2 Performance data to include:
 - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.

1.3 REFERENCES

- .1 Test Requirements: 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 and publishes the results in their "FIRE RESISTANCE RATINGS DIRECTORY" that is updated annually.
- .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
- .5 Inspection Requirements: ASTM E 2174 – 01, "Standard Practice for On-site Inspection of Installed Fire Stops.
- .6 CAN/ULC-S102-M, Standard Test Method for Surface Burning Characteristics of Building Materials.
- .7 All major building codes: NBC and BCBC.
- .8 NFPA 101 - Life Safety Code

1.4 DEFINITIONS

- .1 Firestopping: Material or combination of materials used to retain integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke, and hot gases through penetrations in fire rated wall and floor assemblies.

1.5 QUALITY ASSURANCE

- .1 Engage an experienced Installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having been provided the necessary training to install manufacturer's products per specified requirements. A manufacturer's willingness to sell its firestopping products to the Contractor or to an Installer engaged by the Contractor does not in itself confer qualification on the buyer.
- .2 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 City of Vancouver, and provide a report on all installations. The fire stopping engineer shall provide letters of assurance to the Departmental Representative, in accordance with the Vancouver Building Bylaw.
- .3 A manufacturer's direct representative (not distributor or agent) to be on-site during initial installation of firestop systems to train appropriate contractor personnel in proper selection and installation procedures. This will be done per manufacturer's written recommendations published in their literature and drawing details.
- .4 Firestop System installation must meet requirements of CAN4-S115-M or ULC S-115-M tested assemblies that provide a fire rating.

- .5 Proposed firestop materials and methods shall conform to applicable governing codes having local jurisdiction.
- .6 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).
- .7 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.

1.6 ACCEPTABLE MANUFACTURERS

- .1 Subject to compliance with through penetration firestop systems listed in U.L.C Fire Resistance Directory – Volume III or UL Products Certified for Canada (cUL) Directory, provide products that are listed in the U.L.C Fire Resistance Directory – Volume III or UL Products Certified for Canada (cUL) Director.

Part 2 Products

2.1 FIRESTOPPING, GENERAL

- .1 Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by the firestopping manufacturer based on testing and field experience.
- .2 Provide components for each firestopping system that are needed to install fill material. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.

2.2 MATERIALS

- .1 Use only firestop products that have been ULC or cUL tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance.

- .2 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

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.

Part 3 Execution

3.1 PREPARATION

- .1 Verification of Conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.
- .1 Verify penetrations are properly sized and in suitable condition for application of materials.
 - .2 Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, rust, laitance, release agents, water repellents, and any other substances that may affect proper adhesion.
 - .3 Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.
 - .4 Comply with manufacturer's recommendations for temperature and humidity conditions before, during and after installation of firestopping.
 - .5 Do not proceed until unsatisfactory conditions have been corrected.

3.2 COORDINATION

- .1 Coordinate location and proper selection of cast-in-place Firestop Devices with trade responsible for the work. Ensure device is installed before placement of concrete.

3.3 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 the Departmental Representative, 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.

3.4 FIELD QUALITY CONTROL

- .1 Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas.
- .2 Keep areas of work accessible until inspection by applicable code authorities.
- .3 Inspection of through-penetration firestopping shall be performed by the Engineer retained by the Contractor in accordance with ASTM E 2174, "Standard Practice for On-Site Inspection of Installed Fire Stops" or other recognized standard.
- .4 Perform under this section patching and repairing of firestopping caused by cutting or penetrating of existing firestop systems already installed by other trades.

3.5 ADJUSTING AND CLEANING

- .1 Remove equipment, materials and debris, leaving area in undamaged, clean condition.
- .2 Clean all surfaces adjacent to sealed holes and joints to be free of excess firestop materials and soiling as work progresses.

END OF SECTION

Part 1 General

1.1 GENERAL

- .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 RELATED WORK

- .1 Also refer to Section 22 07 18 Plumbing Piping Insulation.

1.3 DESCRIPTION OF WORK

- .1 Furnish and install a complete CSA Certified system of heaters and components, listed specifically for maintaining domestic hot water temperatures at selected temperatures.

Part 2 Products

2.1 HEATERS

- .1 The self-regulating heater shall consist of two (2) 16 AWG nickel-coated radiation-crosslinked conductive polymer core. It shall be covered by a radiation-crosslinked, polyolefin dielectric jacket surrounded by polymer-coated aluminum wrap, and enclosed in a tinned copper braid of 14 AWG equivalent wire size. The braid shall be covered with a (nominal) 40 mil polymer outer jacket, colour coded for easy identification.
- .2 The cable shall have a minimum cut-through resistance of 45 kg per the IEEE 515.1 and CSA 130-03 Resistance to Cutting Tests. The cable shall have a minimum impact resistance of 13.6 N-m per the IEEE 515.1 and CSA 130-03 Impact Tests. The cable shall have a minimum abrasion resistance of 2500 cycles per the IEEE 515.1 Abrasion Test. The cable shall withstand a crush resistance of 102 kg per the IEEE 515.1. Deformation Test and withstand a crush resistance of 157 kg per the CSA 130-03 Crush Resistance Test.
- .3 The heater shall operate on a line voltage of 208 volts and have the option of operating on 208 or 240 volts with a HWAT-ECO Controller.
- .4 All heating cable connection kits shall be CSA Certified for use as part of the system to maintain hot water temperature. Component enclosures shall be rated NEMA 4X to prevent water ingress and corrosion. Installation shall not require the installing contractor to cut into the heating cable core to expose the bus wires. Connection systems requiring the installing contractor strip the bus wires, or which use crimp or terminal blocks, shall not be acceptable. All connection kits except for the power connection shall be installed under the thermal insulation. The end seal shall use silicone gel.

- .5 Installed system shall include at least one agency-approved electronic controller. The controller shall not be of line sensing over-limit design. The controller shall be capable of setting different pipe temperatures based on ambient and voltage with 24 hour, 7 day/week programmable options, energy savings, BMS interface capabilities and flexible wiring configurations to operate individually or control up to eight additional controllers.
- .6 The system shall maintain temperatures between 40°C and 60°C at 208V or 240V. Temperature shall be maintained by utilizing an electronic controller with straight runs of heating cable on the pipe.

Part 3 Execution

3.1 INSTALLATION

- .1 Install self-regulating heaters and components on domestic hot water supply piping mains and risers as indicated on the plans and specifications after the piping has been pressure tested, but before the thermal insulation is applied. Secure the heater to the piping with fiberglass tape.
- .2 Apply "electric traced" signs to the outside of the thermal insulation jacketing.

3.2 PIPE INSULATION

- .1 Pipe Insulation Thickness Table

Copper Pipe Size (NPS)	Insulation Thickness inches [mm]
1/2	1 [25]
3/4	1 [25]

- .2 Install the system in accordance with the drawings and the manufacturer's instructions. The installer shall be responsible for providing a functional system, installed in accordance with applicable local, provincial and National requirements. Protect each circuit with a 30 mA ground-fault protection device.

3.3 TESTS

- .1 After installation and before and after installing the thermal insulation, test all heater cables using a 2500 VDC megger. The heater circuits shall be continuous and megger readings shall be at least 1000 megohm regardless of the heater length. Repair or replace circuits yielding unacceptable readings.
- .2 The Contractor shall submit final megger test results and the results to be included in O & M manuals.

END OF SECTION

Part 1 General

1.1 SECTION SCOPE

- .1 This Section shall be read in conjunction with and as a supplement to Section 23 07 19 – HVAC Piping Insulation. Comply with all requirements of that Section of work as related to general requirements, products and execution. This Section indicates additional scope for thermal insulation and jacketing for plumbing piping and plumbing piping accessories.

1.2 GENERAL REQUIREMENTS

- .1 Provide thermal insulation on all plumbing piping, valves and fittings and as follows:
 - .1 Domestic cold water, domestic hot water and condensate.
 - .2 All piping provided with the domestic hot water temperature maintenance system.
 - .3 Do not insulate exposed run-outs to plumbing fixtures, chrome plated piping, valves, fittings. Do not insulate run-outs to individual units and equipment not exceeding 3600 mm long.

1.3 PIPING INSULATION MINIMUM THICKNESS SCHEDULE

Type Of System	Design Operating Temperature Range °C	Thermal Conductivity of Insulation		Nominal Pipe Diameter (NPS)				
		Conductivity Range W/m.°C	Mean Rating Temperature °C	Runouts	1 to 1.25	1.5 to 3	4 to 6	≥ 8
				≤ 1	Minimum Thickness of Piping Insulation (mm)			
Hot Water Systems	61-93	0.036-0.042	52	40	40	50	50	50
	41-60	0.035-0.040	38	25	25	40	40	40
Cold Water Systems	5-13	0.033-0.039	24	25	25	25	25	25
	<5	0.029-0.037	10	25	25	25	25	40

- .1 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.
 - .1 U2 = proposed insulation “k” value at the table mean rating temperature.
 - .2 U1 = upper range limit “k” value from the table above.
- .2 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.
 - .1 U2 = proposed insulation “k” value at the table mean rating temperature.

.2 U1 = lower range limit “k” value from the table above.

1.4 PIPING FINISH SCHEDULE

.1 Conform to the following:

Duty	Type	TIAC Code
Indoors, concealed	Factory	CPF/2
Indoors, exposed in mechanical room and elsewhere	Canvas Jacket	CPF/1
Indoors, exposed in utility areas etc.	PVC Jacket	CPF/4

1.5 WASTE MANAGEMENT

.1 Refer to the requirements in Section 01 74 19 – Waste Management & Disposal.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation for copper domestic water service used in the following:
 - .1 Hard drawn copper for hot and cold domestic water piping.

1.2 RELATED SECTIONS

- .1 Section 23 05 00 – Common Work Results - Mechanical.
- .2 Section 23 05 01 – Pipe Installation.
- .3 Section 23 05 22 – Valves - Bronze.
- .4 Section 23 05 93 – Testing, Adjusting and Balancing - HVAC.

1.3 REFERENCES

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers International (ASME).
 - .1 ANSI/ASME B16.15- [02], Cast Bronze Threaded Fittings, Classes 125 and 250.
 - .2 ANSI/ASME B16.18- [01], Cast Copper Alloy Solder Joint Pressure Fittings.
 - .3 ANSI/ASME B16.22-[01], Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
- .2 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM B88M- [03], Standard Specification for Seamless Copper Water Tube (Metric).
- .3 American Water Works Association (AWWA).
 - .1 AWWA C111- [00], Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .4 Canadian Standards Association (CSA International).
 - .1 CSA B242- [M1980 (R1998)], Groove and Shoulder Type Mechanical Pipe Couplings.
- .5 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).
 - .1 MSS-SP-67- [02], Butterfly Valves.
 - .2 MSS-SP-70- [98], Cast Iron Gate Valves, Flanged and Threaded Ends.
 - .3 MSS-SP-71- [97], Cast Iron Swing Check Valves, Flanged and Threaded Ends.
 - .4 MSS-SP-80- [03], Bronze Gate, Globe, Angle and Check Valves.

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 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Place materials defined as hazardous or toxic in designated containers.
- .4 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 PIPING

- .1 Domestic hot, cold and recirculation systems, within building. Refer to application schedule on drawings.
 - .1 Above ground: copper tube, hard drawn, type K to ASTM B88M.

2.2 FITTINGS

- .1 Bronze pipe flanges and flanged fittings, Class 150 to ANSI/ASME B16.24.
- .2 Cast bronze threaded fittings, Class 125: to ANSI/ASME B16.15.
- .3 Cast copper, solder type: to ANSI/ASME B16.18.
- .4 NPS 2 and larger: roll grooved to CSA B242. Fittings shall be wrought copper to ANSI/ASME B16.22 or cast bronze to ANSI/ASME B16.18, with cooper-tube dimensioned grooved ends. (Flaring tube or fitting ends to accommodate alternate sized couplings is not permitted.) Basis of Design: Victaulic Copper-Connection.

2.3 JOINTS

- .1 Rubber gaskets, latex-free, 1.6 mm thick: to AWWA C111.
- .2 Bolts, nuts, hex head and washers: to ASTM A307, heavy series.
- .3 Solder: 95/5 - tin copper alloy : lead free.
- .4 Teflon tape: for threaded joints.
- .5 Grooved couplings: designed with angle bolt pads to provide rigid joint at cooper-tubing sizes, complete with EPDM-HP flush seal type gasket, suitable for water temperature to +120°C [+250°F]. Installation-Ready, for direct slab installation without field disassembly. Basis of Design: Victaulic Style 607H.
- .6 Dielectric connections between dissimilar metals: dielectric fittings to ASTM F492 complete with thermoplastic liner. Basic of Design: Victaulic Style 47.

2.4 GATE VALVES

- .1 NPS 2 and under, soldered:
 - .1 Rising stem: to MSS-SP-80, Class 125, 860 kPa, bronze body, screw-in bonnet, solid wedge disc as specified Section 23 05 22 - Valves - Bronze.

2.5 BALL VALVES

- .1 NPS 2 and under, soldered:
 - .1 To ANSI/ASME B16.18, Class 150.
 - .2 Bronze body, chrome plated brass ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle, with NPT to copper adaptors as specified Section 23 05 22 - Valves - Bronze

Part 3 Execution

3.1 INSTALLATION

- .1 Install in accordance with Plumbing Code and local authority having jurisdiction.
- .2 Assemble piping using fittings manufactured to ANSI standards.
- .3 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.

3.2 VALVES

- .1 Isolate equipment, fixtures and branches with ball valves.
- .2 Balance recirculation system using lockshield globe valves. Mark settings and record on as-built drawings on completion.

3.3 PRESSURE TESTS

- .1 Conform to requirements of Section 23 05 00 - Common Work Results - Mechanical.
- .2 Test pressure: greater of 1.5 times maximum system operating pressure or 860 kPa.

3.4 FLUSHING AND CLEANING

- .1 Flush entire system for 8 h. Ensure outlets flushed for 2 h. Let stand for 24 h, then draw one sample off longest run. Let system flush for additional 2 h, then draw off another sample for testing.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 The installation of drainage waste and vent piping.

1.2 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM B32- [03], Specification for Solder Metal.
 - .2 ASTM B306- [02], Specification for Copper Drainage Tube (DWV).
 - .3 ASTM C564- [03a], Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- .2 Canadian Standards Association (CSA International).
 - .1 CSA B67- [1972(R1996)], Lead Service Pipe, Waste Pipe, Traps, Bends and Accessories.
 - .2 CAN/CSA-B70- [02], Cast Iron Soil Pipe, Fittings and Means of Joining.
 - .3 CAN/CSA-B125- [01], Plumbing Fittings.

Part 2 Products

2.1 MATERIAL

2.2 COPPER TUBE AND FITTINGS

- .1 Above ground sanitary, condensate and vent piping: Type DWV - copper to: ASTM B306.
 - .1 Fittings:
 - .1 Cast brass: to CAN/CSA-B125.
 - .2 Wrought copper: to CAN/CSA-B125.
 - .2 Solder: lead free, tin- 95:5, to ASTM B32.

2.3 CAST IRON PIPING AND FITTINGS

- .1 Above ground sanitary and vent: to CAN/CSA-B70.
 - .1 Joints:
 - .1 Hub and spigot:
 - .1 Caulking lead: to CSA B67.
 - .2 Mechanical joints:
 - .1 Neoprene or butyl rubber compression gaskets with stainless steel clamps.

Part 3 Execution

3.1 INSTALLATION

- .1 In accordance with Section 23 05 01 – Pipe Installation.
- .2 Install in accordance with National Plumbing Code and Vancouver Building By-law.
- .3 Grade horizontal drainage piping @ 2% minimum, unless noted otherwise.

3.2 TESTING

- .1 Hydraulically test to verify grades and freedom from obstructions.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 The supply and installation of Plumbing Fixtures and Trim.
- .2 Related Sections:
 - .1 Section 01 33 00 - Shop Drawings, Product Data and Samples.
 - .2 Section 01 78 30 – Closeout Submittals.

1.2 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 product of one manufacturer. Fittings of same type shall be of product of one manufacturer.
- .4 Protect fixtures against use and damage during construction.

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CAN/CSA-B45 Series-02, Plumbing Fixtures.
 - .2 CAN/CSA-B125-01, Plumbing Fittings.
 - .3 CAN/CSA-B651-95 (R2001), Barrier-Free Design.

1.4 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Shop Drawings, Product Data and Samples.
- .2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 33 – Health and Safety Requirements
 - .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Shop Drawings, Product Data and Samples.
 - .1 Indicate, for all fixtures and trim:
 - .1 Dimensions, construction details, roughing-in dimensions.
 - .2 Water usage and energy conservation measures.
- .3 Closeout Submittals:
 - .1 Submit maintenance data in accordance with Section 01 78 30 - Closeout Submittals.

- .2 Include:
 - .1 Description of fixtures and trim, giving manufacturer's name, type, model, year, capacity.
 - .2 Details of operation, servicing, maintenance.

1.5 DELIVERY STORAGE AND DISPOSAL

- .1 Waste Management and Disposal:
 - .1 Separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .2 Collect and separate for disposal all recyclable material for recycling in accordance with Waste Management Plan.
 - .3 Fold up metal and plastic banding, flatten and place in designated area for recycling.

1.6 WASTE MANAGEMENT

- .1 Refer to the requirements in Section 01 74 19 – Waste Management & Disposal.

Part 2 Products

2.1 MANUFACTURED UNITS

- .1 Fixtures: manufacture in accordance with CAN/CSA-B45 series.
- .2 Trim, fittings: manufacture in accordance with CAN/CSA-B125.
- .3 Exposed plumbing brass to be chrome plated.
- .4 Number, locations: architectural drawings to govern.
- .5 Fixtures in any one location to be product of one manufacturer and of same type.
- .6 Trim in any one location to be product of one manufacturer and of same type.

Part 3 Execution

3.1 INSTALLATION

- .1 Install each fixture with its own threaded chrome plated for all sinks trap, easily removable for servicing and cleaning. At completion thoroughly clean plumbing fixtures, P-traps and equipment.
- .2 Provide chrome plated rigid at wall with flexible risers or supplies to fixtures with screwdriver stops, reducers and escutcheons. Sinks to have minimum 375 mm long flexible risers.
- .3 Provide Sealant between finished walls and horizontal surfaces of water closets, urinals, lavatories and janitor sinks, etc. Sealant shall be a continuous smooth with a beveled watershed, sealant shall be mildew/algae resistant.

- .4 Sinks shall not be used to clean paint brushes, trowels, etc. Do not dispose construction waste down any plumbing fixtures.
- .5 All waste arms from traps shall be mechanical joint to risers not soldered.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 91 00 - Commissioning
- .2 Division 21 – Fire Suppression
- .3 Division 22 – Plumbing
- .4 Division 23 – Heating, Ventilation & Air Conditioning

1.2 INTENT

- .1 Provide complete, fully tested and operational mechanical and plumbing systems to meet the requirements described herein and in complete accord with applicable codes and ordinances.
- .2 Contract documents and drawings of this Division are diagrammatic and approximately to scale unless detailed otherwise. They establish scope, material and installation quality and are not detailed installation instructions.
- .3 Follow manufacturers' recommended installation details and procedures for equipment, supplemented by requirements of Contract Documents.
- .4 Install equipment generally in locations and routes shown. Run piping and ductwork 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 satisfaction of the Departmental representative at no extra cost.
- .5 Install equipment to provide access and ease of maintenance.
- .6 Connect to equipment specified in other sections. Uncrate equipment, move in place and install complete; start up and test.
- .7 Install control valves, control dampers, thermal wells, and other devices on piping and ducts, furnished by Controls Contractor.
- .8 Provide seismic restraints for all required equipment, piping and ductwork.
- .9 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.
- .10 If the equipment is used during construction, the guarantee or guarantee period shall not be shortened or altered.
- .11 'Provide' shall mean; supply and install'.

- .12 The Contractor shall retain a Seismic Engineer, registered in the Province of British Columbia, for the design of all seismic restraints. The Seismic Engineer shall provide and submit to the Departmental Representative, 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.
- .13 If the equipment is indicated on the schedules or within the motorlist (both included in the mechanical drawings) as a single point connection, the equipment shall be provided with all integral HOA type starters, internal wiring to all motors, starters, lighting, service outlets etc. Such that a single electrical connection can be utilized to power all components within the unit. The unit shall also incorporate the required step-down transformers and wiring to connect to all of these internal components including controls wiring. Coordinate with the controls subcontractor for the supply, installation, and wiring of control components.

1.3 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 Any areas indicated as space for future materials or equipment shall be left clear.

1.4 PERMITS

- .1 All work shall comply with national, provincial, municipal, bylaws and authorities having jurisdiction.
- .2 Obtain all permits and pay all fees applicable to the work.
- .3 Contractor shall arrange for inspections of the work by the authorities having jurisdiction and shall provide certificates indicating Final Approval.
- .4 Contractor shall provide schedule B1/B2 letters of assurance for seismic engineering and for fire protection/sprinkler system engineer.

1.5 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Shop Drawings, Product Data and Samples.
- .2 Shop drawings; submit 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 per NFPA-13.

- .3 Shop drawings and product data 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 of compliance to applicable codes.
- .4 Closeout Submittals:
 - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 30 - Closeout Submittals.
 - .2 Operation data to include:
 - .1 Control schematics for systems including environmental controls.
 - .2 Description of systems and their controls.
 - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
 - .4 Operation instruction for systems and component.
 - .5 Description of actions to be taken in event of equipment failure.
 - .6 Valves schedule and flow diagram.
 - .7 Colour coding chart.
 - .3 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.
 - .4 Performance data to include:
 - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified.
 - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 – Testing, Adjusting & Balancing - HVAC.
 - .5 Approvals:
 - .1 Submit 1 copy of draft Operation and Maintenance Manual to the Departmental Representative for approval. Submission of individual data will not be accepted unless directed by the Departmental Representative.
 - .2 Make changes as required and re-submit as directed by The Departmental Representative.

- .6 Additional data:
 - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
 - .2 Chemical treatment reports
 - .3 Back-flow preventer reports
 - .4 List of spare parts turned over to the Departmental representative.
- .7 Site records:
 - .1 PWGSC will provide white prints @ contractors cost to mark changes as work progresses and as changes occur.
 - .2 Use different colour waterproof ink for each service.
 - .3 Make available for reference purposes and inspection.
- .8 As-built drawings:
 - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
 - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (date).
 - .3 Submit to the Departmental Representative for approval and make corrections as directed.
 - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
 - .5 Submit PDF copies of as-built drawings for inclusion in final TAB report. The PDF shall be saved in a USB flash memory.
 - .6 Provide one (1) full scale hard copy of as-built drawings to the Departmental Representative.
 - .7 Refer to Section 01 78 30 – Closeout Submittals.

1.6 MAINTENANCE

- .1 Furnish spare parts in accordance with Section 01 78 30 - Closeout Submittals and as follows:
 - .1 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.
- .2 Additional spare parts shall also be included as outlined in their appropriate sections.

1.7 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.

1.8 QUALITY OF WORK

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

1.9 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

<i>mm</i>	<i>Inches (NPS)</i>	<i>mm</i>	<i>Inches (NPS)</i>	<i>mm</i>	<i>Inches (NPS)</i>
3	1/8	65	2-1/2	375	15
6	1/4	75	3	450	18
10	3/8	100	4	500	20
15	1/2	125	5	600	24
20	3/4	150	6	750	30
25	1	200	8		
30	1-1/4	250	10		
40	1-1/2	300	12		
50	2				

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

1.10 ALTERNATE MATERIALS AND EQUIPMENT

- .1 The price submitted for this contract shall be based on the use of materials and equipment as specified.
- .2 The Contractor shall be fully responsible for any additional work or materials required by the trades or other Contractors to accommodate use of other than specified materials or equipment. Extras will not be approved to cover such work.

1.11 DRAWINGS AND SPECIFICATIONS

- .1 Drawings and specifications are complementary each to the other, and what is called for by one shall be binding as if called for by both.

1.12 SALVAGE

- .1 Remove from site all equipment, ducting or piping which is no longer required because of work under this Contract.
- .2 Refer to the requirements in Section 01 74 19 – Waste Management & Disposal.

1.13 CUTTING, PATCHING AND CORING

- .1 Provide holes and sleeves, cutting and fitting required for mechanical work. Relocate improperly located holes and sleeves.
- .2 Prior to drilling for expansion bolts, hanger rods, brackets, and support, obtain GPR scan of proposed location to ensure drilled anchor will avoid any existing post-tensioning cable or reinforcing steel. Advise the Departmental Representative of any conflicts.
- .3 General Contractor shall retain and pay for a structural engineer registered in the Province of British Columbia to review and provide approval for coring as part of this project. No existing structural members shall be cut or burn.
- .4 Patch building where damaged from equipment installation, improperly located holes etc. Use matching materials as specified in the respective section.

1.14 INSTALLATION OF EQUIPMENT

- .1 Pipe all equipment drains to building drains.
- .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.

1.15 CONNECTIONS TO EXISTING SERVICES

- .1 Refer to Appendix B for requirements with regards to access, and any interruptions and shutdowns of existing building services.

1.16 EQUIPMENT AND MATERIALS

- .1 Materials and equipment installed shall be new, full weight 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 All equipment supplied to the project will meet efficiencies as defined in ASHRAE Standard 90.1 2010.

1.17 EQUIPMENT PROTECTION AND CLEAN UP

- .1 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 and duct systems.
- .2 Protect equipment with polyethylene covers and crates.
- .3 Operate, drain and flush out unsealed bearings and refill with new change of oil, before final acceptance.
- .4 Thoroughly clean piping, ducts and equipment of dirt, cuttings and other foreign substances.
- .5 Protect bearings and shafts during installation. Grease shafts and sheaves to prevent corrosion. Supply and install necessary extended nipples for lubrication purposes.
- .6 Ensure that existing equipment is carefully dismantled and not damaged or lost. Do not reuse existing materials and equipment unless specifically indicated.

1.18 ELECTRICAL MOTORS

- .1 Supply mechanical equipment complete with electrical motors.
- .2 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.
- .3 Motors less than 1-hp shall be 120 V, 60 Hz, 1 phase. Motors 1-hp and larger shall be 3 phase at the indicated voltage.
- .4 All motors shall be 1800 rpm unless otherwise noted.
- .5 Provide motors complete with equipment except where indicated.
- .6 Provide motors with grease or oil lubricated anti-friction type ball or roller bearings.
- .7 Provide motors designed with Class B insulation; Class F insulation for totally enclosed motors.
- .8 Refer to electrical specifications, Division 26, for voltage, frequency, and phase data. This shall take precedence over any reference in Division 23.
- .9 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.
- .10 Minimum certified motor efficiency shall be as outlined in ASHRAE 90.1 2010.

1.19 ACCESS DOORS

- .1 Provide access doors for maintenance or adjustment purposes for all mechanical system components including:
 - .1 Valves;
 - .2 Volume and splitter dampers;
 - .3 Fire dampers;

- .4 Controls, coils and terminal units;
- .5 Expansion joints.
- .6 Filters
- .7 Strainers
- .2 Mark removable ceiling tiles used for access with colour coded dots.
- .3 Provide ULC-listed fire rated access doors installed in rated wall and ceilings.
- .4 Refer to Section 23 05 00 for additional requirements.

1.20 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.

1.21 PIPE SLEEVES

- .1 Pipe sleeves shall be provided for piping passing through walls and floors. Minimum schedule 40 steel pipes. Sleeves shall extend 25 mm on either side of the wall.
- .2 Pipe sleeves are not required where pipes pass through cored concrete walls or floors.

1.22 ESCUTCHEON AND PLATES

- .1 Provide escutcheon and plates on piping and ductwork passing through finished walls, floors and ceilings.
- .2 Escutcheons shall be split type, stainless or chrome plated steel.

1.23 TEMPORARY HEAT

- .1 Do not use the permanent system for temporary heating purposes without written permission from the Departmental Representative.
- .2 Thoroughly clean and overhaul permanent equipment used during the construction period, replace worn or damaged parts before final inspection.
- .3 Use of permanent systems for temporary heat shall not modify terms of warranty.
- .4 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.
- .5 Air systems shall not be used for temporary heating.
- .6 When permanent systems are used for temporary heat, provide alarm indicating system failure. Connect alarm to independent alarm company system.

1.24 TEMPORARY OR TRIAL USAGE

- .1 Temporary or trial usage by the Departmental Representative 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.

1.25 SUBSTANTIAL AND TOTAL PERFORMANCE

- .1 Prior to requesting an inspection for Substantial Performance, provide a complete list of items which are deficient.
- .2 A certificate of Substantial Performance will not be granted unless the following items are completed:
 - .1 Heating air conditioning, plumbing and 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 The necessary tests on equipment and systems including those required by authorities have been completed with certificates of approval.
 - .3 Air and water systems have been balanced with draft report submitted to Provide one (1) full scale hard copy of as-built drawings to the Departmental Representative.
 - .4 Valve tagging and equipment identification is complete.
 - .5 Warranty forms have been mailed to the manufacturer. Provide copy of original warranty for equipment which has warranty period longer than one year.
 - .6 Systems have been chemically cleaned. Flush and initiate water treatment. Provide report from manufacturer's representative to confirm status of treatment.
 - .7 Draft Operating/Maintenance Manuals have been submitted.
 - .8 Operating and Maintenance demonstrations have been provided to Provide one (1) full scale hard copy of as-built drawings to the Departmental Representative.
 - .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 All seismic restraint devices have been installed.
 - .12 All previously identified deficiencies have been corrected.
- .3 The following shall be an outline checklist of the minimum requirements to be met by the contractor prior to the Departmental Representatives' Substantial Performance by the contractor.
- .4 Inspection:
 - .1 Complete Commissioning Checklists
 - .2 Final Plumbing Inspection Certificate from local plumbing inspector

- .3 Final Sprinkler Materials and Test Certificate
- .4 Final Backflow Prevention test reports for all backflow devices
- .5 Controls Commissioning, Checklist
- .6 Fire alarm test certificate (via DIV.26)
- .7 Fire stopping and Fire Damper test letter
- .8 Seismic Engineers inspection of all Seismic restraints and schedule B and C letters of assurance
- .9 Sprinkler Contractors Engineer of record inspection and Schedule B and C letter of assurance
- .10 Chemical Treatment supplies final inspection and test certificate
- .11 Final As-Built Drawings ready for review
- .12 Maintenance and operation manuals, ready for review
- .5 Prior to 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.
- .6 The Contractor shall provide qualified personnel in appropriate numbers to operate the facility until substantial performance is declared.

1.26 ACCEPTABLE MANUFACTURERS

- .1 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.

1.27 SELECTIVE DEMOLITION

- .1 Reference Standards
 - .1 Unless otherwise specified, carry out demolition work in accordance with CSA S350-M1980, Code of Practice for Safety in Demolition of Structures.
- .2 Existing Conditions
 - .1 Visit and examine the site and note all characteristics and irregularities affecting the work of this Section.
- .3 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 Departmental Representative 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
- .4 Salvageable Materials
 - .1 Except as otherwise stated, salvageable materials from area of demolition shall become the property of the Contractor. All material shall be removed off from this site and disposed of as required by any applicable disposal regulations.

Part 2 Products

2.1 OPERATING AND MAINTENANCE MANUALS

- .1 Secure and assemble all necessary literature describing the operation and maintenance of all equipment provided.
- .2 Provide one (1) 216 mm x 280 mm capacity, expanding spine catalogue binders, bound with heavy fabric, hot stamped lettering front and spine. Provide PDF copy as well.
- .3 Index binder according to the following system:
 - .1 Tab-1.0 Mechanical Systems:
 - .1 Title page with clear plastic protection cover.
 - .2 Tab-1.1 List of Mechanical Drawings:
 - .3 Tab-1.2 System Descriptions:
 - .1 Provide complete description of the operating sequence for all systems. Include detailed system description, with individual components described, explanation of how components interface with others and to the complete system, location of thermostats, controllers or operating variances, and controller operating setpoints.
 - .4 Tab-1.3 Operating Division:
 - .1 Provide complete and detailed operation of major components and systems. Provide information on location of components, how to energize switches and controls, how components interface with other components, operation of controls including operational sequence, operational changes for summer of winter operation, how to accomplish the changeover, complete trouble shooting sequence, emergency operating sequences in event of major component failure, and safeguards to indicate if equipment goes off-line.
 - .5 Tab-1.4 Maintenance and Lubrication Division:
 - .1 Provide general maintenance and lubrication schedule for major components to include daily, weekly, monthly, semi-annual and yearly checks and tasks. Explain how to execute maintenance tasks required for typical equipment such as bearings, drives, motors, and filters. Compile this information for equipment and separate from shop drawings.

- .6 Tab-1.5 List of Equipment Suppliers and Contractors:
 - .1 Provide list of equipment suppliers and contractors, including address and telephone number. Outline procedures for purchasing parts and equipment.
- .7 Tab-Certification (2.0, 2.1, ...):
 - .1 Include copy of test data on degreasing and flushing of heating system, analysis of system water taken at time system was put into operation, hydrostatic or air tests performed on piping systems, equipment alignment certificates, copy of balancing data for air and water systems, copy of valve tag identification and pipe colour code, inspection approval certificates for plumbing system, heating and ventilation systems, operational tests on oil-fired equipment and commissioning reports.
- .8 Tab-Shop Drawings and Maintenance Bulletins (3.0, 3.1, ...):
 - .1 Provide materials received in compliance with clause "Shop Drawings".
- .4 The divider tabs shall be laminated mylar plastic and coloured according to Section. The colouring is as follows: Mechanical Systems - 1.0 - 1.5 Orange; Certification - 2.0 - 2.4 Green; Shop Drawings & Maintenance - 3.0 - 3.17 Yellow. Plastic tabs with typewritten card insertions will not be accepted.

2.2 EXISTING SERVICES

- .1 Disconnect and cap all mechanical services in accordance with requirements of local 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 all building services during demolition/removal of existing.
- .3 Maintain all trap seals and 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 Departmental Representative.
- .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 in accordance with Appendix B.

2.4 CORE DRILLING

- .1 Clearly identified 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 Departmental Representative of any conflicts as a result of the x-rays.
- .2 Prior to pricing for piping penetrations and anchors through existing slabs, walls etc., obtain GPR scan of proposed location to ensure core will avoid structural members i.e. post-tensioning cable or reinforcing steel, advise the Departmental Representative of any conflicts.

Part 3 Execution

3.1 REPAIRS/ RESTORATION

- .1 Prime and touch up marred finished paintwork to match original.
- .2 Restore to new condition, finishes which have been damaged extensively for priming and touch-up.

3.2 CLEANING

- .1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

3.3 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.4 DEMONSTRATION

- .1 The Departmental Representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Supply tools, equipment and personnel to demonstrate and instruct 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 or 23 manufacturers to provide demonstrations and instructions.

- .4 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.
- .5 Instruction duration time requirements as specified in appropriate sections.
- .6 Contractor will record these demonstrations on video tape for future reference.

3.5 PROTECTION

- .1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 22 05 05 – Firestopping – Mechanical.
- .2 Section 23 08 06 - Cleaning and Start-up of Mechanical Piping Systems.

1.2 WASTE MANAGEMENT

- .1 Refer to the requirements in Section 01 74 19 – Waste Management & Disposal.

Part 2 Execution

2.1 CONNECTIONS TO EQUIPMENT

- .1 In accordance with manufacturer's instructions unless otherwise indicated.
- .2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.
- .3 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.

2.2 CLEARANCES

- .1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer.
- .2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer or as indicated whichever is greater without interrupting operation of other system, equipment, and components.

2.3 DRAINS

- .1 Install piping with grade in direction of flow except as indicated.
- .2 The contractor shall allow for piping cooling coil drainpans and all condensate collection points to the nearest condensate riser. If a gravity drained connection cannot be made because of invert elevations, the contractor shall provide a packaged condensate pump with integral float control to be wired by this contractor to the unit power connection. The condensate drain line shall be insulated with continuous minimum 25mm thick insulation from the point of connection to the existing condensate riser connection.

2.4 DIELECTRIC COUPLINGS

- .1 General: Compatible with system, to suit pressure rating of system.
- .2 Locations: Where dissimilar metals are joined.
- .3 NPS 2 and under: isolating unions or bronze valves.

- .4 Over NPS 2: Isolating flanges.
- .5 Dielectric waterway fittings may be used in lieu of unions or flanged connections. Waterways shall be grooved and/or threaded end(s), with inert thermoplastic lining.

2.5 PIPEWORK INSTALLATION

- .1 Screwed fittings jointed with Teflon tape.
- .2 Protect openings against entry of foreign material.
- .3 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.
- .4 Assemble piping using fittings manufactured to ANSI standards.
- .5 Saddle type branch fittings may be used on mains if branch line is no larger than half the size of main.
 - .1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.
- .6 Install concealed pipework to minimize furring space, maximize headroom, and conserve space.
- .7 Slope piping, except where indicated, in direction of flow for positive drainage and venting.
- .8 Install, except where indicated, to permit separate thermal insulation of each pipe.
- .9 Group piping wherever possible.
- .10 Ream pipes, remove scale and other foreign material before assembly.
- .11 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.
- .12 Provide for thermal expansion as indicated.
 - .1 For water systems, flexible-type couplings may be used on header piping to accommodate thermal growth and contraction, and for the elimination of expansion loops. The contractor is responsible for retaining and paying for an engineer registered in the province of BC to provide an engineered design to demonstrate thermal expansion capability and requirements where loops are required, use flexible-type couplings on the loops.
- .13 Valves:
 - .1 Install in accessible locations.
 - .2 Remove interior parts before soldering.
 - .3 Install with stems above horizontal position unless otherwise indicated.
 - .4 Valves accessible for maintenance without removing adjacent piping.
 - .5 Install globe valves in bypass around control valves.
 - .6 Use ball valves at branch take-offs for isolating purposes except where otherwise specified.

- .7 The mechanical contractor shall coordinate with the balancing subcontractor regarding the appropriate sizing of all balancing valves and calibrated balancing valves. The balancing subcontractor shall provide direction to the mechanical contractor for the appropriate size for each balancing valve within each system that is to be balanced. The valves shall be selected to provide appropriate throttling range without imposing a pressure drop of more than 17.2 kPa. The balancer is to determine each valves respective flow rate (even if heat transfer and temperature differential calculations are required to determine flowrates). If full line sized valving meets these requirements, then a full line installation of appropriate fittings to transition from the pipe size indicated on the drawings to the recommended valve size.
- .14 Check Valves:
 - .1 Install silent check valves on discharge of pumps and in vertical pipes with downward flow and elsewhere as indicated.
 - .2 Install swing check valves in horizontal lines on discharge of pumps and elsewhere as indicated.
- .15 Avoid installation of service components (such as valves, air vents, strainers etc in secure areas.
- .16 Provide expansion compensation for all closed piping systems including but not limited to: heating water, chilled water, and all other closed piping systems that operate at varying temperatures. Expansion compensation as described in this section may be eliminated from open systems such as domestic cold, domestic hot, domestic hot recirculating systems.
- .17 It is the Contractor`s responsibility to retain the services of a qualified professional engineer registered in BC to design the thermal pipe expansion system for the actual installed layout of all piping systems covered by this specifications section.
- .18 The Contractor also is required to review the mechanical, structural, and architectural documents for the identification of any seismic joints or seismic separations within the building structure that affects the installation of any mechanical systems. At each of these locations, the Contractor shall allow for the design, supply, and installation of applicable mechanical system flexible connections along with support of these systems on each side of the seismic joint or separation. This applies to all piping systems as well as ductwork systems. Refer to this section for piping system products, and 23 33 00 for ductwork products.
- .19 The Contractor is to install flexible piping connections to all 4-pipe fan coil units.

2.6 PREPARATION FOR FIRESTOPPING

- .1 Material and installation within annular space between pipes, ducts, insulation and adjacent fire separation to Section 22 05 05 – Fire-stopping - Mechanical.
- .2 Un-insulated unheated pipes not subject to movement: No special preparation.
- .3 Un-insulated heated pipes subject to movement: Wrap with non-combustible smooth material to permit pipe movement without damaging fire-stopping material or installation.

- .4 Insulated pipes and ducts: Ensure integrity of insulation and vapour barriers.

2.7 FLUSHING OUT OF PIPING SYSTEMS

- .1 Contractor shall flush out piping system in accordance with section 23 08 06. - Cleaning and Start-up of Mechanical Piping Systems.
- .2 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

2.8 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

- .1 Advise the Departmental Representative shall flush out piping system in accordance with section 230806. - Cleaning and Start-up of Mechanical Piping Systems. 48 hours minimum prior to performance of pressure tests.
- .2 Pipework: Test as specified in relevant sections of Division 21, 22 & 23.
- .3 Maintain specified test pressure without loss for 8 hours minimum unless specified for longer period of time in relevant sections of Division 21, 22 & 23.
- .4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.
- .5 Conduct tests in presence of the Departmental representative c/w signed form outlining piping being witnessed.
- .6 Pay costs for repairs or replacement, retesting, and making good. The Departmental Representative to determine whether repair or replacement is appropriate.
- .7 Insulate or conceal work only after approval and certification of tests by the Departmental Representative.

END OF SECTION

Part 1 General

1.1 INTENT

- .1 Removal of all existing piping, equipment and ductwork that is redundant because of renovations.

1.2 REFERENCE STANDARDS

- .1 Unless otherwise specified, carry out demolition work in accordance with CSA S350-M1980, Code of Practice for Safety in Demolition of Structures.

1.3 EXISTING CONDITIONS

- .1 Visit and examine the site and note all characteristics and irregularities affecting the work of this Section.

1.4 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 Departmental Representative 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

1.5 SALVAGEABLE MATERIALS

- .1 All material shall be removed off from this site and disposed of as required by any applicable disposal regulations.
- .2 Refer to the requirements in Section 01 74 19 – Waste Management & Disposal.

Part 2 Execution

2.1 EXISTING SERVICES

- .1 Disconnect and cap all mechanical services in accordance with requirements of local authority having jurisdiction.
- .2 Building Mechanical Services: Maintain all building services during demolition/removal of existing.
- .3 Maintain all trap seals and ensure no sewer gas enters the building during renovations or demolition work. Maintain all existing sewer piping in a wet condition daily.

2.2 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 Departmental Representative.
- .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 Departmental Representative.

END OF SECTION

Part 1 General

1.1 RELATED SECTION

- .1 Section 01 33 00 - Shop Drawings, Product Data and Samples.
- .2 Section 01 74 19 – Waste Management And Disposal.
- .3 Section 01 78 30 - Closeout Submittals.
- .4 Section 09 21 16 - Gypsum Board Assemblies.

1.2 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Shop Drawings, Product Data and Samples.
- .2 Submit catalogue details for each type of door illustrating profiles, dimensions and methods of assembly.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for cleaning and maintenance of stainless steel finishes for incorporation into manual specified in Section 01 78 30 - Closeout Submittals.

Part 2 Products

2.1 ACCESS DOOR TYPES

- .1 Drywall Surface:
20 gauge galvanized formed door panel with flange of textured galvanized steel drywall taping bead with pre-punched holes. Slot screwdriver operated cam latch. 5 stage iron phosphate preparation with white baked-on polyester powder coat on door panel. Frame to be mill finish.
- .2 Ductwork:
Stainless steel, insulated duct access doors with gaskets, hinge, and camlocks. Doors shall be tested to meet DW144 Class C leakage requirements.

2.2 CONSTRUCTION

- .1 Flush to frame type steel door with rounded safety corners: 16 GA door, 18 GA frame under 400 mm x 400 mm, and 14 GA door, 16 GA frame over 400 mm x 400 mm. Concealed bar hinge and one piece trim flange.
- .2 For ductwork provide access doors with lever locks, insulated for insulated ductwork.
- .3 Cam type, screwdriver operated locking device on the side opposite the hinges.
- .4 Prime coat grey baked enamel after 5 stage iron phosphate preparation, or stainless steel #4 satin finish where required.

- .5 300 mm x 300 mm minimum for inspection and hand access.
- .6 450 mm x 450 mm minimum, larger if indicated on drawings, where entry is required and access is difficult.
- .7 Size to suit masonry modules when located in a masonry wall.
- .8 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.

Part 3 Execution

3.1 INSTALLATION

- .1 Installation:
 - .1 Access doors are to be provided by the Mechanical Division. This contractor is responsible for coordinating locations, cutting opening and installing panels. Any secondary supports will be by the ceiling or wall contractor.
 - .2 Access doors in mechanical equipment to be provided and installed by the mechanical division.
- .2 Access for maintenance or adjustment of all parts of the mechanical system shall be provided. This shall apply but not be limited to valves, volume dampers including splitter dampers, fire dampers, cleanouts and controls.
- .3 Where equipment is concealed by a removable tile ceiling, the location of equipment shall be indicated by coloured markings on the T bar system.
- .4 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.
- .5 Provide stainless steel doors in walls of washrooms and janitor rooms.
- .6 All fasteners on access panels shall be tamper proof, contractor shall provide three (3) sets of keys.

3.2 LOCATION

- .1 Location: Ensure that equipment is within view and accessible for operating, inspecting, adjusting, servicing without using special tools.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Bronze - valves.
- .2 Related Sections:
 - .1 Section 01 33 00 - Shop Drawings, Product Data and Samples.
 - .2 Section 01 78 30 - Closeout Submittals.
 - .3 Section 23 05 01 – Pipe Installation.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/ American Society of Mechanical Engineers (ASME).
 - .1 ANSI/ASME B1.20.1- [1983(R2001)], Pipe Threads, General Purpose (Inch).
 - .2 ANSI/ASME B16.18-[2001], Cast Copper Alloy Solder Joint Pressure Fittings.
- .2 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS).
 - .1 MSS-SP-25- [1998], Standard Marking System for Valves, Fittings, Flanges and Unions.
 - .2 MSS-SP-80- [2003], Bronze Gate Globe, Angle and Check Valves.
 - .3 MSS-SP-110- [1996], Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Shop Drawings, Product Data and Samples.
- .2 Closeout Submittals:
 - .1 Submit maintenance data for incorporation into manual specified in Section 01 78 30 - Closeout Submittals.

Part 2 Products

2.1 MATERIALS

- .1 Valves:
 - .1 Except for specialty valves, to be single manufacturer.
 - .2 All products to have CRN registration numbers.

- .2 End Connections:
 - .1 Connection into adjacent piping/tubing:
 - .1 Steel pipe systems: Screwed ends to ANSI/ASME B1.20.1.
 - .2 Copper tube systems:
 - .1 Solder ends to ANSI/ASME B16.18.
 - .2 Grooved ends similar to CSA B242. (Copper-tube dimensioned.)
- .3 Gate Valves:
 - .1 Requirements common to gate valves, unless specified otherwise:
 - .1 Standard specification: MSS SP-80.
 - .2 Bonnet: Union with hexagonal shoulders.
 - .3 Connections: Screwed with hexagonal shoulders.
 - .4 Inspection and pressure testing: to MSS SP-80. Tests to be hydrostatic.
 - .5 Packing: Non-asbestos.
 - .6 Handwheel: Non-ferrous.
 - .7 Handwheel Nut: Bronze to ASTM B62.
 - .2 NPS 2 and under, non-rising stem, solid wedge disc, Class 125
 - .1 Body: With long disc guides, screwed bonnet with stem retaining nut.
 - .2 Operator: Handwheel.
- .4 Globe Valves:
 - .1 Requirements common to globe valves, unless specified otherwise:
 - .1 Standard specification: MSS SP-80.
 - .2 Bonnet: Union with hexagonal shoulders.
 - .3 Connections: Screwed with hexagonal shoulders.
 - .4 Pressure testing: to MSS SP-80. Tests to be hydrostatic.
 - .5 Stuffing box: Threaded to bonnet with gland follower, packing nut, high-grade non-asbestos packing.
 - .6 Handwheel: Non-ferrous.
 - .7 Handwheel Nut: Bronze to ASTM B62.
 - .2 NPS 2 and under, composition disc, Class 125:
 - .1 Body and bonnet: Screwed bonnet.
 - .2 Disc and seat: renewable rotating PTFE disc, composition to suit service conditions, regrindable bronze seat, loosely secured to bronze stem to ASTM B505.
 - .3 Operator: Lockshield.
- .5 Balancing Valves:
 - .1 Up to 50 mm
 - .1 Return side of heating/cooling elements.

- .2 Read out ports, drain valve and cap.
- .3 Position readout and memory.
- .4 Polyurethane packaging (R4-5) to be used as removable insulation.
- .5 Coil-Hook-up Connections: Provide coil connection kit. The kit shall include a circuit-balancing valve, Strainer-Ball, Union-Port fitting, with ball valve and required coil hoses. A differential pressure controller shall be provided as required. A meter shall be provided by the valve manufacturer that shall remain with the building after commissioning.
- .6 Ball Valves:
 - .1 NPS 2 and under:
 - .1 Body and cap: Cast high tensile bronze to ASTM B62.
 - .2 Pressure rating: Class125
 - .3 Connections: Screwed ends to ANSI B1.20.1 and with hexagonal shoulders.
 - .4 Stem: Tamperproof ball drive.
 - .5 Stem packing nut: External to body.
 - .6 Ball and seat: Replaceable stainless steel solid ball and teflon seats.
 - .7 Stem seal: TFE with external packing nut.
 - .8 Operator: Removable lever handle.

Part 3 Execution

3.1 INSTALLATION AND APPLICATION

- .1 Install valves with stem upright or horizontal, not inverted.
- .2 Provide threaded lug type butterfly valves for equipment isolation service. Provide wafer or threaded lug type valves for zone shut-off service.
- .3 Use eccentric plug valves in water systems for throttling/balancing service.
- .4 Provide drain valves at main shut-off valves, low points of piping and apparatus and terminal units.
- .5 Size drain lines and drain valves equal to size of apparatus drain connection.
- .6 For pipe sizes 20 mm and over, minimum drain size to be 20 mm.
- .7 Provide hose thread connection with cap and chain for 20 mm drain valves located in ceiling and public areas.
- .8 Provide male NPT nipples with threaded pipe cap for drain sizes over 20 mm where not piped directly to floor drains.
- .9 Provide valved drain and hose connections off the bottom of all strainers.
- .10 Install gate or ball valves for shut off and isolating service, to isolate equipment, part of system, and vertical risers. Ball valves shall be used up to and including 50 mm.

- .11 Use bronze body ball valves for domestic water service.
- .12 Provide valves upstream of all meters, gauges, automatic air vents, etc. for isolation purposes.
- .13 Remove internal parts before soldering.
- .14 Install valves with unions at each piece of equipment arranged to allow servicing, maintenance, and equipment removal.

3.2 VALVE CONNECTIONS

- .1 Provide valves suitable to connect to adjoining piping as specified for pipe joints. Use pipe size valves.
- .2 Thread pipe sizes 50 mm and smaller.
- .3 Solder or screw to solder adapters for copper tubing.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Concrete housekeeping pads, hangers and supports for mechanical piping, ducting and equipment.
 - .2 Sustainable requirements for construction and verification.

1.2 REFERENCES

- .1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)
 - .1 ANSI/ASME B31.1- [04], Power Piping.
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A125- [1996(R2001)], Specification for Steel Springs, Helical, Heat-Treated.
 - .2 ASTM A307- [04], Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .3 ASTM A563- [04a], Specification for Carbon and Alloy Steel Nuts.
- .3 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
 - .1 MSS SP58- [2002], Pipe Hangers and Supports - Materials, Design and Manufacture.
 - .2 ANSI/MSS SP69- [2003], Pipe Hangers and Supports - Selection and Application.
 - .3 MSS SP89- [2003], Pipe Hangers and Supports - Fabrication and Installation Practices.
- .4 Underwriters Laboratories of Canada (ULC)

1.3 SYSTEM DESCRIPTION

- .1 Design Requirements:
 - .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
 - .2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP58.
 - .3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
 - .4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.

- .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP58.

1.4 HEALTH AND SAFETY

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

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 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 - Waste Management and Disposal.

Part 2 Products

2.1 GENERAL

- .1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP58.
- .2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.2 PIPE HANGERS

- .1 Finishes:
 - .1 Pipe hangers and supports: galvanized.
 - .2 Ensure steel hangers in contact with copper piping are copper plated or epoxy coated.
- .2 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 minimum greater than rod diameter.
 - .2 Concrete inserts: wedge shaped body with knockout protector plate UL listed to MSS SP69.
- .3 Shop and field-fabricated assemblies:
 - .1 Trapeze hanger assemblies.
 - .2 Steel brackets:

- .4 Hanger rods: threaded rod material to MSS SP58:
 - .1 Ensure that hanger rods are subject to tensile loading only.
 - .2 Provide linkages where lateral or axial movement of pipework is anticipated.
- .5 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 for all HOT PIPING.
- .6 Adjustable clevis: material to MSS SP69 UL listed, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
 - .1 Ensure "U" has hole in bottom for riveting to insulation shields.
- .7 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP69.
- .8 U-bolts: carbon steel to MSS SP69 with 2 nuts at each end to ASTM A563.
 - .1 Finishes for steel pipework: galvanized with epoxy coated in areas described above.
 - .2 Finishes for copper: epoxy coated.
- .9 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP69.

2.3 INSULATION PROTECTION SHIELDS

- .1 Insulated cold piping:
 - .1 64 kg/m³ density insulation plus insulation protection shield to: MSS SP69, galvanized sheet carbon steel. Length designed for maximum 3 m span.
- .2 Insulated hot piping:
 - .1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP69.

2.4 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

- .1 Provide templates to ensure accurate location of anchor bolts.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install in accordance with:
 - .1 Manufacturer’s instructions and recommendations.
- .2 Vibration Control Devices:
 - .1 Install on piping systems at pumps, fancoils, 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.

3.3 HANGER SPACING

- .1 Plumbing piping: to Provincial Plumbing code.
- .2 Fire protection: to applicable fire code.
- .3 Copper piping: up to NPS 1/2: every 1.5 m.
- .4 Flexible joint roll groove pipe: in accordance with table below, but not less than one hanger at joints.
- .5 Within 300-mm of each elbow.

Maximum Pipe Size : NPS	Maximum Spacing Steel	Maximum Spacing Copper
up to 30	2.1 m	1.8 m
40	2.7 m	2.4 m
50	3.0 m	2.7 m
65	3.6 m	3.0 m
75	3.6 m	3.0 m
100	4.2 m	3.6 m

3.4 HANGER INSTALLATION

- .1 Install hanger so that rod is vertical under operating conditions.
- .2 Adjust hangers to equalize load.
- .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

3.5 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.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Vibration isolation materials and components, and their installation.
- .2 Related Sections:
 - .1 Section 01 33 00 - Shop Drawings, Product Data and Samples.
 - .2 Section 01 78 30 - Closeout Submittals.
 - .3 Section 23 91 13 – Commissioning Requirements - General

1.2 REFERENCES

- .1 National Fire Protection Association (NFPA)
 - .1 NFPA 13-2013, Standard for the Installation of Sprinkler Systems.
- .2 National Building Code of Canada (NBC) – 2010
- .3 British Columbia Building Code – 2012.
- .4 Vancouver Building By-law – 2014.

1.3 GENERAL

- .1 Where imperial units have been indicated in brackets following the requirements in SI units, the conversion is approximate and provided for convenience. The SI units shall govern.
- .2 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. For fans less than 0.35 kW (0.5 HP), provide isolation with neoprene grommets at the support points.
- .3 Select equipment isolators and other components as indicated to satisfy the following requirements of Table 1.
- .4 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 Table 1 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.
- .5 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.

- .6 Use ductile materials in all vibration isolation equipment.
- .7 Install flexible duct connectors on all ductwork connected to isolated equipment. The flexible duct connectors shall meet the requirements of the mechanical equipment specifications.
- .8 All electrical connections to vibration isolated equipment shall be made with flexible conduit or other flexible means acceptable to the Departmental representative so as not to restrict the maximum anticipated movement of the equipment under the design seismic excitation. Co-ordinate with Division 26.
- .9 Provide resilient hangers on all piping, etc., rigidly connected to vibration isolated equipment. Provide the hangers for a distance of 3.0m for a 25mm pipe and 13.5m for a 250mm 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 static deflection or the static deflection of the isolated equipment. Select the remaining isolators for the lesser of 25mm static deflection or one-half the static deflection of the isolated equipment.
- .10 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.

Part 2 Products

2.1 GENERAL

- .1 Vibration isolation equipment and materials by one supplier.
- .2 All elastomeric components in isolation pads, mounts, and seismic snubbers shall be bridge bearing neoprene, meeting CSA Standard CAN3-S6 Section 11.10.

2.2 ISOLATORS-GENERAL

- .1 Supply all of the vibration isolation equipment by one approved supplier with the exception of isolators which are factory installed and are standard equipment with the machinery.
- .2 Select isolators at the supplier's optimum recommended loading and do not load beyond the limit specified in the manufacturer's literature.
- .3 All spring isolators shall be "open spring" unless otherwise stated. Seismically rated housed springs isolators such as Mason Type SSLFH may be used in place of the "open spring" isolators provided that they meet the requirements of the seismic restraint section.
- .4 Select isolators for motor driven fans of less than 0.5 HP for a minimum static deflection of 3mm.
- .5 Provide neoprene isolators for deflections 6mm and under.
- .6 Provide either neoprene or steel spring isolators for deflections between 6mm and 12mm.

2.3 ISOLATORS – STEEL SPRING

- .1 Springs shall have a working deflection between 0.3 and 0.6 of solid deflection and for base mounted equipment shall be “Iso-Stiff” ($k_x/k_y = 1.0$ to 1.5).
- .2 Springs shall meet the requirements of the following standards:
 - .1 Cold Wound/Oil Tempered:
 - .1 Standard Spring Steel – SAE 1065/ASTM225
 - .2 Chromium Silicon Steel – ASTM A-401.
 - .2 Hot Wound:
 - .1 Various Spring Steel Alloys – SAE 1095, SAE 5160, SAE 4161.
- .3 Spring mounts shall be complete with leveling devices and minimum 5mm thick neoprene acoustical spring cups located between the spring and the mount housing on at least one end of the spring.
- .4 Acoustical spring cups shall be sized for a minimum deflection of 1mm and shall meet the requirements for neoprene isolators.
- .5 Use compression springs for all spring isolators.
- .6 Springs shall be stable under operating conditions.

2.4 NEOPRENE ISOLATORS

- .1 Neoprene isolators shall have a manufacturer’s warranty covering a minimum of ten (10) years from the date of acceptance of the work, or shall be manufactured from bridge bearing quality neoprene meeting CAN/CSA-S6-88 Section 11.5.8.
- .2 Neoprene isolators shall not exceed 50 durometer.
- .3 Provide steel inter-layers to distribute the load in a multi-layered isolator. Where a ribbed pad is supplied, the height of the rib shall not exceed 0.7 times the width of the rib.
- .4 Neoprene pads or elements shall be selected at the supplier’s optimum recommended loading and shall not be loaded beyond the limit specified in the neoprene manufacturer’s literature.
- .5 Use dynamic stiffness for sizing elastomers.

2.5 HANGER MOUNTS

- .1 Satisfy requirements of this section for steel spring or neoprene isolators.
- .2 Provide hangers capable of a 15° misalignment (+/- 15°) without binding.

2.6 FLEXIBLE PIPING CONNECTORS

- .1 Provide flexible piping connectors meeting the following requirements:
 - .1 Flexible spherical expansion joints shall employ peroxide cured EPDM in the covers, liners and polyester tire cord fractioning. Curing must take place in steel moulds closed within heated hydraulic presses. Solid steel rings shall be used within the raised face rubber flanged ends to prevent pullout. Flexible cable bead wire is not acceptable.
 - .2 Connectors shall be rated at a pressure exceeding the design operating pressure of the equipment on which it will be used at the maximum operating temperature expected. All expansion joints must be factory tested to 150% of rated pressure for 12 minutes before shipment. Safety factors to burst and flange pullout shall be a minimum of 300%.
 - .3 Sizes 20mm to 40mm shall have threaded one piece bolted flange assemblies with a single sphere. Sizes 50mm to 350mm shall have two spheres reinforced with a ductile iron external ring between the spheres. Sizes 400mm and higher shall be single sphere. Sizes 50mm and higher shall be complete with split ductile iron or steel flanges with hooked or similar interlocks.
- .2 Submittals shall include test reports by independent parties on this or a similar flexible connector by the same manufacturer, demonstrating minimum reductions of 20dB in vibration accelerations and 10dB in sound pressure levels at typical blade passage frequencies for the equipment being isolated.
- .3 Provide specification data and shop drawings for proposed alternate connectors for approval, if the requirements in 2.6.1 cannot be met due to the nature of the fluid conveyed.
- .4 Protect flexible connectors from strain beyond their design limits. If control rods are required, they shall be cable type and shall include 6mm thick neoprene washer bushings sized to meet the design loading with a factor of safety of 3:1.
- .5 In order to prevent heat build-up and to facilitate inspection, flexible piping connectors in hot lines shall not be insulated unless otherwise directed.

Part 3 Execution

3.1 INSTALLATION

- .1 Execute the work in accordance with the specification and where applicable, in accordance with the manufacturer's instructions and only by workers experienced in this type of work.
- .2 Install the isolators so that they provide the rated vibration isolation after equipment start-up. Do not attach isolators to equipment or to structure in a fashion which impairs their isolation capabilities.
- .3 Provide a minimum clearance of 50mm to other structures, piping, equipment, etc., for all equipment mounted on vibration isolators.

- .4 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.
- .5 After installation and adjustment of isolators, verify deflection under load to ensure loading is within specified range.
- .6 Where isolated piping connected to noise generating equipment, position isolated piping to avoid contact with the structure, framing, gypsum wallboard and other elements which may radiate noise.
- .7 Ensure that the installed seismic restraints do not adversely affect the proper functioning of any vibration isolation products required by this section.
- .8 Install flexible duct connectors so that duct cross-section is not reduced by the deflection of the flexible connector.

3.2 INSPECTION AND REPORT

- .1 Arrange for the Departmental Representative to inspect the isolated equipment after installation and equipment start-up and to submit a concise report to the Departmental representative stating any deficiencies in the installation.

.1 Isolation Schedule

Type	Minimum Static Deflection in mm Equipment Supported By:	
	Slab on Grade	Elevated Slab
Fans, Blowers & Packaged H & V Units:		
Under 0.5 HP	1	1
0.5 HP to 7.5 HP	25	25
Over 30 KW (40 Hp) – over 400 rpm	25	40
NOTES:		
1. Table indicates required static deflection of isolators for all fans regardless of power rating and for all other motor driven equipment over 0.37kW (0.5 HP).		
2. Advise the Departmental representative of equipment not contained in this table and obtain clarification as to the isolation performance requirements.		
3. Neoprene isolators shall be used for deflections 6mm and under.		

3.3 FLEXIBLE DUCT CONNECTORS

- .1 Type D1: Flexible duct connectors.
 - .1 Provide 75 mm flexible duct connectors and a 40 mm metal to metal gap.
 - .2 Provide stabilizing springs limiting movement at flexible connections to 25% of fabric width under steady state conditions and 40% at start up.
 - .3 Flexible duct connections shall be installed so that duct size is not reduced by the deflection of the flexible connector.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Seismic restraint systems (SRS) for statically supported and vibration isolated equipment and systems; described in Sections 21, 22 and 23.
- .2 Related Sections:
 - .1 Section 01 33 00 - Shop Drawings, Product Data and Samples
 - .2 Section 01 78 30 - Closeout Submittals.
 - .3 Section 21 13 13 - Wet Pipe Sprinkler Systems
 - .4 Section 23 05 48 - Vibration Isolation for Piping & Equipment.
- .3 Contractor to retain and pay for the service of a seismic engineer registered in the Province of British Columbia to provide and submit to the Departmental Representative Assurance of Professional Design and Commitment for Field Review Schedule B and Assurance of Professional Field Review and Compliance Schedule C-B for seismic restraints

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA G40.20/G40.21-[13], General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .2 National Building Code of Canada (NBC) – 2010.
- .3 British Columbia Building Code - 2012.
- .4 Vancouver Building By-law – 2014.

1.3 DEFINITIONS

- .1 SRS: acronym for Seismic Restraint System.
- .2 SCS: acronym for Slack Cable System.
- .3 RC: acronym for Reinforced Concrete.

1.4 SYSTEM DESCRIPTION

- .1 SRS fully integrated into, and compatible with:
 - .1 Noise and vibration controls specified elsewhere.
 - .2 Structural, mechanical, electrical design of project.
- .2 Systems, equipment not required to be operational during and after seismic event.
- .3 During seismic event, SRS to prevent systems and equipment from causing personal injury and from moving from normal position.

- .4 Designed by Professional Engineer specializing in design of SRS and registered in Province of British Columbia.

1.5 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Shop Drawings, Product Data and Samples.
- .2 Shop drawings: submit drawings stamped and signed by an engineer registered or licensed in Province of British Columbia, Canada.
- .3 Submit additional copy of shop drawings and product data to the Departmental Representative for review of connection points to building structure.
- .4 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Shop Drawings, Product Data and Samples.
 - .1 Provide signed and sealed letters of assurance, as required by the authority having jurisdiction, taking responsibility for the seismic restraints.
 - .2 Provide these letters of assurance sealed by a registered Professional Engineer for the seismic restraints, "Assurance of Professional Design and Commitment for Field Review" as well as "Assurance of Professional Field Review and Compliance".
- .5 Closeout Submittals:
 - .1 Provide maintenance data including monitoring requirements for incorporation into manuals specified in Section 01 78 30 - Closeout Submittals.

Part 2 Products

2.1 SRS MANUFACTURER

- .1 SRS from one manufacturer regularly engaged in SRS production.

2.2 GENERAL

- .1 SRS to provide gentle and steady cushioning action and avoid high impact loads.
- .2 SRS to restrain seismic forces in every direction.
- .3 Fasteners and attachment points to resist same load as seismic restraints. No equipment, equipment supports or mounts to fail before failure of structure.
- .4 SRS of Piping systems compatible with:
 - .1 Expansion, anchoring and guiding requirements.
 - .2 Equipment vibration isolation and equipment SRS.
- .5 SRS utilizing cast iron, threaded pipe, other brittle materials not permitted.
- .6 Attachments to RC structure:
 - .1 Use high strength mechanical expansion anchors.
 - .2 Drilled or power driven anchors not permitted.

- .7 Seismic control measures not to interfere with integrity of firestopping.

2.3 SRS FOR STATIC EQUIPMENT & SYSTEMS

- .1 Suspended equipment, systems:
 - .1 Use one or combination of following methods:
 - .1 Install tight to structure.
 - .2 Cross-brace in every direction.
 - .3 Brace back to structure.
 - .4 Slack cable restraint system.
 - .2 SCS to prevent sway in horizontal plane, "rocking" in vertical plane, sliding and buckling in axial direction. Seismic restraints to provide gentle and steady cushioning action.
 - .3 Hanger rods to withstand compressive loading and buckling.

2.4 SRS FOR VIBRATION ISOLATED EQUIPMENT

- .1 Seismic control measures not to jeopardize noise and vibration isolation systems. Provide 6 to 9 mm clearance during normal operation of equipment and systems between seismic restraint and equipment.
- .2 Incorporate seismic restraints into vibration isolation system to resist complete isolator unloading.
- .3 Provide flexible duct connectors on all air moving equipment with motors.
- .4 Provide flexible pipe connectors on all floor-mounted pumps above grade.
- .5 As indicated.

2.5 SLACK CABLE RESTRAINT SYSTEM (SCS)

- .1 Use elastomer materials or similar to avoid high impact loads and provide gentle and steady cushioning action.
- .2 Bracing methods:
 - .1 Structural angles or channels.
 - .2 Cable restraint system incorporating grommets, shackles and other hardware to ensure alignment of restraints and to avoid bending of cables at connection points. Incorporate neoprene into cable connections to reduce shock loads.
- .3 SCS to prevent sway in horizontal plane, "rocking" in vertical plane, sliding and buckling in axial direction.
- .4 Hanger rods to withstand compressive loading and buckling.

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 Slack Cable Systems (SCS):
 - .1 Connect to suspended equipment so that axial projection of wire passes through centre of gravity of equipment.
 - .2 Use appropriate grommets, shackles, other hardware to ensure alignment of restraints and to avoid bending of cables at connection points.
 - .3 Piping systems: provide transverse SCS at 10 m spacing maximum, longitudinal SCS at 20 m maximum or as limited by anchor/slack cable performance.
 - .4 Small pipes may be rigidly secured to larger pipes for restraint purposes, but not reverse.
 - .5 Orient restraint wires on ceiling hung equipment at approximately 90 degrees to each other (in plan), tie back to structure at maximum of 45 degrees to structure.
 - .6 Adjust restraint cables so that they are not visibly slack but permit vibration isolation system to function normally.
 - .7 Tighten cable to reduce slack to 40 mm under thumb pressure. Cable not to support weight during normal operation.
- .2 Install SRS at least 25 mm from equipment, systems, and services.
- .3 Miscellaneous equipment not vibration-isolated:
 - .1 Bolt through housekeeping pad to structure.
- .4 Co-ordinate connections with other disciplines.

3.3 FIELD QUALITY CONTROL

- .1 Inspection and Certification:
 - .1 SRS: inspected and certified by Seismic Engineer upon completion of installation.
 - .2 Provide written report to the Departmental Representative with Letters of Assurance as required in the building code.
- .2 Commissioning Documentation:
 - .1 Upon completion and acceptance of certification, hand over to the Departmental Representative complete set of construction documents, revised to show "as-built" conditions.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and requirements for the identification of piping systems, ductwork, valves and controllers, including the installation and location of identification systems.
 - .2 Sustainable requirements for construction and verification.
- .2 Related Sections:
 - .1 Sections 21, 22 & 23.

1.2 REFERENCES

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.60- [97], Interior Alkyd Gloss Enamel.
 - .2 CAN/CGSB-24.3- [92], Identification of Piping Systems.
- .2 National Fire Protection Association (NFPA)
 - .1 NFPA 13-2013, Standard for the Installation of Sprinkler Systems.
- .3 Canadian Standards Association (CSA)
 - .1 CSA B128.1-06/B128.2.06 Design and Installation of non-potable water systems.

Part 2 Products

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

- .1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.
- .2 Lettering and numbers raised or recessed.
- .3 Information to include, as appropriate:
 - .1 Equipment: manufacturer's name, model, size, serial number, capacity.
 - .2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.2 SYSTEM NAMEPLATES

- .1 Colours:
 - .1 Hazardous: red letters, white background.
 - .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).

- .2 Construction:
 - .1 3 mm thick laminated plastic or white anodized aluminum, matte finish, with square corners, letters accurately aligned and machine engraved into core.

.3 Sizes:

- .1 Conform to following table:

Size # mm	Sizes (mm)	No. of Lines	Height of Letters (mm)
1	10 x 50	1	3
2	13 x 75	1	5
3	13 x 75	2	3
4	20 x 100	1	8
5	20 x 100	2	5
6	20 x 200	1	8
7	25 x 125	1	12
8	25 x 125	2	8
9	35 x 200	1	20

- .2 Use maximum of 25 letters/numbers per line.

.4 Locations:

- .1 Terminal cabinets, control panels: use size # 5.

2.3 IDENTIFICATION OF PIPING SYSTEMS

- .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 Legend:
 - .1 Block capitals to sizes and colours listed in CAN/CGSB 24.3.
- .3 Arrows showing direction of flow:
 - .1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.
 - .2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.
 - .3 Use double-headed arrows where flow is reversible.
- .4 Extent of background colour marking:
 - .1 To full circumference of pipe or insulation.
 - .2 Length to accommodate pictogram, full length of legend and arrows.
- .5 Materials for background colour marking, legend, arrows:
 - .1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.

- .2 Other pipes: pressure sensitive vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150 degrees C and intermittent temperature of 200 degrees C.

.6 Colours and Legends:

- .1 Where not listed, obtain direction from the Departmental Representative.
- .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:

Contents	Background Colour Marking	Legend
Chilled Water Supply	Blue	CHILLED SUPPLY
Chilled Water Return	Blue	CHILLED RETURN
Heating Water	Yellow	HEATING SUPPLY
Heating Water	Yellow	HEATING RETURN
Domestic hot water supply	Green	DOM. HW SUPPLY
Dom. HWS recirculation	Green	DOM. HW CIRC
Domestic cold water supply	Green	DOM. CW SUPPLY
Condensate Drain	Green	COND

2.4 VALVES, CONTROLLERS

- .1 Brass tags with 12 mm stamped identification data filled with black paint.
- .2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

2.5 CONTROLS COMPONENTS IDENTIFICATION

- .1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.
- .2 Inscriptions to include function and (where appropriate) fail-safe position.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 TIMING

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

3.3 INSTALLATION

- .1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- .2 Provide ULC and/or CSA registration plates as required by respective agency.
- .3 Identify systems, equipment to conform to PWGSC PMSS.

3.4 NAMEPLATES

- .1 Locations:
 - .1 In conspicuous location to facilitate easy reading and identification from operating floor.
- .2 Standoffs:
 - .1 Provide for nameplates on hot and/or insulated surfaces.
- .3 Protection:
 - .1 Do not paint, insulate or cover.

3.5 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

- .1 On long straight runs in open areas in ceiling: at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
- .2 Adjacent to each change in direction.
- .3 At least once in each small room through which piping or ductwork passes.
- .4 On both sides of visual obstruction or where run is difficult to follow.
- .5 On both sides of separations such as walls, floors, partitions.
- .6 Where system is installed in pipe chases, ceiling spaces, confined spaces, at entry and exit points, and at access openings.
- .7 At beginning and end points of each run and at each piece of equipment in run.
- .8 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.
- .9 Identification easily and accurately readable from usual operating areas and from access points.
 - .1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.6 VALVES, CONTROLLERS

- .1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S" hooks.

- .2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass located in upper boiler room. Provide one copy in each operating and maintenance manual.
- .3 Number valves in each system consecutively.
 - .1 Plumbing to be numbers P-1, P-2, P-3...
 - .2 HVAC to be numbered H-1, H-2, H-3...
 - .3 Fire Protection to be numbered F-1, F-2, F-3...

3.7 IDENTIFICATION

- .1 The contractor is to provide Avery coloured dots on the t-bar ceiling grid below valves and mechanical devices above. The colour of the dot shall identify the service above. i.e. red dot = heating valve above. The label shall indicate what the device is above – i.e. fancoil, below a fancoil above or Heating Valve etc.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 TAB is used throughout this Section to describe the process, methods and requirements of testing, adjusting and balancing for HVAC.
- .2 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.
- .3 Contractor shall request the existing building O & M manual prior to start of balancing to get the balancing information for the existing fancoils that the contractor requires to balance as part of this project.

1.2 QUALIFICATIONS OF TAB PERSONNEL

- .1 Submit names of personnel to perform TAB to the Departmental Representative within 60 days of award of contract.
- .2 Provide documentation confirming qualifications, successful experience.
- .3 TAB: performed in accordance with the requirements of standard under which TAB Firm's qualifications are approved:
 - .1 Associated Air Balance Council, (AABC) National Standards for Total System Balance, MN-1-[2002]
 - .2 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems-[1998]
 - .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing-[2002]
- .4 Recommendations and suggested practices contained in the TAB Standard: mandatory.
- .5 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.
- .6 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.
- .7 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.
- .8 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 TAB Specialist.
 - .2 Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

1.3 PURPOSE OF TAB

- .1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads
- .2 Adjust and regulate equipment and systems to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.
- .3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

1.4 EXCEPTIONS

- .1 TAB of systems and equipment regulated by codes, standards to satisfaction of authority having jurisdiction.

1.5 CO-ORDINATION

- .1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule to ensure completion before acceptance of project.
- .2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

1.6 START-UP

- .1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.
- .2 Follow special start-up procedures specified elsewhere in Division 23.

1.7 OPERATION OF SYSTEMS DURING TAB

- .1 Operate systems for length of time required for TAB and as required by the Departmental Representative for verification of TAB reports.

1.8 START OF TAB

- .1 Notify the Departmental Representative 7 days prior to start of TAB.
- .2 Start TAB when building is essentially completed, including:
- .3 Installation of ceilings, doors, windows, other construction affecting TAB.
- .4 Pressure, leakage, other tests specified elsewhere Division 23.
- .5 Provisions for TAB installed and operational.
- .6 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, airshafts, ceiling plenums are airtight to within specified tolerances.
- .4 Correct fan rotation.
- .5 Fire, volume control dampers installed and open.
- .6 Coil fins combed, clean.
- .7 Access doors, installed, closed.
- .8 Outlets installed, volume control dampers open.
- .3 Liquid systems:
 - .1 Flushed, filled, vented.
 - .2 Isolating and balancing valves installed, open.
 - .3 Calibrated balancing valves installed, at factory settings.

1.9 APPLICATION TOLERANCES

- .1 Do TAB to following tolerances of design values:
 - .1 HVAC systems: plus or minus 5%
 - .2 Hydronic systems: plus or minus 10 %

1.10 ACCURACY TOLERANCES

- .1 Measured values accurate to within plus or minus 2% of actual values.

1.11 INSTRUMENTS

- .1 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.
- .2 Calibrate within 3months of TAB. Provide certificate of calibration to Departmental Representative.

1.12 PRELIMINARY TAB REPORT

- .1 Submit for checking and approval of the Departmental Representative, prior to submission of formal TAB report, sample of rough TAB sheets. Include:
 - .1 Details of instruments used.
 - .2 Details of TAB procedures employed.
 - .3 Calculations procedures.
 - .4 Summaries.

1.13 TAB REPORT

- .1 Format in accordance with referenced standard.
- .2 TAB report to show results in SI units and to include:
 - .1 Project record drawings.
 - .2 System schematics.

- .3 Submit one (1) hard copy and one (1) PDF of TAB Report to the Departmental Representative for verification and approval, in D-ring binders, complete with index tabs.

1.14 VERIFICATION

- .1 Reported results subject to verification by the Departmental Representative.
- .2 Provide personnel and instrumentation to verify up to 20% of reported results.
- .3 Number and location of verified results as directed by the Departmental Representative.
- .4 Pay costs to repeat TAB as required to satisfaction of the Departmental Representative.

1.15 SETTINGS

- .1 After TAB is completed to satisfaction of the Departmental Representative, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.
- .2 Permanently mark settings to allow restoration at any time during life of facility. Do not eradicate or cover markings.

1.16 COMPLETION OF TAB

- .1 TAB considered complete when final TAB Report received and approved by the Departmental Representative.

Part 2 Execution

2.1 MANUFACTURER'S INSTRUCTIONS

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

2.2 TEST PROCEDURES

- .1 Maximum lengths of ducts to be tested consistent with capacity of test equipment.
- .2 Section of duct to be tested to include:
 - .1 Fittings, branch ducts, tap-ins.
- .3 Repeat tests until specified pressures are attained. Bear costs for repairs and repetition to tests.
- .4 Base partial system leakage calculations on SMACNA HVAC Air Duct Leakage Test Manual.
- .5 Seal leaks that can be heard or felt, regardless of their contribution to total leakage.

2.3 SITE TOLERANCES

- .1 System leakage tolerances specified are stated as percentage of total flow rate handled by system. Pro-rate specified system leakage tolerances. Leakage for sections of duct systems: not to exceed total allowable leakage.
- .2 Leakage tests on following systems not to exceed specified leakage rates.
 - .1 Small duct systems up to 250 Pa: leakage 2%.
 - .2 Large low pressure duct systems up to 500 Pa: leakage 2 %.
- .3 Evaluation of test results to use surface area of duct and pressure in duct as basic parameters.

2.4 TESTING

- .1 Test ducts before installation of insulation or other forms of concealment.
- .2 Test after seals have cured.
- .3 Test when ambient temperature will not affect effectiveness of seals, and gaskets.

2.5 AIR SYSTEM PROCEDURE

- .1 Perform balancing, adjusting and testing with building doors and windows in their normal operation position.
- .2 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 $\pm 10\%$ airflow.
 - .3 Balance branches, mains to $\pm 10\%$ airflow.
 - .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).
- .3 When balancing air outlets:
 - .1 Rough balance furthest outlets and then balance sequentially back to source.
 - .2 Fine balance furthest outlet back to source.
- .4 Take static pressure readings and air supply temperature readings at 10 points on each air system.
- .5 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.

- .6 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.
- .7 Vary total system air quantities by adjustment of fan speeds. Vary branch air quantities by damper regulation.
- .8 Where modulating dampers are provided, take measurements and balance at extreme conditions. (Balance variable volume systems at maximum airflow rate - full cooling, and at minimum airflow rate - full heating).
- .9 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.
- .10 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.

2.6 BALANCING OF HYDRONIC SYSTEMS

- .1 Open all (excepting pressure bypass must be closed) valves to fully open position including balancing valves, isolation valves, and control valves.
- .2 Execute air balance prior to initiating hydronic balance (if coils are provided).
- .3 Position and mark all automatic valves, hand valves and balancing cocks for design flow through all coils, connectors and all items in system requiring circulation of chilled water and hot water.
- .4 Upon completion of flow readings and coil adjustments, mark setting and record data.
- .5 Calibrate all pressure and temperature gauges.

2.7 BALANCING REPORT

- .1 Submit draft copies of reports prior to final acceptance of project.
- .2 Include types, serial number and dates of calibration of instruments.
- .3 Submit with report, fan curves with operating conditions plotted. Submit grille and diffuser shop drawings and diffusion factors.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Section, apply to work specified in this section.
- .2 Division 21 – Fire Suppression
- .3 Division 22 – Plumbing
- .4 Division 23 – Heating, Ventilation & Air Conditioning
- .5 Division 25 – Integrated Automation

1.2 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Shop Drawings, Product Data and Samples.
- .2 Shop drawings to show:
 - .1 Material Specification including CSA or ULC reference numbers.
 - .2 Installation details for various types of piping materials.
 - .3 Operating and maintenance requirements.
- .3 Shop drawings and product data accompanied by:
 - .1 Manufacturer to certify current model production.
 - .2 Certification of compliance to applicable codes.
- .4 Closeout Submittals:
 - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 30 - Closeout Submittals.
 - .2 Performance data to include:
 - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.

1.3 REFERENCES

- .1 Test Requirements: 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 and publishes the results in their "FIRE RESISTANCE RATINGS DIRECTORY" that is updated annually.

- .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
- .5 Inspection Requirements: ASTM E 2174 – 01, "Standard Practice for On-site Inspection of Installed Fire Stops.
- .6 CAN/ULC-S102-M, Standard Test Method for Surface Burning Characteristics of Building Materials.
- .7 All major building codes: NBC and BCBC.
- .8 NFPA 101 - Life Safety Code

1.4 DEFINITIONS

- .1 Firestopping: Material or combination of materials used to retain integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke, and hot gases through penetrations in fire rated wall and floor assemblies.

1.5 QUALITY ASSURANCE

- .1 Engage an experienced Installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having been provided the necessary training to install manufacturer's products per specified requirements. A manufacturer's willingness to sell its firestopping products to the Contractor or to an Installer engaged by the Contractor does not in itself confer qualification on the buyer.
- .2 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 Departmental Representative, in accordance with the BC Building Code.
- .3 A manufacturer's direct representative (not distributor or agent) to be on-site during initial installation of firestop systems to train appropriate contractor personnel in proper selection and installation procedures. This will be done per manufacturer's written recommendations published in their literature and drawing details.
- .4 Firestop System installation must meet requirements of CAN4-S115-M or ULC S-115-M tested assemblies that provide a fire rating.
- .5 Proposed firestop materials and methods shall conform to applicable governing codes having local jurisdiction.
- .6 Firestop Systems do not re-establish the structural integrity of load bearing partitions/assemblies, or support live loads and traffic. Installer shall retain and pay for the services of a structural engineer registered in the Province of British Columbia to review structure prior to penetrating any load bearing assembly.

- .7 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)

1.6 ACCEPTABLE MANUFACTURERS

- .1 Subject to compliance with through penetration firestop systems listed in U.L.C Fire Resistance Directory – Volume III or UL Products Certified for Canada (cUL) Directory, provide products that are listed in the U.L.C Fire Resistance Directory – Volume III or UL Products Certified for Canada (cUL) Director.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Storage and Protection:
 - .1 Store materials indoors in dry location.
 - .2 Store and protect materials from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.
- .3 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.

Part 2 Products

2.1 FIRESTOPPING, GENERAL

- .1 Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by the firestopping manufacturer based on testing and field experience.
- .2 Provide components for each firestopping system that are needed to install fill material. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.
- .3 Firestopping Materials are “post installed”.

2.2 MATERIALS

- .1 Use only firestop products that have been ULC or cUL tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance.
- .2 Sealants or caulking materials for use with non-combustible items including steel pipe, copper pipe, rigid steel conduit and electrical metallic tubing (EMT) that are listed in the U.L.C Fire Resistance Directory – Volume III or UL Products Certified for Canada (cUL) Directory
- .3 Intumescent sealants or caulking materials for use with combustible items (penetrants consumed by high heat and flame) including insulated metal pipe, PVC jacketed, flexible cable or cable bundles and plastic pipe. Products listed in the U.L.C Fire Resistance Directory – Volume III or UL Products Certified for Canada (cUL) Directory
- .4 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

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.

Part 3 Execution

3.1 PREPARATION

- .1 Verification of Conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.
 - .1 Verify penetrations are properly sized and in suitable condition for application of materials.
 - .2 Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, rust, laitance, release agents, water repellents, and any other substances that may affect proper adhesion.
 - .3 Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.
 - .4 Comply with manufacturer's recommendations for temperature and humidity conditions before, during and after installation of firestopping.
 - .5 Do not proceed until unsatisfactory conditions have been corrected.

3.2 COORDINATION

- .1 Coordinate location and proper selection of cast-in-place Firestop Devices with trade responsible for the work. Ensure device is installed before placement of concrete.
- .2 Responsible trade to provide adequate spacing of field run pipes to allow for installation of cast-in-place firestop devices without interferences.

3.3 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 the Departmental Representative, 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.

3.4 FIELD QUALITY CONTROL

- .1 Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas.
- .2 Keep areas of work accessible until inspection by applicable code authorities.
- .3 Inspection of through-penetration firestopping shall be performed in accordance with ASTM E 2174, "Standard Practice for On-Site Inspection of Installed Fire Stops" or other recognized standard.
- .4 Perform under this section patching and repairing of firestopping caused by cutting or penetrating of existing firestop systems already installed by other trades.

3.5 ADJUSTING AND CLEANING

- .1 Remove equipment, materials and debris, leaving area in undamaged, clean condition.
- .2 Clean all surfaces adjacent to sealed holes and joints to be free of excess firestop materials and soiling as work progresses.

END OF SECTION

Part 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
- .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 CGSB 51-GP-52MA – Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation
- .7 ASTM C612 – Standard Specification for Mineral Fiber Block and Board Thermal Insulation
- .8 ASTM C534 Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- .9 ASTM C553 – Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
- .10 ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining.
- .11 ASTM C1290 – Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.

1.4 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), 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).
 - .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 HVAC ductwork and as follows:
 - .1 Hot duct and plenum - 20°C to 65°C (-4°F to 149°F)
 - .2 Cold or dual temp duct and plenum - sub-ambient to 65°C (149°F)
 - .3 Insulation may be omitted on return air and exhaust air ducts and plenums located within the conditioned space.
 - .4 Insulation may be omitted on exposed ductwork in the area served by that duct.
 - .5 Insulation may be omitted on ductwork in return air plenums provided the ductwork serves that area.
 - .5 Provide acoustic internal insulation on ductwork and as follows:
 - .1 All ductwork indicated on drawings with cross hatching.
 - .6 Make good all existing insulation disturbed or removed to facilitate alterations and additions to existing piping.
- 1.5 WASTE MANAGEMENT**
- .1 Refer to the requirements in Section 01 74 19 – Waste Management & Disposal.

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS

- .1 The contractor shall provide products that meet or exceed the performance specification.

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.

2.3 INTERMEDIATE TEMPERATURE RANGE INSULATION (15°C TO 315°C)

- .1 External flexible duct wrap insulation (TIAC C-2):
 - .1 Service temperature 5°C to 121°C
 - .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
 - .7 Minimum RSI 0.49/25mm installed
- .2 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 Density 48kg/m³
 - .6 Minimum RSI 0.76/25mm

.7 Insertion loss:

Thickness mm	Frequency (Hz.)						
	125	250	500	1000	2000	4000	NRC
25	0.13	0.24	0.56	0.83	0.92	0.98	0.65
40	0.19	0.41	0.89	1.02	1.03	1.04	0.85
50	0.33	0.67	1.07	1.07	1.03	1.06	0.95

.3 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 Density 24kg/m³
- .6 Minimum RSI 0.74/25mm
- .7 Insertion loss:

Thickness mm	Frequency (Hz.)						
	125	250	500	1000	2000	4000	NRC
25	0.18	0.36	0.59	0.86	0.95	0.9	0.7
40	0.35	0.51	0.83	0.93	0.97	0.96	0.8
50	0.34	0.64	0.96	1.03	1	1.03	0.9

2.4 FASTENINGS, ADHESIVES AND COATINGS

- .1 Insulation Fastenings:
 - .1 1.6 mm (16 ga) galvanized 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, 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 fire retardant canvas jacket for covering mechanical insulation indoors, 25/50 fire class, plain wave cotton, no dyes.

Part 3 Execution

3.1 GENERAL

- .1 Supply and return ductwork exposed in the space being served does not require insulation.
- .2 Installation shall be to Thermal Insulation Association of Canada (TIAC): National Insulation Standards and the following:

3.2 FLEXIBLE INSULATION EXTERNAL APPLICATION

- .1 Hot Duct and Plenum - 20°C to 65°C (CEF/1)
 - .1 On rectangular ducts ≥ 600 mm 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 Cold or Dual Temp Duct and Plenum – sub-ambient to 65°C (CEF/2)
 - .1 On rectangular ducts ≥ 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 Hot Duct and Plenum Fire Barrier – ambient to 538°C
 - .1 As per manufacturers installation instructions

3.3 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 RSI value specified for external insulation. Where no external insulation is required internal acoustic duct liner shall be a minimum 25mm.

- .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 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 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 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 use metal nosing.

3.4 FINISHES

- .1 General
 - .1 Insulation on concealed ductwork shall be left with factory finish. No further finish is required.

3.5 DUCT INSULATION MINIMUM THICKNESS TABLE (ASHRAE 90.1 ZONE 5, 6, 7)

Duty	Plenum(4)	Duct Location - Interior	
		Conditioned Space	Unconditioned Space
	Insulation R-Value RSI (R)		
Cooling Air Supply	0.7	0.7	0.7
Heating Air Supply	1	1	1
Combined H/C Supply	1	1	1
Return Air	0.7	0	0.7
Exhaust Air (1)(2)	0.7	0	0.7
Tempered Air	0.7	0.7	0.7
See note (3) for internal duct liner			
See note (5) for factory installed duct and plenums			

- .1 Note 1: Air temperatures 15°C to 49°C (60°F to 120°F)
- .2 Note 2: Provide RSI 0.58 insulation on all exhaust air ductwork from outside wall or roof to damper but a minimum of 1.5 m inside building.
- .3 Note 3: Where an interior duct liner is used the thickness shall be selected to match the RSI value specified for external insulation. Internal acoustic duct liner shall be a minimum 25mm where external insulation is not required.
- .4 Note (4): Provides 1 hour fire rating. Thickness shall be doubled for 2 hour applications
- .5 Note (5): Factory installed ductwork and plenums provided with equipment need not comply with this table provided they meet the minimum energy efficiency requirements listed in ASHRAE 90.1 tables 6.8.1A through 6.8.1K.

3.6 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
Indoor Exposed in Utility Areas, etc.	Utility Finish	CRF/2	Utility Finish	CRD/2

END OF SECTION

Part 1 General

1.1 SECTION SCOPE

- .1 Thermal insulation and jacketing for HVAC piping and HVAC 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
- .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 C534 – Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- .7 ASTM C547 – Standard Specification for Mineral Fibre Pipe Insulation.

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), 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).
- .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 HVAC piping, valves and fittings and as follows:
 - .1 Hot water heating supply and return piping.
 - .2 Condensate piping.
 - .3 Insulate the following valves and fittings if the pipe is insulated:
 - .1 Elbows, tees, reducers.
 - .2 Valve bodies on valves and check valves, over 2½ NPS
 - .3 Flanges.
 - .4 Strainers.
 - .5 Chilled water piping, refrigerant piping, fittings, and valves shall be insulated and vapour sealed unless noted otherwise. This includes:
 - .1 Chilled water supply and return.
 - .6 Insulate and vapour seal the following fittings, if the pipe is insulated:
 - .1 Elbows, tees, reducers.
 - .2 Valves, (bodies and bonnets) except check valve covers.
 - .3 Strainers.
 - .4 Flanges.
 - .5 Unions.
 - .7 DO NOT insulate the following, unless otherwise noted:
 - .1 Drain lines for sumps 15°C and over.
 - .8 Make good all existing insulation disturbed or removed to facilitate alterations and additions to existing piping

1.6 WASTE MANAGEMENT

- .1 Refer to the requirements in Section 01 74 19 – Waste Management & Disposal.

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS

- .1 The Contractor shall provide products that meet or exceed the specified performance.

2.2 GENERAL

- .1 Products shall not contain asbestos, lead, mercury, mercury compounds or Polybrominated diphenyl ethers (PBDE).
- .2 Mineral fibre specified includes glass fibre 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 Foam insulation products shall not use CFC or HCFC blowing agents in the manufacturing process and be formaldehyde free.
- .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.

2.3 PREFORMED PIPE COVERING

- .1 Low Temperature Thermal Insulation
 - .1 Piping service temperature -40°C to 5°C
 - .2 Complying with ASTM C534
 - .3 Preformed and pre-slit flexible foamed elastomeric insulation with self-adhesive self seal or lap seal joints:
 - .1 Maximum "K" value at 24°C = 0.039 W/m.°C
 - .4 Preformed flexible closed cell insulation:
 - .1 Maximum "K" value at 24°C = 0.036 W/m.°C
 - .5 Phenolic closed cell preformed rigid insulation with all service jacket vapour retarder (ASJ). ASJ shall be re-enforced with glass fibre, factory applied with pressure sensitive lap closure.
 - .1 Maximum "K" value at 24°C = 0.019 W/m.°C
- .2 Low to Intermediate Temperature Thermal Insulation
 - .1 Piping service temperature 5°C to 315°C
 - .2 Preformed insulation, mineral glass 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 Complying with ASTM C547.
 - .4 ASJ vapour transmission rate 0.02 perms maximum

- .5 Maximum “K” value at 38°C = 0.035 W/m.°C

2.4 FASTENINGS, ADHESIVES AND COATINGS

- .1 Insulation Fastenings: 1.6 mm galvanized 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:

Part 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 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
- .5 Install hangers, supports outside vapour retarder jacket.
- .6 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.
- .7 Ensure insulation is continuous through inside walls. Pack around pipes with fire proof self-supporting insulation material, properly sealed.
- .8 Insulate piping, fittings, and valves. Do not insulate unions, flanges (except on flanged valves), couplings, strainers, flexible connections, and expansion joints. Terminate insulation neatly with plastic material trowelled on a bevel.

- .9 Locate insulation or cover seams in least visible locations. Locate seams on piping in ceiling spaces on the underside of the pipe.
- .10 Terminate insulation 75 mm back from all uninsulated fittings to provide working clearance. Terminate insulation at 90°, finish with reinforced scrim cloth, and vapour barrier mastic system or use vapour barrier mastic and pre-formed fitting cover over.
- .11 Do not insulate exposed run-outs to heating fixtures, valves, fittings etc. Runouts to individual terminal units shall not exceed 3700mm in length.

3.2 INSTALLATION COLD AND CHILLED WATER APPLICATION - (5°C TO 15°C) TIAC 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 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) TIAC 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 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.
 - .1 Exposed Piping Indoor (Canvas) CPF/1:
 - .2 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

3.5 APPLICATION DESIGN OPERATING TEMPERATURES

- .1 Chilled Water 7°C
- .2 Heating Water 82°C

3.6 PIPING INSULATION MINIMUM THICKNESS SCHEDULE

Type Of System	Design Operating Temperature Range °C	Thermal Conductivity of Insulation		Nominal Pipe Diameter NPS				
		Conductivity Range W/m.°C	Mean Rating Temperature °C	Runouts ≤ 1	1 to 1.25	1.5 to 3	4 to 6	≥ 8
				Minimum Thickness of Piping Insulation (mm)				
Heating Systems (Hot Water)	>177	0.046-0.049	121	115	125	125	125	125
	122-177	0.042-0.046	93	75	100	115	115	115
	94-121	0.039-0.043	65	65	65	75	75	75
	61-93	0.036-0.042	52	40	40	50	50	50
	41-60	0.032-0.040	38	25	25	40	40	40
Cooling Systems (Chilled Water, Refrigeration)	5-13	0.033-0.039	24	25	25	25	25	25
	<5	0.029-0.037	10	25	25	25	25	40

- .1 Note: For piping located exterior to the building envelope (incl. unheated areas of the building i.e. parkade) the insulation thickness shall increase to the next higher row for temperature range in the table above (i.e. 82°C HWS would move from 61-93°C range to the 94-121°C range).
- .2 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 U_2/U_1 .
 - .1 U_2 = proposed insulation “k” value at the table mean rating temperature.
 - .2 U_1 = upper range limit “k” value from the table above.
- .3 Note: Where thermal conductivity of proposed insulation is less than the range specified above, the thickness may be decreased by the ratio of U_2/U_1 .
 - .1 U_2 = proposed insulation “k” value at the table mean rating temperature.
 - .2 U_1 = lower range limit “k” value from the table above.

3.7 PIPING FINISH SCHEDULE

- .1 Conform to the following:

Duty	Type	TIAC Code
Indoors, Concealed	Factory	CPF/2
Indoors, Exposed in Mechanical Room	Canvas Jacket	CPF/1
Indoors, Exposed in Utility Areas etc.	PVC Jacket	CPF/4

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Procedures and cleaning solutions for cleaning mechanical piping systems.
- .2 Related Sections:
 - .1 Section 21 13 13 Wet Piping Sprinkler System.
 - .2 Section 22 10 16 Domestic Water Piping

1.2 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Shop Drawings, Product Data and Samples. Include product characteristics, performance criteria, and limitations.
 - .2 Submit shop drawings with complete description of proposed chemicals, quantities, calculations, procedures, test kits and equipment to be supplied. Along with product shop drawings, provide copies of data sheets, procedure instructions and analysis reports to be used on this project. Shop drawings shall be submitted within 10 working days of the award of contract.
 - .3 Include with the shop drawings Material Safety Data Sheets (MSDS) for all chemicals to be used.
 - .4 Provide written reports containing procedure of system cleaning and degreasing, giving times, dates, conditions of water and problems and actions encountered.

1.4 QUALITY CONTROL:

- .1 Provide proper storage and containment of mechanical chemical treatment.
 - .1 Design and construction of storage spaces for hazardous materials in accordance with BC building and fire codes.
 - .2 Provide ventilation of areas, which contain potential sources of air contamination. Comply with standards for storage of flammable, combustible and hazardous materials, explosives, compressed gas cylinders, and reactive, corrosive and oxidizing materials.
 - .3 Storage conditions, ventilation requirements, construction materials storage areas, containers, drums and tanks, compatibility issues, and labelling: in accordance with federal and municipal guidelines supplemented as follows:

- .1 Confine storage of chemicals to designated areas with security of access.
- .2 Provide access to hose bib and water for mixing concentrated chemicals.
- .3 Provide containment to prevent spills from entering drains.
- .4 Provide venting to exterior.
- .5 Keep storage areas under negative pressure, where possible.

Part 2 Products

2.1 CLEANING SOLUTIONS

- .1 Tri-sodium phosphate: 0.40 kg per 100 L water in system.
- .2 Sodium carbonate: 0.40 kg per 100 L water in system.
- .3 Low-foaming detergent: 0.01 kg per 100 L water in system.

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 CLEANING HYDRONIC SYSTEMS

- .1 Timing: systems operational, hydrostatically tested and with safety devices functional, before cleaning is carried out.
- .2 Cleaning Agency:
 - .1 Retain qualified water treatment specialist to perform system cleaning.
- .3 Install instrumentation such as flow meters, flow-metering valves only after cleaning is certified as complete.
- .4 Cleaning procedures:
 - .1 Provide detailed report outlining proposed cleaning procedures at least 2 weeks prior to proposed starting date. Report to include:
 - .1 Cleaning procedures, flow rates, elapsed time.
 - .2 Chemicals and concentrations used.
 - .3 Inhibitors and concentrations.
 - .4 Specific requirements for completion of work.
 - .5 Special precautions for protecting piping system materials and components.
 - .6 Complete analysis of water used to ensure water will not damage systems or equipment.

- .5 Conditions at time of cleaning of systems:
 - .1 Systems: free from construction debris, dirt and other foreign material.
 - .2 Control valves: operational, fully open to ensure that terminal units can be cleaned properly.
 - .3 Strainers: clean prior to initial fill.
 - .4 Install temporary filters on pumps not equipped with permanent filters.
 - .5 Install pressure gauges on strainers to detect plugging.
- .6 Report on Completion of Cleaning:
 - .1 When cleaning is completed, submit report, complete with certificate of compliance with specifications of cleaning component supplier.
- .7 Hydronic Systems:
 - .1 Fill system with water, ensure air is vented from system.
 - .2 Fill expansion tanks 1/3 to 1/2 full, charge system with compressed air to at least 35 kPa (does not apply to diaphragm type expansion tanks).
 - .3 Use water meter to record volume of water in system to +/- 0.5%.
 - .4 Add chemicals under direct supervision of chemical treatment supplier.
 - .5 Closed loop systems: circulate system cleaner at 60 degrees C for at least 36 h. Drain as quickly as possible. Refill with water and inhibitors. Test concentrations and adjust to recommended levels.
 - .6 Flush velocity in system mains and branches to ensure removal of debris. System pumps may be used for circulating cleaning solution provided that velocities are adequate.
 - .7 Add chemical solution to system.
 - .8 Establish circulation, raise temperature slowly to maximum design. Circulate for 12 h, ensuring flow in all circuits. Remove heat; continue to circulate until temperature is below 38 degrees C. Drain as quickly as possible. Refill with clean water. Circulate for 6 h at design temperature. Drain and repeat procedures specified above. Flush through low point drains in system. Refill with clean water adding to sodium sulphite (test for residual sulphite).
- .8 Protect and/or remove control devices from systems during cleaning. All terminal control valves shall be in open position during cleaning. Particular attention is to be made to control valves which have a normally closed position.
- .9 Make systems completely operational, totally filled, thoroughly vented, and completely started.
- .10 For hot water heating (and geothermal loop heat exchanger systems if used) apply heat while circulating, raise temperature to 71°C slowly and maintain at 71°C for a minimum of 12 hours. Remove heat and circulate systems to 38°C or less. Drain system, entirely at one time, including all low points and coils. Intermittent start/stop of drainage is not approved. The mechanical contractor to provide additional temporary pipe, pumps as necessary and drainage location for complete drainage. Refill the entire system with clean water, circulate for six hours at design temperature, provide complete venting and

deaeration, repeat the draining procedure. Refill complete system with clean water and retest.

- .11 For chilled water systems utilize the same procedures specified above for hot water heating systems; however, circulate at ambient temperature for a minimum of 48 hours.
- .12 For open systems clean, degrease and flush in the same methods utilized for closed systems of same temperature. Drain completely and refill.
- .13 Inspect, clean of sludge and flush all low points with clean water after cleaning and degreasing process is completed. Include disassembly of components as required. All cleaning and flushing of low points, coils, boilers, etc. shall be done prior to final fill and chemical treatment.
- .14 All domestic hot, cold and domestic recirculation water systems will be required to be flushed and disinfected. Add chlorine to water in system to 50 milligrams per litre and let stand for 24 hours. Check chlorine content after 24 hours and insure the content is not less than 20 mg per L. If less than 20 mg per L repeat process. Flush system until the chlorine content of water being drained is equal to the chlorine content of the make-up water. Utilize plumbing fixtures (i.e. lav., sinks, flushometers, etc.) for drainage.

3.3 START-UP OF HYDRONIC SYSTEMS

- .1 After cleaning is completed and system is filled:
 - .1 Establish circulation and expansion tank level, set pressure controls.
 - .2 Ensure air is removed.
 - .3 Check pumps to be free from air, debris, possibility of cavitation when system is at design temperature.
 - .4 Dismantle system pumps used for cleaning, inspect, replace worn parts, install new gaskets and new set of seals.
 - .5 Clean out strainers repeatedly until system is clean.
 - .6 Check water level in expansion tank with cold water with circulating pumps OFF and again with pumps ON.
 - .7 Repeat with water at design temperature.
 - .8 Check pressurization to ensure proper operation and to prevent water hammer, flashing, cavitation. Eliminate water hammer and other noises.
 - .9 Perform TAB as specified in Section 23 05 93 – Testing, Adjusting and Balancing - HVAC.
 - .10 Adjust pipe supports, hangers, springs as necessary.
 - .11 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.
 - .12 Re-tighten bolts using torque wrench, to compensate for heat-caused relaxation. Repeat several times during commissioning.
 - .13 Check operation of drain valves.
 - .14 Adjust valve stem packings as systems settle down.
 - .15 Fully open balancing valves (except those that are factory-set).

- .16 Check operation of over-temperature protection devices on circulating pumps.
- .17 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.

3.4 FIELD QUALITY CONTROL

- .1 Verification requirements include:
 - .1 Submission of MSDS Sheets of all chemicals stored.
 - .2 Documentation of all chemicals being properly disposed of after flushing is completed
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.
- .3 Provide a written report, for inclusion in the O&M manuals, of the pipe cleaning and results. Keep accurate logs for addition of cleaner, removal of cleaner and addition of inhibitor or glycol.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 The control sequences contain a general description of the intent of the operation of the systems to be controlled. The Contractor shall review individual systems to ensure equipment and life safety interlocks are not overridden.
- .2 The relationships between the points, systems and building are described in the control sequences.
- .3 Consult with the Departmental Representative during the shop drawing stage to finalize the control sequences for each system.
- .4 All controls to be done by base building controls contractor – Trane.

Part 2 Products

2.1 NOT APPLICABLE

Part 3 Execution

3.1 GENERAL

- .1 Provide database for all hardware points listed for system operation to meet specification operating sequences.
- .2 BAS to tie into existing 401 Burrard BAS system.
- .3 All control wiring shall be in conduit.

3.2 SEQUENCE OF OPERATION

- .1 Fan Coils – existing
 - .1 No upgrade required – fan coils currently controlled by existing Trane DDC system.
 - .2 Fan coils 7.25 and 8.24 – New four pipe heating and cooling.
 - .1 General
 - .1 Four pipe fan coils to provide heating and cooling to individual spaces. All two-way valves to be modulating.
 - .2 Provide wall mounted sensor as per base building and connect to DDC system.
 - .3 Heating: on call for heating, cooling coil valve to modulate closed. On further call for heating coil to modulate open.
 - .4 Cooling: On call for cooling, heating coil valve to modulate closed. On further call for cooling coil to modulate open.

- .5 Provide S/A duct temperature sensor for information point.
- .6 Fan coil to start/stop based on time of day schedule as per base building.
- .7 Provide status point.
- .2 Alarms
 - .1 No alarms required.
- .3 Graphics – DDC graphics to illustrate all related points as described above and to meet base building standards.
- .3 Fan Coil 8.25: New two-pipe cooling only (server room#809)
 - .1 General
 - .1 Two-pipe fancoil to provide cooling only to server room.
 - .2 Provide wall mounted sensor as per base building and connect to DDC system.
 - .3 Cooling: On call for cooling, cooling coil valve to modulate open.
 - .4 Provide S/A duct temperature sensor for information point.
 - .5 Fan coil to run based upon call for cooling.
 - .6 Provide status report.
 - .7 Fan coil to be programmed to run 24/7 with chilled water available at all times.
 - .2 Alarms
 - .1 Provide high temperature alarm.
 - .3 Graphics – DDC graphics to illustrate all related points as described above and to meet base building standards.
- .4 Fan coils 8.1, 8.2, 8.16, 8.17, 8.18, 8.20, 8.21, 8.24: Four-pipe heating and cooling for 24/7 operation.
- .5 Exhaust Fan for EF 7.1
 - .1 General
 - .1 Fan to run based on time of day schedule.
 - .2 Provide status.
 - .2 Alarm
 - .1 No alarms required.
 - .2 Graphics - DDC graphics to illustrate all related points as described above and to meet base building standards.
- .6 Exhaust Fan for EF 7.2
 - .1 General
 - .1 Fan to run based on time of day schedule.
 - .2 Provide status.
 - .2 Alarm
 - .1 No alarms required.

- .3 Graphics - DDC graphics to illustrate all related points as described above and to meet base building standards.
- .7 Clean Agent Fire Protection System
 - .1 Clean agent releasing panel has 24 V dry contacts provided. Controls contractor to wire from panel to these devices.
 - .2 Provide 24 V control wiring from panel to S/A motorized damper. Low leakage damper and 24 V actuator by control contractor.
 - .3 Provide 24V control wiring from panel to R/A motorized damper. Low leakage damper and 24 V actuator by control contractor.
 - .4 Provide 24 V control wiring from panel to fan motor to stop for upon release of agent.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

- .1 Copper piping valves and fittings for hydronic systems.

1.2 RELATED SECTIONS.

- .1 Section 01 33 00 - Shop Drawings, Product Data and Samples.
- .2 Section 01 78 30 - Closeout Submittals.
- .3 Section 23 05 00 - Common Work Results - Mechanical.
- .4 Section 23 08 06 - Cleaning and Start-up of Mechanical Piping Systems.
- .5 Section 23 05 01 – Pipe Installation.
- .6 Section 23 05 22 - Valves - Bronze.
- .7 Section 23 05 93 – Testing, Adjusting and Balancing - HVAC.

1.3 REFERENCES

- .1 American National Standards Institute (ANSI)/American Welding Society (AWS)
 - .1 ANSI/AWS A5.8/A5.8M-[04], Specification Filler Metals for Brazing and Bronze Welding.
- .2 American Society of Mechanical Engineers (ASME)
 - .1 ANSI/ASME B16.4- 98, Gray-Iron Threaded Fittings.
 - .2 ANSI/ASME B16.15- 2004, Cast Bronze Threaded Fittings.
 - .3 ANSI B16.18- 2001, Cast Copper Alloy, Solder Joint Pressure Fittings.
 - .4 ANSI/ASME B16.22- 2001, Wrought Copper and Copper-Alloy Solder Joint Pressure Fittings.
- .3 American Society for Testing and Materials International (ASTM)
 - .1 ASTM B32- 04, Standard Specification for Solder Metal.
- .4 Manufacturers Standardization Society (MSS)
 - .1 MSS SP67- [2002a], Butterfly Valves.
 - .2 MSS SP70- [1998], Cast Iron Gate Valves, Flanged and Threaded Ends.
 - .3 MSS SP71- [1997], Grey Iron Swing Check Valves, Flanged and Threaded Ends.
 - .4 MSS SP80- [2003], Bronze Gate, Globe, Angle and Check Valves.
 - .5 MSS SP85- [2002], Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.4 SUBMITTALS

- .1 Closeout Submittals:
 - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 30 - Closeout Submittals.

1.5 WASTE MANAGEMENT

- .1 Refer to the requirements in Section 01 74 19 – Waste Management & Disposal.

Part 2 Products

2.1 PIPING

- .1 Type A hard drawn copper tubing: to ASTM B88M
- .2 Type 'L' hard copper ASTM B88M

2.2 FITTINGS

- .1 Cast bronze threaded fittings: to ANSI/ASME B16.15.
- .2 Wrought copper and copper alloy solder joint pressure fittings: to ANSI/ASME B16.22.
- .3 Cast iron threaded fittings: to ANSI/ASME B16.4.
- .4 Cast copper alloy solder joint pressure fittings: to ANSI B16.18.

2.3 FLANGES

- .1 Brass or bronze: threaded.
- .2 Cast iron: threaded.
- .3 Orifice flanges: slip-on, raised face, 2100 kPa.

2.4 JOINTS

- .1 Solder, tin-antimony, 95:5: to ASTM B32.
- .2 Silver solder BCUP: to ANSI/AWS A5.8.
- .3 Brazing: as indicated.

2.5 VALVES

- .1 Connections:
 - .1 NPS 2 and smaller: ends for soldering.
 - .2 NPS 2 1/2 and larger: flanged and / or grooved ends.
- .2 Gate Valves : Application: isolating equipment, control valves, pipelines:
 - .1 Class 125, as specified Section 23 05 22 - Valves - Bronze.

- .3 Globe valves: application: throttling, flow control, emergency bypass:
 - .1 Class 125 as specified Section 23 05 22 - Valves - Bronze.
- .4 Balancing, for TAB:
 - .1 Sizes: calibrated balancing valves, as specified.
 - .2 Class 125, as specified Section 23 05 22 - Valves - Bronze.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 PIPING INSTALLATION

- .1 Connect to equipment in accordance with manufacturer's instruction unless otherwise indicated.
- .2 Install concealed pipes close to building structure to keep furring space to minimum. Install to conserve headroom and space. Run exposed piping parallel to walls. Group piping wherever practical.
- .3 Slope piping in direction of drainage and for positive venting.
- .4 Use eccentric reducers at pipe size change installed to provide positive drainage or positive venting.
- .5 Provide clearance for installation of insulation and access for maintenance of equipment, valves and fittings.
- .6 Assemble piping using fittings manufactured to ANSI standards.

3.3 VALVE INSTALLATION

- .1 Install rising stem valves in upright position with stem above horizontal.
- .2 Install gate or ball valves at branch take-offs and to isolate each piece of equipment, and as indicated.
- .3 Install globe valves in by-pass around control valves as indicated.
- .4 Install circuit setting globe valves for balancing with lockshield.
- .5 Install silent check valves on discharge of pumps and in vertical pipes with downward flow and as indicated.
- .6 Install swing check valves in horizontal lines on discharge of pumps.
- .7 Install plug cocks for gas isolation service.
- .8 Triple duty valves are not allowed.

3.4 CIRCUIT BALANCING VALVES

- .1 Install flow measuring stations and flow balancing valves at all balancing locations.
- .2 Tape joints in prefabricated insulation on valves installed in chilled water mains.

3.5 FLUSHING AND CLEANING

- .1 Flush and clean in presence of the Departmental representative and chemical treatment representative. Refer to section 23 08 06 Cleaning and Start Up of Mechanical Piping Systems.
- .2 Flush after pressure test for a minimum of 4h.
- .3 Fill with solution of water and non-foaming, phosphate-free detergent 3% solution by weight. Circulate for minimum of 8h.
- .4 Refill system with clean water. Circulate for at least 4h. Clean out strainer screens/baskets regularly. Then drain.
- .5 Refill system with clean water. Circulate for at least 2h. Clean out strainer screens/baskets regularly. Then drain.
- .6 Drainage to include drain valves, dirt pockets, strainers, low points in system.

3.6 FILLING OF SYSTEM

- .1 Refill system with clean water adding water treatment as specified.

3.7 FIELD QUALITY CONTROL

- .1 Testing:
 - .1 Test system in accordance with Section 23 05 00 - Common Work Results - Mechanical.

3.8 CLEANING

- .1 Proceed in accordance with Refer to section 23 08 06 Cleaning and Start Up of Mechanical Piping Systems.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes.
 - .1 Materials and installation for steel piping, valves and fittings for hydronic systems.
 - .2 Sustainable requirements for construction and verification.
- .2 Related Sections.
 - .1 Section 01 33 00 - Shop Drawings, Product Data and Samples.
 - .2 Section 01 74 19 - Waste Management And Disposal.
 - .3 Section 01 35 33 - Health and Safety Requirements.
 - .4 Section 01 78 30 - Closeout Submittals.
 - .5 Section 23 05 00 - Common Work Results - Mechanical.
 - .6 Section 23 08 06- Cleaning and Start-up of Mechanical Piping Systems.
 - .7 Section 23 05 01 – Pipe Installation.
 - .8 Section 23 05 22 - Valves - Bronze.
 - .9 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

1.2 REFERENCES

- .1 American Society of Mechanical Engineers (ASME).
 - .1 ASME B16.1- [98], Cast Iron Pipe Flanges and Flanged Fittings.
 - .2 ASME B16.3- [98], Malleable Iron Threaded Fittings.
 - .3 ASME B16.5- [03], Pipe Flanges and Flanged Fittings.
 - .4 ASME B16.9- [01], Factory-Made Wrought Buttwelding Fittings.
 - .5 ASME B18.2.1- [03], Square and Hex Bolts and Screws (Inch Series).
 - .6 ASME B18.2.2- [87(R1999)], Square and Hex Nuts (Inch Series).
- .2 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM A47/A47M- [99], Standard Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A53/A53M- [02], Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
 - .3 ASTM A536- [84(1999) e1], Standard Specification for Ductile Iron Castings.
 - .4 ASTM B61- [02], Standard Specification for Steam or Valve Bronze Castings.
 - .5 ASTM B62- [02], Standard Specification for Composition Bronze or Ounce Metal Castings.
 - .6 ASTM E202- [00], Standard Test Method for Analysis of Ethylene Glycols and Propylene Glycols.

- .3 Canadian Standards Association (CSA International).
 - .1 CSA B242- [M1980 (R1998)], Groove and Shoulder Type Mechanical Pipe Couplings.
 - .2 CAN/CSA W48-[01], Filler Metals and Allied Materials for Metal Arc Welding (Developed in cooperation with the Canadian Welding Bureau).
- .4 Manufacturer's Standardization of the Valve and Fittings Industry (MSS).
 - .1 MSS-SP-67- [025], Butterfly Valves.
 - .2 MSS-SP-70- [98], Cast Iron Gate Valves, Flanged and Threaded Ends.
 - .3 MSS-SP-71- [97], Cast Iron Swing Check Valves Flanged and Threaded Ends.
 - .4 MSS-SP-80- [03], Bronze Gate, Globe, Angle and Check Valves.
 - .5 MSS-SP-85- [02], Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal.
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
 - .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard and packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
 - .4 Fold up metal and plastic banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 PIPE

- .1 Steel pipe: to ASTM A53/A53M, Sch. 40, Grade B:

2.2 PIPE JOINTS

- .1 NPS2 and under: screwed fittings with PTFE tape or lead-free pipe dope.
- .2 NPS2-1/2 and over: welding fittings and flanges to CAN/CSA W48.
- .3 Flanges: plain, slip-on to AWWA C111.
- .4 Orifice flanges: slip-on raised face, 2100 kPa.
- .5 Flange gaskets: to AWWA C111.
- .6 Pipe thread: taper.
- .7 Bolts and nuts: to ASME B18.2.1 and ASME B18.2.2.

2.3 FITTINGS

- .1 Screwed fittings: malleable iron, to ASME B16.3, Class 150, Sch. 40.
- .2 Pipe flanges and flanged fittings:
 - .1 Cast iron: to ASME B16.1, Class 125.
 - .2 Steel: to ASME B16.5.
- .3 Butt-welding fittings: steel, to ASME B16.9.
- .4 Unions: malleable iron, to ASTM A47/A47M.

2.4 VALVES

- .1 Connections:
 - .1 NPS2 and smaller: screwed ends.
 - .2 NPS2.1/2 and larger: Flanged or grooved ends.
- .2 Gate valves: Application: Isolating equipment, control valves, pipelines:
 - .1 NPS2 and under:
 - .1 As specified Section 23 05 22 - Valves - Bronze.
- .3 Globe valves: Application: Throttling, flow control, emergency bypass:
 - .1 NPS2 and under:
 - .1 As specified Section 23 05 22 - Valves - Bronze.
- .4 Balancing, for TAB:
 - .1 Sizes: Calibrated balancing valves, as specified Section 23 05 22 – Valves Bronze
- .5 Drain valves: Gate, as specified Section 23 05 22 - Valves - Bronze.
- .6 Swing check valves:
 - .1 NPS2 and under:
 - .1 As specified Section 23 05 22 - Valves - Bronze.
- .7 Silent check valves:
 - .1 NPS2 and under:
 - .1 As specified Section 23 05 22 - Valves - Bronze.
- .8 Ball valves:
 - .1 NPS2 and under: as specified Section 23 05 22 - Valves - Bronze.

Part 3 Execution

3.1 PIPING INSTALLATION

- .1 Install pipework in accordance with Section 23 05 01 - Installation of Pipe Work.

3.2 CIRCUIT BALANCING VALVES

- .1 Install flow measuring stations and flow balancing valves per section 23 05 22 Valves Bronze and as indicated.
- .2 Remove handwheel after installation and when TAB is complete.
- .3 Tape joints in prefabricated insulation on valves installed in chilled water mains.

3.3 CLEANING, FLUSHING AND START-UP

- .1 In accordance with Section 23 08 06 - Cleaning and Start-Up of Mechanical Piping Systems.

3.4 TESTING

- .1 Test system in accordance with Section 23 05 00 - Common Work Results - Mechanical.

3.5 BALANCING

- .1 Balance water systems to within plus or minus 5 % of design output.
- .2 Refer to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC for applicable procedures.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and installation of low-pressure and high pressure metallic ductwork, joints and accessories.
 - .2 Specialty exhaust systems including: Kitchen Exhaust (grease hood, condensate hood), welding exhaust, dust collection exhaust.
- .2 Related Sections:
 - .1 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

1.2 REFERENCES

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
- .2 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM A480/A480M-03c, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
 - .2 ASTM A635/A635M-02, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.
 - .3 ASTM A653/A653M-03, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .3 National Fire Protection Association (NFPA).
 - .1 NFPA 90A-02, Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - .2 NFPA 90B-02, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
 - .3 NFPA 91, Standard for Exhaust Systems for Air Conveying of Vapors, Mists, and Non-combustible Particulate Solids.
 - .4 NFPA 96-01, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
 - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2nd Edition [1995] and Addendum No. 1, [1997].
 - .2 SMACNA HVAC Air Duct Leakage Test Manual, [1985], 1st Edition.
 - .3 IAQ Guideline for Occupied Buildings Under Construction [1995], 1st Edition.

1.3 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Shop Drawings, Product Data and Samples.
- .2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 74 19 – Waste Management and Disposal for the following:
 - .1 Sealants.
 - .2 Tape.
 - .3 Proprietary Joints

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Protect on site stored or installed absorptive material from moisture damage.
- .2 Store all ductwork elevated off the ground and covered to prevent moisture & dirt migration. Ductwork MUST be protected at all times.
- .3 Shield ductwork from dust and construction material during construction. Clean any ductwork found to be dirty at no extra cost to the Contract.
- .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 Remove from site and dispose of packaging materials at appropriate recycling facilities.

1.5 GENERAL

- .1 Duct sizes on drawings indicate clear inside dimensions and acoustically lined or internally insulated ducts must maintain inside duct dimensions.
- .2 Proper sized openings shall be arranged for in the correct locations through all slabs and walls. Openings shall be planned to include for the installation of fire dampers at all rated fire separations.
- .3 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.
- .4 Ductwork used on this project shall be clean and free from scale, corrosion and deposits. All ductwork shall be degreased and wiped clean of all oil and other surface films with appropriate solvents prior to installation.
- .5 All ductwork shall be delivered clean to the site and maintained in clean condition. Dirty ductwork shall be removed from site.

- .6 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.

Part 2 Products

2.1 SEAL CLASSIFICATION

- .1 Seal classification:
 - .1 Class C: transverse joints and connections made air tight with gaskets or sealant or combination thereof.

2.2 SEALANT

- .1 Sealant: oil resistant, water borne, polymer type flame resistant duct sealant. Temperature range of minus 30 degrees C to plus 93 degrees C.

2.3 TAPE

- .1 Tape: polyvinyl treated, open weave fiberglass tape, 50 mm wide.

2.4 DUCT LEAKAGE

- .1 In accordance with SMACNA HVAC Air Duct Leakage Test Manual

2.5 FITTINGS

- .1 Fabrication: to SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2nd Edition [1995] and Addendum No. 1, [1997].
- .2 Radiused elbows.
 - .1 Rectangular: standard radius with single thickness turning vanes Centreline radius: 1.5 times width of duct.
 - .2 Round: smooth radius piece. Centreline radius: 1.5 times diameter.
- .3 Mitred elbows, rectangular:
 - .1 To 400 mm: with single thickness turning vanes.
 - .2 Over 400 mm: with double thickness turning vanes.
- .4 Branches:
 - .1 Rectangular main and branch: 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.
 - .4 Main duct branches: with splitter damper.

- .5 Transitions:
 - .1 Diverging: 20 degrees maximum included angle.
 - .2 Converging: 30 degrees maximum included angle.
- .6 Offsets:
 - .1 Short radiused elbows.
- .7 Obstruction deflectors: maintain full cross-sectional area.

2.6 FIRE STOPPING

- .1 Retaining angles around duct, on both sides of fire separation in accordance with Section 23 33 16 – Dampers - Fire.
- .2 Fire stopping material and installation must not distort duct.

2.7 GALVANIZED STEEL

- .1 Lock forming quality: to ASTM A653/A653M, Z90 zinc coating.
- .2 Thickness, fabrication and reinforcement: to SMACNA.
- .3 Joints: to SMACNA construction.

2.8 HANGERS AND SUPPORTS

- .1 Hangers and Supports: in accordance with Section 23 05 29 - Hangers and Supports.
 - .1 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.
 - .2 Hanger configuration: to SMACNA.
 - .3 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

- .4 Upper hanger attachments:
 - .1 For concrete: manufactured concrete inserts.
 - .2 For steel joist: manufactured joist clamp.
 - .3 For steel beams: manufactured beam clamps.

2.9 DUCTWORK AND PLENUM PRESSURES

- .1 Provide ductwork and plenums fabricated from galvanized steel for the static pressure categories listed below.
 - .1 500 Pa static pressure
 - .1 All supply ductwork downstream from mixing boxes/air valves to terminal air outlets.
 - .2 All supply ductwork and plenums on systems without mixing boxes/air valves.
 - .3 All return air ductwork and plenums, except where otherwise specified.
 - .4 All exhaust and relief air ductwork and plenums, except where otherwise specified (welding/sawdust exhaust).
 - .5 All outdoor air ductwork and plenums, except as otherwise specified.

2.10 DUCTWORK - 500 PA [2" W.G.] STATIC PRESSURE

- .1 Provide galvanized iron ductwork for system operating pressures 500 Pa and less. Ductwork shall be constructed, reinforced, sealed and installed to withstand 1-1/2 times the working static pressure.
- .2 Construct rectangular ductwork in accordance with Section I including Tables 1-5, 1-10, 1-11, 1-12, 1-13 and Figs. 1-4 through 1-18 of the SMACNA Duct Standards.
- .3 Nomasco "Ductmate System, Lockformer TDC " or Exanno "Nexus System" may be used for rectangular duct joints.
- .4 At least two opposite faces of all rectangular ductwork must be joined together using a type of joint, which cannot pull apart.
- .5 Construct rectangular duct fittings in accordance with Section II including Figs. 2-1 to 2-11 and Figs. 2-16 to 2-18 of the SMACNA Duct Standards.
- .6 Construct round ductwork in accordance with Section III including Table 3-2 and Figs. 3-1 and 3-2 of the SMACNA Duct Standards, but excluding beaded crimp joints and snaplock seams.
- .7 Construct flat oval ductwork in accordance with Section III including Table 3-4 and Fig. 3-6 of the SMACNA Duct Standards. Joints and seams shall be similar to those indicated for round ducts. Flat oval duct to be used for positive pressure application only.
- .8 Construct round and flat oval duct fittings in accordance with Section III including Table 3-1 and Figs. 3-3 through 3-6 of the SMACNA Duct Standards. 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.

Part 3 Execution

3.1 GENERAL

- .1 Do work SMACNA HVAC Duct Construction Standards.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods.
 - .1 Insulate strap hangers 100 mm beyond insulated duct.
- .3 Support risers SMACNA.
- .4 Install breakaway joints in ductwork on sides of fire separation.
- .5 Manufacture duct in lengths and diameter to accommodate installation of acoustic duct lining.
- .6 Where a duct contains a fire or smoke damper, construct the duct so that the free area of the duct is maintained through the fire or smoke damper.
- .7 Where a duct is to be internally insulated, enlarge the duct so as not to reduce the duct free area.
- .8 Make the taper of diverging transitions less than 20 deg. and the taper of converging transitions less than 30 deg., in accordance with Fig. 2-9 of the SMACNA Duct Standards. Maximum divergence upstream of equipment to be 30 deg. and 45 deg. convergence downstream.
- .9 Make the inside radius of any rectangular duct elbow at least equal to the duct width, measured in the direction of the radius. If space conditions do not permit a full radius elbow to be installed, use square elbows with multi-blade turning vanes.
- .10 Turning vanes shall be single wall type. 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 centres and shall turn through 90 deg., with a radius of 50 mm. Vanes shall not include a straight trailing edge. Refer to Figs. 2-3 and 2-4 of the SMACNA Duct Standards. Vanes and runners in aluminum ducts shall be constructed from aluminum. Aluminum vanes shall be 0.86 mm thick [18 ga].
- .11 For 500 Pa pressure systems, install tie rods to limit the maximum unsupported vane length to 914 mm. Refer to Fig. 2-4 of the SMACNA Duct Standards.
- .12 Install duct necks before grilles, registers and diffusers and cushion heads after diffuser take-offs as required to suit site conditions.
- .13 Where indicated, install adjustable air turning devices, where full radius take-off fittings cannot be installed, in accordance with Fig. 2-16 of the SMACNA Duct Standards. Adjustment shall be accessible outside the duct with lockable quadrant operator or through the grille or register with key-operated worm gear mechanism.
- .14 Cross-break or bead all metal duct panels unless otherwise noted.
- .15 Do not cross-break bottom duct panels when ductwork is handling moisture.

- .16 Support ductwork using galvanized steel straps, cadmium plated threaded rods, flat bar or angle hangers. Attachments to the structure shall be compatible with the structure and selected for the load of the ductwork. Install ductwork hangers in accordance with Section IV including Tables 4-1 through 4-3 and Figs. 4-1 through 4-9 of the SMACNA Duct Standards.
- .17 Prior to the fabrication of ductwork, co-ordinate and field measure all ductwork to ensure a complete installation respecting all other services. Provide all necessary fittings, offsets, and alternate construction methods to facilitate the installation.
- .18 Arrange ductwork and plenums so that duct and plenum mounted equipment can be easily removed.
- .19 Ducts passing through non-rated fire separations, sound insulated walls and through non-rated walls and floors shall be tightly fitted and sealed on both sides of the separation with silicon sealant to prevent passage of smoke and/or transmission of sound. (U.L.C. approved fire stop sealant is not a requirement). Where ducts are insulated provide a 0.61 mm [24 ga] thick galvanized steel band tightly fitted around insulation and then caulk to band.
- .20 During construction, protect openings in ductwork, from dust infiltration, by covering with polyethylene, and protect floor outlet duct openings with metal caps.

3.2 HANGERS

- .1 Strap hangers: install in accordance with SMACNA.
- .2 Angle hangers: complete with locking nuts and washers.
- .3 Hanger spacing: in accordance with ASHRAE as follows:

Duct Size (mm)	Spacing (mm)
to 1500	3000
1501 and over	2500

3.3 SEALING AND TAPING

- .1 Apply sealant to outside of joint to manufacturer's recommendations.
- .2 Bed tape in sealant and recoat with minimum of one coat of sealant to manufacturers recommendations.

3.4 DUCTWORK AND PLENUM CLEANING

- .1 All ductwork and equipment installed shall be free of scale, debris and dirt.
- .2 Maintain all duct and equipment openings covered with poly or equivalent to prevent the entry of dirt.
- .3 Clean all plenums and buried supply ductwork with an industrial vacuum cleaner on completion of the duct and plenum installation.

- .4 Ductwork shall be considered clean when all foreign material visible to the naked eye has been removed. A random sampling review by the Departmental representative will be conducted to check for cleanliness. Any system deemed to require re-cleaning shall be re-cleaned in its entirety.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and installation for duct accessories including flexible connections, access doors, vanes and collars.
 - .2 Sustainable requirements for construction and verification.
- .2 Related Sections:
 - .1 Section 01 33 00 - Shop Drawings, Product Data and Samples.
 - .2 Section 01 35 33 - Health and Safety Requirements.
 - .3 Section 01 74 19 - Waste Management and Disposal.
 - .4 Section 01 78 30 - Closeout Submittals.

1.2 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
 - .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible, [95].

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Shop Drawings, Product Data and Samples.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheet. Indicate the following:
 - .1 Flexible connections.
 - .2 Duct access doors.
 - .3 Turning vanes.
 - .4 Instrument test ports.
- .3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
 - .1 Certification of ratings: catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

- .5 Instructions: submit manufacturer's installation instructions.

1.4 HEALTH AND SAFETY

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

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
 - .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard and packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan (WMP).
 - .4 Separate for reuse and recycling and place in designated containers Metal and Plastic waste in accordance with Waste Management Plan (WMP).
 - .5 Divert unused materials from landfill to recycling facility.

Part 2 Products

2.1 GENERAL

- .1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.

2.2 FLEXIBLE CONNECTIONS

- .1 Frame: galvanized sheet metal frame 150 mm thick with fabric clenched by means of double locked seams.
- .2 Material:
 - .1 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.

2.3 ACCESS DOORS IN DUCTS

- .1 Non-Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.
- .2 Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.
- .3 Gaskets: neoprene.
- .4 Hardware:
 - .1 Up to 300 x 300 mm: two sash locks complete with safety chain.

- .2 301 to 450 mm: four sash locks complete with safety chain.
- .3 451 to 1000 mm: piano hinge and minimum two sash locks.
- .4 Hold open devices.

2.4 TURNING VANES

- .1 Factory or shop fabricated double thickness with trailing edge, to recommendations of SMACNA and as indicated.

2.5 INSTRUMENT TEST

- .1 1.6 mm thick steel zinc plated after manufacture.
- .2 Cam lock handles with neoprene expansion plug and handle chain.
- .3 28 mm minimum inside diameter. Length to suit insulation thickness.
- .4 Neoprene mounting gasket.

2.6 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.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Flexible Connections:
 - .1 Install in following locations:
 - .1 Inlets and outlets to supply air units and fans.
 - .2 Inlets and outlets of exhaust and return air fans.
 - .3 As indicated.
 - .2 Length of connection: 150 mm.
 - .3 Minimum distance between metal parts when system in operation: 75 mm.
 - .4 Install in accordance with recommendations of SMACNA.
 - .5 When fan is running:
 - .1 Ducting on sides of flexible connection to be in alignment.
 - .2 Ensure slack material in flexible connection.

- .2 Access Doors and Viewing Panels:
 - .1 Size:
 - .1 300 x 300 mm for inspection & hand access.
 - .2 450 x 450 mm for servicing entry.
 - .3 As indicated.
 - .2 Locations:
 - .1 Fire and smoke dampers.
 - .2 Control dampers.
 - .3 Devices requiring maintenance.
 - .4 Required by code.
 - .5 Reheat coils.
 - .6 Elsewhere as indicated.
- .3 Instrument Test Ports:
 - .1 General:
 - .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
 - .2 Locate to permit easy manipulation of instruments.
 - .3 Install insulation port extensions as required.
 - .4 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 And as indicated.
 - .2 For temperature readings:
 - .1 At outside air intakes.
 - .2 In mixed air applications in locations as approved by the Departmental representative.
 - .3 At inlet and outlet of coils.
 - .4 Downstream of junctions of two converging air streams of different temperatures.
 - .5 And as indicated.
- .4 Turning vanes:
 - .1 Install in accordance with recommendations of SMACNA and as indicated.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Balancing dampers for mechanical forced air ventilation and air conditioning systems.
 - .2 Sustainable requirements for construction and verification.

1.2 REFERENCES

- .1 Sheet Metal and Air Conditioning National Association (SMACNA)
 - .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible- [1985].
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.3 HEALTH AND SAFETY

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

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with manufacturer's recommendation.
- .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 – Waste Management and Disposal.

Part 2 Products

2.1 APPROVED MANUFACTURES

- .1 The Contractor shall provide products that meet or exceed the specified performance.

2.2 GENERAL

- .1 Manufacture to SMACNA standards.

2.3 SPLITTER DAMPERS

- .1 Fabricate from same material as duct but one sheet metal thickness heavier, with appropriate stiffening.

- .2 Double thickness construction.
- .3 Control rod with locking device and position indicator.
- .4 Rod configuration to prevent end from entering duct.
- .5 Pivot: piano hinge.
- .6 Folded leading edge.

2.4 SINGLE BLADE DAMPERS

- .1 Fabricate from same material as duct, but one sheet metal thickness heavier. V-groove stiffened.
- .2 Size and configuration to recommendations of SMACNA, to a maximum height 100 mm.
- .3 Inside and outside nylon end bearings.
- .4 Channel frame of same material as adjacent duct, complete with angle stop.

2.5 MULTI-BLADED DAMPERS

- .1 Factory manufactured of material compatible with duct.
- .2 Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA.
- .3 Maximum blade height: 100 mm.
- .4 Bearings: self-lubricating nylon.
- .5 Linkage: shaft extension with locking quadrant.
- .6 Channel frame of same material as adjacent duct, complete with angle stop.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install where indicated and as outlined below.
- .2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
- .3 Locate balancing dampers in each branch duct, for supply, return and exhaust systems.
- .4 Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts.
- .5 Dampers: vibration free.

PWGSC Project No. R.073227.004
CRA-CID Fit-out
401 Burrard Street, Vancouver, BC
2016-06-15
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Section 23 33 14
DAMPERS - BALANCING

Page 3 of 3

- .6 Ensure damper operators are observable and accessible.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

- .1 Fire and smoke dampers, and fire stop flaps.

1.2 REFERENCES

.1 American National Standards Institute/National Fire Protection Association (ANSI/NFPA)

- .1 ANSI/NFPA 90A- [2002], Standard for the Installation of Air Conditioning and Ventilating Systems.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

- .1 Material Safety Data Sheets (MSDS).

.3 Underwriters Laboratories of Canada (ULC)

- .1 CAN4-S112- [M1990], Fire Test of Fire Damper Assemblies.
- .2 CAN4-S112.2- [M84], Standard Method of Fire Test of Ceiling Firestop Flap Assemblies.
- .3 ULC-S505- [1974], Fusible Links for Fire Protection Service.

1.3 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 Indicate the following:

- .1 Fire dampers.
- .2 Operators.
- .3 Fusible links.
- .4 Design details of break-away joints.

.2 Closeout Submittals:

- .1 Provide maintenance data for incorporation into manual specified in Section 01 70 00 - Closeout Submittals.

1.4 HEALTH AND SAFETY

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.

- .2 Certificates:
 - .1 Catalogue or published ratings those obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

Part 2 Products

2.1 APPROVED MANUFACTURES

- .1 Provide products that meet or exceed the specifications.

2.2 FIRE DAMPERS

- .1 Fire dampers: arrangement Type B, listed and bear label of ULC. Fire damper assemblies fire tested in accordance with CAN4-S112.
- .2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.
 - .1 Fire dampers: Match the rating of the assembly. Refer to architectural drawings for fire ratings.
 - .2 Fire dampers: automatic operating type and have dynamic rating suitable for maximum air velocity and pressure differential to which it will be subjected.
- .3 Top hinged: offset single damper, round or square; multi-blade hinged or interlocking type; sized to maintain full duct cross section as indicated on drawings.
- .4 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow.
- .5 40 x 40 x 3 mm retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.
- .6 Equip fire dampers with steel sleeve or frame installed disruption ductwork or impair damper operation.
- .7 Equip sleeves or frames with perimeter mounting angles attached on both sides of wall or floor opening. Construct ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce ceiling to conform with ULC.
- .8 Design and construct dampers to not reduce duct or air transfer opening cross-sectional area.
- .9 Dampers shall be installed so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition or floor slab depth or thickness.
- .10 Unless otherwise indicated, the installation details given in SMACNA Install Fire Damper HVAC and in manufacturer's instructions for fire dampers shall be followed.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install in accordance with ANSI/NFPA 90A and in accordance with conditions of ULC listing.
- .2 Maintain integrity of fire separation.
- .3 After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.
- .4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.
- .5 Co-ordinate with installer of firestopping.
- .6 Ensure access doors/panels, fusible links, damper operators are easily observed and accessible.
- .7 Install break-away joints of approved design on each side of fire separation.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and installation of flexible ductwork, joints and accessories.
- .2 Sustainable requirements for construction and verification.
- .3 Related Sections:
 - .1 Section 01 33 00 – Shop Drawings, Product Data and Samples.
 - .2 Section 01 35 33 – Health and Safety Requirements.
 - .3 Section 01 74 19 – Waste Management and Disposal.

1.2 REFERENCES

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .3 National Fire Protection Association (NFPA).
 - .1 NFPA 90A- [02], Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - .2 NFPA 90B- [02], Standard for Installation of Warm Air Heating and Air-Conditioning Systems.
- .4 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA).
 - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, [95] (Addendum No.1, November 1997).
 - .2 SMACNA IAQ Guideline for Occupied Buildings under Construction, 1st Edition [1995].
- .5 Underwriters' Laboratories Inc. (UL).
 - .1 UL 181- [96], Standard for Factory-Made Air Ducts and Air Connectors.
- .6 Underwriters' Laboratories of Canada (ULC).
 - .1 CAN/ULC-S110- [1986(R2001)], Fire Tests for Air Ducts.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Protect on site stored or installed absorptive material from moisture damage.
- .2 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard and packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Place materials defined as hazardous or toxic in designated containers.
- .5 Handle and dispose of hazardous materials in accordance with Regional and Municipal regulations.
- .6 Ensure emptied containers are sealed and stored safely.
- .7 Fold up metal and plastic banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 GENERAL

- .1 Factory fabricated to CAN/ULC-S110.
- .2 Pressure drop coefficients listed below are based on relative sheet metal duct pressure drop coefficient of 1.00.
- .3 Flame spread rating not to exceed 25. Smoke developed rating not to exceed 50.

2.2 NON-METALLIC - INSULATED

- .1 Type 4: non-collapsible, coated mineral base fabric type mechanically bonded to, and helically supported by, external steel wire with factory applied, 37 mm thick flexible mineral fibre thermal insulation with vapour barrier and vinyl jacket, as indicated.

Part 3 Execution

3.1 DUCT INSTALLATION

- .1 Install flexible ductwork where indicated on the drawings or within suspended ceilings for a maximum of 1 meter of flex.
- .2 Provide intermediate supports for flexible ducts so that sagging does not occur. Very sharp turns and reduction in the area of the duct will not be permitted.
- .3 Connect to ductwork, diffusers, and terminal units with stainless steel worm drive clamps, adjustable clamps or duct straps applied over two wraps of duct tape.
- .4 Provide separate cable support to all diffusers in suspended ceilings, secured back to structure.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation for acoustic duct lining.

1.2 RELATED SECTIONS

- .1 Section 23 07 13 – Duct Insulation

1.3 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM C423-[02a], Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
 - .2 ASTM C916- [85(2001) e1], Standard Specification for Adhesives for Duct Thermal Insulation.
 - .3 ASTM C1071-[00], Standard specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
 - .4 ASTM C1338- [00], Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.
- .2 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA).
 - .1 SMACNA IAQ Guideline for Occupied Buildings 95.

Part 2 Products

2.1 DUCT LINER

- .1 General:
 - .1 Mineral Fibre duct liner: air surface coated with mat facing.
 - .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50 when tested in accordance with CAN/ULC-S102.
 - .3 Fungi resistance: to ASTM C1338.
- .2 Flexible:
 - .1 Use on surfaces indicated on drawings and as outlined below.
 - .2 25 mm thick, to ASTM C1071, Type 1, fibrous glass blanket duct liner.
 - .3 Density: 24 kg/m³ minimum.
 - .4 Thermal resistance to be minimum 0.37 (m².degrees C)/W for 12 mm thickness when tested in accordance with ASTM C177, at 24 degrees C mean temperature.
 - .5 Maximum velocity on coated airside: 30.5 m/sec.
 - .6 Minimum NRC of 0.65 at 25 mm thickness based on Type A mounting to ASTM C423.

2.2 ADHESIVE

- .1 Adhesive: to NFPA 90A and NFPA 90B.
- .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 29 °C to plus 93 °C.
- .3 Water-based fire retardant type.

2.3 FASTENERS

- .1 Weld pins 2.0 mm diameter, length to suit thickness of insulation. Metal retaining clips, 32 mm square.

2.4 JOINT TAPE

- .1 Poly-Vinyl treated open weave fiberglass membrane 50 mm wide.

2.5 SEALER

- .1 Meet requirements of NFPA 90A and NFPA 90B.
- .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 68 °C to plus 93 °C.

Part 3 Execution

3.1 GENERAL

- .1 Line inside of ducts where indicated.
- .2 Duct dimensions, as indicated, are clear inside duct lining.
- .3 Provide a minimum of 3m acoustic downstream of exhaust fans.

3.2 DUCT LINER

- .1 Install in accordance with manufacturer's recommendations, and as follows:
 - .1 Fasten to interior sheet metal surface with 100 % coverage of adhesive to ASTM C916
 - .1 Exposed leading edges and transverse joints to be factory coated or coated with adhesive during fabrication.
 - .2 In addition to adhesive, install weld pins not less than 2 rows per surface and not more than 425 mm on centres, impact driven mechanical fasteners to compress duct liner sufficiently to hold it firmly in place.

3.3 JOINTS

- .1 Seal butt joints, exposed edges, weld pin and clip penetrations and damaged areas of liner with joint tape and sealer. Install joint tape in accordance with manufacturer's written recommendations, and as follows:
 - .1 Bed tape in sealer.

- .2 Apply two coats of sealer over tape.
- .2 Replace damaged areas of liner.
- .3 Protect leading edges of duct sections with sheet metal nosing having 15 mm overlap and fastened to duct.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .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- [2003], Standards Handbook.
 - .2 AMCA 300- [1996], Reverberant Room Method for Sound Testing of Fans.
 - .3 AMCA 301- [1990], 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- [1999], Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB 1.181-[99], 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 - Shop Drawings, Product Data and Samples. Include product characteristics, performance criteria, and limitations.
- .2 Shop Drawings:
 - .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Shop Drawings, Product Data and Samples.
- .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 - Shop Drawings, Product Data and Samples.
 - .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 30 - Closeout Submittals.

1.5 HEALTH AND SAFETY

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

1.6 MAINTENANCE

- .1 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 30 - Closeout Submittals.
 - .2 Furnish list of individual manufacturer's recommended spare parts for equipment, include:
 - .1 Bearings and seals.
 - .2 Addresses of suppliers.
 - .3 List of specialized tools necessary for adjusting, repairing or replacing.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 61 10 – 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 - Waste Management and Disposal.

Part 2 Products

2.1 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.
 - .1 Provide products that meet or exceed specifications.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 FAN INSTALLATION

- .1 Install fans as indicated, complete with 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

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Supply, return and exhaust grilles and registers, diffusers and linear grilles, for commercial and use.
 - .2 Sustainable requirements for construction and verification.

1.2 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.

1.3 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.

1.4 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 with 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.

1.5 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Shop Drawings, Product Data and Samples. 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.
- .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Shop Drawings, Product Data and Samples.

1.6 HEALTH AND SAFETY

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

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 61 10 – 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 – Waste Management and Disposal.

Part 2 Products

2.1 APPROVED MANUFACTURERS

- .1 The Contractor to provide products that meet or exceed the specified performance.

2.2 GENERAL

- .1 Base air outlet application on space noise level of NC 30 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 of 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 specifications of air outlets.

Part 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.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and installation for fan coil units.
 - .2 Materials and installation for converters with CPU style fans used for perimeter heating and/or cooling.

1.2 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 23 05 00 – Common Work Results - Mechanical. Include product characteristics, performance criteria, and limitations.
 - .1 Product data to include:
 - .1 Filters, fan accessibility.
 - .2 Suspension of cabinet.
 - .3 Physical size.
 - .4 Thermostat, transformer, controls where integral.
 - .5 Finish.
 - .6 kW rating, voltage, phase.
 - .7 Cabinet material thicknesses.
 - .8 Sound data.

1.3 EXTRA MATERIALS

- .1 Provide one spare set of filters for each unit size.
- .2 Provide list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual

1.4 WASTE MANAGEMENT

- .1 Refer to the requirements in Section 01 74 19 – Waste Management & Disposal.

Part 2 Products

2.1 FAN COIL UNITS

- .1 Cabinet: steel, 1.2 mm thick, ceiling mounting, recessed. Front inlet, back outlet.
- .2 Coils: Copper tube with aluminum fins covering full length of coil.
- .3 Blower motors: three speed, single phase.

- .4 Wall mounted thermostats / space sensor: Refer to Section 23 09 23 – Controls Sequences.
- .5 Filter: 25 mm throwaways mounted in a return air filter box.
- .6 Assembly fully wired to one outlet location.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Provide vibration isolation in accordance to specification. Refer to Section 23 05 48 Vibration Isolation for Piping and Equipment.
- .2 Make control connections.
- .3 This contractor is to provide all control valves and actuators. Refer to drawings for zoning.

END OF SECTION

Part 1 General

- .1 For Commissioning requirements of all mechanical systems refer to the following specification sections:
 - .1 Section 01 91 13 – General Commissioning Requirements
 - .2 Section 01 91 31 – Commissioning Plan
 - .3 Section 01 91 33 – Commissioning Forms
 - .4 Section 01 91 41 – Commissioning Training

END OF SECTION

- .5 Verify that documents are in proper form, contain full information, and are notarized.
- .6 Co-execute submittals when required.
- .7 Retain warranties and bonds until time specified for submittal.

1.11 COMPLETION

- .1 Cx Documentation: submit completed Cx Documentation. Refer to Section 01 91 00.
- .2 Submit a written certificate that the following have been performed:
 - .1 Defects have been corrected and deficiencies have been completed.
 - .2 Equipment and systems have been tested, adjusted and balanced, and are fully operational.
 - .3 Operation of systems has been demonstrated to the personnel indicated by the Departmental Representative.
 - .4 Work is complete and ready for final inspection.

END OF SECTION

- .3 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
- .4 Indicate of drawings clearances for operation, maintenance, and replacement of operating equipment devices.
- .5 Submit number of copies as outlined in the front end documents.
- .6 If changes are required, notify Departmental Representative or Consultant of these changes before they are made.
- .6 Certificates:
 - .1 Provide CSA certified equipment and materials.
 - .2 Where CSA certified equipment and material is not available, submit such equipment and material to inspection authorities for special approval before delivery to site.
 - .3 Submit test results of installed electrical systems and instrumentation.
 - .4 Permits and fees: in accordance with General Conditions of contract.
 - .5 Submit, upon completion of Work, load balance report as described in PART 3 - LOAD BALANCE.
 - .6 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental Representative and Consultant.
- .7 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.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 30 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for all equipment for incorporation into manual.
 - .1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
 - .2 Operating instructions to include following:
 - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
 - .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
 - .3 Safety precautions.
 - .4 Procedures to be followed in event of equipment failure.
 - .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.
 - .3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.
 - .4 Post instructions where directed.

- .5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.
- .6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 10 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground and indoors in a dry location 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 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.

2.2 MATERIALS AND EQUIPMENT

- .1 Provide material and equipment in accordance with Section 01 61 10 - Common Product Requirements.
- .2 Material and equipment to be CSA certified.
- .3 Factory assemble control panels and component assemblies.

2.3 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- .1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.

2.4 WARNING SIGNS

- .1 Warning Signs: in accordance with requirements of authority having jurisdiction, Departmental Representative and Consultant.
- .2 Porcelain enamel or decal signs, 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: lamicoïd, black face, white lettering accurately aligned and engraved into core and mechanically attached with self tapping screws.
 - .2 Sizes as follows:

NAMEPLATE SIZES			
Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

- .2 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.
- .3 Wording on nameplates to be approved by Departmental Representative and 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 and coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour coding: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.

2.8 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, boxes and metallic sheathed cables.
- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.
- .3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

Prime	Auxiliary	
up to 250 V	Yellow	
up to 600 V	Yellow	Green
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 rust resistant primer inside and outside, and at least two coats of finish enamel.
 - .1 Paint indoor switchgear and distribution enclosures light gray.

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.

3.2 INSTALLATION

- .1 Do complete installation in accordance with CSA C22.1 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 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .2 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

3.5 LOCATION OF OUTLETS

- .1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- .2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.
- .4 Locate light switches on latch side of doors.

- .1 Locate disconnect devices in mechanical and elevator machine rooms on latch side of 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 (measured to centre of device) unless indicated otherwise.
 - .1 Local switches: 1200 mm.
 - .2 Wall receptacles:
 - .1 General: 400 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: 1400 mm.
 - .7 Fire alarm bells: not less than 2300 mm to top of device.
 - .8 Television outlets: 300 mm.
 - .9 Wall mounted speakers: 2100 mm.
 - .10 Clocks: 2100 mm.
 - .11 Door bell 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 Load Balance:
 - .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
 - .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
 - .3 Provide upon completion of work, load balance report as directed in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS, phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under

normal load, as well as hour and date on which each load was measured, and voltage at time of test.

- .2 Conduct following tests in accordance with Division 01 specifications.
 - .1 Power distribution system including phasing, voltage, grounding and load balancing.
 - .2 Circuits originating from branch distribution panels.
 - .3 Lighting and its control.
 - .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
 - .5 Systems: fire alarm.
 - .6 Insulation resistance testing:
 - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
 - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
 - .3 Check resistance to ground before energizing.
- .3 Carry out tests in presence of Departmental Representative or Consultant.
- .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .5 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.9 SYSTEM STARTUP

- .1 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.
- .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.

3.10 CLEANING

- .1 Progress Cleaning: clean in accordance with Division 01 specifications.
 - .1 Leave Work area clean at end of each day.

- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Division 01 specifications.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 CSA International
 - .1 CAN/CSA-C22.2 No.18-98(R2003), Outlet Boxes, Conduit Boxes and Fittings.
 - .2 CAN/CSA-C22.2 No.65-03(R2008), Wire Connectors (Tri-National Standard with UL 486A-486B and NMX-J-543-ANCE-03).
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
 - .1 EEMAC 1Y-2-[1961], Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).
- .3 National Electrical Manufacturers Association (NEMA)

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 30 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for wire and box connectors for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 10 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials [off ground] [indoors] [in dry location] and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

- .1 Pressure type wire connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper conductors as required.
- .2 Fixture type splicing connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- .3 Bushing stud connectors: to EEMAC 1Y-2 and NEMA to consist of:
 - .1 Connector body and stud clamp for copper conductors.
 - .2 Clamp for copper conductors.
 - .3 Stud clamp bolts.
 - .4 Bolts for copper conductors.
 - .5 Sized for conductors as indicated.
- .4 Clamps or connectors for armoured cable, TECK cable as required to: CAN/CSA-C22.2 No.18.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for wire and box connectors installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of the Consultant.
 - .2 Inform the 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 the Consultant.

3.2 INSTALLATION

- .1 Remove insulation carefully from ends of conductors and cables 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 EEMAC 1Y-2 and NEMA.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Division 01 specifications.

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

PWGSC Project No. R.073227.004
CRA-CID Fit-Up
401 Burrard Street, Vancouver, BC
2016-06-15
Issued for Tender

Section 26 05 20

WIRE AND BOX CONNECTORS (0-1000 V)

Page 4 of 4

END OF SECTION

Part 1 General

1.1 PRODUCT DATA

- .1 Provide product data in accordance with Section [01 33 00 - Submittal Procedures].

Part 2 Products

2.1 BUILDING WIRES

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .1 Copper conductors: size as indicated, with 1000 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE, Jacketted.
- .2 Copper conductors: size as indicated, with thermoplastic insulation type TWU or TWH rated at 600 V.

2.2 TECK 90 CABLE

- .1 Cable: in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Conductors:
 - .1 Grounding conductor: copper.
 - .2 Circuit conductors: copper, size as indicated.
- .3 Insulation:
 - .1 Ethylene propylene rubber EP.
 - .2 Cross-linked polyethylene XLPE.
 - .3 Rating: , 1000 V.
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: interlocking galvanized steel or aluminum.
- .6 Overall covering: thermoplastic polyvinyl chloride, compliant to applicable Building Code classification for this project.
- .7 Fastenings:
 - .1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
 - .2 Channel type supports for two or more cables at 1000 mm centers.
 - .3 Threaded rods: 6 mm diameter to support suspended channels.
- .8 Connectors:
 - .1 Watertight, approved for TECK cable.

2.3 ARMOURED CABLES

- .1 Conductors: insulated, copper, size as indicated.
- .2 Type: AC90.
- .3 Armour: interlocking type fabricated from galvanized steel or aluminum strip.
- .4 Type: ACWU90 flame retardant jacket over thermoplastic armour and compliant to applicable Building Code classification for this project.
- .5 Connectors: anti short connectors.

Part 3 Execution

3.1 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform tests using method appropriate to site conditions and to approval of the Consultant and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.

3.2 GENERAL CABLE INSTALLATION

- .1 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - (0-1000 V).
- .2 Cable Colour Coding: to Section 26 05 00 - Common Work Results for Electrical.
- .3 Conductor length for parallel feeders to be identical.
- .4 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.
- .5 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.
- .6 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.
- .7 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

3.3 INSTALLATION OF BUILDING WIRES

- .1 Install wiring as follows:
 - .1 In conduit systems in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

3.4 INSTALLATION OF TECK90 CABLE (0 -1000 V)

- .1 Group cables wherever possible on channels.

3.5 INSTALLATION OF ARMOURED CABLES

- .1 Group cables wherever possible on channels.

PWGSC Project No. R.073227.004
CRA-CID Fit-Up
401 Burrard Street, Vancouver, BC
2016-06-15
Issued for Tender

Section 26 05 21

WIRES AND CABLES (0-1000 V)
Page 4 of 4

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.41-[M1987(R1999)], Grounding and Bonding Equipment.

1.2 PRODUCT DATA

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

1.3 CERTIFICATES

- .1 Obtain inspection certificate of compliance covering high voltage stress coning from inspection authority and include it with maintenance manuals.

Part 2 Products

2.1 CONNECTORS AND TERMINATIONS

- .1 Copper long barrel or short barrel compression connectors to CSA C22.2 standards as required sized for conductors.
- .2 Contact aid for aluminum cables where applicable.

Part 3 Execution

3.1 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.

PWGSC Project No. R.073227.004
CRA-CID Fit-Up
401 Burrard Street, Vancouver, BC
2016-06-15
Issued for Tender

Section 26 05 22

CONNECTORS AND TERMINATIONS

Page 2 of 2

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American National Standards Institute /Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE 837-[02], IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 30 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for [grounding equipment] for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

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

Part 2 Products

2.1 EQUIPMENT

- .1 Grounding conductors: bare stranded copper, tinned, soft annealed, size as indicated.
- .2 Insulated grounding conductors: green, copper conductors, size as indicated.
- .3 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.
- .4 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
 - .1 Grounding and bonding bushings.
 - .2 Protective type clamps.
 - .3 Bolted type conductor connectors.

- .4 Thermit welded type conductor connectors.
- .5 Bonding jumpers, straps.
- .5 Pressure wire connectors.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for grounding equipment installation in accordance with manufacturer's written instructions.

3.2 INSTALLATION GENERAL

- .1 Install complete permanent, continuous grounding system including conductors, connectors, accessories. Where EMT is used, run ground wire in conduit.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Soldered joints not permitted.
- .4 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .5 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.
- .6 Ground secondary service pedestals.

3.3 SYSTEM AND CIRCUIT GROUNDING

- .1 Install system and circuit grounding connections to neutral of secondary voltage system.

3.4 EQUIPMENT GROUNDING

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, generators, elevators and escalators, distribution panels, outdoor lighting, cable trays.

3.5 GROUNDING BUS

- .1 Install copper grounding bus mounted on insulated supports on wall of electrical room and communication equipment room.
- .2 Ground items of electrical equipment in electrical room and IT equipment in communication equipment room to ground bus with individual bare stranded copper connections size 2/0AWG.

3.6 COMMUNICATION SYSTEMS

- .1 Install grounding connections for telephone, sound, fire alarm, security systems, intercommunication systems as follows:
 - .1 Telephones: make telephone grounding system in accordance with telephone company's requirements.
 - .2 Sound, fire alarm, security systems, intercommunication systems as indicated.

3.7 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of the Departmental Representative and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.
- .4 Disconnect ground fault indicator during tests.

3.8 CLEANING

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

PWGSC Project No. R.073227.004
CRA-CID Fit-Up
401 Burrard Street, Vancouver, BC
2016-06-15
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Section 26 05 28

GROUNDING - SECONDARY

Page 4 of 4

END OF SECTION

Part 1 Products

1.1 SUPPORT CHANNELS

- .1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted or suspended.

Part 2 Execution

2.1 INSTALLATION

- .1 Secure equipment to solid masonry, tile and plaster surfaces with lead anchors or nylon shields.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .4 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.
- .5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .6 Fasten exposed conduit or cables to building construction or support system using straps.
 - .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
 - .2 Two-hole steel straps for conduits and cables larger than 50 mm.
 - .3 Beam clamps to secure conduit to exposed steel work.
- .7 Suspended support systems.
 - .1 Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.
 - .2 Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.
- .8 For surface mounting of two or more conduits use channels at 1.5 m on centre spacing.
- .9 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .10 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .11 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .12 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Departmental Representative.

HANGERS AND SUPPORTS FOR ELECTRICAL
SYSTEMS

- .13 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 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-06, Canadian Electrical Code, Part 1, latest Edition.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.

Part 2 Products

2.1 SPLITTERS

- .1 Construction: sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.
- .2 Terminations: main and branch lugs, connection blocks to match required size and number of incoming and outgoing conductors as indicated.
- .3 Spare Terminals: minimum three spare terminals or lugs on each connection or lug block sized less than 400 A.

2.2 JUNCTION AND PULL BOXES

- .1 Construction:welded steel enclosure.
- .2 Covers Flush Mounted: 25 mm minimum extension all around.
- .3 Covers Surface Mounted: screw-on flat covers.

2.3 CABINETS

- .1 Construction: welded sheet steel, hinged door, handle, latch, lock 2 keys and catch Type E Empty: surface return flange, flush overlapping sides mounting.
- .2 Type T Terminal: surface return flange or flush overlapping sides mounting containing 19 mm G1S fir plywood backboard.

Part 3 Execution

3.1 SPLITTER INSTALLATION

- .1 Mount plumb, true and square to building lines.
- .2 Extend splitters full length of equipment arrangement except where indicated otherwise.

3.2 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Mount cabinets with top not higher than 2 m above finished floor except where indicated otherwise.
- .3 Install terminal block as indicated in Type T cabinets.
- .4 Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1.

3.3 IDENTIFICATION

- .1 Equipment Identification: to Section 26 05 00 - Common Work Results for Electrical.
- .2 Identification Labels: size 2 indicating system name, voltage and phase or as indicated.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-[06], Canadian Electrical Code, Part 1, latest Edition.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit samples for floor box in accordance with Section 01 33 00 - Submittal Procedures.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 10 - Common Product Requirements.

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.
- .7 For outlet boxes in rooms required to be air tight (i.e. server rooms), electrical boxes shall be installed with a 'plastic blister' to provide vapor barrier around the box along with a foam gasket.

2.2 GALVANIZED STEEL OUTLET BOXES

- .1 One-piece electro-galvanized construction.
- .2 Single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .3 Utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.
- .4 102 mm square or octagonal outlet boxes for lighting fixture outlets.
- .5 Extension and plaster rings for flush mounting devices in finished plaster or tile walls.

2.3 CONCRETE BOXES

- .1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.4 FLOOR BOXES

- .1 Refer to drawings for types of floor boxes.
- .2 For all locations noted as a flush, fully recessed poke-thru style, provide 8" diameter, five compartment, 4" deep poke-thru with power, data cabling and AV capability.

2.5 POKE-THRU RECESSED FLUSH FLOOR BOXES

- .1 For all locations noted as a flush, fully recessed poke-thru style, provide 8" diameter, five compartment, 4" deep poke-thru with power, data cabling and audio-visual (AV) capability.
- .2 Poke-thru to be die-cast aluminum cover assembly with flip-up style lid.
- .3 AV compartment shall have 3-gang compartment suitable for decorator style designs.
- .4 Provide tile or carpet version cover. Refer to architectural drawings for floor finish.
- .5 Provide all conduit as noted on drawings for respective compartments.

2.6 CONDUIT BOXES

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

2.7 COMMUNICATION OUTLETS (DATA OUTLETS)

- .1 Provide double gang recessed outlet boxes with single gang mud-ring for all communication data outlets in walls. Provide 27mmC, EMT, from the communications outlet box up to the accessible ceiling space. Provide pullstring in all empty conduit.

2.8 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.

PWGSC Project No. R.073227.004
CRA-CID Fit-Up
401 Burrard Street, Vancouver, BC
2016-06-15
Issued for Tender

Section 26 05 32

OUTLET BOXES, CONDUIT BOXES AND FITTINGS

Page 4 of 4

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA C22.2 No. 18-98(R2003), Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
 - .2 CSA C22.2 No. 45-M1981(R2003), Rigid Metal Conduit.
 - .3 CSA C22.2 No. 56-04, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .4 CSA C22.2 No. 83-M1985(R2003), Electrical Metallic Tubing.
 - .5 CSA C22.2 No. 211.2-M1984(R2003), Rigid PVC (Unplasticized) Conduit.
 - .6 CAN/CSA C22.2 No. 227.3-05, Nonmetallic Mechanical Protection Tubing (NMPT), A National Standard of Canada (February 2006).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data: submit manufacturer's printed product literature, specifications and datasheets.
 - .1 Submit cable manufacturing data.
- .3 Quality assurance submittals:
 - .1 Test reports: submit certified test reports.
 - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .3 Instructions: submit manufacturer's installation instructions.

Part 2 Products

2.1 CONDUITS

- .1 Rigid metal conduit: to CSA C22.2 No. 45, hot dipped galvanized steel threaded.
- .2 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.

2.2 CONDUIT FASTENINGS

- .1 One hole steel straps to secure surface conduits NPS 2, 50 mm and smaller.
 - .1 Two hole steel straps for conduits larger than NPS 2, 50 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at 1.5 m on centre.

- .4 Threaded rods, 6 mm diameter, to support suspended channels.

2.3 CONDUIT FITTINGS

- .1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified.
Coating: same as conduit.
- .2 Ensure factory "ells" where 90 degrees bends for NPS 1, 25 mm and larger conduits.
- .3 Watertight connectors and couplings for EMT.
 - .1 Set-screws are not acceptable.

2.4 EXPANSION FITTINGS FOR RIGID CONDUIT

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 100 mm 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.

2.5 FISH CORD

- .1 Polypropylene.

2.6 ENCLOSED METAL RACEWAY

- .1 Existing perimeter enclosed metal dual channel raceway for power and data cabling is Wiremold 4000 Series.
- .2 New enclosed metal dual channel raceway shall match existing standard in type (Wiremold 4000 Series), and finish (grey). Provide all necessary accessories and trims for a complete operational system.
- .3 Refer to drawings for locations and lengths.

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.
- .3 Surface mount conduits are acceptable in the UPS room.

- .4 Use rigid hot dipped galvanized steel threaded conduit except where specified otherwise.
- .5 Use electrical metallic tubing (EMT) except in cast concrete.
- .6 Minimum conduit size for lighting and power circuits: 19 mm.
- .7 Bend conduit cold:
 - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .8 Mechanically bend steel conduit over 19 mm diameter.
- .9 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .10 Install fish cord in empty conduits.
- .11 Run 2-25 mm spare conduits up to ceiling space and 2-25 mm spare conduits down to ceiling space from each flush panel.
 - .1 Terminate these conduits in 152 x 152 x 102 mm junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in surface type box.
- .12 Remove and replace blocked conduit sections.
 - .1 Do not use liquids to clean out conduits.
- .13 Dry conduits out before installing wire.

3.3 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on suspended or surface channels.
- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.4 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 CLEANING

- .1 Proceed in accordance with Section 01 specifications.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

PWGSC Project No. R.073227.004
CRA-CID Fit-Up
401 Burrard Street, Vancouver, BC
2016-06-15
Issued for Tender

Section 26 05 34

CONDUITS, CONDUIT FASTENINGS AND
CONDUIT FITTINGS

Page 4 of 4

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA C22.1 No.126.1-[02], Metal Cable Tray Systems.
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA FG 1-[1993], Fibreglass and Cable Tray Systems.
 - .2 NEMA VE 1-[2002], Metal Cable Tray Systems.
 - .3 NEMA VE 2-[2001], Cable Tray Installation Guidelines.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: submit manufacturer's product data sheets for cable tray indicating dimensions, materials, and finishes, including classifications and certifications.
- .3 Shop Drawings: submit shop drawings showing materials, finish, dimensions, accessories, layout, and installation details.
- .4 Identify types of cabletroughs used.
- .5 Show actual cabletrough installation details and suspension system.

Part 2 Products

2.1 CABLETROUGH

- .1 Ladder Ventilated type, to CAN/CSA C22.2 No.126.1/126.2.
- .2 Fittings: horizontal elbows, end plates, drop outs, vertical risers and drops, tees, wyes, expansion joints and reducers where required, manufactured accessories for cabletrough supplied.
- .3 Solid covers for complete cabletrough system including fittings.
- .4 Barriers where different voltage systems are in same cabletrough.
- .5 Ground cable trays with #2 AWG bare copper conductor attached to each tray section in accordance with CEC requirements.
- .6 Provide fire stop material at firewall penetrations.

2.2 SUPPORTS

- .1 Provide splices, supports for a continuously grounded system as required.

Part 3 Execution

3.1 INSTALLATION

- .1 Install complete cabletrough system in accordance with NEMA VE 2.
- .2 Support cabletrough on both sides.
- .3 Remove sharp burrs or projections to prevent damage to cables or injury to personnel.

3.2 CABLES IN CABLETROUGH

- .1 Installation of data cables by others.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 CSA International
 - .1 CSA C22.2 No.26-1952(R2009), Construction and Test of Wireways, Auxiliary Gutters and Associated Fittings.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 30 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for wireways and auxiliary gutters for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 10 - Common Product Requirements and with manufacturer's written instructions.

Part 2 Products

2.1 WIREWAYS

- .1 Wireways and fittings: to CSA C22.2 No.26.
- .2 Sheet steel with hinged or bolted cover to give uninterrupted access.
- .3 Finish: baked grey enamel in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .4 Elbows, tees, couplings and hanger fittings manufactured as accessories to wireway supplied.

Part 3 Execution

3.1 INSTALLATION

- .1 Install wireways and auxiliary gutters in accordance with manufacturer's written recommendations.

- .2 Keep number of elbows, offsets, connections to minimum.
- .3 Install supports, elbows, tees, connectors, fittings.
- .4 Install barriers where required.
- .5 Install gutter to full length of equipment.
- .6 Ground metallic wireways and gutters as required.

3.2 CLEANING

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

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No. 100-04, Motors and Generators.
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
 - .1 EEMAC M1-7-1992, Standard for Motors and Generators.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Quality Assurance Submittals:
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Manufacturer's Instructions: submit manufacturer's installation instructions.
- .3 Closeout Submittals:
 - .1 Provide maintenance data for fractional horsepower motors for incorporation into manual specified in Section 01 78 30 - Closeout Submittals.

Part 2 Products

2.1 FRACTIONAL HORSEPOWER MOTOR

- .1 Non-hazardous locations: to CSA C22.2 No. 100, EEMAC M1-7.
- .2 Motor with inherent overheating protectors.

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 wiring, flexible connections and grounding.
- .2 Check rotation before coupling to driven equipment.

3.3 CLEANING

- .1 Proceed in accordance with Division 01 specifications.

- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 91 00 of MMM Group's specifications (Commissioning Authority - CxA).

1.2 SUMMARY

- .1 Section Includes:
 - .1 Materials and installation for low voltage control system designed to provide remote switching of lighting loads by use of:
 - .1 Existing low voltage relay system. Existing is Douglas Lighting Control System.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
- .2 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Closeout Submittals:
 - .1 Submit maintenance data in accordance with Section 01 78 30 - Closeout Submittals.
- .4 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Test reports:
 - .1 Submit certified test reports indicating compliance with specifications for specified performance characteristics and physical properties.
 - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .3 Manufacturer's Instructions: submit manufacturer's installation instructions.
 - .4 Manufacturer's Field Reports: manufacturer's field reports specified.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 61 10 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

Part 2 Products

2.1 SUSTAINABLE REQUIREMENTS

2.2 MATERIALS

- .1 Control system: by one manufacturer and assembled from compatible components. Match existing manufacturer which is Douglas Lighting.

2.3 REMOTE CONTROL SWITCHES

- .1 Single pole, double throw, momentary contact, standard duty, rated 15 A, 25 V, double push-button action with pilot lights.

2.4 LOW VOLTAGE RELAYS

- .1 Electrically operated by momentary impulse, mechanically latched until activated.
- .2 Two coil solenoid type with one coil to close relay contacts and one coil to open relay contacts.
- .3 Operating voltage: 24 V, AC.
- .4 Load contacts: 20 A, 347 V, AC.
- .5 Auxiliary contacts for pilot light.
- .6 Coloured pre-stripped leads.

2.5 CONTROL TRANSFORMER

- .1 Low voltage power Class 2, input 347 V, AC, 60 Hz, output 24 V.

2.6 RECTIFIER

- .1 Selenium type: 24 V, AC, 60 Hz input, 0.36 A continuous duty output.
- .2 Silicon type: 24 V, AC, 60 Hz input, 20 A intermittent duty output.

2.7 MOTOR OPERATED MASTER CONTROL

- .1 Motor-driven multiple contact momentary switching device.
- .2 Radial contact arm to rotate through one revolution in 17 s.
- .3 Contact made in succession between 25 points around circle.
- .4 One master required for "ON" operation and one for "OFF" operation.
- .5 Motor master units connected in cascade to control circuits.
- .6 Interface equipment as required to convert maintained contact signals to momentary contact control pulses.

2.8 PHOTO SENSORS

- .1 New photo sensors, as indicated on drawings, must match existing base building standard and be fully compatible with the existing Douglas Lighting Control System.

2.9 VACANCY/OCCUPANCY SENSORS

- .1 New vacancy/occupancy sensors, as indicated on drawings, must match existing base building standard and be fully compatible with the existing Douglas Lighting Control System. Sensors indicated as dimming shall have full 0-10V dimming capability.

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.

3.4 CLEANING

- .1 Proceed in accordance with Division 01 specifications.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

PWGSC Project No. R.073227.004
CRA-CID Fit-Up
401 Burrard Street, Vancouver, BC
2016-06-15
Issued for Tender

Section 26 09 24

LIGHTING CONTROL DEVICES - LOW VOLTAGE

Page 4 of 4

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 91 00 of MMM Group's specifications (Commissioning Authority - CxA).

1.2 REFERENCES

- .1 CSA International
 - .1 CSA C22.2 No.29-[11], Panelboards and Enclosed Panelboards.

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 panelboards and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit shop drawings of panels.
 - .2 Include on drawings:
 - .1 Electrical detail of panel, branch breaker type, quantity, kAIC, ampacity and enclosure dimension.

1.4 CLOSEOUT SUBMITTALS

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

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 10 - Common Product Requirements] [with manufacturer's written instructions.

Part 2 Products

2.1 PANELBOARDS

- .1 Panelboards: to CSA C22.2 No.29 and product of one manufacturer.
 - .1 Install circuit breakers in panelboards before shipment.
 - .2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.

- .2 250V panelboards: bus and breakers rated as per drawing.
- .3 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.
- .4 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
- .5 Minimum of 2 flush locks for each panel board.
- .6 Two keys for each panelboard and key panelboards alike.
- .7 Copper bus with neutral of same ampere rating of mains.
- .8 Mains: suitable for bolt-on breakers.
- .9 Trim with concealed front bolts and hinges.
- .10 Trim and door finish: baked enamel as per colour schedule.
- .11 Isolated ground bus.
- .12 Include grounding busbar with 3 of terminals for bonding conductor equal to breaker capacity of the panel board.
- .13 KAIC rating of new panels must be of the same rating as the upstream panel.

2.2 BREAKERS

- .1 Breakers: to Section 26 28 16.02 - Moulded Case Circuit Breakers.
- .2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
- .3 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.
- .4 Do not use any re-furbished or second hand breakers. All new breakers must be new.

2.3 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Nameplate for each panelboard size 4 engraved.
- .3 Nameplate for each circuit in distribution panelboards size 2 engraved.
- .4 Complete circuit directory with typewritten legend showing location and load of each circuit, mounted in plastic envelope at inside of panel door.

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 panelboards installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.

3.2 INSTALLATION

- .1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2 Install surface mounted panelboards on plywood backboards. Where practical, group panelboards on common backboard.
- .3 Mount panelboards to height specified in Section 26 05 00 - Common Work Results for Electrical or as indicated.
- .4 Connect loads to circuits.
- .5 Connect neutral conductors to common neutral bus with respective neutral identified.
- .6 Where panels of different systems (i.e. Standard and Vital Power) supply a common patient care area, ground busses in panels to be interconnect with a minimum #6 AWG ground conductor.

3.3 CLEANING

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

3.4 PROTECTION

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

PWGSC Project No. R.073227.004
CRA-CID Fit-Up
4010 Burrard Street, Vancouver, BC
2016-06-15
Issued for Tender

Section 26 24 16.01

PANELBOARDS BREAKER TYPE

Page 4 of 4

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 CSA International
 - .1 CSA C22.2 No. 5-[09], Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, and NMX-J-266-ANCE-2010).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for circuit breakers and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Include time-current characteristic curves for breakers with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage.
- .4 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 review.
 - .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:

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 10 - Common Product Requirements and with manufacturer's written instructions.

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 with temperature compensation for 40 degrees C ambient.
- .3 Common-trip breakers: with single handle for multi-pole applications.

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 OPTIONAL FEATURES

- .1 Include:
 - .1 Shunt trip.
 - .2 Auxiliary switch.
 - .3 Motor-operated mechanism [c/w time delay unit].
 - .4 Under-voltage release.
 - .5 On-off locking device.
 - .6 Handle mechanism.

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.

3.2 INSTALLATION

- .1 Install circuit breakers in panel.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Division 01 specifications.

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

PWGSC Project No. R.073227.004
CRA-CID Fit-Up
401 Burrard Street, Vancouver, BC
2016-06-15
Issued for Tender

Section 26 28 16.02

MOULDED CASE CIRCUIT BREAKERS

Page 4 of 4

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 CSA International
 - .1 CAN/CSA C22.2 No.94.1-[07], Enclosures for Electrical Equipment, Non Environment Considerations.
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA 250-[2008], Enclosures for Electrical Equipment (1000 Volts Maximum).
- .3 The Munsell System of Colour Notation

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 30 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for electrical cabinets and enclosures for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 10 - Common Product Requirements and with manufacturer's written instructions.

Part 2 Products

2.1 MATERIALS

- .1 Enclosure constructed with 2.7 mm thick minimum steel, with weather and corrosion resistant finish to CAN/CSA C22.2, Munsell Notation 7.5GY3.5/1.5, size as indicated.
- .2 Entire enclosure to be capable of withstanding maximum impact force of 86 MN/m² area without rupture of material.
- .3 Removable enclosure panels with formed edges, galvanized steel external fasteners removable only from inside enclosure.
- .4 Equip enclosure with hot dipped galvanized mounting rails 1 m adjustable horizontally and vertically to enable mounting of equipment at any location within housing.

- .1 Rails: 14 mm holes and 50 x 14 mm slots on 100 mm centres for horizontal adjustment.
- .2 Holes in side panel flanges in 60 mm increments for vertical adjustment.
- .5 Cover: tamperproof, bolt-on, domed to shed water.
- .6 Door: 3 point latching, with padlocking means.
- .7 Ventilation panel constructed to allow air circulation yet preventing entry of foreign objects, wild life, and vermin.
- .8 Door interlocks.
- .9 Enclosure construction such as to allow configuration of single or ganged enclosures.
- .10 Enclosure capable of being shipped in knocked-down condition.

Part 3 Execution

3.1 INSTALLATION

- .1 Assemble enclosure in accordance with manufacturer's instructions and securely mount on building structure with channels, supports and fastenings.
- .2 Mount equipment in enclosure.
- .3 Label electrical cabinets and enclosure to Section 26 05 00 - Common Work Results for Electrical.

3.2 CLEANING

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

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 CSA International
 - .1 CSA C22.2 No.42-10, General Use Receptacles, Attachment Plugs and Similar Devices.
 - .2 CAN/CSA C22.2 No.42.1-00(R2009), Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
 - .3 CSA C22.2 No.55-M1986(R2008), Special Use Switches.
 - .4 CSA C22.2 No.111-10, General-Use Snap Switches (Bi-national standard, with UL 20).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for wiring devices and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings of specified devices.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 30 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for wiring devices for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 10 - Common Product Requirements with manufacturer's written instructions.

Part 2 Products

2.1 SWITCHES

- .1 15 or 20 A, 120 V or 347 V, single pole, double pole, three-way switches to: CSA C22.2 No.55 and CSA C22.2 No.111.
- .2 Manually-operated general purpose AC switches with following features:
 - .1 Terminal holes approved for No. 10 AWG wire.
 - .2 Silver alloy contacts.

- .3 Urea or melamine moulding for parts subject to carbon tracking.
- .4 Suitable for back and side wiring.
- .5 Ivory toggle.
- .3 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads heating loads.
- .4 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 Ivory urea moulded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Break-off links for use as split receptacles.
 - .4 Eight back wired entrances, four side wiring screws.
 - .5 Triple wipe contacts and riveted grounding contacts.
- .2 Single receptacles CSA type 5-15 R, 125 V, 15 A, U ground with following features:
 - .1 Ivory 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.
- .5 Match existing receptacle color of ivory with stainless steel faceplates.

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, vertically brushed, 1 mm thick cover plates cover plates, thickness 2.5 mm] for wiring devices mounted in flush-mounted outlet box.
- .4 Sheet metal cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.

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.
- .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.
 - .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
 - .4 Install GFI type receptacles as indicated.
 - .5 Provide 20A breakers for all house-keeping and copier receptacles indicated as t-slot.
 - .6 Provide 20A breakers for all kitchen above counter receptacles.
- .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 CLEANING

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

3.3 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.

PWGSC Project No. R.073227.004
CRA-CID Fit-Up
401 Burrard Street, Vancouver, BC
2016-06-15
Issued for Tender

Section 26 27 26
WIRING DEVICES
Page 4 of 4

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 International Electrotechnical Commission (IEC)
 - .1 IEC 947-4-1-2002, Part 4: Electromechanical contactors and motor-starters.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide maintenance materials in accordance with Section 01 78 30 - Closeout Submittals.
- .2 Submit operation and maintenance data for each type and style of motor starter for incorporation into maintenance manual.
- .3 Extra Materials:
 - .1 Provide listed spare parts for each different size and type of starter.
 - .1 [3] contacts, stationary.
 - .2 [3] contacts, movable.
 - .3 [1] contacts, auxiliary.
 - .4 [1] control transformer[s].
 - .5 [1] operating coil.
 - .6 [2] fuses.
 - .7 [10]% indicating lamp bulbs used.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 10 - Common Product Requirements.

Part 2 Products

2.1 MATERIALS

- .1 Starters: to IEC 947-4 with AC4 utilization category.

2.2 MANUAL MOTOR STARTERS

- .1 Single or Three phase manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:
 - .1 Switching mechanism, quick make and break.
 - .2 One or Three overload heater[s], manual reset, trip indicating handle.
- .2 Accessories:
 - .1 Pushbutton switch: standard type, labelled as indicated.
 - .2 Indicating light: standard type and colour as indicated.
 - .3 Locking tab to permit padlocking in "ON" or "OFF" position.

2.3 CONTROL TRANSFORMER

- .1 Single phase, dry type, control transformer with primary voltage as indicated and 120 V secondary, complete with secondary fuse, installed in with starter as indicated.
- .2 Size control transformer for control circuit load plus 20% spare capacity.

2.4 FINISHES

- .1 Apply finishes to enclosure in accordance with Section 26 05 00 - Common Work Results for Electrical.

2.5 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Manual starter designation label, white plate, black letters, size 1.
- .3 Magnetic starter designation label, white plate, black letters.

Part 3 Execution

3.1 INSTALLATION

- .1 Install starters and control devices in accordance with manufacturer's instructions.
- .2 Install and wire starters and controls as indicated.
- .3 Ensure correct fuses installed.
- .4 Confirm motor nameplate and adjust overload device to suit.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and manufacturer's instructions.
- .2 Operate switches and contactors to verify correct functioning.
- .3 Perform starting and stopping sequences of contactors and relays.

- .4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

3.3 CLEANING

- .1 Clean in accordance with Division 01 specifications.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

PWGSC Project No. R.073227.004
CRA-CID Fit-Up
401 Burrard Street, Vancouver, BC
2016-06-15
Issued for Tender

Section 26 29 10

MOTOR STARTERS TO 600 V

Page 4 of 4

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American National Standards Institute (ANSI)
 - .1 ANSI C82.1-[04], Lamp Ballasts-Line Frequency Fluorescent Lamp Ballast.
- .2 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE C62.41-[1991], Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
- .3 Canadian Standards Association (CSA International)
- .4 Underwriters' Laboratories of Canada (ULC)

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Provide complete photometric data prepared by independent testing laboratory for luminaires where specified, for review by Departmental Representative.
 - .3 Photometric data to include: VCP Table where applicable and spacing criterion.
- .3 Product Shop Drawings:
 - .1 Submit shop drawings of all new exit signs.
- .4 Samples:
 - .1 Provide samples as indicated. Include any costs for mock-ups on site.

1.3 QUALITY ASSURANCE

- .1 Provide mock-ups in accordance with Division 01 specifications.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 10 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Divert unused metal materials from landfill to metal recycling facility.
- .4 Disposal and recycling of fluorescent lamps as per local regulations.

- .5 Disposal of old PCB filled ballasts.

Part 2 Products

2.1 LAMPS

- .1 Fluorescent lamps to be - T8, 32 Watt, medium bi-pin, rapid-start, 4100 K, 30,000 hour lamp life, 2950 initial lumens, CRI [80]; or as indicated.
- .2 Compact fluorescent lamps to be - 18 Watt, G24q-2 base, 12,000 hour lamp life, 12,000 initial lumens, 4100 K, CRI [80]; or as indicated.
- .3 LED lamps to be as per luminaire schedule details.

2.2 BALLASTS

- .1 Fluorescent ballast: CBM and CSA certified, energy efficient type, IC electronic and IC electronic dimmable where noted.
 - .1 Rating: 347 V, 60 Hz, for use with 2-32W, rapid start lamps.
 - .2 Totally encased and designed for 40 degrees Celsius ambient temperature.
 - .3 Power factor: minimum 95 % with 95% of rated lamp lumens.
 - .4 Current crest factor: 1.7 maximum.
 - .5 Harmonics: 10 % maximum THD.
 - .6 Operating frequency of electronic ballast: 20 kHz minimum.
 - .7 Ballast factor: greater than 0.90.
 - .8 Sound rated: Class A.

2.3 FINISHES

- .1 Light fixture finish and construction to meet ULC listing and CSA certification related to intended installation.

2.4 OPTICAL CONTROL DEVICES

- .1 As indicated in luminaire schedule.

2.5 LUMINAIRE SCHEDULE

- .1 Type 'A': Minimum standard of acceptance is 120V, recessed in t-bar or dry wall (as required) 4 inch LED down light with 0-10V dimming, 1100 lumens, 3500K and 14W.
- .2 Type 'B': Minimum standard of acceptance is 120V, suspended, direct/indirect LED pendant light with 0-10V dimming, 5121 lumens, 3500K and 50W. Confirm mounting height with Departmental Representative and center to the table.
- .3 Type 'C': Minimum standard of acceptance is 120V, recessed in t-bar or dry wall (as required) 6 inch LED down light with 0-10V dimming, 2000 lumens, 3500K and 23W.

- .4 Type 'D': Minimum standard of acceptance is 120V, recessed in t-bar, 20 inch x 48 inch LED with 0-10V dimming, 3500K and 50W. Provide filler panel kits to fit 20 inch x 60 inch t-bar grid.
- .5 Type 'E': Minimum standard of acceptance is 120V, surface mounted to under cabinet in a clear channel. Light is to have 3M industrial strength adhesive tape but not to be taped directly to cabinet. Light is to be 8MM linear LED strip (length to suit as per drawings). LED life is to be minimum 50,000 hours with 24VDC input voltage, dimmable with dimming power supply and no more than 10 watts/meter. Lumens are to be 3400K.
- .6 Alternate products will be considered after tender closes or during the shop drawing review process providing that the alternate is equal to or exceeds the specifications of the minimum standard of acceptance.
- .7 No alternates will be reviewed during the tender period.

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.

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 CLEANING

- .1 Clean in accordance with Division 01 specifications.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

PWGSC Project No. R.073227.004
CRA-CID Fit-Up
401 Burrard Street, Vancouver, BC
2016-06-15
Issued for Tender

Section 26 50 00

LIGHTING
Page 4 of 4

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.141-[02], Unit Equipment for Emergency Lighting.
 - .2 CSA C860-[01(December 2002)], Performance of Internally-Lighted Exit Signs.
- .2 National Fire Protection Association (NFPA)
 - .1 NFPA 101-[2006], Life Safety Code.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Product Shop Drawings:
 - .1 Submit shop drawings of all new exit signs.

Part 2 Products

2.1 STANDARD UNITS

- .1 Exit lights: to CSA C22.2 No.141 and CSA C860.
- .2 Exit sign to be one-piece aluminum housing, white in colour and green running man style.
- .3 Provide arrows as indicated on the drawings.
- .4 Lamps: LED, less than 5 watts per face. Rated for 500,000 hours.
- .5 Third lamp socket for emergency lamp lighting circuit.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install exit lights to manufacturer's recommendations, listing requirements, NFPA standard and local regulatory requirements.
- .2 Connect fixtures to exit light circuits.
- .3 Connect emergency lamp sockets to emergency circuits.
- .4 Ensure that exit light circuit breaker is locked in on position.

3.3 CLEANING

- .1 Proceed in accordance with Division 01 specifications.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1 General

1.1 OVERVIEW

- 1.1.1 Supply and install a Sound Masking System as indicated on drawings and specifications. Acceptable sound masking system shall meet the minimum standards of Cambridge Sound Management.
- 1.1.2 The Sound Masking System shall comprise of a sound masking generator, controller, amplifier and emitters.
- 1.1.3 The Sound Masking System ceiling mounted emitters shall come with factory pre-made patch cables.
- 1.1.4 The Sound Masking System controller/amplifier shall be located in the facilities communications room. Coordinate exact location with departmental representative.
- 1.1.5 The sound masking system contractor shall provide all required power supplies.
- 1.1.6 The sound masking system contractor shall adjust sound masking levels to suite departmental representative's requirements.
- 1.1.7 The sound masking system contractor shall install the emitters in a 10' x 10' grid.
- 1.1.8 The sound masking system contractor shall carry and allowance to return to site a minimum of three times for sound masking adjustments such as overall volume, frequency adjustments and final level adjustments of individual sound masking emitters.

1.2 SECTION INCLUDES

- 1.2.1 This section specifies the materials and installation for the Sound Masking Systems in various configurations.

1.3 REFERENCES

- 1.3.1 Industry Canada - Terminal Attachment Program
 - 1.3.1.1 CS-03-1996, Telecommunication Apparatus Compliance Specification, Issue 8.

1.4 SYSTEM DESCRIPTION

- 1.4.1 Sound Masking systems to incorporate:
 - 1.4.1.1 Sound masking system generators
 - 1.4.1.2 Sound masking system controllers
 - 1.4.1.3 Sound masking system emitters

- 1.4.1.4 Sound masking system cables
- 1.4.1.5 Sound masking system power supplies

1.4.2 Systems in various configurations shall be cabinet or wall mounted.

1.5 SUBMITTALS

1.5.1 Product Data: Submit manufacturer's printed product literature, specifications and data sheets.

1.5.2 Shop Drawings:

1.5.2.1 Submit shop drawings to indicate project layout, device locations, point-to-point diagrams, cable schematics, risers, mounting details and identification labeling scheme including:

- 1.5.2.1.1 Functional description of equipment
- 1.5.2.1.2 Technical data sheets of all devices
- 1.5.2.1.3 Device location plans and cable lists
- 1.5.2.1.4 Sound Masking System interconnection detail drawings
- 1.5.2.1.5 Programming worksheets

1.5.3 Samples:

1.5.3.1 Submit sample floor plans with device layout that shall be used with the Sound Masking System.

1.5.4 Quality Assurance Submittals:

1.5.4.1 Test Reports: Submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

1.5.4.2 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.5.4.2.1 Submit UL/CSA Product safety Certificates.

1.5.4.3 Instructions: Submit manufacturer's installation instructions.

1.5.5 Maintenance Data:

1.5.5.1 System configuration and equipment physical layout

1.5.5.2 Functional description of equipment

1.5.5.3 Instructions on operation, adjustment and cleaning

1.5.5.4 Illustrations and diagrams to supplement procedures

1.5.5.5 Manufacturer's operation instructions

1.5.5.6 All programming worksheets

1.5.6 Seismic Restraints:

- 1.5.6.1 The contractor shall provide seismic restraint and anchorage for all equipment and services in accordance with the current edition of the Vancouver Building By-Law, and all applicable building bylaws.
- 1.5.6.2 The contractor shall provide certified professionally sealed shop and placement drawings where applicable for all Sound Masking System equipment assemblies showing the methods of attachment to the particular structure for each piece of equipment and assembly and provide anchorage/attachment details approved and sealed by a professional engineer registered in the province of British Columbia.
- 1.5.6.3 Include in the tendered price all services of a professional engineer including but not limited to providing letters of assurance for the project in respect of the seismic restraint of all Sound Masking System equipment, conducting the necessary site reviews and providing a letter at the conclusion of the project, confirming that all seismic restraints for the Sound Masking System equipment has been installed in accordance with the engineer's instructions. Pay all associated fees as required. Seismic engineer shall provide proof of insurance and credentials if requested.

1.6 WARRANTY

- 1.6.1 For all materials, the 12-month warranty for parts and labor.
- 1.6.2 Provide a separate maintenance and service agreements options for the following:
 - 1.6.2.1 Extending warranty by 12-months
 - 1.6.2.2 Extending warranty by 24-months
 - 1.6.2.3 Extending warranty by 36-months
 - 1.6.2.4 Additional maintenance and service agreements, with parts to be considered as extra.
- 1.6.3 Manufacturer's Warranty: Submit, for Department Representative's acceptance, manufacturer's standard warranty document executed by authorized company official.

1.7 CONTRACTOR QUALIFICATIONS

- 1.7.1.1 The Sound Masking System contractor shall be a certified for the system that is being installed, in accordance to manufacturers requirements.
- 1.7.1.2 All Sound Masking System programmers shall be Certified. Provide all programmers qualifications with tender submission.
- 1.7.1.3 The Sound Masking System contractor shall have a minimum of five (5) years of experience with similar installations. Provide proof of experience with tender submission.

1.8 SUPPORT SERVICES

- 1.8.1 Provide manufacturer/dealer advice, information and support services for 1 year.

1.9 CLOSEOUT SUBMITTALS

1.9.1 Provide operation and maintenance data for the Sound Masking System for incorporation into manual.

1.9.2 Include:

1.9.2.1 Operation/Maintenance manuals for each component.

1.9.2.2 Operation instructions.

1.9.2.3 Description of system operation.

1.9.2.4 Description of each subsystem operation.

1.9.2.5 List specifying each piece of equipment in system or subsystem by its original manufacturer name and model number.

1.9.2.6 Part list specifying parts used in equipment by identification numbers that are standard to electronic industry.

1.10 SYSTEM START-UP

1.10.1 Installation contractor's departmental representative to instruct:

1.10.1.1 Maintenance personnel in maintenance of system.

1.10.1.2 Operating personnel in use of system.

2 Products

2.1 SUPPLY OF SYSTEM COMPONENTS

2.1.1 Unless otherwise specified in this document, the contractor shall supply all components necessary to complete the Sound Masking System. All materials shall be new and of the latest hardware, software, and firmware versions.

2.1.2 All components shall be new and CSA/UL approved.

2.2 MATERIALS

2.2.1 Sound Masking System Controller:

2.2.1.1	Max Coverage Area:	72,000ft ²
2.2.1.2	Emitter Capacity:	2 x 60, total of 720
2.2.1.3	Masking Spectrum:	Pre-set at factory to CSM standard
2.2.1.4	Masking Channels:	4 per zone
2.2.1.5	Module control:	Front Panel, iOS app
2.2.1.6	Security:	"hidden" front panel lock switch
2.2.1.7	Aux audio inputs:	2
2.2.1.8	Aux Audio Input Level:	-10dBV
2.2.1.9	Emitter connector type:	RJ-45
2.2.1.10	Zones:	6
2.2.1.11	Power requirements:	100-240VAC
2.2.1.12	Power Consumption:	Supported
2.2.1.13	Operating Temperature:	4°C - 32°C

2.2.1.14	Dimensions:	343mmW x 89mmH x 97mmD
2.2.1.15	Weight:	1,400g
2.2.1.16	Acceptable Product:	Cambridge Sound MGMT CSM-QT-600

2.2.2 Sound Masking System Emitters:

2.2.2.1	Grill Diameter:	83mm
2.2.2.2	Emitter Type:	White, adjustable
2.2.2.3	Enclosure Height:	64mm
2.2.2.4	Weight:	159g
2.2.2.5	Wiring:	Standard Cat3 or better
2.2.2.6	Sensitivity:	50dB @ 1 meter
2.2.2.7	Spectral Output:	Standard ISO 1/3 octave bands
2.2.2.8	Certifications:	Plenum-rated, UL listed, UL-2043
2.2.2.9	Nominal Impedance:	4k ohms
2.2.2.10	Frequency Response:	flat +/- 1dB
2.2.2.11	Masking Output Level:	36-57dB
2.2.2.12	Directivity:	3dB Hemispherical
2.2.2.13	Max Sound Pressure Output:	74dB @ 1 meter
2.2.2.14	Power Handling Capacity:	2 watts
2.2.2.15	Acceptable Product:	Cambridge Sound MGMT CSM-EAW-16

2.2.3 Cables:

2.2.3.1	Type:	CAT3 with RJ45 connectors
2.2.3.2	Cable Length:	Factory pre-made 16ft or as required
2.2.3.3	Rating:	Plenum
2.2.3.4	Wiring configuration:	T568B Standard
2.2.3.5	Acceptable Product:	Cambridge Sound Management

3 Execution

3.1 INSTALLATION

- 3.1.1 Install equipment in accordance with manufacturer's instructions, and as indicated.
- 3.1.2 Install equipment in accordance with local bylaw and the Canadian Electrical code.
- 3.1.3 Install cables neatly along building lines.
- 3.1.4 All cables shall have a permanent label. Label shall match shop drawings.
- 3.1.5 Provide seismic restraints for Sound Masking System equipment, cabinets, racks, emitters and suspended equipment.
- 3.1.6 Shielded cables shall be grounded at the cabinet/rack end only.

- 3.1.7 All cable runs shall be neatly fastened at minimum 4ft spans.
- 3.1.8 All cables in equipment rack shall be neatly fastened.
- 3.1.9 All rack mounted equipment shall have a permanent label indicating use.
- 3.1.10 Route all cables as far away for high voltage sources as possible. Minimum distance for parallel horizontal runs shall be 24 inches.

3.2 PROGRAMMING

- 3.2.1 Provide all required programming for each component of the Sound Masking System systems.
- 3.2.2 Coordinate with departmental representatives regarding Sound Masking System controller installation location.

3.3 FIELD QUALITY CONTROL

- 3.3.1 Test all Sound Masking System features to the satisfaction of the departmental representatives.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 91 00.
- .2 Sections 01 91 41 training.

1.2 SUMMARY

- .1 Section Includes:
 - .1 Materials and installation for fire alarm systems.
 - .2 The fire alarm system zones within the tenant space are existing and are part of an overall system within the building.
 - .3 Manual alarm stations.
 - .4 Audible signal devices.
 - .5 End-of-line devices.
 - .6 Visual alarm signal devices.
- .2 Modifications
 - .1 Connect all new & relocated fire alarm devices to local zone. All new devices are to match existing manufacturer. Extend conduit & wiring as required for all relocated devices. Provide written verification for all new, relocated, and existing devices in the affected zone(s). Contractor to allow for upgrading the graphic display in fire alarm annunciator.

1.3 REFERENCES

- .1 Government of Canada
 - .1 TB OSH Chapter 3-04, [1994-12-22], Treasury Board of Canada, Occupational Safety and Health, Chapter 3-04, Standard for Fire Alarm Systems.
- .2 Underwriter's Laboratories of Canada (ULC)
 - .1 CAN/ULC-S524-2001, Standard for the Installation of Fire Alarm Systems.
 - .2 CAN/ULC-S525-[999, Audible Signal Device for Fire Alarm Systems.
 - .3 CAN/ULC-S526-2002, Visual Signal Devices for Fire Alarm Systems.
 - .4 CAN/ULC-S527-1999, Control Units.
 - .5 CAN/ULC-S528-1991, Manual Pull Stations for Fire Alarm Systems.
 - .6 CAN/ULC-S529-2002, Smoke Detectors for Fire Alarm Systems.
 - .7 CAN/ULC-S530-M1991, Heat Actuated Fire Detectors for Fire Alarm Systems.
 - .8 CAN/ULC-S531-2002, Standard for Smoke Alarms.
 - .9 CAN/ULC-S536-S537-2004, Burglar and Fire Alarm Systems and Components.
- .3 National Fire Protection Agency

- .1 NFPA 72-2002, National Fire Alarm Code.
- .2 NFPA 90A-2002, Installation of Air Conditioning and Ventilating Systems.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Closeout Submittals:
 - .1 Submit maintenance and engineering data for incorporation into manual specified in Section 01 78 30 - Closeout Submittals in accordance with ANSI/NFPA 20.
 - .2 Submit following:
 - .1 Manufacturer's Data for:
 - .1 Fire alarm speakers.
 - .2 Visual strobe lights.
 - .3 Smoke detectors
 - .4 Updated annunciator graphic.
 - .2 Test Reports:
 - .1 Final verification report from the testing vendor:

1.5 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installer: company or person specializing in fire alarm system installations approved by manufacturer and landlord.
- .2 Provide services of representative or technician from manufacturer of system, experienced in installation and operation of type of system being provided, to supervise installation, adjustment, preliminary testing, and final testing of system and to provide instruction to project personnel.
- .3 Maintenance Service:
 - .1 Provide one year's free maintenance with two inspections by manufacturer during warranty period. Inspection tests to conform to CAN/ULC-S536. Submit inspection report to Departmental Representative.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 61 10 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

Part 2 Products

2.1 MATERIALS

- .1 Equipment and devices: ULC listed and labelled and supplied by single manufacturer.
- .2 Audible signal devices: to CAN/ULC-S525.
- .3 Visual signal devices: to CAN/ULC-S526.
- .4 Manual pull stations: to CAN/ULC-S528.
- .5 Thermal detectors: to CAN/ULC-S530.
- .6 Smoke detectors: to CAN/ULC-S529.
- .7 Smoke alarms: to CAN/ULC-S531.

2.2 SYSTEM OPERATION

- .1 Provide complete, electrically supervised, zoned, annunciated, fire alarm system.
- .2 Provide separate circuits from control panel to each zone of initiating devices. Transmission of signals from more than one zone over common circuit to control panel is prohibited.
- .3 Two stage operation: operation to actuation following:
 - .1 Manual station.
 - .2 Heat detector.
 - .3 Smoke detector.
 - .4 Automatic fire sprinkler system.
 - .5 Fire extinguishing system.
 - .6 Fire standpipe system.
- .4 Actuation of two stage operation device to initiate following:
 - .1 Audible signal devices throughout building to sound at 20 strokes per minute.
 - .2 Audible signal devices in zone of alarm and adjacent zones on same floor level as well as zones on floor level immediately above and floor level immediately below to sound continuously while other audible signal devices throughout building sound at 20 strokes per minute.
 - .3 Zone of alarm to be indicated on control panel and remote annunciator.
 - .4 Transmit signal to fire department via fire alarm monitoring station.
 - .5 Air conditioning and ventilating fans to shut down or to function so as to provide required control of smoke movement.
 - .6 Fire doors and smoke control doors if normally held open, to close automatically.
 - .7 Electro-magnetic door holders to de-energize.
 - .8 Operations to remain in alarm mode (except alarm notification appliances if manually silenced) until system is manually restored to normal.
- .5 Operation of alarm initiating device on second stage to:

.1 Cause audible signal devices throughout building to sound continuously.

.6 Capability to program smoke detector status change confirmation on any or zones in accordance with CAN/ULC-S527, Appendix C.

2.3 CONTROL PANEL

.1 Control panel is existing two-stage system by Simplex.

2.4 MANUAL ALARM STATIONS

.1 Manual alarm pull stations are existing to remain as is.

2.5 AUTOMATIC ALARM INITIATING DEVICES

.1 Heat detectors: provide heat detectors designed for detection of fire by combination fixed temperature rate-of-rise principle.

.2 Combination Fixed Temperature Rate-Of-Rise Detectors (Spot Type): designed for surface or semi-flush outlet box mounting and supported independently of conduit, tubing or wiring connections.

.1 Contacts: self-resetting after response to rate-of-rise actuation

.2 Operation under fixed temperature actuation to result in external indication.

.3 Detector units located in boiler rooms, showers, or other areas subject to abnormal temperature changes to operate on fixed temperature principle only.

.3 Open-Area Smoke Detectors: provide detectors designed for detection of abnormal smoke densities by ionization principle.

.1 Detectors: 4-wire type.

.2 Provide necessary control and power modules required for operation integral with control panel.

.3 Detectors and associated modules: compatible with control panel and suitable for use in supervised circuit.

.4 Malfunction of electrical circuits to detector or its control or power units to result in operation of system trouble signals.

.5 Equip each detector with visible indicator lamp that will flash when detector is in normal standby mode and glow continuously when detector is activated.

.6 Each detector: plug-in type with tab-lock or twist-lock, quick disconnect head and separate base in which detector base contains screw terminals for making wiring connections.

.7 Detector head: removable from its base without disconnecting wires. Removal of detector head from its base to cause activation of system trouble signals.

.8 Screen each detector to prevent entrance of insects into detection chamber(s).

.4 4-Wire Smoke Detectors: detector circuits 4-wire type capable of transmitting detector operating power over conductors separate from initiating circuit.

.1 Provide separate, power circuit for each smoke detection initiating circuit (zone).

- .2 Failure of power circuit to be indicated as trouble condition on corresponding initiating circuit.
- .5 2-Wire Smoke Detectors: detector circuits of 2-wire type capable of transmitting detector operating power over initiating circuit are permitted, provided detectors used are approved by control panel manufacturer for use with control panel provided and are ULC listed as being compatible with control panel.
 - .1 Total number of detectors on any detection circuit: not exceed 80% of maximum number of detectors allowed by control panel manufacturer for that circuit. Provide additional zones if required to meet this requirement.
- .6 Ionization Detectors: multiple chamber type responsive to both invisible and visible particles of combustion.
 - .1 Detectors: not susceptible to operation by changes in relative humidity.
- .7 Photoelectric Detectors: operate on light scattering principle using LED light source.
 - .1 Detector: respond to both flaming and smoldering fires.
- .8 Locate detectors in accordance with their listing by ULC and the requirements of NFPA 72, except provide at least 2 detectors in rooms of 54 square meters or larger in area.
- .9 Mount detectors at underside of ceiling or deck above unless otherwise indicated.
 - .1 For mounting heights greater than 3 m above floor level, reduce actual detector linear spacing from listed spacing as required by NFPA 72.
 - .2 For heights greater than 9 m space detectors no farther apart than 34% of their listed spacing.
- .10 Temperature rating of detectors: in accordance with NFPA 72.
- .11 Locate detectors minimum 300 mm to lighting fixtures and not closer than 600 mm to air supply or return diffuser.
- .12 Ensure detectors, located in areas subject to moisture or exterior atmospheric conditions or hazardous locations as defined by NFPA 70, are approved for such locations.
- .13 Provide detectors with terminal screw type connections.
- .14 Removal of detector head from its base to cause activation of system trouble signals if detectors are provided with separable heads and bases.

2.6 ALARM INITIATING DEVICE SPACING AND LOCATION

- .1 Detector spacing and location: in accordance with manufacturer's recommendations and requirements of NFPA 72.
- .2 Provide at least 2 detectors in rooms of 54 square meters or larger.
- .3 Spacing: not to exceed 9 m by 9 m per detector, and 9 linear m per detector along corridors.
- .4 In areas without finished ceilings, mount detectors at underside of deck above unless otherwise indicated.

2.7 AUDIBLE SIGNAL DEVICES

- .1 Provide fire alarm speaker to match existing type, 12" round speaker.
- .2 Speaker to have tap settings of ¼ watt, ½ watt, ¾ watt and 1 watt.

2.8 GRAPHIC ANNUNCIATOR PANEL

- .1 Update existing fire alarm graphic.

2.9 VISUAL ALARM SIGNAL DEVICES

- .1 Flush-mounted assembly of stroboscopic type suitable for use in electrically supervised circuit and powered from notification appliance circuit[s].
- .2 Appliances: minimum of 75 candela measured as approved by ULC, but not less than effective intensity.
- .3 Protect lamps with thermoplastic lens and labelled "FIRE" in letters at least 12 mm high.
- .4 Provide visible appliances within 300 mm of each audible appliance.
- .5 Visible appliances may be part of audio-visual assembly, where more than two appliances are located in same room or corridor.

2.10 WIRING

- .1 Wire for 120 V circuits: No. 12 AWG minimum solid copper conductor.
- .2 Wire for low voltage DC circuits: No. 14 AWG minimum solid copper conductor
- .3 Wire to remote annunciators: No. 18 AWG minimum solid copper conductor.
- .4 Insulation 75 degrees C minimum with nylon jacket.
- .5 Colour code wiring.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install systems in accordance with CAN/ULC-S524.
- .2 Locate and install detectors and connect to alarm circuit wiring. Do not mount detectors within 1 m of air outlets. Maintain at least 600 mm radius clear space on ceiling, below and around detectors. Locate duct type detectors in straight portions of ducts.
- .3 Connect alarm circuits to main control panel.
- .4 Locate and install speakers and visual signal devices and connect to signalling circuits.

- .5 Connect signalling circuits to main control panel.
- .6 Install end-of-line devices.
- .7 Provide new zone for pre-action system and tie into base building system.
- .8 Connect fire suppression systems to control panel.

3.3 FIELD QUALITY CONTROL

- .1 Site Tests:
 - .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and CAN/ULC-S537.
 - .2 Fire alarm system:
 - .1 Test each device and alarm circuit to ensure manual stations, thermal smoke detectors transmit alarm to control panel and actuate first stage alarm.
 - .2 Check annunciator panels to ensure zones are shown correctly.
 - .3 Simulate grounds and breaks on alarm and signalling circuits to ensure proper operation of system.
 - .4 Class A circuits.
 - .1 Test each conductor on circuits for capability of providing alarm signal on each side of single open-circuit fault condition imposed near midmost point of circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.
 - .2 Test each conductor on circuits for capability of providing alarm signal during ground-fault condition imposed near midmost point of circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.
 - .5 Class B circuits.
 - .1 Test each conductor on circuits for capability of providing alarm signal on line side of single open-circuit fault condition imposed at electrically most remote device on circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.
 - .2 Test each conductor on circuits for capability of providing alarm signal during ground-fault condition imposed at electrically most remote device on circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.
 - .2 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

- .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.4 CLEANING

- .1 Proceed in accordance with Division 01 specifications.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Appendix A

Douglas Jung Building - 401 Burrard Street, Vancouver

1 General Access

1.1 Access to Non-Public Areas

- Access to any non-public areas of the building requires a commissioner and/or an access card
- Government of Canada Reliability-Level clearance is the minimum requirements for workers requiring unescorted access to this site.
- Certain areas of this facility may require a higher level of clearance. Per Government Security Policy, all such areas will have signage identifying SECRET or TOP SECRET clearance requirements.
- Access to any area of this facility is restricted to those having a legitimate business purpose.
- Workers who have not obtained the required Government of Canada security clearance, will not be permitted access to any area of the site without an APPROVED escort.
- An APPROVED escort is defined as a tenant employee, member of building security, commissioner or a Brookfield GIS staff member.
 - Building Security and Brookfield GIS staff members are not to be used as escorts unless approved by the Brookfield GIS Facility Manager.
- Access to tenant areas or work that may affect tenants directly will need to be pre-approved by Building Operations Staff and will require a minimum 48 business hours' notice.
 - Where a tenant employee is required to escort the contractor, such as within particular secure areas of the building, a minimum of 48 business hours will be required and work will need to be scheduled around tenant employee availability.

1.2 Access to Public Areas

Normal Business Days

- Lobby doors are open between 6AM – 6PM
- Parkade will be open from 6AM -8PM
- Onsite building security commissioner from 6AM to 10PM.

Weekend

- Lobby doors are locked and closed
- Parkade will be closed
- Weekend building security commissioner will be onsite between 8AM – 4PM
- Site access will be unavailable to contractors without a security commissioner or required access card (access card can only be given to someone with security clearance).

Access to these spaces outside of these hours should be conducted as if they were non-public areas (see Section 1.1 above)

1.3 Obtaining Security Clearance

- All workers requiring unescorted access to this site for business purposes will require Government of Canada Reliability-Level screening as a minimum.

2 Requirements for Commissionaires (if required)

- Commissionaire will be required if all contractors onsite do not have Security Clearance.
- If contractors are working in different spaces, a separate commissionaire will be required for each area to supervise the work. Different spaces includes trips to an onsite vehicle or the loading dock.

3 Parking

- Public pay parking is available within the building
- If a vehicle is over height, paid public street parking is available.

4 Use of Washrooms and Conditions for Use

- BGIS MTL has confirmed that the 7th floor is vacant and the washrooms can be used by contractors.
- The 8th floor washrooms are not to be used by any contractors as it is a shared space with tenants.
- General cleaning of the washroom is required on a daily basis. A final cleaning of the washroom is required at the end of the project.

5 Use of Loading Docks

- BGIS Maintenance Team Lead will arrange for space at the loading dock to be available for the disposal bin
- Loading dock is available for contractor use for loading and unloading of materials with prior preapproval from the BGIS MTL for scheduling purposes.
 - To obtain approval, the contractor should discuss their loading dock needs with the BGIS Maintenance Team Lead in person or on the phone and provide the times they require the use of the loading dock. Times must be coordinated to avoid conflicts with other deliveries.
- Only loading docks may be used to bring in construction materials to the site. In order to ensure the safety of all parties onsite, contractors are forbidden to bring materials in through the other entrances/exits at the site.
 - Should material need to be brought in through another entrance/exit, prior approval must be obtained from Brookfield GIS.
 - The Contractor will arrange for the safety of building occupants during such a move and will arrange for alternate exits if they intend to move material through a life safety corridor.
 - As this work will affect tenants, a minimum 72 business hours' notice is required.
 - The contractor should discuss this plan with the BGIS Facility Manager for approval.

- Only one Contractor will be permitted to use each loading dock at any given time. This is to ensure the safety of the workers through separation of the work activities via time and space.
- A commissionaire must be present to open all overhead doors and loading dock man doors. The Commissionaire is required to remain at the loading dock for the entire duration that the doors are open.
- All materials unloaded at a loading dock must immediately be removed from the loading dock area to an approved staging area.

6 Use of Water and Power for Construction Purposes.

- Power is available for use for construction purposes
- Water will be available for washroom use only.
 - Sinks must not be jury-rigged to provide water to any tool or equipment
 - Washrooms are for personal sanitation only. Tools, boots and equipment are not to be cleaned within this space.

7 Use of Garbage Disposal Areas / Need For Construction Garbage Bins.

- BGIS MTL will make space available for a disposal bin if this is requested.
- Contractor must make all arrangements for the construction bin itself, its delivery and its disposal at the end of the project.
- If odorous waste is produced, or if the disposal bin is becoming full, the contractor may need to schedule for additional disposals.
- All garbage generated during this project must be disposed of in the contractor's bin.
- Waste generated should be dealt with in accordance with LEED requirements.
- Contractors are to clean and remove all non-hazardous solid waste and recyclables at regular intervals throughout the shift and at the end of each shift. Required waste containers are to be provided by the Contractor.

8 Housekeeping.

- If the contractor is transporting material through common spaces such as hallways, loading docks and elevators, the contractor is required to ensure that these common areas are kept free of dust, garbage and waste.
 - These areas should be inspected and cleaned at the end of every trip to ensure their continued cleanliness.
- If any materials, dust or waste is tracked into other parts of the building the contractor is responsible for cleaning these areas as well.

9 How To Request System Shut-Down (Mechanical And Electrical).

- The BGIS MTL will require 24 hours' notice prior to any mechanical or electrical system shut downs
 - 48 business hours' notice will be required if this mechanical or electrical system shut down will affect building tenants.
- Fire Life Safety System bypasses will also require minimum 48 business hours' notice.

10 Hot Work

- Hot Work (such as welding, cutting or grinding) will also need to be identified on the Work Permit and the completion of a BGIS Hot Work Permit will be required.
 - Excessive dust generation may also require the completion of a BGIS Hot Work Permit and Fire Life Safety System by-passes to ensure that no building smoke detectors are triggered.
- The contractor is ultimately responsible for ensuring that any required bypasses of the fire and life safety system are in place prior to starting Hot Work.

11 Elevators

- A freight elevator is present on site and can be booked with the BGIS Maintenance Team Lead.
 - To book the freight elevator for particularly large loads, please contact the onsite BGIS Maintenance Team Lead and provide them the times that you require the elevator. Bookings based on availability.
- Contractors must use the freight elevator when transporting tools, materials or equipment
- The freight elevator should be inspected and cleaned of dust and waste after every load.
- Contractors must make themselves familiar with the elevators posted load limit and must respect this limit at all times when using the elevator.

12 Complete Detailed Work Permit Process.

- The Work Permit is used by Brookfield GIS in the role of OHS Control Authority so as to remain fully aware of all work activities occurring on site, as well as to appropriately coordinate and separate work activities from a safety standpoint.
- The Work Permit also allows Brookfield GIS to review the work plans to ensure that all risks, hazards and controls have been considered relative to any planned work activity.
- Upon review of submitted Work Permits, Brookfield GIS may also request to see evidence of qualification, training, instrument calibration, etc. so as to ensure that the workers are qualified and properly equipped relative to the task.

12.1 To Apply For A Work Permit.

- A Blank Work Permit Form should be requested from the local BGIS HSE Coordinator for the building.
- Submit the completed Work Permit form via email to PAC-RP1workpermit@brookfieldgis.com
- This Work Permit should be submitted at least 48 business hours prior to the work scheduled to allow for the review and approval process.
- Upon receipt of the completed Work Permit, it will be forwarded to the appropriate Brookfield GIS HSE Coordinator and Brookfield GIS Property Management delegates for review.
- Upon completion of the review, the Brookfield GIS Property Management delegate will either “Approve” or “Decline” the Work Permit and contact the original requestor.
- In the event that a Work Permit is declined, The HSE Coordinator will provide detail as to why it was declined and a contact will be provided to assist the requestor with the follow-up.
- Work Permits are mandatory for all work activities, including project work.

- A copy of the Work Permit (hardcopy or electronic) must be available at the work site. Workers unable to produce a copy of an approved Work Permit will be required to cease all work activity until it can be produced.
- Work Permits are required weekly for all work activities.
- General Contractors are required to complete a single Work Permit each week. A detailed daily scope of the work to be conducted is required for the Work Permit and must account for all sub trade activities that week. This scope can be entered into the Work Permit, or submitted in a separate document.
 - In the event that the work scope changes, the requestor should contact the Brookfield GIS HSE Coordinator to request an amended Work Permit. These requests should also be made 48 business hours prior to the work that is to change to allow for an adequate review of the request by Building Maintenance and the HSE Coordinator.
- Work Permits can cover a period of up to one week if a detailed enough scope can be submitted for the week.
- Work Permit authorization can be obtained up to one week in advance of the planned work activity.
- The Work Permit is ultimately for safety purposes, requests for system isolations or bypasses should be made separately to the Building Operations Team.

13 Normal Hours of Work.

- Demolition/noisy work can only be scheduled for 6 PM to 6 AM and on weekends. Any demolition work or overly noisy work conducted during normal business hours will stop if tenants or building maintenance determine that the work is too noisy or disruptive.

14 Anything That Would Affect the GC's Work and the Costs of the Work.

- Brookfield GIS policy is to initiate a Stop Work whenever a potentially dangerous circumstance is identified.
- Notification of a Stop Work will be provided by the Brookfield GIS Facility Manager to PWGSC as per standard Incident Process and will be communicated to the Tenant Joint Health & Safety Committee.
- The situation will then be investigated fully by Brookfield GIS, who will work with management and all parties involved ensuring that the identified hazard is controlled to the satisfaction of the party who reported the concern as well as the Tenant Joint Health & Safety Committee.

For all other project variables, please consult with the Property Management department for further details and requirements.

WORK PERMIT

PURPOSE: To increase safety and security, all work activities managed by Brookfield, PWGSC, or Tenants that require contractor access to any part of Brookfield managed facilities must have a Work Permit.

- INSTRUCTION**
1. Fill in all relevant fields completely. Permits with blank fields may be rejected.
 2. E-mail the completed permit to the email address listed for your region on the final page of this document.
 3. Await authorization from Brookfield GIS prior to commencing work.
 4. Retain a hard or soft copy of authorized work permit. An authorized work permit must be available on site every day for the duration of this job or project.

NOTE: To ensure timely authorized, please submit work permit **at least 48 hours** prior to the anticipated start time of work activities.
Questions regarding the Work Permit process can be sent to the region-specific email address.

LOCATION OF THE WORK

Province / Territory: City:

Floor / Room Number:

Building (Name or Address):

WORK INITIATOR

Work Requested By:

Work Order # or Project # (If Applicable):

DATE & DURATION OF THE WORK								
Schedule of Work			Work Hours					
<input type="checkbox"/> Day time	<input type="checkbox"/> After Hours	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Start Date								
End Date								
Provide a detailed description of the work to be conducted. Attach a job safety plan as appropriate.								

WORK DESCRIPTION

Will life safety systems be impacted or impaired (fire alarm or other)?

Will other building systems be impacted or impaired (HVAC, lighting, elevator, etc.)?

RISK ASSESSMENT

Please note, this Risk Assessment is not intended to replace a Job Safety Assessment (JSA). "Controls" as identified are intended as prompts for the permit authorizer. The permit holder is responsible for conducting a proper JSA and safety briefing to the workers prior to the commencement of the work and implementing any additional controls that may be required specific to the work task.

	Yes/ No	If Yes, See Associated Control	Control
Requires access to a secure area where escort may be needed?	<input type="checkbox"/>	1, 2	1. Workers to complete BGIS online orientation. (Available via Comply Works or through HSE Coordinator).
Requires access to a confined or restricted space?	<input type="checkbox"/>	1, 7, 9, 10, 11	2. Additional Clearance or Authorized Escort required.
Requires work from heights?	<input type="checkbox"/>	1, 7, 9, 10, 11	3. Tenant Notification or Escort required.
Requires hot work?	<input type="checkbox"/>	1,6,7,9,11,12	4. Shutdown Notice required.
Requires energy isolation?	<input type="checkbox"/>	1, 9, 10, 11	5. Security Coverage required.
Will life safety systems be impacted (fire alarm or other)?	<input type="checkbox"/>	1, 12	6. Hot Work Permit & Fire Watch required.
Workers have all licenses, training, and tools needed to perform task?	<input type="checkbox"/>	1, 10	7. Safety Barriers required.
Could generate noise or odours?	<input type="checkbox"/>	1, 3	8. Review of Asbestos Survey / BGIS Document Library required.
Requires obstruction of building access or egress?	<input type="checkbox"/>	1, 3, 5, 7	9. Additional High Hazard Permit required (Confined Space, LOTO, etc.).
Involves electrical or mechanical disruption?	<input type="checkbox"/>	1, 3, 4, 9	10. Additional License or Certifications required (Confined Space, Fall Arrest, etc.).
Have asbestos & hazardous materials surveys been reviewed by those conducting work?	<input type="checkbox"/>	1, 8	11. Specialized Personal Protective Equipment and Work Procedures required.
Will asbestos / other hazardous materials be disrupted during work activities?	<input type="checkbox"/>	1, 8, 11	12. Notify Fire Department / Fire Alarm Monitoring Company.
Involves working around or with hazardous chemicals?	<input type="checkbox"/>	1, 11, 14	13. Conservation Plan required. 14. Ensure MSDS or SDS are available.
Work taking place at heritage site?	<input type="checkbox"/>	1, 2, 13	

PERMIT HOLDER DETAILS

Company Name:

Permit Holder (Supervisor):

Permit Holder Contact Number:

Permit Holder Email:

Names of All Workers:

BGIS SAFETY REVIEW

Name of Reviewer:

Date of Review: Authorized?

Comments

BGIS FACILITIES REVIEW

Name of Reviewer:

Date of Review: Authorized?

Comments

Sample

EMAIL COMPLETED WORK PERMIT TO THE ADDRESS LISTED FOR YOUR REGION

Region	Region Description	Email Address
Atlantic Canada	Newfoundland, PEI, NB, NS	ATL-RP1workpermit@BrookfieldGIS.com
Quebec	Quebec Other Than Gatineau	QC-RP1workpermit@BrookfieldGIS.com
National Capital Area	Ottawa, Gatineau	NCA-RP1workpermit@BrookfieldGIS.com
Ontario	Ontario Other Than Ottawa	ON-RP1workpermit@BrookfieldGIS.com
Western Canada	Manitoba, Saskatchewan, Alberta	WEST-RP1workpermit@BrookfieldGIS.com
Pacific Canada	British Columbia, Yukon	PAC-RP1workpermit@BrookfieldGIS.com



PRELIMINARY HAZARD ASSESSMENT FORM

Project Number:	R.073227 (.004 and .102)
Location:	401 Burrard Street, Vancouver, BC
Date:	2016-06-03
Name of Departmental Representative:	Monique Simard
Name of Client:	PWGSC Accommodation Management; and Canada Revenue Agency (CRA)
Name of Client Project Co-ordinator	PWGSC Mary Amoore CRA Janet Rickaby

Site Specific Orientation Provided at Project Location Yes

Notice of Project Required Yes

NOTE:
PWGSC REQUIRES A Notice of Project FOR ALL CONSTRUCTION WORK RELATED ACTIVITIES

NOTE:
OHS law is made up of many municipal, provincial, and federal acts, regulations, bylaws and codes. There are also many other pieces of legislation in British Columbia that impose OHS obligations.

Important Notice: This hazard assessment has been prepared by PWGSC for its own project planning process, and to inform the service provider of actual and potential hazards that may be encountered in performance of the work. PWGSC does not warrant the completeness or adequacy of this hazard assessment for the project and the paramount responsibility for project hazard assessment rests with the service provider.

TYPES OF HAZARDS TO CONSIDER	Potential Risk for:				COMMENTS
	PWGSC, OGD's, or tenants		General Public or other contractors		
Examples: Chemical, Biological, Natural, Physical, and Ergonomic Listed below are common construction related hazards. Your project may include pre-existing hazards that are not listed. Contact the Regional Construction Safety Coordinator for assistance should this issue arise.	Yes	No	Yes	No	Note: When thinking about this pre-construction hazard assessment, remember a hazard is anything that may cause harm, such as chemicals, electricity, working from heights, etc; the risk is the chance, high or low, that somebody could be harmed by these and other hazards, together with an indication of how serious the harm could be.

Typical Construction Hazards					
Concealed/Buried Services (electrical, gas, water, sewer etc)		x		x	None know in the immediate area of work



Slip Hazards or Unsound Footing		x		x	None know in the immediate area of work
Working at Heights		x		x	None know in the immediate area of work
Working Over or Around Water		x		x	None know in the immediate area of work
Heavy overhead lifting operations, mobile cranes etc.		x		x	None know in the immediate area of work
Marine and/or Vehicular Traffic (site vehicles, public vehicles, etc.)		x		x	None know in the immediate area of work
Fire and Explosion Hazards		x		x	None know in the immediate area of work
High Noise Levels		x		x	None know in the immediate area of work
Excavations		x		x	None know in the immediate area of work
Blasting		x		x	None know in the immediate area of work
Construction Equipment	x			x	
Pedestrian Traffic (site personnel, tenants, visitors, public)	x		x		
Multiple Employer Worksite	x		x		Example: Contractor working in an occupied Federal Employee space.

Electrical Hazards					Comments
Contact With Overhead Wires		x		x	None know in the immediate area of work
Live Electrical Systems or Equipment	x			x	
Other:					
Physical Hazards					
Equipment Slippage Due To Slopes/Ground Conditions		x		x	None know in the immediate area of work
Earthquake	x		x		
Tsunami		x		x	
Avalanche		x		x	
Forest Fires		x		x	
Fire and Explosion Hazards		x		x	
Working in Isolation		x		x	
Working Alone		x		x	
Violence in the Workplace		x		x	
High Noise Levels		x		x	
Inclement weather		x		x	
High Pressure Systems		x		x	None know in the immediate area of work
Other:					
Hazardous Work Environments					
Confined Spaces / Restricted Spaces		x		x	None know in the immediate area of work



					work.
Suspended / Mobile Work Platforms		X		X	
Other:					
Biological Hazards					
Mould Proliferations		X		X	None know in the immediate area of work
Accumulation of Bird or Bat Guano		X		X	None know in the immediate area of work
Bacteria / Legionella in Cooling Towers / Process Water		X		X	None know in the immediate area of work
Rodent / Insect Infestation		X		X	None know in the immediate area of work
Poisonous Plants		X		X	None know in the immediate area of work
Sharp or Potentially Infectious Objects in Wastes		X		X	None know in the immediate area of work
Wildlife		X		X	None know in the immediate area of work
Chemical Hazards					
Asbestos Materials on Site		X		X	None know in the immediate area of work
Designated Substance Present		X		X	None know in the immediate area of work
Chemicals Used in work	X			X	Contractor to provide MSDS for all products used in this contract.
Lead in paint		X		X	None know in the immediate area of work
Mercury in Thermostats or Switches		X		X	None know in the immediate area of work
Application of Chemicals or Pesticides		X		X	
PCB Liquids in Electrical Equipment		X		X	None know in the immediate area of work
Radioactive Materials in Equipment		X		X	None know in the immediate area of work
Other:					
Contaminated Sites Hazards					
Hazardous Waste		X		X	None know in the immediate area of work
Hydrocarbons		X		X	None know in the immediate area of work
Metals		X		X	None know in the immediate area of work
Other:					

Security Hazards					Comments
Risk of Assault		X		X	
Other:					
Other Hazards					



Other Compliance and Permit Requirements ¹	YES	NO	Notes / Comments ²
Is a Building Permit required?	x		
Is an Electrical permit required?	x		
Is a Plumbing Permit required?	x		
Is a Sewage Permit required?		x	
Is a Dumping Permit required?	x		
Is a Hot Work Permit required?	x		
Is a Permit to Work required?	x		Mandatory for ALL BGIS managed work sites.
Is a Confined Space Entry Permit required?	x		Mandatory if applicable
Is a Confined Space Entry Log required	x		Mandatory for all Confined Spaces if applicable
Discharge Approval for treated water required	x		To be determined

Notes:

- (1) Does not relieve Service Provider from complying with all applicable federal, provincial, and municipal laws and regulations.
- (2) TBD means To Be Determined by Service Provider.

Service Provider Acknowledgement: We confirm receipt and review of this Pre-Project Hazard Assessment and acknowledge our responsibility for conducting our own assessment of project hazards, and taking all necessary protective measures (which may exceed those cited herein) for performance of the work.			
Service Provider Name			
Signatory for Service Provider		Date Signed	
RETURN EXECUTED DOCUMENT TO PWGSC DEPARTMENTAL REPRESENTATIVE PRIOR TO ANY WORK COMMENCING			