MATSQUI INSTITUTION
BLDG. M2C
LIVING UNIT 5
UNDER-SLAB SUPPLY VENTING REPAIR

33344 King Road, Abbotsford, BC

Project No.: R.111315.001

Issued for Tender
January 28, 2021

Project Specifications

Public Services and Procurement Canada

Requisition No. EZ899-212260

DRAWINGS & SPECIFICATIONS
for

Matsqui Institution, BLDG. M2C, Living Unit 5
Under-slab Supply Venting Repair

Project No.: R111315.001

APPROVED BY:

Mehrabadi, Behzad
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DN: CN = Mehrabadi, Behzad C = CA
O = GC OU = PWGSC-TPSGC
Date: 2021.01.07 16:46:24 -08'00'

Regional Manager, AES Date

Chris Patterson
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Construction Safety Coordinator Date

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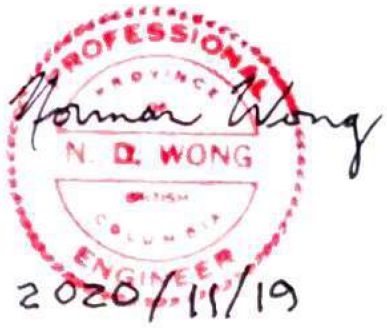
Project Manager Date

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

CONSULTANTS – SEAL & SIGNATURE

Discipline	Seal / Signature / Date
Mechanical (Prime) Integral Group	PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA I. NIKOLIC # 33435 2020-11-19
Architectural Mallen Gowing Berzins Architecture Inc. Edwin Berzins Architect - AIBC	REGISTERED ARCHITECT EDWIN BERZINS 2020-11-18 BRITISH COLUMBIA
Structural CWMM Consulting Engineers Ltd.	Nov 18, 2020 PROVINCE OF BRITISH COLUMBIA Y. W. P. LAM PROFESSIONAL ENGINEER # 14686 DESIGNATED STRUCTURAL ENGINEER

Discipline	Seal / Signature / Date
Electrical WSP Canada Group Limited	
Hazardous Material Assessment Stantec Consulting Ltd.	 Sean Brigden, B.Sc., P.B.Dipl., CRSP (Reg. No. 13-5045)

END OF SECTION

DIVISION 22 - PLUMBING

DIVISION 23 - HEATING, VENTILATION & AIR-CONDITIONING

DIVISION 25 – INTEGRATED AUTOMATION

DIVISION 26 - ELECTRICAL

List of Drawings (Bound Separately):

ARCHITECTURAL

G000	TITLE SHEET & OVERALL SITE PLAN
G001	ABBREVIATIONS, SYMBOL LEGEND, AND GENERAL NOTES
A101	ROOF AND SECOND FLOOR PLANS
A102	GROUND FLOOR AND BASEMENT MECHANCIAL ROOM PLANS
A501	DETAILS
A502	DETAILS
A503	DETAILS
A801	EXISTING CONDITION PHOTOGRAPHS
A802	EXISTING CONDITION PHOTOGRAPHS

STRUCTURAL

S1	GENERAL NOTES
S2	FIRST FLOOR PLAN & DETAILS
S3	SECOND FLOOR PLAN & ROOF PLAN
S4	SECTIONS & DETAILS

MECHANICAL

M100	COVER PAGE
M101	MECHANICAL – FIRST AND SECOND FLOOR PLANS - DEMO
M102	PHOTOS
M201	MECHANICAL – FIRST AND SECOND FLOOR PLANS - RENO
M202	MECHANICAL - ROOF PLAN - RENO
M203	MECHANICAL – BASEMENT PLAN – DEMO & RENO
M204	MECHANICAL - SECTIONS
M205	MECHANICAL - SCHEMATIC
M206	PLUMBING – RAIN WATER LEADERS & SERVICE CHASE
M207	FIRE PROTECTION – FIRST FLOOR
M208	MECHANICAL – DETAILS
M209	MECHANICAL – DETAILS CONTINUED

ELECTRICAL

E100	SITE PLAN, LEGEND, DRAWING LIST AND DETAILS
E107	M2d 2ND LEVEL FLOOR PLAN – POWER/LIGHTING LAYOUT
E108	M2c MAIN LEVEL FLOOR PLAN –POWER/LIGHTING LAYOUT
E119	M2c & M2d - PANEL ‘EH’ SCHEDULE/SINGLE LINE DIAGRAM
E120	ROOF PLAN – NEW POWER/LIGHTING LAYOUT

END OF SECTION

PART 1 GENERAL

1.1 Summary of Work

.1 Work covered by Contract Documents:

.1 This Contract covers the following work at the Matsqui Institution, Abbotsford, BC:

.1 Provide and install new mechanical roof top units and associated ducts & supports.

.2 Provide and install new heaters in exterior mechanical shafts.

.3 Modify existing concertina tape installation, relocate existing security cameras, and modify existing rain water leaders to suit new exterior ducts.

.4 Provide and install new radiant panels and extend existing hydronic heating loop.

.5 Provide and install new exhaust fan in the Kitchen.

.6 Replace existing mechanical unit in the basement mechanical room.

.2 Additional work to be performed under this Contract includes, but not limited to, the following items covered further in the Contract documents:

.1 Provide a detailed work plan including a project schedule and phasing. This detailed work plan shall be submitted to the Departmental Representative for review to verify that there will be no interruption of service.

.2 Do not start work until all essential equipment is delivered to the site and the work can proceed without delays.

.3 Provide as-built drawings and closeout submittals.

.3 Contractor's Use of Premises:

.1 Contractor has limited use of site for work of this contract until Substantial Completion:

.1 Contractor use of premises for storage and access, as approved by the Departmental representative.

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

.2 Vehicular access through the Sally Port will be restricted during the inmate "count" at breakfast, lunch and dinner hours. Confirm times with Departmental Representative. Delays may occur when entering and exiting the Institution with vehicles due to security situations and heavy traffic.

1.2 Work Restrictions

.1 Notify Departmental Representative of intended interruption of power, communication and plumbing services; and provide a schedule of interruption times.

.2 Where Work involves breaking into or connecting to existing services, give departmental Representative 48 hours of notice for necessary interruption of services throughout course of work. Keep duration of interruptions to a minimum. Coordinate interruptions with local authority having jurisdiction and local residences and businesses affected by the disruption.

.3 Provide for access by pedestrian and vehicular traffic on and around site where work is in progress.

.4 Construct barriers in accordance with Part 1.11 Temporary Barriers and Enclosures.

.5 Security Requirements: refer to Section 01 14 10 - Security Requirements.

.6 Hours of work:

.1 Perform work during normal working hours of the Institution 0730 to 1600, Monday through Friday except holidays.

.2 When it is necessary, arrange in advance with Departmental Representative to work outside of normal working hours.

1.3 Construction Work Schedule

.1 Commence work immediately upon official notification of acceptance of offer, and reach Substantial Performance of the Work and Closeout within twenty (20) work weeks from the date of such notification. All work indicated must be fully installed and operational before the inspection of approval by the Departmental Representative.

.2 Ensure that it is understood that Award of Contract or time of beginning, rate of progress, Substantial Certificate and Final Certificate as defined times of completion are of essence of this contract.

.3 Submittal:

.1 Submit to Departmental Representative within 10 working days of Award of Contract, a Bar (GANTT) Chart as Master Plan for planning, monitoring and reporting of construction progress.

.2 Identify each trade or operation.

.3 Show dates for delivery of items requiring long lead time.

.4 Departmental Representative will review schedule and return one copy.

.5 Re-submit two (2) copies of finalized schedule to Departmental Representative within five (5) working days after return of reviewed preliminary copy.

.4 Project Scheduling Reporting:

.1 Update Project Schedule on bi-weekly basis reflecting activity changes and completions, as well as activities in progress.

.2 Include as part of Project Schedule, narrative report identifying Work status to date, comparing current progress to baseline, presenting current forecasts, defining problem areas, anticipated delays and impact with possible mitigation.

.5 Project Meetings:

.1 Discuss Project Schedule at bi-weekly site meetings, identify activities that are behind schedule and provide measures to regain slippage. Activities considered behind schedule are those with projected start or completion dates later than current approved dates shown on baseline schedule.

.2 Weather related delays with their remedial measures will be discussed and negotiated.

.3 Before submitting first progress claim submit breakdown of Contract price in detail as directed by Departmental Representative and aggregating contract price. After approval by Departmental Representative cost breakdown will be

used as basis for progress payments. Only Public Works and Government Services Canada (PWGSC) paper work is acceptable.

1.4 Submittal Procedures

.1 Administrative:

.1 Submit to Departmental Representative submittal listed for review. Submit with reasonable promptness and in orderly sequence so as to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.

.2 Work affected by submittal shall not proceed until review is complete.

.3 Present shop drawings, product data, samples and mock-ups in SI Metric units.

.4 Where items or information is not produced in SI Metric units converted values are acceptable.

.5 Review submittal prior to submission to Departmental Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents. Submittal not stamped, signed, dated and identified as to specific project will be returned without being examined and shall be considered rejected.

.6 Notify Departmental Representative in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.

.7 Verify field measurements and affected adjacent Work are coordinated.

.8 Contractor's responsibility for errors and omissions in submission is not relieved by Departmental Representative review of submittal.

.9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Departmental Representative review.

10 Keep one reviewed copy of each submission on site.

.2 Shop Drawings:

.1 Drawings to be originals prepared by Contractor, Subcontractor, Supplier or Distributor, which illustrate appropriate portion of work; showing fabrication, layout, setting or erection details as specified in appropriate sections.

.3 Product Data:

.1 Certain specification Sections specify that manufacturer's standard schematic drawings, catalogue sheets, diagrams, schedules, performance charts, illustrations and other standard descriptive data will be accepted in lieu of shop drawings, provided that the product concerned is clearly identified. Submit in sets, not as individual submissions.

.4 Samples:

.1 Submit samples in sizes and quantities specified.

.2 Where colour is criterion, submit full range of colours.

.3 Submit all samples as soon as possible after the contract is awarded, to facilitate production of complete colour scheme by the Departmental Representative.

.5 Progress Photographs:

.1 Provide construction photographs in accordance with procedures and submission requirements specified in this clause.

.2 Progress Photographs:

.1 Provide digital photographs with images of minimum 3.1 mega pixel resolution and stored in Jpeg format with minimal compression.

.2 Number of viewpoints: four (4), locations of viewpoints directed by Departmental Representative.

.3 Frequency: monthly, submitted on disk with monthly progress statement, sent via e-mail or as directed by Departmental Representative.

.4 Identify photos by location, date and sequential numbering system.

.3 Final Photographs:

.1 Provide digital photographs with images of minimum 3.1 mega pixel resolution and stored in Jpeg format with minimal compression. Where photos are e-mailed compression can be increased.

.2 Number of viewpoints:

.1 Each side of building for a total of 4.

.2 Interior of rooms and finishes for a total of 8.

.3 Locations of viewpoints determined by Departmental Representative.

.3 Submit final photographs in digital format on CD, before final acceptance of building.

.4 Label disks and identify with project name and number. Indicate exposure dates and viewpoints of each photo and photo number.

.6 Submission Requirements:

.1 Schedule submissions at least ten days before dates reviewed submissions will be needed.

.2 Submit number of copies of product data, shop drawings which Contractor requires for distribution plus four (4) copies which will be retained by Departmental Representative.

.3 Accompany submissions with transmittal letter in duplicate.

.4 Submit bond copies (hard copy) as directed by Departmental Representative.

.7 Coordination of Submissions:

.1 Review shop drawings, product data and samples prior to submission.

.2 Coordinate with field construction criteria.

.3 Verify catalogue numbers and similar data.

.4 Coordinate each submittal with requirements of the work of all trades and contract documents.

.5 Responsibility for errors and omissions in submittal is not relieved by Departmental Representative's review of submittal.

.6 Responsibility for deviations in submittal from requirements of Contract documents is not relieved by Departmental Representative's review of submittal, unless Departmental Representative gives written acceptance of specified deviations.

.7 Notify Departmental Representative, in writing at time of submission, of deviations in submittal from requirements of Contract documents.

.8 Make any changes in submissions which Departmental Representative may require consistent with Contract Documents and re-submit as directed by Departmental Representative.

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

.10 Shop Drawings Review:

.1 Review of shop drawings by PWGSC is for the sole purpose of ascertaining conformance with the general concept.

.2 The Departmental Representative’s review does not mean that PWGSC approves the detail design inherent in the shop drawings, responsibility remains with the contractor submitting same, and such review will 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.

.3 Without restricting the generality of the foregoing, the Contractor is responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation, and for co-ordination of the work of all subtrades.

1.5 Health and Safety

.1 Specified in Section 01 35 33 Health and Safety Requirements.

1.6 Environmental Procedures

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

.2 Do not bury rubbish and waste materials on site unless approved by Departmental Representative.

.3 Do not dispose of waste or volatile materials such as oil, paint thinner or mineral spirits into waterways, storm or sanitary systems.

.4 Provide temporary drainage and pumping as necessary to keep excavations and site free from water during excavation and grading activities.

.5 Control disposal of run-off of water containing suspended materials or other harmful substances in accordance with local authority requirements. Construct settlement ponds and silt fences as required by the Provincial Environmental authority.

.6 Cover or wet down dry materials and rubbish to prevent blowing dust and debris.

.7 Under no circumstances dispose of rubbish or waste materials on adjoining property.

1.7 Regulatory Requirements

.1 References and Codes:

.1 Perform Work in accordance with National Building Code of Canada (NBCC2015) and where applicable British Columbia Building Code (BCBC2018) including all amendments up to bid closing date and other codes of provincial or local application provided that in case of conflict or discrepancy, more stringent requirements apply.

.2 Meet or exceed requirements of:

.1 Contract documents.

.2 Specified standards, codes and referenced documents.

1.8 Quality Control

.1 Inspection:

.1 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by Departmental Representative instructions, or law of Place of Work.

.2 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.

.3 Departmental Representative may order any part of Work to be examined if Work is suspected to be not in accordance with Contract Documents. If, upon examination such work is found not in accordance with Contract Documents, correct such Work and pay cost of examination and correction. If such Work is found in accordance with Contract Documents, Departmental Representative shall pay cost of examination and replacement.

.2 Procedures:

.1 Notify appropriate agency and Departmental Representative in advance of requirement for tests, in order that attendance arrangements can be made.

.2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in an orderly sequence so as not to cause delay in Work.

.3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

.3 Rejected Work:

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

.2 Make good other Contractor's work damaged by such removals or replacements promptly.

.4 Reports:

.1 Submit (4) four copies of inspection and test reports to Departmental Representative.

.5 Tests:

.1 Furnish test results as may be requested.

.6 Mock-ups:

.1 Prepare mock-ups for Work specifically requested in specifications. Include for Work of all Sections required to provide mock-ups.

.2 Construct in locations acceptable to Departmental Representative and as specified in specific Section.

.3 Prepare mock-ups for Departmental Representative review with reasonable promptness and in an orderly sequence, so as not to cause any delay in Work.

.4 Failure to prepare mock-ups in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.

.7 Test Certificates:

.1 Submit test certificates as requested and as required of specification Sections.

.8 Equipment and Systems:

.1 Submit adjustment and balancing reports for mechanical systems.

.2 Refer to specific Section for definitive requirements.

1.9 Temporary Utilities

.1 Installation and Removal:

.1 Provide temporary utilities controls in order to execute work expeditiously.

.2 Remove from site all such work after use.

.2 Water Supply:

.1 Existing water supply system may be used for construction requirements, provided that guarantees and existing functions are not affected thereby. Submit written request, include the location and duration of water supply use, to Departmental Representative for approval. Replace damaged components and pay for their cost.

.3 Temporary Power and Light:

.1 Existing electrical power and lighting may be used for construction purposes, provided that guarantees and existing functions are not affected thereby. Submit written request, include the location and duration of power and light use, to Departmental Representative for approval. Replace damaged electrical components used for temporary power when damaged, and pay for their cost.

.4 Temporary Communication Facilities:

.1 Provide and pay for temporary cellular phone(s) necessary for own use.

.2 Refer to Section 01 14 10 Security Requirements for additional communication system limitations within a Correctional Institution.

.5 Fire Protection:

.1 If existing fire protection system has to be interrupted for perform Work, notify Departmental Representative minimum of 2 working days prior to. During the period when the system is disconnected, provide and maintain temporary fire protection equipment and fire watch, as required by governing codes, regulations and bylaws. Arrange and pay for new commissioning and reports.

1.10 Construction Facilities

.1 Installation and Removal:

.1 Provide construction facilities in order to execute work expeditiously.

.2 Remove from site all such work after use.

.2 Scaffolding:

.1 Design, construct and maintain scaffolding in rigid, secure and safe manner, in accordance with WorkSafeBC regulations and Section 01 35 33.

.2 Erect scaffolding independent of walls. Remove promptly when no longer required.

.3 Hoisting:

.1 Provide, operate and maintain hoists required for moving of workers, materials and equipment. Make financial arrangements with Subcontractors for use thereof.

.2 Hoists to be operated by qualified operator.

.4 Site Storage/Loading:

.1 Confine work and operations of employees by Contract Documents. Do not unreasonably encumber premises with products.

.2 Do not load or permit to load any part of Work with a weight or force that will endanger the Work.

.5 Construction Parking:

.1 Make good damage to existing roads used for access to project site.

.2 Build and maintain temporary access where required and provide snow removal during period of Work.

.3 Park vehicles outside perimeter fence in designated parking areas.

.6 Contractor's Site Office and enclosure:

.1 Provide office of size to accommodate Contractor's operations.

.2 Provide a clearly marked and fully stocked first-aid case in a readily available location.

.3 Provide temporary fenced area to enclose site and operations. See Specification 32 31 13 Fences and Gates for fence type.

.7 Equipment, Tools and Material Storage:

.1 Provide and maintain, in a clean and orderly condition, lockable weatherproof sheds for storage of tools, equipment and materials.

.2 Locate materials not required to be stored in weatherproof sheds on site in a manner to cause least interference with work activities.

.8 Sanitary Facility:

.1 Permanent facility may be used on approval of Departmental Representative. Maintain facility to Institution standard and replenish supplies to full capacities and replace any damaged equipment, pay maintenance and replacement cost.

.9 Submittal

.1 Prior to mobilization on site, provide a site plan indicating the proposed layout of all temporary facilities, security features, construction fencing, material laydown, storage containers, contractor parking, site office, and extent of work for Departmental Representative to review and approve. Provide a spray paint layout of temporary fencing prior to installation.

1.11 Temporary Barriers and Enclosures

.1 Hoarding:

.1 Erect temporary site enclosure for construction areas outside of the Institution's security perimeter fence lines using new 1.8 m high temporary self-supporting welded mesh sectional construction fencing. The top of the fence also has its vertical wire, or integrated spikes projecting over the top rail to discourage breach. Provide lockable truck gate. Maintain fence in good repair. See specification Section 32 31 13 Fences and Gates.

.2 Enclosure of Structure:

.1 Provide temporary weathertight enclosures and protection for exterior openings until permanently enclosed. Design enclosures to withstand wind pressure. Provide lockable entry as required for moving personnel equipment and materials.

.2 Provide temporary enclosures to secure work area from entry of unauthorized personnel during construction period.

.3 Guardrails and barriers:

.1 Provide secure, rigid guard rails, hand rails and barricades around open edges of floors and roofs etc.

.2 Provide as required by governing authorities.

.4 Access to Site:

.1 Maintain immediate local access roads in clean condition used during work of this contract.

.5 Protection for Off-Site and CSC Property:

.1 Protect surrounding CSC property from damage during performance of Work.

.2 Be responsible for damage incurred. Repair damaged property and pay for repair.

.6 Protection of Building Finishes:

.1 Provide protection for finished and partially finished building finishes and equipment during performance of Work.

.2 Provide necessary screens, covers, and hoardings.

.3 Confirm with Departmental Representative locations and installation schedule minimum three (3) working days prior to installation.

.4 Be responsible for damage incurred due to lack of or improper protection.

1.12 Common Product Requirements

.1 Reference Standards:

.1 If there is question as to whether any product or system is in conformance with applicable standards, Departmental Representative reserves right to have such products or systems tested to prove or disprove conformance.

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

.3 Conform to latest date of issue of referenced standards in effect on date of submission of Bids, except where specific date or issue is specifically noted.

.2 Quality:

.1 Products, materials, equipment and articles (referred to as products throughout specifications) incorporated in Work shall be new, not damaged or defective, and of best quality (compatible with specifications) for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.

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

.3 Should any dispute arise as to quality or fitness of products, decision rests strictly with Departmental Representative based upon requirements of Contract Documents.

.4 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.

.5 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

.3 Storage, Handling and Protection:

.1 Handle and store products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.

.2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.

.3 Store products subject to damage from weather in weatherproof enclosures.

.4 Store cementitious products clear of earth or concrete floors, and away from walls.

.5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.

.6 Store sheet materials, lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.

.7 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.

.8 Remove and replace damaged products at own expense and to satisfaction of Departmental Representative.

.9 Touch-up damaged factory finished surfaces to Departmental Representative's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

.4 Transportation:

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

.5 Manufacturer’s Instructions:

.1 Unless otherwise indicated in specifications, install or erect products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with products. Obtain written instructions directly from manufacturers.

.2 Notify Departmental Representative in writing, of conflicts between specifications and manufacturer's instructions, so that Departmental Representative may establish course of action.

.3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes Departmental Representative to require removal and re-installation at no increase in Contract Price or Contract Time.

.6 Quality of Work:

.1 Ensure Quality of Work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify Departmental Representative if required Work is such as to make it impractical to produce required results.

.2 Do not employ anyone unskilled in their required duties. Departmental Representative reserves right to require dismissal from site, workers deemed incompetent or careless.

.3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with Departmental Representative, whose decision is final.

.7 Co-ordination:

.1 Ensure cooperation of workers in laying out Work. Maintain efficient and continuous supervision.

.2 Be responsible for coordination and placement of openings, sleeves and accessories.

8 Concealment:

.1 In finished areas, conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.

.2 Before installation, inform Departmental Representative if there is interference. Install as directed by Departmental Representative.

.9 Remedial Work:

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

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

.10 Location of Fixtures:

.1 Consider location of fixtures, outlets, and mechanical and electrical items indicated as approximate.

.2 Inform Departmental Representative of conflicting installation. Install as directed.

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

.11 Fastenings:

.1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.

.2 Prevent electrolytic action between dissimilar metals and materials.

.3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in affected specification Section.

.4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.

.5 Keep exposed fastenings to a minimum, space evenly and install neatly.

.6 All exposed fasteners to have security/tamper-proof heads.

.7 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

.12 Fastenings - Equipment:

.1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.

.2 Use heavy hexagon heads, semi-finished unless otherwise specified. Use No. 304 stainless steel for exterior areas.

.3 Bolts may not project more than one diameter beyond nuts.

.4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.

.13 Protection of Work in Progress:

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

.14 Existing Utilities:

.1 Where work involves breaking into or connecting to existing services, carry out work at times directed by governing authorities, with minimum of disturbance to pedestrian and vehicular traffic.

.2 Before commencing work, establish location and extent of service lines in areas of work and notify Departmental Representative of findings.

.3 Submit schedule to and obtain approval from Departmental Representative for any shut-down or closure of active service or facility. Adhere to approved schedule and provide notice to affected parties.

.4 Where unknown services are encountered, immediately advise Departmental Representative and confirm findings in writing.

.5 Record locations of maintained, capped and re-routed services lines.

.15 Contractors Options for Selection of Products:

.1 Products 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 “Instructions to Bidders".

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

.16 Substitution after award of Contract:

.1 No substitutions are permitted without prior written approval of the Departmental Representative.

.2 When materials are specified by trade names or trademarks, or by manufacturers' or suppliers' names, the bid shall be based on use of the named materials. During the solicitation period, alternative materials may be considered provided full technical data is received in writing by the Contracting Officer at least ten (10) calendar days prior to the solicitation closing date.

.3 Proposals will be considered by the Departmental Representative if:

.1 products selected by tenderer from those specified are not available;

.2 delivery date of products selected from those specified would unduly delay completion of Contract, or

.3 alternative product to that specified, which is brought to the attention of and considered by Departmental Representative as equivalent to the product specified, and will result in a credit to the Contract amount.

.4 Should the proposed substitution be accepted either in part or in whole, assume full responsibility and costs when substitution affects other work on the project. Pay for design or drawing changes required as result of substitution.

.5 Amounts of all credits arising from approval of the substitutions will be determined by the Departmental Representative, and the Contract price will be reduced accordingly.

1.13 Examination and Preparation

.1 Existing Services:

.1 Before commencing work, establish location and extent of service lines in area of Work and notify Departmental Representative of findings.

.2 Remove abandoned service lines within 2 m of structures. Cap or otherwise seal lines at cut-off points as directed by Departmental Representative.

.2 Location of Equipment and Fixtures:

.1 Location of equipment, fixtures and outlets indicated or specified are to be considered as approximate.

.2 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space and in accordance with manufacturer's recommendations for safety, access and maintenance.

.3 Inform Departmental Representative of impending installation and obtain approval for actual location.

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

1.14 Execution Requirements

.1 Preparation:

.1 Inspect existing conditions, including elements subject to damage or movement during cutting and patching.

.2 After uncovering, inspect conditions affecting performance of Work.

.3 Beginning of cutting or patching means acceptance of existing conditions.

.4 Provide supports to assure structural integrity of surroundings; provide devices and methods to protect other portions of project from damage.

.5 Provide protection from elements for areas which may be exposed by uncovering work; maintain excavations free of water.

.2 Execution:

.1 Execute cutting, fitting, and patching including excavation and fill, to complete Work.

.2 Fit several parts together, to integrate with other Work.

.3 Uncover Work to install ill-timed Work.

.4 Remove and replace defective and non-conforming Work.

.5 Provide openings in non-structural elements of Work for penetrations of mechanical and electrical Work.

.6 Execute Work by methods to avoid damage to other Work, and which will provide proper surfaces to receive patching and finishing.

.7 Employ original installer to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.

.8 Cut rigid materials using purpose made saw or core drill. Pneumatic or impact tools not allowed on brittle materials without prior approval.

.9 Restore work with new products in accordance with requirements of Contract Documents.

.10 Fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

.11 At penetration of fire rated wall, ceiling, or floor construction, completely seal voids with firestopping material, full thickness of the construction element.

.12 Refinish surfaces to match adjacent finishes: For continuous surfaces refinish to nearest intersection; for an assembly, refinish entire unit.

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

1.15 Cleaning

.1 Project Cleanliness:

.1 Maintain Work in tidy condition, free from accumulation of waste products and debris.

.2 Remove waste materials from site at regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials on site, unless approved by Departmental Representative.

.3 Clear snow and ice from access to building.

.4 Provide on-site containers for collection of waste materials and debris.

.5 Provide and use clearly marked separate bins for recycling. Refer to-Construction/Demolition Waste Management and Disposal.

.6 Clean interior areas prior to start of finish work, and maintain areas free of dust and other contaminants during finishing operations.

.7 Store volatile waste in covered metal containers, and remove from premises at end of each working day.

.8 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.

.9 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.

.10 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

.2 Final Cleaning:

.1 When Work is Substantially Performed, remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.

.2 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.

.3 Prior to final review, remove surplus products, tools, construction machinery and equipment.

.4 Remove waste products and clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, and mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.

.5 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, and floors.

.6 Clean lighting reflectors, lenses, and other lighting surfaces.

.7 Vacuum clean and dust building interiors, behind grilles, louvres and screens.

.8 Wax, seal, vacuum clean, shampoo or prepare floor finishes, as recommended by manufacturer.

.9 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.

.10 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.

.11 Remove dirt and other disfiguration from exterior surfaces.

.12 Sweep and wash clean paved areas.

.13 Clean equipment and fixtures to a sanitary condition; clean or replace filters of mechanical equipment.

.14 Clean roofs, downspouts, and drainage systems.

.15 Remove snow and ice from access to building.

1.16 Construction/Demolition Waste Management and Disposal

.1 Provide on-site facilities for collection, handling, and storage of anticipated quantities of reusable and/or recyclable materials and waste.

.1 Separate non-salvageable materials from salvaged items.

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

.3 Transport and deliver non-salvageable items to licensed disposal facility.

.2 Provide containers to deposit reusable and/or recyclable materials. Locate containers in locations, to facilitate deposit of materials without hindering daily operations. Provide containers to deposit reusable and/or recyclable materials.

.3 Collect, handle, store on-site and transport off-site, salvaged materials in separate condition. Transport to approved and authorized recycling facility and/or users of material for recycling.

.4 Locate waste and salvage bins on site as directed by Departmental Representative.

1.17 Closeout Procedures

.1 Inspection and Declaration:

.1 Contractor's Inspection: Conduct an inspection of Work with all subcontractors, identify deficiencies and defects, and repair as required to conform to Contract Documents.

.2 Notify Departmental Representative in writing of satisfactory completion of Contractor's Inspection and that corrections have been made.

.3 Request Departmental Representative’s Inspection.

.2 Inspection: Departmental Representative and Contractor will perform inspection of Work to identify obvious defects or deficiencies. Contractor shall correct Work accordingly.

.3 Substantial Completion: submit written certificate that following have been performed:

.1 Work has been completed and inspected for compliance with Contract Documents.

.2 Defects have been corrected and deficiencies have been completed.

.3 Equipment and systems have been tested, adjusted and balanced and are fully operational.

.4 Include a fire alarm verification report per CAN/ULC-S537, confirmation of proper operation of fire alarm system to CAN/ULC-S527, and signed off by a fire alarm technician. General Contractor to pay for verification and report.

.5 Include a sprinkler system test certificate, signed off by a qualified technician. General Contractor to pay for test and certificate.

.6 Operation of systems have been demonstrated to Departments personnel.

.7 Work is complete and ready for Final Inspection.

.4 Final Inspection: when items noted above are completed, request final inspection of Work by Departmental Representative. If Work is deemed incomplete by Departmental Representative, complete outstanding items and request re-inspection.

1.18 Closeout Submittal

.1 Record Drawings:

.1 As work progresses, maintain accurate records to show all deviations from the Contract Drawings. Note on as-built drawings as changes occur. At completion supply:

.1 Four (4) sets of CD's in AutoCad file format (version: 2010) with all as-built information on the diskettes.

.2 Four (4) sets of as-built plotted reproducible drawings.

.3 Four (4) sets of printed as-built drawings.

.4 Submit one copy of check plots to Departmental Representative prior to final printing of as-built drawings.

.5 Departmental Representative will supply copies of the original AutoCad files.

.6 Retain original logo and title block on the as-built drawings. Contractor may place on the upper right-hand title block area a small company logo, the text "AS-BUILT" and the date.

.2 Costs for transferring as-built information from marked up working set of drawings to electronic format using ACAD and plotting service is included in the Contract.

.2 Maintenance manual:

.1 On completion of project submit to Departmental Representative four (4) CD R/ disk copies and four (4) paper copies (in loose leaf type binder) of Operations and Maintenance Manual, made up as follows:

.1 Provide maintenance manual on CDs using pdf, or other approved format for descriptive writing, page size images and page size drawings. Organize manuals into industry standard maintenance manual tabs with

links in index to each descriptive section describing the component or maintenance procedure etc.

.2 Organize files into CSI Masterformat numbering system or other approved descriptive titles.

.3 Label disk "Operation and Maintenance Data", project name, date, names of Contractor, subcontractors, consultants and subconsultants.

.4 Include scanned guarantees, diagrams and drawings.

.5 Organize contents into applicable sections of work to parallel project specification break-down. Mark each section by labeled tabs (navigational buttons).

.6 Drawings, diagrams and manufacturer's literature must be legible.

.7 Refer to Mechanical and Electrical Divisions for specific details for Mechanical and Electrical data.

.3 Maintenance Materials, Special Tools and Spare Parts:

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

.2 Deliver maintenance materials, special tools and spare parts to Departmental Representative and store in designated area as directed by Departmental Representative.

.3 Prepare lists of maintenance materials, special tools and spare parts for inclusion in Manual specified in Clause 18.2.

.4 Maintenance materials:

.1 Deliver wrapped, identify on carton or package, colour, room number, system or area as applicable where item is used.

.5 Special tools:

.1 Assemble as specified;

.2 Include identifications and instructions on intended use of tools.

.6 Spare parts:

.1 Assemble parts as specified;

.2 Include part number, identification of equipment or system for which parts are applicable;

.3 Installation instructions;

.4 Name and address of nearest supplier.

.4 Warranties and Bonds:

.1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing in maintenance manual.

.2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principals.

.3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten days after completion of the applicable item of work.

.4 Except for items put into use with Departmental Representative's permission, leave date of beginning of time of warranty until the Date of Interim Completion is determined.

.5 Verify that documents are in proper form, contain full information, and are notarized.

.6 Retain warranties and bonds until time specified for submittal.

1.19 Demonstration and Training

.1 Demonstration and Training:

.1 Demonstrate operation and maintenance of equipment and systems to maintenance personnel following interim Completion and prior to date of final certificate of completion

.2 Departmental Representative will provide list of personnel to receive instructions, and will coordinate their attendance at agreed-upon times.

1.20 General Commissioning

.1 Commission installed systems prior to Demonstration and Training.

END OF SECTION

PART 1 GENERAL

1.1 Purpose

.1 To ensure that both the construction project and the institutional operations may proceed without undue disruption or hindrance and that the security of the Institution is maintained at all times.

1.2 Purpose

.1 "Contraband" means:

.1 an intoxicant, including alcoholic beverages, drugs and narcotics

.2 a weapon or a component thereof, ammunition for a weapon, and anything that is designed to kill, injure or disable a person or that is altered so as to be capable of killing, injuring or disabling a person, when possessed without prior authorization,

.3 an explosive or a bomb or a component thereof,

.4 currency over any applicable prescribed limit, $25.00, and

.5 any item not described in paragraphs (a) to (d) that could jeopardize the security of a Penitentiary or the safety of persons, when that item is possessed without prior authorization.

.2 Unauthorized smoking and related Items@ means all smoking items including, but not limited to, cigarettes, cigars, tobacco, chewing tobacco, cigarette making machines, and matches and lighters.

.3 "Commercial Vehicle" means any motor vehicle used for the shipment of material, equipment and tools required for the construction project.

.4 "CSC" means Correctional Service Canada.

.5 "Director" means Director or Warden of the Institution as applicable or their representative.

.6 "Construction employees" means persons working for the general contractor, the sub-contractors, equipment operators, material suppliers, testing and inspection companies and regulatory agencies.

.7 "Departmental Representative" means the Public Works and Government Services Canada representative defined in General Conditions.

.8 "Perimeter" means the fenced or walled area of the institution that restrains the movement of the inmates.

.9 "Construction zone" means the area, as indicated in the contract documents, that the contractor will be allowed to work". This area may or may not be isolated from the security area of the institution. Limits to be confirmed at construction start-up meeting.

1.3 Preliminary Proceedings

.1 At construction start-up meeting:

.1 Discuss the nature and extent of all activities involved in the Project.

.2 Establish mutually acceptable security procedures in accordance with this instruction and the institution's particular requirements.

.2 The Contractors' responsibilities:

.1 Ensure that all construction employees are aware of the CSC security requirements.

.2 Ensure that a copy of the CSC security requirements is always prominently on display at the job site.

.3 Co-operate with institutional personnel in ensuring that security requirements are observed by all construction employees.

1.4 Construction Employees

.1 Submit Gate Pass application form and scanned copy of government issued ID for each employee to the Departmental Representative.

.2 Allow 10 working days for processing of security clearances. Employees will not be admitted to the Institution without a valid security clearance in place and a recent picture identification such as a provincial driver's license. Security clearances obtained from other CSC institutions are not valid at this institution except as approved otherwise.

.3 The Director may require that facial photographs may be taken of construction employees and these photographs may be displayed at appropriate locations in the institution or in an electronic database for identification purposes. The Director may require that Photo ID cards be provided for all construction workers. ID cards will then be left at the designated entrance to be picked upon arrival at the institution and shall be displayed prominently on the construction employees clothing at all time while employees are at the institution.

.4 Entry to Institutional Property will be refused to any person there may be reason to believe may be a security risk.

.5 Any person employed on the construction site will be subject to immediate removal from Institutional Property if they:

.1 appear to be under the influence of alcohol, drugs or narcotics.

.2 behave in an unusual or disorderly manner.

.3 are in possession of contraband.

1.5 Vehicles

.1 All unattended vehicles on CSC property must have windows closed; fuel caps locked, doors and trunks locked and keys removed. The keys must be securely in the possession of the owner or an employee of the company that owns the vehicle.

.2 The director may limit at any time the number and type of vehicles allowed within the Institution.

.3 Drivers of delivery vehicles for material required by the project will require security clearances and must remain with their vehicle the entire time that the vehicle is in the Institution. The director may require that these vehicles be escorted by Institutional staff or PWGSC Construction Escorts while in the Institution.

.4 If the Director permits trailers to be left inside the secure perimeter of the Institution, the trailer doors must be locked at all times. All windows must be securely locked bars when left unoccupied. Cover all windows with expanded metal mesh. When not in use lock all storage trailers located inside and outside the perimeter. All storage trailers inside and outside the perimeter must be locked when not in use.

1.6 Parking

.1 The parking area(s) to be used by construction employees will be designated by the Director. Parking in other locations will be prohibited and vehicles may be subject to removal.

1.7 Shipments

.1 To avoid confusion with the institution's own shipments, address all shipments of project material, equipment and tools in the Contractor's name and have a representative on site to receive any deliveries or shipments. CSC or PWGSC staff will **NOT** accept receipt of deliveries or shipments of any material equipment or tools for the contractor.

1.8 Telephones

.1 The installation of telephones, facsimile machines and computers with Internet connections is not permitted within the Institution perimeter unless prior approved by the Director.

.2 The Director will ensure that approved telephones, facsimile machine and computers with Internet connections are located where they are not accessible to inmates. All computers will have an approved password protection that will stop an Internet connection to unauthorized personnel.

.3 Wireless cellular and digital telephones, including but not limited to devices for telephone messaging, pagers, Blackberries, PDAs, telephone used as 2-way radios are not permitted within the Institution unless approved by the Director. If wireless cellular telephones are permitted, the user will not permit their use by any inmate.

.4 The Director may approve but limit the use of 2-way radios.

1.9 Work Hours

.1 Work hours within the Institution are: conform to Division.

.2 Work is not permitted during weekends and statutory holidays without the permission of the Director. A minimum of seven days advance notice will be required to obtain the required permission. In case of emergencies or other special circumstances, this advance notice may be waved by the Director.

1.10 Overtime Work

.1 Conform to Division 1.

.2 Provide 48 hours advance notice to Director for all work to be performed after normal working hours of the Institution. Notify Director immediately if emergency work is required, such as to complete a concrete pour or make the construction site safe and secure.

1.11 Tools and Equipment

.1 Maintain a complete list of all tools and equipment to be used during the construction project. Make this inventory available for inspection when required by the Institution.

.2 Throughout the construction project maintain up-to-date the list of tools and equipment specified above.

.3 Keep all tools and equipment under constant supervision, particularly power-driven and cartridge-driven tools, cartridges, files, saw blades, rod saws, wire, rope, ladders and any sort of jacking device.

.4 Store all tools and equipment in approved secure locations.

.5 Lock all tool boxes when not in use. Keys to remain in the possession of the employees of the contractor. Secure and lock scaffolding when not erected and when erected Secure in a manner agreed upon with the Institution designate.

.6 Report all missing or lost tools or equipment immediately to the Departmental Representative/Director.

.7 The Director will ensure that the security staff members carry out checks of the Contractor's tools and equipment against the list provided by the Contractor. These checks may be carried out at the following intervals:

.1 At the beginning and conclusion of every work day or shift upon entering and exiting the Institution.

.2 At any time when contractor is on Institution property.

.8 Certain tools/equipment such as cartridges and hacksaw blades are highly controlled items. The contractor will be given at the beginning of the day, a quantity that will permit one day's work. Used blades/cartridges will be returned to the Director's representative at the end of each day. Maintain up to date inventory of all used blades/cartridges.

.9 If propane or natural gas is used for heating the construction, the institution will require that the contractor supervise the construction site during non-working hours.

1.12 Keys

.1 Use standard construction cylinders for locks for this use during the construction period.

.2 Issue instructions to employees and sub-trades, as necessary, to ensure safe custody of the construction set of keys.

1.13 Prescription Drugs

.1 Employees of the contractor who are required to take prescription drugs during the workday shall obtain approval of the Director to bring a one day supply only into the Institution.

1.14 Smoking Restrictions

.1 Smoking is not permitted inside correctional facilities or outdoors within the perimeter of a correctional facility and persons must not possess unauthorized smoking items within the perimeter of a correctional facility.

.2 Persons in violation of this policy will be requested to immediately cease smoking or dispose of any unauthorized smoking items and, if they persist will be directed to leave the Institution.

.3 Smoking is permitted outside the perimeter of a correctional facility in an area designated by the Director.

1.15 Contraband

.1 Weapons, ammunition, explosives, alcoholic beverages, drugs and narcotics are prohibited on institutional property.

.2 The discovery of contraband on the construction site and the identification of the person(s) responsible for the contraband shall be reported immediately to the Director.

.3 Contractors should be vigilant with both their staff and the staff of their sub-contractors and suppliers that the discovery of contraband may result in cancellation of the security

clearance of the affected employee. Serious infractions may result in the removal of the company from the Institution for the duration of the construction.

.4 Presence of arms and ammunition in vehicles of contractors, sub-contractors and suppliers or employees of these will result in the immediate cancellation of security clearances for the driver of the vehicle.

1.16 Searches

.1 All vehicles and persons entering institutional property may be subject to search.

.2 When the Director suspects, on reasonable grounds, that an employee of the Contractor is in possession of contraband, he may order that person to be searched.

.3 All employees entering the Institution may be subject to screening of personal effects for traces of contraband drug residue.

1.17 Access and Removal from Institution Property

.1 Construction personnel and commercial vehicles will not be admitted to the institution after normal working hours, unless approved by the Director.

1.18 Movement Vehicles

.1 Construction vehicles are not to leave the Institution until an inmate count is completed. Escorted commercial vehicles will be allowed to enter or leave the institution through the vehicle access gate during the following hours:

.1 AM: 0745 hrs. to 1100 hrs.

.2 PM: 1300hrs. to 1530 hrs.

.2 The contractor will advise the Director twenty-four (24) hours in advance to the arrival on the site of heavy equipment such as concrete trucks, cranes, etc.

.3 Vehicles being loaded with soil or other debris, or any vehicle considered impossible to search, must be under continuous supervision by CSC staff or PWGSC construction escorts working under the authority of the Director.

.4 Commercial vehicles will only be allowed access to institutional property when their contents are certified by the Contractor or his representative as being strictly necessary to the execution of the construction project.

.5 Vehicles will be refused access to institutional property if, in the opinion of the Director, they contain any article which may jeopardize the security of the institution. Arrange with Director for parking of contractor=s vehicles at minimum security Institutions.

.6 Private vehicles of construction employees will not be allowed within the security wall or fence of medium or maximum security institutions without the authorization of the Director.

.7 With the approval of the Director, certain equipment may be permitted to remain on the construction site overnight or over the weekend. This equipment must be securely locked, with the battery removed. The Director may require that the equipment be secured with a chain and padlock to another solid object.

1.19 Movement of Construction Employees on Institutional Property

.1 Subject to the requirements of good security, the Director will permit the Contractor and his employees as much freedom of action and movement as is possible.

.2 However, notwithstanding paragraph above, the Director may:

.1 Prohibit or restrict access to any part of the institution.

.2 Require that in certain areas of the institution, either during the entire construction project or at certain intervals, construction employees only be allowed access when accompanied by a member of the CSC security staff or PWGSC Construction Escort Officer.

.3 During the lunch and coffee/health breaks, all construction employees will remain within the construction site. Construction employees are not permitted to eat in the Institution cafeteria and dining room.

1.20 Surveillance and Inspection

.1 Construction activities and all related movement of personnel and vehicles will be subject to surveillance and inspection by CSC security staff members to ensure that established security requirements are met.

.2 CSC staff members will ensure that an understanding of the need to carry out surveillance and inspections, as specified above, is established among construction employees and maintained throughout the construction project.

1.21 Stoppage of Work

.1 The director may request at any time that the contractor, his employees, sub-contractors and their employees not enter or leave the work site immediately due to a security situation occurring within the Institution. The contractor's site supervisor will note the name of the staff member giving the instruction, the time of the request and obey the order as quickly as possible.

.2 The contractor shall advise the Departmental Representative of this interruption of the work within 24 hours.

1.22 Contact with Inmates

.1 Unless specifically authorized, it is forbidden to come into contact with inmates, to talk with them, to receive objects from them or to give them objects. Any employee doing any of the above will be removed from the site and his security clearance revoked.

.2 Digital cameras (or any other type) are not allowed on CSC property.

.3 Notwithstanding the above paragraph, if the director approves of the use of cameras, it is strictly forbidden to take pictures of inmates, of CSC staff members or of any part of the Institution other than those required as part of this contract.

1.23 Completion of Construction Project

.1 Upon completion of the construction project or, when applicable, the takeover of a facility, the Contractor shall remove all remaining construction material, tools and equipment that are not specified to remain in the Institution as part of the construction contract.

END OF SECTION

Part 1 GENERAL

1.1 Intent

.1 The intent of Delegated Design Submittals required by this section is to account for professional engineering responsibility for design, review and acceptance of components of Work forming a part of permanent Work in accordance with Building Code, and that has been assigned to a design entity other than Consultant including, but not limited to, the following:

.1 Design requiring structural analysis of load bearing components and connections.

.2 Design requiring compliance with fire safety regulations.

.3 Design requiring compliance with life or health safety regulations.

.2 Use Letters of Assurance, Schedule S-B & S-C, complying with requirements of Building Code and design delegated to a professional Engineer within technical specification sections.

.3 Delegated Design Submittals are not required for components of Work requiring engineering for temporary Work (i.e.: crane hoisting, engineered lifts, false Work, shoring, concrete formwork) that would normally form a part of Contractor's scope of Work.

.4 The requirements of this section are in general conformance with recommended Responsibilities for Engineering Services for Building Projects published by Association of Professional Engineers and Geoscientists of British Columbia (APEGBC), with regards to duties of specialty professionals appointed during construction period.

.5 The requirements of this section do not diminish responsibilities of Consultant's role as Registered Professional of Record; submittals will be used by Consultant to establish that Work is substantially performed in accordance with Building Code.

1.2 Related Sections

.1 Section 05 05 19 – Post-Installed Concrete Anchors

.2 Section 05 50 00 – Metal Fabrications

.3 Section 06 10 00 – Rough Carpentry

.4 Section 11 24 31 – Roof Fall Restraint

.5 Section 23 05 48 – VIBRATION & SEISMIC CONTROLS FOR DUCTWORK PIPING & EQUIPMENT

.6 Section 26 50 05 – Seismic Requirements

1.3 Delegated Design

.1 Performance and Design Criteria: Provide products and systems complying with specific performance and design criteria indicated where professional design services or certifications by a design professional are specifically required of Contractor by Contract Documents.

.2 If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Consultant.

.3 Delegated design will be required for elements designed by a specialty professional, which may include:

.1 Elements normally fabricated off-site

.2 Elements that require specialized fabrication equipment or a proprietary fabrication process not usually available at job site (i.e.: open web steel joists,

wood trusses, combination wood and metal or plywood joists, prefabricated metal furniture).

.4 Cost of delegated design shall be included in the contract price.

Part 2 PRODUCTS

2.1 Letters of Assurance

.1 Submit a signed and sealed Schedule S-B addressed to Professional of Record, prior to starting Work requiring design and seal of a professional engineer.

.2 Submit a signed and sealed Schedule S-C addressed to Professional of Record, on completion of Work requiring design and seal of a professional engineer.

Part 3 EXECUTION

3.1 Implementation

.1 Include summary of Work as a part of the required Letters of Assurance.

.2 Prepare required submittals and present to Consultant within sufficient time to allow for Consultant’s detailed review and acceptance.

END OF SECTION

PART 1 - GENERAL

1.1 References

.1 Government of Canada.

.1 Canada Labour Code - Part II (as amended).

.2 Canada Occupational Health and Safety Regulations (as amended).

.2 National Building Code of Canada (NBC):

.1 Part 8, Safety Measures at Construction and Demolition Sites.

.3 The Canadian Electrical Code (as amended).

.4 Canadian Standards Association (CSA) as amended:

.1 CSA Z797-2009 Code of Practice for Access Scaffold

.2 CSA S269.1-1975 (R2003) Falsework for Construction Purposes

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

.4 CSA Z1006-10 Management of Work in Confined Spaces.

.5 CSA Z462- Workplace Electrical Safety Standard.

.5 National Fire Code of Canada 2015 (as amended)

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

.6 American National Standards Institute (ANSI): (as amended)

.1 ANSI A10.3, Operations – Safety Requirements for Powder-Actuated Fastening Systems.

.7 Province of British Columbia:

.1 Workers Compensation Act Part 3-Occupational Health and Safety (as amended).

.2 Occupational Health and Safety Regulation (as amended)

.8 Appendix:

.1 “Hazardous Building Materials Assessment, 39 Buildings/Structures at CSC Matsqui Institution, 33344 King Road, Abbotsford, BC: Findings and Recommendations – Building M2C/M2D – (831-07-RP)”, dated March 2019

.2 “Pre-Renovation Hazardous Building Materials Assessment – Site Review Report; Reference: Design of Under-Slab Supply Venting at Matsqui Institution Building M2C/M2D (Living Unit 5)”, dated August 28, 2020

1.2 Related Sections

1. Section 01 01 50 - General Instructions
2. Section 02 07 50 – Cutting and Patching
3. Section 02 44 99 – Demolition of Minor Works
4. Section 02 81 01 – Hazardous Materials

1.3 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.

1.4 Compliance with Regulations

.1 PWGSC may terminate the Contract without liability to PWGSC where the Contractor, in the opinion of PWGSC, refuses to comply with a requirement of the Workers' Compensation Act or the Occupational Health and Safety Regulations.

.2 It is the Contractor's responsibility to ensure that all workers are qualified, competent and certified to perform the work as required by the Workers' Compensation Act or the Occupational Health and Safety Regulations.

.3 Contractor to include COVID-19 Protocols and Procedures, in alignment with Provincial and Federal requirements, in the Health and Safety Plan submittal for Departmental Representative approval.

1.5 Submittals

.1 Submit to Departmental Representative submittals listed for review in accordance with Section 01 01 50 – General Instructions, Submittals.

.2 Work effected by submittal shall not proceed until review is complete.

.3 Submit the following:

1. Organizations Health and Safety Plan.
2. Site Specific Safety Plan or Health and Safety Plan (SSSP or HASP), including COVID-19 Protocols and Procedures.
3. Copies of reports or directions issued by Federal and Provincial health and safety inspectors.
4. Copies of incident and accident reports.
5. Complete set of Material Safety Data Sheets (MSDS), and all other documentation required by Workplace Hazardous Materials Information System (WHMIS) requirements.
6. Project-specific Hazardous Material Exposure Control Plan.
7. Emergency Response Procedures.

.4 The Departmental Representative will review the Contractor's Site Specific Safety Plan (SSSP) or Health and Safety Plan (HASP) and emergency response 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 Site Specific Safety Plan or Health and Safety Plan, Hazardous Materials Exposure Control Plans, and any revised versions, 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.

.7 Submit final air quality report for the indicated material.

1.6 Responsibility

1. Assume responsibility as the Prime Contractor for work under this contract.
2. Be responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.
3. Provide staff with required safety training and protective equipment, including the ones for entering and working in asbestos and silica exposure control, and in conformance with COVID-19 Protocols and Procedures.
4. Comply with and enforce compliance by employees with safety requirements of Contract documents, applicable Federal, Provincial, Territorial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

1.7 Health and Safety Coordinator

.1 Assign a competent and qualified Health and Safety Coordinator who shall:

.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 Safety Plan (SSSP) or Health and Safety Plan (HASP).

.3 Be on site during execution of work.

.4 Have minimum two (2) years of site-related working experience.

.5 Have working knowledge of the applicable occupational safety and health regulations.

1.8 General Conditions

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

.2 Ensure that non-authorized persons are not allowed to circulate in designated construction areas of the work site.

.1 Provide appropriate means by use of barricades, fences, warning signs, traffic control personnel, and temporary lighting as required.

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

1.9 Project/Site Conditions

.1 Work at site will involve contact with:

.1 Multi-employer work site.

.2 Federal employees and general public.

.3 Energized electrical services.

.4 Working from heights.

.5 Persons incarcerated in the federal institutional system.

.6 Hazards – PSPC Preliminary Hazardous Building Materials Assessment reports as Appendices to Specifications.

1.10 Utility Clearances

.1 The Contractor is solely responsible for all utility detection and clearances prior to starting the work.

.2 The Contractor will not rely solely upon the Reference Drawings or other information provided for utility locations.

1.11 Regulatory Requirements

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

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

1.12 Filing of Notice

.1 The General Contractor is to file Notice of Project with Provincial authorities prior to commencement of work. (All construction projects require a Notice of Work)

.2 Provide copies of all notices to the Departmental Representative.

1.13 Site Specific 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 the Site Specific Safety Plan (SSSP) or Health and Safety Plan (HASP) based on the required 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.

.11 COVID-19 Protocols and Procedures.

.12 Institution Emergency Communication Plan must also include the following:

FIRE:

In all cases of a fire (active or extinguished), the following emergency communication protocol must be immediately initiated by the PC (Prime Contractor).

.1 The PC shall notify the commissionaire of the details of the emergency and if fire department service is required.

.2 The commissionaire shall notify the CSC MCCP (Main Communications and Control Post) via radio of the type and particulars of the fire emergency and if fire services are required.

.3 CSC MCCP will advise the commissionaire as to any further action is required and or taken.

.4 The commissionaire will advise the PC as directed from CSC MCCP.

EMERGENCY MEDICAL:

In all cases where emergency services (ambulance) are requested, the following emergency communication protocol must be immediately initiated by the PC.

.1 The PC shall notify the commissionaire of the details of the emergency and if an ambulance has been requested.

.2 The commissionaire shall notify the CSC MCCP via radio of the type and particulars of the incident and if an ambulance has been requested.

.3 CSC MCCP will advise the commissionaire as to any further action is required and or taken.

.4 The commissionaire will advise the PC as directed from CSC MCCP.

If an institutional security or emergency situation arises, the commissionaire through CSC staff will instruct the contractor and their workers on the direction to take.

.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 Site Specific Safety Plan (SSSP) or Health and Safety Plan (HASP) as required, and re-submit to the Departmental Representative.

.5 Departmental Representative's review: the review of Site Specific Safety Plan and/or Health and Safety Plan by Public Works and Government Services Canada (PWGSC) shall not relieve the Contractor of responsibility for errors or omissions in final Site Specific Safety Plan and/or Health and Safety Plan or of responsibility for meeting all requirements of construction, Contract documents, and legislated requirements.

1.14 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.

.5 A route map with written directions to the nearest hospital or medical clinic.

.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 Revise and update emergency procedures as required, and re-submit to the Departmental Representative.

.6 Contractors must not rely solely upon 911 for emergency rescue in a confined space, working at heights, etc.

1.15 Hazardous Products

.1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS, current edition) regarding use, handling, storage and disposal of hazardous materials, and regarding labeling and provision of Material Safety Data Sheets (MSDS) acceptable to the Departmental Representative and in accordance with the Canada Labour Code.

.2 Where use of hazardous and toxic products cannot be avoided:

.1 Advise Departmental Representative beforehand of the product(s) intended for use. Submit applicable MSDS and WHMIS (current edition) documents as per Section 01 01 50.

.2 In conjunction with Departmental Representative, schedule to carry out work during "off hours" when tenants have left the building.

.3 Provide adequate means of ventilation in accordance with Section 01 51 00 and Section 02 81 01.

.4 The contractor shall ensure that the product is applied as per manufacturers recommendations.

.5 The contractor shall ensure that only pre-approved products are brought onto the work site in an adequate quantity to complete the work.

1.16 Asbestos Hazard

1. Remove, handle, and dispose asbestos-containing material in accordance with Section 02 81 01 – Hazardous Materials and Abatement and current applicable Provincial / Federal Regulations.

1.17 PCB Removals

.1 Remove, handle, transport, and dispose PCB-containing equipment in accordance with Section 02 81 01 – Hazardous Materials and Abatement and applicable Provincial / Federal Regulations.

1.18 Removal of Lead-Containing Paint

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

.2 Dry Scraping/Sanding of any materials containing lead is strictly prohibited.

.3 The use of Methylene Chloride based paint removal products is strictly prohibited.

.4 Remove, handle, and dispose lead-containing paint in accordance with Section 02 81 01 – Hazardous Materials and Abatement and applicable Provincial / Federal Regulations.

1.19 Silica Exposure Control

.1 Control exposure of respirable crystalline silica and rock dust in compliance with Section 02 81 01 – Hazardous Materials and Abatement and Provincial / Federal Regulations.

.2 Submit Exposure Control Plan in accordance with Section 02 81 01 – Hazardous Materials and Abatement.

.3 Coordinate with Client's air sampling procedures in accordance with Section 02 81 01.

1.20 Volatile Organic Compounds

1. Removal, handling, or disposal of VOC-containing material is not anticipated to be required during the Work.

1.21 Electrical Safety Requirements
(Reference: Worksafe BC OHS Regulation Part 19 – Electrical Safety)

.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 arc flash protection, required energizing and de-energizing of new and existing circuits with Departmental Representative.

.2 Maintain electrical safety procedures and take necessary precautions to ensure safety of all personnel working under this Contract, as well as safety of other personnel on site.

1.22 Electrical Lockout

.1 Develop, implement and enforce use of established procedures to provide electrical lockout and to ensure the health and safety of workers for every event where work must be done on any electrical circuit or facility.

.2 Prepare the lockout procedures in writing, listing step-by-step processes to be followed by workers, including how to prepare and issue the request/authorization form. Have procedures available for review upon request by the Departmental Representative.

.3 Keep the documents and lockout tags at the site and list in a log book for the full duration of the Contract. Upon request, make such data available for viewing by Departmental Representative or by any authorized safety representative.

1.23 Overloading

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

1.24 Falsework

.1 Design and construct falsework in accordance with CSA S269.1-1975 (R2003) (as amended).

1.25 Scaffolding

.1 Design, construct and maintain scaffolding in a rigid, secure and safe manner, in accordance with CSA Z797-2009 (as amended) Code of Practice for Access Scaffold and BC Occupational Health and Safety Regulations (as amended).

1.26 Confined Spaces

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

1.27 Power-Actuated Devices

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

1.28 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.

.3 Hot Work permits are mandatory requirement for any hot work activities.

1.29 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 (as amended).

.3 Portable gas and diesel fuel tanks are not permitted on most federal work sites. Approval from the Departmental Representative is required prior to any gas or diesel tank being brought onto the work site.

1.30 Fire Protection and Alarm System

.1 Fire protection and alarm systems shall not be:

.1 Obstructed.

.2 Shut off.

.3 Left inactive at the end of a working day or shift.

.2 Do not use fire hydrants, standpipes and hose systems for purposes other than firefighting.

.3 Be responsible/liable for costs incurred from the fire department, the building owner and the tenants, resulting from false alarms.

1.31 Unforeseen Hazards

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

1.32 Posted Documents

.1 Post legible versions of the following documents on site:

.1 Site Specific Safety Plan (SSSP) or Health and Safety Plan (HASP).

.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. Must be posted in an area not accessible by inmates and locked up when not being used.

.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, current edition) 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.

.11 All Hazardous Material and Substance Reports including Lab Analysis.

.2 Post all Material Safety Data Sheets (MSDS) on site, in a common area, visible to all workers and in locations accessible to tenants when work of this Contract includes construction activities adjacent to occupied areas.

.3 Postings should be protected from the weather, and visible from the street or the exterior of the principal construction site shelter provided for workers and equipment, or as approved by the Departmental Representative.

1.33 Meetings

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

1.34 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".

PART 2 - PRODUCTS

2.1 Not Used

PART 3 - EXECUTION

3.1 Not Used

END OF SECTION

PART 1 GENERAL

1.1 Description of Work

.1 Includes general requirements for commissioning facilities and facility systems.

.2 Refer to sections of Mechanical and Electrical disciplines.

1.2 Definitions

.1 Acronyms:

AFD - Alternate Forms of Delivery, service provider.

Cx - Commissioning.

EMCS - Energy Monitoring and Control Systems.

O&M - Operation and Maintenance.

PI - Product Information.

PV - Performance Verification.

TAB - Testing, Adjusting and Balancing.

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

1.3 Quality Assurance

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

.2 Comply with applicable procedures and standards of the certification sponsoring association.

.3 Perform services under direction of supervisor qualified under certification requirements of sponsoring association.

1.4 References

.1 Associated Air Balance Council (AABC): National Standards for Field Measurement and Instrumentation, Total Systems Balance, Air Distribution-Hydronics Systems.

1.5 Submittals

.1 Prior to start of Work, submit name of organization proposed to perform services. Designate who has managerial responsibilities for coordination of entire testing, adjusting and balancing.

.1 Submit documentation to confirm organization compliance with quality assurance provision.

.2 Submit 3 preliminary specimen copies of each of report forms proposed for use.

.3 Ten (10) days prior to Substantial Performance, submit 3 copies of final reports on applicable forms.

.4 Submit reports of testing, adjusting and balancing postponed due to seasonal, climatic, occupancy, or other reasons beyond Contractor's control, promptly after execution of those services.

1.6 Procedures

.1 Comply with procedural standards of certifying association under whose standard services will be performed.

.2 Notify Departmental Representative 3 days prior to beginning of operations.

.3 Accurately record data for each step.

.4 Report to Departmental Representative any deficiencies or defects noted during performance of services.

1.7 Contractor's Responsibilities

.1 Prepare each system for testing and balancing.

.2 Cooperate with testing organization and provide access to equipment and systems.

.3 Provide personnel and operate systems at designated times, and under conditions required for proper testing, adjusting, and balancing.

.4 Notify testing organization 7 days prior to time project will be ready for testing, adjusting, and balancing.

.5 Commission cost to be borne by Contractor.

1.8 Preparation

.1 Provide instruments required for testing, adjusting, and balancing operations.

.2 Make instruments available to Departmental Representative to facilitate spot checks during testing.

.3 Retain possession of instruments and remove at completion of services.

.4 Verify systems installation is complete and in continuous operation.

.5 Verify lighting is turned on when lighting is included in cooling load.

.6 Verify equipment such as computers, laboratory and electronic equipment are in full operation.

1.9 Final Reports

.1 Organization having managerial responsibility shall make reports.

.2 Ensure each form bears signature of recorder, and that of supervisor of reporting organization.

.3 Identify each instrument used, and latest date of calibration of each.

1.10 Completion of Commissioning

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

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

.3 Cx deliverables have been submitted and accepted by Departmental Representative.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1 Section 01 35 33 – Health and Safety Requirements

.2 Section 02 41 99 – Demolition for Minor Works

.3 Section 07 52 00 – Modified Bituminous Membrane Roofing

.4 Section 07 62 00 – Sheet Metal Flashing and Trim

.5 Section 07 84 00 – Firestopping and Smokeseals

.6 Section 07 92 00 – Sealants

1.2 Definitions

.1 Cutting: Removal of existing construction necessary to permit installation or performance of other Work.

.2 Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.3 Submittals

.1 Cutting and Patching Proposal: Submit a proposal describing procedures at least 10 days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:

.1 Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.

.2 Changes to Existing Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.

.3 Products: List products to be used and firms or entities that will perform the Work.

.4 Dates: Indicate when cutting and patching will be performed.

.5 Utilities: List utilities that cutting and patching procedures will disturb or affect. List utilities that will be relocated and those that will be temporarily out of service. Indicate how long service will be disrupted.

.6 Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure to the Departmental Representative prior to making cuts or modifications.

.7 Departmental Representative's Acceptance: Obtain acceptance of cutting and patching proposal before cutting and patching. Review and acceptance of cutting and patching proposal does not waive right to later require removal and replacement of unsatisfactory work.

1.4 Quality assurance

.1 Structural Elements: Do not cut and patch structural elements in a manner that could change their load carrying capacity or load deflection ratio.

.2 Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety, including but not limited to the following:

.1 Primary operational systems and equipment.

.2 Air or smoke barriers.

.3 Fire protection systems.

.4 Control systems.

.5 Communication systems.

.6 Electrical wiring systems.

.3 Miscellaneous Elements: Do not cut and patch the following elements or related components in a manner that could change their load carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety, including but not limited to the following:

.1 Water, moisture, or vapour barriers.

.2 Membranes and lashings.

.3 Exterior curtain wall construction.

.4 Equipment supports.

.5 Piping, ductwork, vessels, and equipment.

.6 Noise and vibration control elements and systems.

.4 Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Departmental Representative's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner. If possible, retain original Installer or fabricator to cut and patch exposed Work listed below. If it is impossible to engage original Installer or fabricator, engage another recognized, experienced, and specialized firm, including but not limited to the following:

.1 Processed concrete finishes.

.2 Masonry.

.3 Preformed metal panels.

.4 Roofing.

.5 Firestopping and smokeseals.

.6 Wall assemblies.

.7 Finished flooring.

.8 Finished coatings.

.9 Wall covering.

.10 HVAC enclosures, cabinets, or covers.

.5 Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.5 Warranty

.1 Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

PART 2 PRODUCTS

2.1 Materials

.1 General: Comply with requirements specified in other Sections of these Specifications.

.2 Existing Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible:

.1 If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of existing materials.

.3 Within Cells: Exposed gaps on surfaces or between fixture and walls: use pick-proof security sealant as per Section 07 92 00.

PART 3 EXECUTION

3.1 Examination

.1 Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed:

.1 Provide GPR or other approved methods to determine locations of existing services and reinforcing in existing concrete slabs and block walls before cutting and renovations. Advise Departmental Representative of findings before proceeding with the Work and revise penetration locations as required and directed by Departmental Representative. Existing concrete slab thickness is to be confirmed by Contractor.

.2 Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

.3 Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 Preparation

.1 Temporary Support: Provide temporary support of Work to be cut.

.2 Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

.3 Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

.4 Existing Services: Where existing services are required to be removed, relocated, or abandoned, bypass such services before cutting to minimize interruption of services to occupied areas.

3.3 Performance

.1 General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay:

.1 Cut existing construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

.2 Cutting: Cut existing construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations:

.1 In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.

.2 Existing Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.

.3 Concrete or Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond core drill.

.4 Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.

.5 Proceed with patching after construction operations requiring cutting are complete.

.3 Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications:

.1 Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.

.2 Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

.3 Floors and Walls: Where walls or partitions that are removed extend from one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, colour, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform colour and appearance.

.1 Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

.4 Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

.5 Ceilings: Patch, repair, or re-hang existing ceilings as necessary to provide an even plane surface of uniform appearance.

.6 Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weather tight condition.

END OF SECTION

PART 1 GENERAL

1.1 Intent

.1 This Section includes, but not limited to, the following:

.1 Demolition, removal completely from site, and disposal of all identified components, materials, equipment and debris.

.2 Selective demolition to allow new walls, bulkheads, ceilings, window, doors and other materials to meet existing construction as indicated.

.3 Repair procedures for selective demolition operations.

.2 This Section does not include the following:

.1 Removal of hazardous materials or asbestos abatement.

.2 Demolition of structural elements.

.3 Mechanical or electrical equipment, except as required to make minor modifications to allow the work to be completed.

.3 Phasing: work of this project will be constructed in phases. Refer to Section 01 01 50 – General Instructions, Summary of Work for required stages.

1.2 Related Sections

.1 Section 01 35 33 – Health and Safety Requirements

.2 Section 02 07 50 – Cutting and Patching

.3 Division 23 – Heating, Ventilation & Air Conditioning

1.3 References

.1 American National Standards Institute (ANSI)

.1 ANSI A10.8-2001, Safety Requirements for Scaffolding.

.2 Canadian Federal Legislation

.1 Motor Vehicle Safety Act (MVSA), 1995

.2 Hazardous Materials Information Review Act, 1985

.3 Canadian Environmental Protection Act (CEPA), 1999, c.33

.4 Canadian Environmental Assessment Act (CEAA), 2012, c.37

.3 Canadian Standards Association (CSA)

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

.4 National Fire Protection Association (NFPA)

.1 NFPA 241-2013, Standard for Safeguarding Construction, Alteration, and Demolition Operations.

.5 Provincial Legislation

.1 Legislation specific to Authority Having Jurisdiction for work governed by this Section

1.4 Definitions

.1 Demolish: Detach items from existing construction and legally dispose of them off site, unless indicated to be removed and salvaged or removed and reinstalled.

.2 Remove and Salvage: Detach items from existing construction and deliver them to Departmental Representative.

.3 Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

.4 Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

.5 Waste Reduction Workplan (WRW): written report which addresses opportunities for reduction, reuse, or recycling of materials. WRW is based on information acquired from WA.

1.5 Administrative Requirements

.1 Pre-Demolition Meeting: Conduct a pre-demolition meeting at Project site in accordance with requirements listed in Section 01 01 50 – General Instructions, Project Meetings, to confirm extent of salvaged and demolished materials; and to review Contractor's demolition plan prepared by a professional engineer.

.2 Coordination:

.1 Coordinate selective demolition work so that work of this Section adheres to aesthetic criteria established by the Drawings and specified dimensions with all elements in planes as drawn, maintaining their relationships with all other building elements.

.2 Coordinate with ongoing site operations, and limit the number of interruptions.

.3 Coordination with continual occupancy of existing building. The existing building will be occupied and operational by the Institution during work of this Contract.

.4 Coordination for shutoff, capping, and continuation of utility services.

.3 Material Ownership:

.1 Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain in the Institution, demolished materials shall become Contractor's property and shall be removed from Project site.

1.6 Submittals

.1 Submit in accordance with Section 01 01 50 – General Instructions, Submittal Procedures.

.2 Proposed Dust-Control and Noise-Control Measures: Submit statement or drawing that indicates the measures proposed for use, proposed locations, and proposed time frame for their operation. Departmental Representative reserves the right to make modifications where proposed methods interfere with the ongoing operations.

.3 Provide the following submittals before starting work of this Section:

.1 Schedule of Selective Demolition Activities: Coordinate with Construction Progress Documentation, and indicate the following:

.1 Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity.

.2 Interruption of utility services.

.3 Schedule of selective demolition.

.4 Coordination for shutoff, capping, and continuation of utility services.

.5 Locations of temporary partitions and means of egress, including for other tenants affected by selective demolition operations.

.2 Submit detailed Waste Reduction Workplan in accordance with Section 01 01 50 – General Instructions, Waste Management and Disposal and indicate:

.1 Descriptions of and anticipated quantities in percentages of materials to be salvaged reused, recycled and landfilled.

.2 Schedule of selective demolition.

.3 Number and location of dumpsters.

.4 Anticipated frequency of tippage.

.5 Name and address of haulers and waste receiving organizations.

.4 Inventory: Submit a list of items that have been removed and salvaged after selective demolition is complete.

.5 Pre-demolition Photographs or Videotape: Submit photographs or videotape indicating existing conditions of adjoining construction and site improvements prior to starting Work. Include finish surfaces that may be misconstrued as damage caused by selective demolition operations.

.6 Informational Submittals: Provide the following submittals when requested by the Departmental Representative:

.1 Qualification Data: Submit information for companies and personnel indicating their capabilities and experience to perform work of this Section including; but not limited to, lists of completed projects with project names and addresses, names and addresses of architects and owners, for work of similar complexity and extent.

1.7 Quality Assurance

.1 Regulatory Requirements: Perform work as follows; use most restrictive requirements where differences occur between the municipal, provincial and federal jurisdictions:

.1 Provincial and Federal Requirements: Perform work in accordance with governing environmental notification requirements and regulations of the Authority Having Jurisdiction.

.2 Municipal Requirements: Perform hauling and disposal operations in accordance with regulations of Authority Having Jurisdiction.

.2 Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project:

.1 Conform to the British Columbia Occupational Health and Safety Act and Regulations.

.2 Conform to Workers' Compensation Board Regulations.

.3 Conform to local municipal bylaws and regulations governing this type of work.

.3 Comply with regulations of local authorities having jurisdiction and standards referenced above. Where differences occur between the local regulations and referenced standards, the most restrictive requirement shall govern.

1.8 Waste Management and Disposal

.1 Separate and recycle waste materials in accordance with Section 01 01 50 – General Instructions, Waste Management and Disposal.

.2 Except where otherwise specified, all materials indicated or specified to be permanently removed from the Place of the Work shall become Contractor's property. Maximize to the fullest extent possible, salvage, and recycling of such materials, consistent with proper economy and expeditious performance of the Work.

.3 To reduce the quantity of material otherwise destined for disposal at a landfill, the Contractor is encouraged to consider utilizing the services of businesses and non-profit organizations that specialize in salvage and recycling of used building materials, but does so at his own option and risk.

1.9 Site Conditions

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

.2 Protect open excavations in accordance with requirements of the Authorities Having Jurisdiction.

.3 Departmental Representative will occupy portions of building immediately adjacent to selective demolition area:

.1 Conduct selective demolition so that operations will not be disrupted.

.2 Provide not less than 72 hours notice to Departmental Representative of activities that will affect operations

.4 Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities:

.1 Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from authorities having jurisdiction.

.5 Should unidentified Asbestos Containing Materials (ACM) or other hazardous substance encountered in course of removal work or cutting and boring activities, stop work, take preventative measures, and notify Departmental Representative immediately. Do not proceed until written instructions have been received from Departmental Representative.

PART 2 PRODUCTS

2.1 Temporary Support Structures

.1 Design temporary support structures required for demolition work necessary for the project using a qualified professional engineer registered or licensed in province of the Work.

2.2 Debris

.1 Make all arrangements for transport and disposal of all demolished materials from the site.

2.3 Equipment

.1 Provide all equipment required for safe and proper demolition.

.2 Use equipment suitable for work identified.

.3 Leave machinery running only while in use, except where extreme temperatures prohibit shutting machinery down.

2.4 Repair Materials

.1 Use repair materials identical to existing materials:

.1 If identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible. Submit samples to Departmental Representative for approval.

.2 Use material whose installed performance equals or surpasses that of existing materials.

.3 Comply with material and installation requirements specified in individual Specification Sections.

.2 Floor Patching and Levelling Compounds: Cement based, trowelable, self-levelling compounds compatible with specified floor finishes. Gypsum based products are not acceptable for work of this Section.

.3 Floor Preparation: Remove sub-floor ridges and bumps. Grind floor to provide uniform levelling between existing and new floor drains. Fill low spots, cracks, joints, holes and other defects with sub-floor filler. Fill openings through slab with cementitious fire stop. Clean and shot blast floor. Apply and average filler; trowel and float to leave smooth, flat hard surface. Prohibit traffic until filler cured and dry.

.4 Concrete Unit Masonry: Lightweight concrete masonry units and mortar, cut and trimmed to fit existing opening to be filled. Provide standard hollow core units, square end units and bond beam units as indicated on drawings.

.5 Gypsum Board Patching Compounds: Joint compound to ASTM C475, bedding and finishing types thinned to provide skim coat consistency to patch and prepare existing gypsum board walls ready for new finishes in accordance with Section 09 21 16 – Gypsum Board Assemblies.

.6 Hoarding and Dust Screens: Refer to Section 01 01 50 – General Instructions, Temporary Barriers and Enclosures and as follows:

.1 Provide dust tight screens or insulated partitions to localize dust generating activities, and for protection of workers, finished areas of Work and public.

.2 Maintain and relocate protection until such work is complete.

2.5 Existing materials

.1 Items to be retained for re-use in new construction include, but are not limited to the following:

.1 As indicated on Drawings.

.2 Confirm with Departmental Representative any materials that appear to be in re-usable condition prior to disposal.

PART 3 EXECUTION

3.1 Examination

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

.2 Locate and protect utilities. Verify that utilities have been disconnected and capped as required.

.3 Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

.4 Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.

.5 Notify the Departmental Representative where existing mechanical, electrical, or structural elements conflict with intended function or design:

.1 Investigate and measure the nature and extent of conflict and submit a written report to Departmental Representative.

.2 Departmental Representative will issue additional instructions or revise drawings as required to correct conflict.

.6 Engage a Professional Engineer to survey condition of building when removing elements that may result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective demolition operations.

.7 Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 Utility Services

.1 Coordinate existing services indicated to remain and protect them against damage during selective demolition operations.

.2 Locate, identify, disconnect, and seal or cap off indicated utilities serving areas to be selectively demolished.

.1 Arrange to shut off affected utilities with utility companies.

.2 If utility services are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary utilities that bypass area of selective demolition and that maintain continuity of service to other parts of building.

.3 Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.

.4 Cut off pipe or conduit to a minimum of 25 mm below slab, and remove concrete mound.

.3 Coordinate with mechanical and electrical sections for shutting off, disconnecting, removing, and sealing or capping utilities.

.4 Do not start selective demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.3 Preparation

.1 Identify and mark all equipment and materials identified to be retained by Departmental Representative or to be re-used in subsequent construction. Separate and store items to be retained in an area away from area of demolition and protect from accidental disposal.

.2 Post warning signs or electrical lines and equipment that must remain energized to serve other areas during period of demolition.

.3 Confirm that all electrical and telephone service lines entering building are not disconnected.

.4 Do not disrupt active or energized utilities crossing the demolition site.

.5 Provide and maintain barricades, warning signs, protection for workmen and the public during the full extent of the Work. Read drawings carefully to ascertain extent of protection required.

.6 Mark all materials required to be re-used, store in a safe place until ready for re-installation.

.7 Adjust all junction boxes, receptacles and switch boxes flush with new wall construction where additional layers to existing construction are indicated.

.8 Drain, purge, or otherwise remove, collect, and dispose of chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with selective demolition operations.

3.4 Protection

.1 Take precautions to guard against damage to adjacent work. Be liable for any damage or injury caused.

.2 Cease operations and notify Departmental Representative if safety or any adjacent work appears to be endangered. Do not resume operations until reviewed with Departmental Representative.

.3 Prevent debris from blocking drainage inlets and systems and ground draining, and protect material and electrical systems and services that must remain in operation.

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

.5 Protect building systems, services and equipment.

.6 Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain and as follows:

.1 Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.

.2 Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.

.3 Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.

.4 Cover and protect furniture, furnishings, and equipment that have not been removed.

.7 Provide temporary enclosures for protection of existing building and construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities.

.1 Provide temporary weather tight enclosure for building exterior.

.2 Where heating or cooling is needed and permanent enclosure is not complete, provide insulated temporary enclosures.

.3 Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.

.8 Provide and maintain fire prevention equipment and alarms accessible during demolition.

.9 Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise.

.10 Do Work in accordance with Section 01 35 33 – Health and Safety Requirements.

3.5 Concrete Slab Reinforcing

.1 Locate location of reinforcing steel in concrete slabs prior to cutting or coring using non-destructive, non-ionizing radio frequency locators.

.2 Core concrete slabs to avoid reinforcing steel, electrical conduit or water pipes; adjust core location and coordinate with Engineer where slab features interfere with core drilling.

.3 Notify the Engineer immediately for further instructions where coring or cutting will damage existing slab features.

3.6 Coring, Drilling and Saw-cutting Concrete

.1 Conduct GPR, ultrasound, or other approved methods to determine locations existing reinforcing in existing concrete assembly before coring, drilling, or cutting. Employ the services of an experienced inspector. Confirm with Departmental Representative before coring or drilling, location of reinforcing steel and raceways that may be present.

.2 Perform coring and drilling after normal working hours, unless specified otherwise. Confirm coring and drilling times with Departmental Representative.

.3 Wet or dry core drilling and saw-cutting are acceptable. Reduce amount of cooling water used to minimum required and collect water used in suitable containers, or use a suitable vacuum system that will collect water.

.4 Do not core concrete assemblies or cut conduits without written permission from Departmental Representative.

.5 Do not cut or damage reinforcing steel.

3.7 Selective Demolition

.1 Demolish and dismantle work in a neat and orderly manner and in strict accordance with all regulations.

.2 At end of each day's work, leave Work in safe condition so that no part is in danger of toppling or falling.

.3 Demolish in a manner to minimize dusting and to prevent migration of dust.

.4 Burning of demolition materials is not permitted.

.5 Remove concrete bases by cutting and chipping, take precautions against slab cracking and degradation. Grind edges smooth, fill and make level with self levelling grout.

.6 Fill all openings in concrete block walls with concrete masonry units, coursing to match existing, prepare ready to receive new finishes to match existing.

- .1 Provide bond beams in new openings cut into existing concrete masonry unit walls.
- .2 Provide finished end masonry units to patch and repair for new jamb sections in existing concrete masonry unit walls.

.7 Demolish existing flooring and adhesive remnants as follows:

- .1 Apply fine mist water spray to floors to minimize dust generation during removal. Avoid spraying near electrical outlets.
- .2 Demolish existing residual floor finishes, remove and dispose of off site.
- .3 Remove adhesive to the greatest extent possible using scrapping tools and as follows:
  - .1 Do not use solvent based cleaners to remove adhesive remnants.
  - .2 Lightly shot blast or grind floor using machine designed for purpose to remove adhesive remnants.
  - .3 Vacuum floor ready for application of skim coating.
  - .4 Repair all slab depressions and damage with cementitious patching compound.
  - .5 Skim coat floor with minimum 1 mm thick cementitious floor underlayment compatible with new flooring materials.
- .4 Floor substrate shall be smooth, free from ridges and depressions, and adhesive remnants that could telegraph through resilient flooring materials and carpets.

.8 Demolish existing tile finishes. Remove setting bed or adhesive to the greatest extent possible using mechanical scrapping tools and as follows:

- .1 Saw cut edge of tile for clean and even transition joint between existing tile to remain and new flooring materials.
- .2 Lightly shot blast or grind floor to remove remnants of setting materials.
- .3 Vacuum floor ready for application of skim coating.
- .4 Repair all slab depressions and damage with cementitious patching compound. Skim coat floor with minimum 1 mm thick cementitious floor underlayment compatible with new flooring materials.

.9 Fill all openings in gypsum board walls with gypsum board and framing to match existing, skim coat to make wall smooth and even.

.10 Demolish ceiling finishes as indicated on Drawings.

.11 Patch and repair all walls, floor and ceilings damaged during demolition with material matching adjacent walls, prepare ready for new finishes.

.12 Patch and repair all mechanical equipment and electrical fixtures damaged or exposed during demolition to match adjacent finished surfaces.

3.8 Patching and Repairing

.1 Floors and Walls: refer to Section 02 07 50 – Cutting and Patching and as follows:

.1 Where walls or partitions that are demolished extend from one finished area into another, patch and repair floor and wall surfaces in the new space.

.2 Provide a level and smooth surface having uniform finish colour, texture, and appearance.

.3 Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform colour and appearance.

.4 Patch with durable seams that are as invisible as possible.

.5 Provide materials and comply with installation requirements specified in other Sections of these Specifications.

.6 Where patching occurs in a painted surface, apply primer and intermediate paint coats over patch and apply final paint coat over entire unbroken surface containing patch. Provide additional coats until patch blends with adjacent surfaces.

.7 When requested, test and inspect patched areas after completion to demonstrate integrity of installation.

.2 Ceilings: Patch, repair, or re-hang existing ceilings as necessary to provide and even-plane surface of uniform appearance.

.3 Restore areas and existing works outside areas of demolition to conditions that existed prior to beginning of Work.

3.9 Salvage

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

.2 Remove items to be reused, store as directed by Departmental Representative and re-install under appropriate section of specification.

3.10 Disposal

.1 Dispose of removed materials, to appropriate recycling facilities except where specified otherwise, in accordance with authority having jurisdiction.

3.11 Cleanup

.1 Promptly as the Work progresses, and on completion, clean up and remove from the site all rubbish and surplus material. Remove rubbish resulting from demolition work daily.

.2 Maintain access to exits clean and free of obstruction during removal of debris.

.3 Keep surrounding and adjoining roads, lanes, sidewalks, municipal rights-of-way clean and free of dirt, soil or debris that may be a hazard to vehicles or persons.

END OF SECTION

PART 1 GENERAL

1.1 References

.1 Refer to the following reports (further referred to herein as the “Assessment Reports”), attached in the Appendix of the Project Specifications, for information pertaining to hazardous building materials that have been identified and will require disturbance (removal and disposal) during the Work:

.1 “Hazardous Building Materials Assessment, 39 Buildings/Structures at CSC Matsqui Institution, 33344 King Road, Abbotsford, BC: Findings and Recommendations – Building M2C/M2D – (831-07-RP)”, prepared by Stantec Consulting Ltd., dated March 2019

.2 “Pre-Renovation Hazardous Building Materials Assessment – Site Review Report; Reference: Design of Under-Slab Supply Venting at Matsqui Institution Building M2C/M2D (Living Unit 5)”, prepared by Stantec Consulting Ltd., dated August 28, 2020

1.2 Definitions

.1 Dangerous Goods: product, substance, or organism that is specifically listed or meets hazard criteria established in Transportation of Dangerous Goods Regulations.

.2 Hazardous Building Material: component of a building or structure that will cause adverse impact to environment or adversely affect health of persons, animals, or plant life when altered, disturbed or removed during maintenance, renovation or demolition.

.3 Hazardous Material: product, substance, or organism that is used for its original purpose; and that is either dangerous goods or a material that may cause adverse impact to environment or adversely affect health of persons, animals, or plant life when released into the environment.

.4 Hazardous Waste: any hazardous material that is no longer used for its original purpose and that is intended for recycling, treatment or disposal.

1.3 Reference Standards

.1 Canadian Environmental Protection Act, 1999 (CEPA 1999).

.1 Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations (SOR/2005-149).

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.3 National Research Council Canada Institute for Research in Construction (NRC-IRC)

.1 National Fire Code of Canada 2015.

.4 Department of Justice Canada

.1 Transportation of Dangerous Goods Act (TDG Act) 1999, (c. 34).

.2 Transportation of Dangerous Goods Regulations (T-19.01-SOR/2003-400).

.5 WorkSafe BC

.1 British Columbia's Occupational Health and Safety Regulation (BC Reg. 296/97), including amendments to date of work)

.2 "Safe Work Practices for Handling Asbestos" (2017)

.3 "Lead-Containing Paints and Coatings; Preventing Exposure in the Construction Industry" (2011)

.4 "Safe Work Practices for Handling Lead" (2017)

.6 Government of Canada

.1 The Canada Labour Code, Part II, Canada Occupational Health and Safety Regulations (COHSR)

.2 The Federal PCB Regulations (SOR/2008-273).

.3 The Federal Halocarbons Regulation (July 2003).

.7 Government of British Columbia

.1 British Columbia Hazardous Waste Regulation (BC Reg. 63/88)

.8 Canadian Construction Association

.1 Standard Construction Document CCA 82 "Mould Guidelines for the Canadian Construction Industry" (2004 – further referred to herein as "CCA 82").

1.4 Submittals

.1 Provide submittals in accordance with Section 01 01 50 – General Instructions.

.2 Product Data:

.1 Submit product data in accordance with Section 01 01 50 – General Instructions.

.1 Submit to Departmental Representative current Material Safety Data Sheet (MSDS) for each hazardous material required prior to bringing hazardous material on site.

1.5 Delivery, Storage, and Handling

.1 Co-ordinate storage of hazardous materials with Departmental Representative and abide by internal requirements for labelling and storage of materials and wastes.

.2 Store and handle hazardous materials and wastes in accordance with applicable federal and provincial laws, regulations, codes, and guidelines.

.3 Store and handle flammable and combustible materials in accordance with current National Fire Code of Canada 2015 requirements.

.4 Keep no more than 45 litres of flammable and combustible liquids such as gasoline, kerosene and naphtha for ready use.

.1 Store flammable and combustible liquids in approved safety cans bearing the Underwriters' Laboratory of Canada or Factory Mutual seal of approval.

.2 Storage of quantities of flammable and combustible liquids exceeding 45 litres for work purposes requires the written approval of the Departmental Representative.

.5 Transfer of flammable and combustible liquids is prohibited within buildings.

.6 Do not transfer of flammable and combustible liquids in vicinity of open flames or heat-producing devices.

.7 Do not use flammable liquids having flash point below 38 degrees C, such as naphtha or gasoline as solvents or cleaning agents.

.8 Store flammable and combustible waste liquids for disposal in approved containers located in safe, ventilated area. Keep quantities to minimum.

.9 Observe smoking regulations, smoking is prohibited in areas where hazardous materials are stored, used, or handled.

.10 Storage requirements for quantities of hazardous materials and wastes in excess of 5 kg for solids, and 5 litres for liquids:

.1 Store hazardous materials and wastes in closed and sealed containers.

.2 Label containers of hazardous materials and wastes in accordance with WHMIS.

.3 Store hazardous materials and wastes in containers compatible with that material or waste.

.4 Segregate incompatible materials and wastes.

.5 Ensure that different hazardous materials or hazardous wastes are not mixed.

.6 Store hazardous materials and wastes in secure storage area with controlled access.

.7 Maintain clear egress from storage area.

.8 Store hazardous materials and wastes in location that will prevent them from spilling into environment.

.9 Have appropriate emergency spill response equipment available near storage area, including personal protective equipment.

.10 Maintain inventory of hazardous materials and wastes, including product name, quantity, and date when storage began.

.11 Ensure personnel have been trained in accordance with Workplace Hazardous Materials Information System (WHMIS) requirements.

.12 Report spills or accidents immediately to Departmental Representative. Submit a written spill report to Departmental Representative within 24 hours of incident.

1.6 Transportation

.1 Transport hazardous materials and wastes in accordance with federal Transportation of Dangerous Goods Act, Transportation of Dangerous Goods Regulations, and applicable provincial regulations.

.2 If hazardous waste is generated on site:

.1 Co-ordinate transportation and disposal with Departmental Representative.

.2 Ensure compliance with applicable federal, provincial and municipal laws and regulations for generators of hazardous waste.

.3 Use licensed carrier authorized by provincial authorities to accept subject material.

.4 Prior to shipping material obtain written notice from intended hazardous waste treatment or disposal facility that it will accept material and that it is licensed to accept this material.

.5 Label containers with legible, visible safety marks as prescribed by federal and provincial regulations.

.6 Ensure that trained personnel handle, offer for transport, or transport dangerous goods.

.7 Provide photocopy of shipping documents and waste manifests to Departmental Representative.

.8 Track receipt of completed manifest from consignee after shipping dangerous goods. Provide a photocopy of completed manifest to Departmental Representative.

.9 Report discharge, emission, or escape of hazardous materials immediately to Departmental Representative and appropriate provincial authority. Take reasonable measures to control release.

1.7 Existing Conditions

.1 Reports and information pertaining to hazardous building materials present within the building that may be handled, removed, or otherwise disturbed and disposed of during this Project are bound into this specification in the Appendix.

.2 Notify Departmental Representative of suspected hazardous building material discovered during Work and not apparent from drawings, specifications, or reports pertaining to the Work. Do not disturb such material pending instructions from Departmental Representative.

PART 2 PRODUCTS

2.1 Materials

.1 Only bring on site quantity of hazardous materials required to perform work.

.2 Maintain MSDS in proximity to where materials are being used. Communicate this location to personnel who may have contact with hazardous materials.

PART 3 EXECUTION

3.1 Hazardous Building Materials Abatement

.1 Abatement shall be conducted to handle, alter, remove and dispose of hazardous building materials as identified in the Assessment Reports in accordance with applicable regulations, guidelines, standards and/or best practices for such work, only where such identified hazardous building materials will be impacted (handled, altered, damaged, removed) by the Work.

.2 Contractor is responsible for reviewing plans, specifications and reports along with their planned methods, processes and/or tools such that they determine the locations and amounts of hazardous building materials that will be impacted by the Work of this Contract.

.3 Where there is a discrepancy between the information in this specification as compared to the information in the Assessment Reports as it pertains to identities, locations and/or quantities of identified hazardous building materials, the information in the Assessment Reports will prevail.

.1 If discrepancies are present pertaining to identities, locations and/or quantities of identified hazardous building materials, it is the Contractor’s responsibility to request information to clarify such discrepancies during the bidding period. No additional costs will be allowed by the Contractor for additional labour or

materials required to complete required abatement related to such discrepancies that could otherwise have been clarified during the bidding period.

.4 The listing below is a summary of the identified hazardous building material categories that are anticipated to require disturbance, along with the associated removal and disposal regulations, guidelines and/or standards.

.1 Asbestos-Containing Materials (ACMs)

.1 Refer to the Assessment Reports for identities and locations of ACMs. Although the Contractor is responsible to review this information in light of their proposed methods for completing the Work, a preliminary review indicates that the following ACMs will require consideration:

.1 Gold duct mastic applied to HVAC ducting throughout.

.2 Concealed packing material inside pipe elbows throughout (potentially present in concealed locations within the project area – if found and requires disturbance, should be considered ACM until proven otherwise).

.3 Tar paper jacket on fiberglass insulation – black mastic on pipe elbows/lagging/wrap (potentially present in concealed locations within the project area – if found and requires disturbance, should be considered ACM until proven otherwise).

.4 Cementitious insulation applied to pipe fittings. Potentially present in wall cavities, pipe chases or other inaccessible areas of the subject building. If discovered, this material should be presumed to be ACM until proven otherwise.

.2 Where ACMs will be disturbed, altered or removed as determined by the Contractor, abatement shall be conducted in accordance with applicable regulations, guidelines, standards and/or best practices for such work.

.1 Submit Provincial and/or local requirements for Notice of Project Form.

.2 Submit proof of Contractor's Asbestos Liability Insurance.

.3 Submit to DCC Representative necessary permits for transportation and disposal of asbestos containing waste and proof that asbestos containing waste has been received and properly disposed.

.4 Submit proof that all asbestos workers and/or supervisor have received appropriate training and education by a competent person in the hazards of asbestos exposure, good personal hygiene and work practices while working in Asbestos Work Areas, and the use, cleaning and disposal of respirators and protective clothing. Instruction and training related to respirators is to include, at a minimum:

.1 Fitting of equipment.

.2 Inspection and maintenance of equipment.

.3 Disinfecting of equipment.

.4 Limitations of equipment.

.3 Contractor is responsible for any and all supplemental assessment and/or pre-work site visits necessary to satisfy the requirements of the BC Reg. 296/97 as they may pertain to appropriate documentation of the following:

.1 Project plan (sequencing of work, duration of work, addressing unknowns [if any], work methods, tools PPE, etc.)

.2 Site-specific hazard assessments/risk assessments, and development of site-specific safe work practices, as necessary

.3 Addressing potential for concealed or previously un-assessed potential ACMs

.4 Removal, disturbance or alteration of identified ACMs is to be conducted in accordance with the requirements of the 2017 WorkSafe BC publication “Safe Work Practices for Handling Asbestos”, by appropriately trained personnel.

.1 Contractor is to conduct a risk assessment and document work procedures for actions/tasks that will or may disturb identified ACMs.

.2 Contractor is to submit the documented work procedures to the Departmental Representative for review, at least 5 days prior to initiation of work.

.3 Contractor must not proceed with work that will impact identified ACMs without approval from Departmental Representative.

.4 If air monitoring is required as part of the Contractor’s work procedures, the Departmental Representative will provide the required air monitoring and inspections.

.5 If, in the opinion of the Departmental Representative, the work procedures developed by the Contractor do not meet the intent of the 2017 WorkSafeBC publication “Safe Work Practices for Handling Asbestos”, revisions will be required, at no cost to the Owner, and at no impact to the schedule.

.5 Waste transportation to be conducted in accordance with BC Reg. 63/88 and the Federal Transportation of Dangerous Goods Regulation.

.6 Waste disposal to be conducted in accordance with BC Reg. 63/88.

.7 Notify Departmental Representative of suspected ACM discovered during Work and not apparent from drawings, specifications, or report pertaining to Work. Do not disturb such material pending instructions from Department Representative

.2 Lead and Lead-Containing Paints (LCPs)

.1 Refer to the Assessment Reports for identities and locations of identified lead-containing materials (including paints with varying concentrations of lead).

.2 Actions that will disturb lead-containing materials (including paints and materials coated with paints) are to be conducted in accordance with the requirements of the 2017 WorkSafe BC publication “Safe Work Practices for Handling Lead”, keeping airborne exposure to lead dust to less than COHSR and BC Reg. 296/97 regulated 8-hour Occupational Exposure Limit (OEL) for lead of 0.05 milligram per cubic metre (mg/m^3).

.1 Actual methods to maintain exposures within applicable limits are to be determined by the contractor through their own risk assessment, which will take into account the lead content of the paints as indicated in the Assessment Reports, along with their planned disturbance methods (and associated dust control), tools, PPE and the overall duration of the work.

.1 Although formal evaluation is ultimately the responsibility of the Contractor, limited hazards are expected associated with the lead content of paints to be disturbed, based on the information in the Assessment Reports.

.3 Although paints and items coated with paints may be disturbed and/or removed for disposal during the Work, unless deemed necessary through risk assessment or cost analysis conducted by the Contractor, comprehensive removal of paints from items or surfaces is not expected to be required during the Work.

.4 Refer to the provisions of the 2017 WorkSafeBC document “Safe Work Practices for Handling Lead” for removal of LCPs from surfaces before any welding and torch-cutting, should the Contractor plan to use such methods to complete the Work.

.1 Contractor will be responsible for verification testing of surfaces where LCPs have been removed. Confirmation of acceptable results is to be provided to the Departmental Representative for review before proceeding with any welding or torch-cutting on surfaces where LCPs were present.

.5 Waste transportation to be conducted in accordance with BC Reg. 63/88 and the Federal Transportation of Dangerous Goods Regulation.

.6 Waste disposal to be conducted in accordance with BC Reg. 63/88.

.3 Polychlorinated Biphenyls (PCBs)

.1 According to the Assessment Reports, florescent light fixtures observed may have ballasts that contain PCBs.

.2 When decommissioned, verify the PCB content of fluorescent lamp ballasts as per the Environment Canada 1991 publication “Identification of Lamp Ballasts Containing PCBs, Report EPS2/CC/2”, or equivalent reference

.1 Separate PCB-containing ballasts from non-PCB ballasts.

.3 Should a material suspected to contain PCBs become uncovered during renovation activities (i.e., dielectric fluids, hydraulic fluids), all work in the areas that may disturb the material should be stopped. Samples of the suspect material should be submitted for laboratory analysis to determine if PCBs are present.

.4 PCB-containing items identified for removal and disposal should be handled, transported, stored and disposed of in accordance with the following:

.1 The transportation and disposal requirements of BC Reg. 63/88.

.2 The transportation requirements of the Federal Transportation of Dangerous Goods Regulation.

.3 The Federal PCB Regulations (SOR/2008-273)

.4 Mould

.1 Removal, alteration and/or disposal of mould-impacted materials is not anticipated to be required during the Work.

.2 Replacement of moisture-stained ceiling tiles can proceed without special precautions for mould.

.5 Mercury

.1 According to the Assessment Reports, mercury vapour is present in the light tubes within fluorescent light fixtures.

.2 When mercury-containing items are removed (fluorescent light tubes), ensure all mercury waste is handled, stored and disposed of in accordance with the requirements the following:

.1 The transportation and disposal requirements of BC Reg. 63/88.

.2 The transportation requirements of the Federal Transportation of Dangerous Goods Regulation.

.3 Precautions should be taken if workers may potentially be exposed to mercury or mercury vapours to ensure that workers exposure levels do not exceed the occupational exposure limit of 0.025 mg/m^3 as per the COHSR and BC Reg. 296/97. This can be achieved by providing respiratory and skin protection applicable to the hazard and task to be completed.

.6 Ozone-Depleting Substances (ODSs)

.1 Removal, alteration and/or disposal of ODS-containing equipment is not anticipated to be required during the Work.

.7 Silica

.1 According to the Assessment Reports, silica is expected to be present in the following:

.1 Cement products such as: concrete foundation/floors/walls/blocks, brick/masonry units and associated grout and mortar, stone/ceramic tiles and associated grouts and mortars.

.2 Gypsum and associated wall/ceiling finish materials.

.3 Suspended ceiling tiles.

.4 Asphalt and asphalt products containing rock or stone (e.g., roof membrane).

.2 When silica-containing materials are to be disturbed and/or removed (e.g., demolition of concrete slabs, masonry or concrete units, or ceramic tiles, removal of gypsum board wall or ceilings, etc.), ensure dust control measures are employed such that airborne silica dust concentrations do not exceed the exposure limit as stipulated by the COHSR and BC Reg. 296/97. (Cristobalite and Quartz – each 0.025 mg/m^3). This would include, but not be limited to, the following:

.1 Providing workers with respiratory protection

.2 Wetting the surface of the materials, use of water or dust suppressing agents to prevent dust emissions

.3 Providing workers with facilities to properly wash prior to exiting the work area.

3.2 Disposal

.1 Dispose of hazardous waste materials in accordance with applicable federal and provincial acts, regulations, and guidelines.

.2 Recycle hazardous wastes for which there is approved, cost effective recycling process available.

.3 Send hazardous wastes to authorized hazardous waste disposal or treatment facilities.

.4 Burning, diluting, or mixing hazardous wastes for purpose of disposal is prohibited.

.5 Disposal of hazardous materials in waterways, storm or sanitary sewers, or in municipal solid waste landfills is prohibited.

.6 Dispose of hazardous wastes in timely fashion in accordance with applicable provincial regulations.

.7 Minimize generation of hazardous waste to maximum extent practicable. Take necessary precautions to avoid mixing clean and contaminated wastes.

.8 Identify and evaluate recycling and reclamation options as alternatives to land disposal, such as:

.1 Hazardous wastes recycled in manner constituting disposal.

.2 Hazardous waste burned for energy recovery.

.3 Lead-acid battery recycling.

.4 Hazardous wastes with economically recoverable precious metals.

3.3 Cleaning

.1 Progress Cleaning: Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

END OF SECTION

Part 1 GENERAL

1.1 Related Sections

.1 Section 02 07 50 – Cutting and Patching

.2 Section 05 50 00 – Metal Fabrications

1.2 References

.1 American Society for Testing and Materials International (ASTM)

- .1 ASTM A36/A36M-14, Standard Specification for Carbon Structural Steel.
- .2 ASTM A108-13, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
- .3 ASTM A153/A153M-16a, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- .4 ASTM A325 10e1, Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
- .5 ASTM A510/A510M-13, Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel, and Alloy Steel.
- .6 ASTM A563-15, Standard Specification for Carbon and Alloy Steel Nuts.
- .7 ASTM B633-15, Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
- .8 ASTM E488/E488M-15, Standard Test Methods for Strength of Anchors in Concrete Elements.
- .9 ASTM F436/F436M-16, Standard Specification for Hardened Steel Washers Inch and Metric Dimensions.

.2 Canadian Standards Association (CSA)

- .1 CSA A23.3-14, Design of Concrete Structures.
- .2 CSA G30.18-09, Billet-steel Bars for Concrete Reinforcement.
- .3 CSA W59-13, Welded Steel Construction.

1.3 Submittals

.1 Submit product data in accordance with Section 01 01 50 – General Instructions, Submittals:

- .1 Submit product data for proprietary products and materials that include:
  - .1 Product specifications with recommended design values and physical characteristics for epoxy dowels, expansion and undercut anchors.
  - .2 Manufacturer's published installation instructions.
  - .3 Installer qualifications & procedures: submit installer qualifications as stated in Section 1.4. Submit a letter of procedure stating method of drilling, the product proposed for use, the complete installation procedure, manufacturer training date, and a list of the personnel to be trained on anchor installation.

1.4 Quality Assurance

.1 Installer Qualifications: the installer shall be experienced in installing anchors equal to type, and into the substrate material required for this project.

.2 Installer Training: prior to construction, train all personnel involved in installation on-site with the manufacturer or the manufacturer's representative. Training to consist of a

review of the complete installation process for drilled-in anchors, to include but not limited to:

.1 hole drilling procedure
.2 hole preparation & cleaning technique
.3 adhesive injection technique & dispenser training / maintenance
.4 rebar dowel preparation and installation
.5 proof loading/torqueing

.3 Installers to provide proof of training upon request of the Departmental Representative.

.4 Refer to Section **3.4 Field Quality Control** below for anchor load testing requirements.

1.5 Delivery, Storage, and Handling

.1 Deliver products to job site in manufacturer's or distributor's packaging undamaged, complete with installation instructions.

.2 Protect and handle materials in accordance with manufacturer's recommendations to prevent damage or deterioration.

1.6 Project Conditions

.1 Adhesive anchors shall be installed in concrete having reached the designed strength at time of anchor installation.

.2 Anchoring adhesives must be stored at temperatures prescribed by the manufacturer and must not be used beyond the expiration date.

.3 The anchor or fastener coating, plating or steel type must provide suitable corrosion resistance for the environment in which the anchor or fastener is installed.

Part 2 PRODUCTS

2.1 Materials

.1 Fasteners and Anchors:

.1 Carbon and alloy steel nuts: to ASTM A563.
.2 Carbon steel washers: to ASTM F436.
.3 Carbon steel threaded rod: to ASTM A36, or ASTM A193 Grade B7, or ISO 898 Class 5.8.
.4 Wedge / expansion anchors: to ASTM A510, or ASTM A108.
.5 Zinc plating: to ASTM B633.
.6 Hot-dip galvanizing: to ASTM A153.
.7 Reinforcing steel dowels: billet steel, Grade 400W, deformed bars to CSA G30.18 unless indicated otherwise.

.2 Epoxy Adhesive:

.1 Bond strength: to ASTM C882M.
.2 Compressive strength and modulus: to ASTM D695.
.3 Tensile strength at 7 days: to ASTM D638.

.3 Drill-in Anchors

.1 Wedge / expansion anchors: wedge type, torque-controlled, with impact section to prevent thread damage complete with required nuts and washers. Provide

anchors with length identification markings. Type and size as indicated on Drawings.

.1 Where anchor manufacturer is not indicated, subject to compliance with requirements and acceptance by the Departmental Representative, provide the following:

.1 Hilti Kwik Bolt TZ, or

.2 Dewalt Power Stud + SD2,or

.3 Approved equivalent

.2 Cartridge injection adhesive anchors: threaded steel rod, inserts or reinforcing dowels, complete with nuts, washers, polymer or hybrid mortar adhesive injection system, and manufacturer's installation instructions. Type and size as indicated on Drawings.

.1 Where anchor manufacturer is not indicated, subject to compliance with requirements and acceptance by the Departmental Representative, provide the following:

.1 Hilti HIT-RE 500 V3, or

.2 Dewalt PURE110+, or

.3 Approved equivalent

Part 3 EXECUTION

3.1 Preparation

.1 Examine supporting base materials and environmental conditions. Do not begin installation until base materials have been properly prepared.

.2 Existing reinforcing bars in the concrete structure may conflict with specific anchor locations. the contractor shall undertake to locate the position of the reinforcing bars at the locations of the concrete anchors, by GPR, X-ray or other non-destructive means. Locally adjust anchor locations to avoid cutting existing reinforcing bars.

.3 Unless otherwise specified, do not drill holes into concrete until it has achieved full design strength.

.4 Install only if environmental conditions are in compliance with manufacturer's recommendations for installation conditions.

3.2 Installation

.1 Drilled-In Anchors:

.1 Drill holes with rotary impact hammer drills using carbide-tipped bits. Alternate drilling methods, such as diamond coring, must be approved by the Departmental Representative. Drill bits shall be of diameters as specified by the anchor manufacturer. Unless otherwise shown on the drawings, all holes shall be drilled perpendicular to the concrete surface.

.1 Cored Holes: Where anchors are permitted to be installed in cored holes, use core bits with matched tolerances as specified by the manufacturer. Properly clean cored hole per manufacturer's instructions.

.2 Embedded Items: Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Exercise care in coring or drilling to avoid damaging existing reinforcing or embedded items. Notify the Departmental Representative if reinforcing steel or other embedded items are encountered during drilling. Take precautions as necessary to avoid damaging prestressing tendons, electrical and telecommunications conduit, and gas lines.

.3 Base Material Strength: Unless otherwise specified, do not drill holes in concrete or masonry until concrete until it has achieved full design strength.

.2 Perform anchor installation in accordance with manufacturer instructions.

.3 Cartridge Injection Adhesive Anchors: Clean all holes per manufacturer instructions to remove loose material and drilling dust prior to installation of adhesive. Inject adhesive into holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive. Follow manufacturer recommendations to ensure proper mixing of adhesive components. Sufficient adhesive shall be injected in the hole to ensure that the annular gap is filled to the surface. Remove excess adhesive from the surface. Shim anchors with suitable device to center the anchor in the hole. Do not disturb or load anchors before manufacturer specified cure time has elapsed.

.4 Observe manufacturer recommendations with respect to installation temperatures for cartridge injection adhesive anchors.

3.3 Field Quality Control

.1 Minimum 1% of anchors and minimum of 2 anchors per each anchor diameter shall be selected by Departmental Representative for load tests to the manufacture's recommendations. The costs of test shall be borne by the contractor.

3.4 Repair of Defective Work

.1 Remove and replace misplaced or malfunctioning anchors. Fill empty anchor holes and patch failed anchor locations with high-strength non-shrink, non-metallic grout. Anchors that fail to meet proof load or installation torque requirements shall be regarded as malfunctioning.

3.5 Protection

.1 Protect elements surrounding the work of this Section from damage or disfiguration.

3.6 Cleaning

.1 Keep work area free from an unnecessary accumulation of tools, equipment, surplus materials and debris.

.2 Perform cleaning after installation to remove construction and accumulated environmental dirt.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1 Section 05 05 19 – Post-Installed Concrete Anchors

.2 Section 09 91 99 – Painting for Minor Works

1.2 References

.1 American Society for Testing and Materials International, (ASTM)

- .1 ASTM A53/A53M-12, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
- .2 ASTM A123/A 123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- .3 ASTM A307-14, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.
- .4 ASTM A623-03, Test Methods for Tool-Resisting Steel Bars, Flats, and Shapes for Detention and Correctional Facilities.
- .5 ASTM E935, Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings.

.2 Canadian General Standards Board (CGSB)

- .1 CAN/CGSB-1.40, Anti-corrosive Structural Steel Alkyd Primer.
- .2 CAN/CGSB-1.181, Ready-Mixed Organic Zinc-Rich Coating.

.3 Canadian Standards Association (CSA International)

- .1 CAN/CSA G40.20/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .2 CAN/CSA G164, Hot Dip Galvanizing of Irregularly Shaped Articles.
- .3 CAN/CSA S16, Design of Steel Structure (2014).
- .4 CSA W48-14, Filler Metals and Allied Materials for Metal Arc Welding.
- .5 CSA W59-13, Welded Steel Construction (Metal Arc Welding), Includes Update No. 1 (2014), Update No. 3 (2015), Update No. 4 (2015).

.4 National Association of Architectural Metal Manufacturers (NAAMM)

- .1 NAAMM AMP 555-92, Code of Standard Practice for the Architectural Metal Industry (Including Miscellaneous Iron).

.5 National Research Council Canada (NRC)

- .1 National Building Code of Canada, 2015 (NBC).

.6 The Society for Protective Coatings (SSPC)

- .1 Systems and Specifications Manual, Volume 2.

1.3 Administrative Requirements

.1 Pre-Installation Meetings: convene pre-installation meeting in accordance with Section 01 01 50 – GENERAL INSTRUCTIONS, Project Meetings to:

- .1 Verify project requirements.
- .2 Review installation and substrate conditions.
- .3 Co-ordination with other building subtrades.
- .4 Review manufacturer's installation instructions.

1.4 Submittals

.1 Provide submittals in accordance with Section 01 01 50 – General Instructions.

.2 Shop drawings:

.1 Shop drawings shall bear the signature and stamp of a qualified Professional Structural Engineer experienced in design of this work and licensed at the place where the Project is located, in the Province of British Columbia. Cost of engineering shall be included in the work of this section.

.2 Indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.

.3 Schedules from Sub-Contractor's Engineer:

.1 Provide Schedules S-B and S-C to Departmental Representative.

1.5 Quality Assurance

.1 Detail and fabricate metal fabrications in accordance with the NAAMM AMP 555.

.2 Details shall be designed by the Sub-Contractor's Professional Engineer.

.3 Perform Work to the highest standard of modern shop and field practice, by personnel experienced in this Work. Accurately fit joints and intersecting members in true planes with adequate fastening. Build and erect the Work plumb, true, square, straight, level, accurate to the sizes shown, and free from distortion or defects.

.4 Fabricator Qualifications: A firm experienced in producing metal fabrications similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

.5 Welding: Qualify procedures and personnel according to the following:

.1 Welders shall be qualified by Canadian Welding Bureau for classification of work being performed.

.2 The fabricator shall be certified to CSA W47.1, Division 1 or 2.1.

.3 Do welding inspection to CSA W178.

.4 Resistance welding: to CSA W55.3.

.5 Fusion welding: to CSA W59.

1.6 Delivery, Storage, and Handling

.1 Deliver, store, and handle materials in accordance with Section 01 01 50 General Instructions.

.2 Exercise due care in storing, handling and erecting all materials and support all materials properly at all times so that no piece will be bent, twisted or otherwise damage structurally or visibly.

.3 Correct damaged material and where the Departmental Representative deems damage irreparable, replace the affected items at no additional expense to the Departmental Representative.

.4 Apply protective covering to face of all exposed finished metalwork before it leaves shop, covering to remain until item installed.

.5 Fabricate large assemblies so they can be safely and easily transported and handled to their place of installation.

1.7 Waste Management and Disposal

.1 Separate and recycle waste materials in accordance with Section 01 01 50 – General Instructions, Waste Management and Disposal.

1.8 Job Conditions

.1 Coordinate this Work with the remainder of the Work and exercise the necessary scheduling to ensure that all Work is carried out and all items incorporated during the appropriate construction phase.

.2 Provide instructions and drawings to other trades for setting bearing plates, anchors blots, and other members that are built in to work of other trades.

.3 Protect other Sections of the Work from damage by this Section of the Work.

PART 2 PRODUCTS

2.1 System Description

.1 Design Requirements:

.1 Design stair rail and guard rail construction and connections to National Building Code of Canada (NBC) vertical and horizontal live load requirements.

.2 Detail and fabricate to NAAMM Metal Stairs Manual.

2.2 Materials

.1 Miscellaneous Steel sections (eg. steel angles) and steel plates: to CAN/CSA G40.20/G40.21, Grade 300W.

.2 Hollow structural steel (HSS): to CAN/CSA G40.20/G40.21, Grade 350W, Class C.

.3 Steel sections and plates: to CAN/CSA-G40.20/G40.21, Grade 300W.

.4 Security bars: 12mm Ø, Grade 3 Homogenous Tool-Resisting Steel to ASTM A627-03; bars received prescribed surface heat tempering to achieve designed cutting resistance.

.5 Welding materials: to CSA W59.

.6 Welding electrodes: to CSA W48 Series.

.7 Fasteners: Bolts, nuts, washers, rivets, lock washers, anchor bolts, machine screws, and machine bolts to be hot-dipped galvanized in accordance with ASTM A153/A153M or CAN/CSA-G164.

2.3 Fabrication

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

.2 Where possible, fit and shop assemble work, ready for installation.

.3 Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush. Seal exterior steel fabrications to provide corrosion protection in accordance with CAN-S16.

.4 Accurately form connections with exposed faces flush, and make mitres and joints tight.

.5 Welding is to conform to CSA W59 and the fabricator certified to CSA W47.1. Include for welding inspection in the Contract.

.6 File or grind all exposed welds smooth and flush. Repair or fill all pits, cracks and holes. Smooth all corners and returns.

.7 Shop fabricate in sections as large and complete as practical.

.8 Insulate when necessary to prevent electrolysis due to contact between different metal types or metal to masonry or concrete contact. Use bituminous paint or other approved method.

.9 Provide fastenings, including anchor bolts, bolts, lag screws, expansion bolts, straps, brackets, etc. required for the installation of work of this Section.

2.4 Finishes

.1 Galvanizing: hot dipped galvanizing with zinc coating to CAN/CSA-G164 and related standards, to 610 grams per square meter for steel components exposed at exterior of the building. All areas of galvanized parts shall be grounded off prior to welding. Paint 2 coats minimum of zinc rich primer ready mix to CAN/CGSB-1.181 after welding.

.2 Zinc primer: ready mix to CAN/CGSB-1.181, alkyd resin, containing 97% pure zinc metal, minimum 88% solid by weight.

.3 Shop primer: where required, to CISC/CPMA 1-73A.

2.5 Rough Hardware

.1 Furnish bent or otherwise custom fabricated bolts, plates, anchors, hangers, dowels, and other miscellaneous steel and iron shapes as required. Fabricate items to sizes, shapes, and dimensions required.

PART 3 EXECUTION

3.1 Examination

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for metal fabrications installation.

.1 Visually inspect substrate.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 Installation

.1 Install Work in accordance with manufacturer's/fabricator's written instructions and Contract Documents.

.2 Do welding work in accordance with CSA W59 unless specified otherwise.

.3 Supply finished items to be built-in to those trades along with instructions for proper installation.

.4 Fasteners to draw adjoining sections together in proper, true alignment, and are capable of field adjustment.

.5 All fasteners, mountings to be non-loosening.

.6 Install security frame with bolts set at min. 50mm into expansion shields. Bolt spacing for security frame shall not exceed 400mm on centers, and install security frame with minimum of 4 bolts. Tag weld bolts to frame.

.7 Install all Work to true, straight lines, accurate to profile, all properly aligned.

.8 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.

.9 Provide suitable means of anchorage acceptable to Departmental Representative such as dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.

.10 Make field connections with high tensile bolts to CSA-S16.1 and weld to prevent loosening.

.11 Touch-up rivets, field welds, bolts and burnt or scratched surfaces after completion of erection with zinc-rich paint.

3.3 Miscellaneous Items

.1 Supply and install miscellaneous metal items as indicated or specified, or as otherwise required for a complete job, in accordance with the design intent of the project.

3.4 Cleaning

.1 Progress Cleaning: clean in accordance with Section 01 01 50 General Instructions, and leave work area clean at end of each day.

.2 Perform cleaning after installation to remove construction and accumulated environmental dirt.

.3 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment barriers in accordance with Section 01 01 50 General Instructions.

3.5 Protection

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by metal stairs and ladders installation.

END OF SECTION

PART 1 GENERAL

1.1 Related Requirements

.1 Section 07 52 00 – Modified Bituminous Membrane Roofing

.2 Section 07 62 00 - Sheet Metal Flashing and Trim

1.2 References

.1 American Society for Testing and Materials International (ASTM)
- .1 ASTM A153/A153M-09, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- .2 ASTM A307-12, Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
- .3 ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealled) by the Hot-Dip Process.
- .4 ASTM D1761-12, Standard Test Methods for Mechanical Fasteners in Wood.

.2 Canadian Standards Association (CSA International)
- .1 CAN/CSA-O80 Series-08, Wood Preservation (R2012)
- .2 CSA O86-14, Engineering Design in Wood, Includes Update No. 1 (2014)
- .3 CSA O86.1S1-98, Supplement No. 1 to O86.1-94, Engineering Design in Wood (Limit States Design)
- .4 CSA B111-74(R2003), Wire Nails, Spikes and Staples.
- .5 CAN/CSA-G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
- .6 CSA O141-05(R2009), Softwood Lumber

.3 National Lumber Grading Association (NLGA):
- .1 NLGA SPS2-2010, Special Products Standards on Machine Stress-Rated Lumber.
- .2 Standard Grading Rules for Canadian Lumber 2014.

1.3 Administrative Requirements

.1 Coordination of wood plates and sill locations:
- .1 Locate existing structural rib members and scan the area to avoid cutting of any reinforcement or prestressing strands, refer to requirement details indicated on drawings.

1.4 Submittals

.1 Submit in accordance with Section 01 01 50 - General Instructions.

.2 Shop drawings and Schedules:
- .1 Sub-contractor to retain a Structural Engineer registered in province of BC, to review and sign & seal shop drawings, refer to requirement details indicated on drawings.
- .2 The Structural Engineer shall also provide adequate field reviews, and Letters of Assurance (Schedule S-B and S-C) address to project's Structural Engineer of Record.

1.5 Quality Assurance

.1 Lumber shall be graded and stamped by an agency certified by Canadian Lumber Standards Accreditation Board.

.2 Plywood, particleboard, OSB and wood based composite panels in accordance with CSA and ANSI standards.

.3 Structural Engineer retained by sub-contractor shall perform necessary field reviews to ensure installation is done according to design.

1.6 Delivery, Storage, and Handling

.1 Deliver wood products bundled or crated to provide adequate protection during transit. Inspect wood products for damage upon delivery and remove and replace damaged materials.

.2 Store materials a minimum of 150 mm off the ground on blocking. Keep materials under cover and dry. Provide for air circulation within and around stacks and under temporary coverings.

1.7 Waste Management and Disposal

.1 Separate and recycle waste materials in accordance with Section 01 01 50 - General Instructions.

PART 2 PRODUCTS

2.1 Lumber and Panel Materials

.1 Lumber: CAN/CSA-O141, softwood, Douglas Fir, S4S, graded and stamped in accordance with National Lumber Grading Association (NLGA) Standard Grading Rules for Canadian Lumber, CSA-O86.1 and as follows:
- .1 Moisture Content: maximum 19% at time of installation.
- .2 Maximum moisture content when used for attachment of drywall: 16%.
- .3 Meeting requirements of the BC Building Code and National Building Code of Canada.
- .4 Grade: No. 1 or better.

.2 Plywood: CAN/CSA-O121 or O151, Douglas Fir, S4S, sheathing grade, thickness as indicated on drawings.

2.2 Wood Preservative

.1 All new lumber or plywood is for this project shall be pressure treated in accordance with CAN/CSA O80.9M and AWPA.

.2 Wood preservatives containing arsenic or chromium are not permitted.

.3 Pressure treat all wood products with waterborne preservatives to minimum retention of 4.0 kg/m3. After treatment, kiln-dry lumber and plywood to maximum moisture content of 19% and 15% respectively.

.4 Complete fabrication of treated items before treatment where possible. If cut after treatment apply field treatment to cut surfaces.

.5 Wood Preservatives: Maximum allowable VOC limit 350 g/L.

2.3 Accessories

.1 Nails, spikes and staples: to CSA B111, hot dipped galvanized or stainless steel for exterior work and pressure preservative treated materials.

.2 Rough Hardware (bolts, nuts, washers, etc.): Hot dip galvanized in conformity to CSA G164 and Grade A low carbon steel, conforming to ASTM A307; or stainless steel.

.3 Proprietary fasteners: toggle bolts, expansion shields and lag bolts, screws and explosive actuated fastening devices shall be hot dipped galvanized or stainless steel, recommended for purpose by manufacturer.

PART 3 EXECUTION

3.1 Preparation

.1 Locate existing structural rib members.

.2 Scan the existing concrete structure to avoid cutting of any reinforcement or prestressing strands. Submit scan results to Structural Engineer of Record for review and approval. Do not proceed with installation until receiving written approval.

3.2 Installation

.1 Install members true to line, levels and elevations, square and plumb.

.2 Construct continuous members from pieces of longest practical length.

3.3 Erection

.1 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.

.2 Countersink bolts where necessary to provide clearance for other work.

3.4 Cleaning

.1 Remove and dispose waste, and clean in accordance with Section 01 01 50 - General Instructions.

END OF SECTION

PART 1 GENERAL

1.1 Summary

.1 Work of this section includes provision of materials and installation for modified bituminous roofing system as follows:
- .1 Components:
  - .1 Cap sheet: torch applied.
  - .2 Base sheet.
  - .3 Protection board.
  - .4 Rigid Insulation.
  - .5 Vapour Retarder.

1.2 Related Requirements

.1 Section 06 10 00 – Rough Carpentry

.2 Section 07 62 00 - Sheet Metal Flashing and Trim

.3 Section 11 24 31 - Roof Fall Restraint

1.3 References

.1 ASTM International Inc.
- .1 ASTM C1104, Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation
- .2 ASTM D6162-00a, Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fibre Reinforcements.
- .3 ASTM D6163-00, Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fibre Reinforcements.
- .4 ASTM D6164/D6164M-16, Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Polyester Reinforcements
- .5 ASTM D6222/D622M-11, Standard Specification for Atactic Polypropylene (APP) Modified Bituminous Sheet Materials Using Polyester Reinforcement.
- .6 ASTM D6223-02, Standard Specification for Atactic Polypropylene (APP) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fiber Reinforcement.
- .7 ASTM D6509/D6509M-09, Standard Specification for Atactic Polypropylene (APP) Modified Bituminous Sheet Materials Using Glass Fiber Reinforcement.

.2 Canadian General Standards Board (CGSB)
- .1 CGSB 37 GP 56M, Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing

.3 Roofing Contractor's Association of British Columbia (RCABC):
- .1 Roof Practices Manual
- .2 Roofing Contractors Association of B.C. Guarantee Corp. Guarantee Program.

.4 Canadian Standards Association (CSA International)
- .1 CSA A123.21-14, Standard test method for the dynamic wind uplift resistance of membrane-roofing systems, Includes Update No. 1 (2010).

.5 Underwriters Laboratories of Canada (ULC)
.1 CAN/ULC-S704-11, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.

1.4 Action and Informational Submittals

.1 Provide submittals in accordance with Section 01 01 50 - General Instructions.

.2 Product Data:
.1 Provide two copies of most recent technical roofing components data sheets describing materials' physical properties and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Submit confirmation as follows:
.1 Applicators have five years of experience.
.2 Applicators are approved by materials' manufacturer.

.4 Confirmation that roofing installation company is a member in good standing with Roofing Contractors Association of BC (RCABC) or bonded with a pre-approved alternate equivalent guarantor.
.1 Provide submittals as required to satisfy 3rd Party Guarantee as per Part 1.10.2
.2 Submit written certificate of registration, training or certification issued by membrane manufacturer related to compliance of warranty requirements.
.3 Submit most recent technical roofing components data sheets describing materials' physical properties.
.4 Manufacturer's Certificate: certify that products meet or exceed specified requirements and materials are compatible.
.5 Reports: indicate procedures followed, ambient temperatures and wind velocity during application.
.6 Submit Shop Drawings of tapered layout.

1.5 Quality Assurance

.1 Standard of Workmanship and Installation:
.1 Roofing Contractor to perform work to RCABC Roof Practices Manual or pre-approved alternate equivalent to satisfy Warranty and Guarantee requirements of Part 1.10.
.2 Roofing Contractor to perform work to standards of membrane manufacturer's warranty specified.

.2 Installer qualifications:
.1 Company or person specializing in application of modified bituminous roofing systems shall be member in good standing with Roofing Contractors Association of BC (RCABC) or bonded with a pre-approved alternate equivalent guarantor.
.2 Trained and registered or certified by membrane manufacturer for warranty specified.
.3 Two apprentices allowed per one Journeyman roofer.
.4 Superintendent: minimum 10 years demonstrated experience.
.5 Have a WorkSafeBC account number and WorkSafeBC clearance letter.
.6 Be licensed and insured at Place of Work.

.3 3rd Party Inspections:
.1 Roofing Contractor to retain a RCABC certified or pre-approved alternate equivalent company to conduct:
.1 frequent field reviews during installation, satisfying Pat 1.10.2 Guarantee
.2 a 2-year post-construction performance review.

.3 periodic, scheduled performance reviews that performance reviews that identify performance and maintenance issues for the building owner such as at year 5 and 8.

.2 All review fees are to be included in Bid price, and held in trust for Departmental Representative.

1.6 Fire Protection

.1 Fire Extinguishers: maintain one cartridge operated type or stored pressure rechargeable type with hose and shut off nozzle, ULC labelled for A, B and C class protection. Size 9 kg or as indicated on roof per torch applicator, within 6 m of torch applicator.

.2 At the end of each workday, use a heat detector gun to spot any smouldering or concealed fire. Job planning must be organized to ensure workers are still on location at least two hours after torch application.

1.7 Delivery, Storage and Handling

.1 Deliver, store and handle materials in accordance with Section 01 01 50 - General Instructions.

.2 Provide and maintain dry, off ground weatherproof storage.

.3 Store rolls of membrane in upright position. Store membrane rolls with selvage edge up.

.4 Remove only in quantities required for same day use.

.5 Place plywood runways over completed Work to enable movement of material and other traffic.

.6 Store sealants at +5 degrees C minimum.

.7 Handle roofing materials in accordance with manufacturer's written directives, to prevent damage or loss of performance

1.8 Waste Management and Disposal

.1 Separate and recycle waste materials in accordance with Section 01 01 50 - General Instructions.

1.9 Field Conditions

.1 Ambient Conditions
- .1 Minimum temperature for solvent based adhesive is 5 degrees C.
- .2 Perform work within environmental conditions prescribed by manufacturer.

.2 Install roofing on dry deck, free of snow and ice, use only dry materials and apply only during weather that will not introduce moisture into roofing system.

1.10 Warranty

.1 Roofing Membrane Manufacturer: Provide manufacturer’s warranty stating that they will repair or replace defective roofing (including labour) and base flashing materials that do not remain watertight, that splits, tears, or separates at the seams or from the substrate within the specified warranty period and as follows:
- .1 Warranty Period: 10 years Standard Warranty, starting from Substantial Performance for the Project.

.2 Name of Warrantee: Warrantor shall issue a written and signed warranty identifying the owner's name as the warrantee, and stating that executed work will remain in place and be free of any defects in materials for the stated warranty period.

.2 Special Guarantee: In addition, provide a RCABC Installer's, or a pre-approved alternate equivalent, starting from the date of Substantial Performance. All related fees are to be included in the bid price including, but not limited to, administrative, third-party inspections, and Warranty costs.

.1 Guarantee must be underwritten by an industry recognized Guarantor:

.1 Who is financially independent of the installer, or material or system manufacturer

.2 with no fewer than twenty (20) years of experience underwriting roofing and waterproofing assemblies.

.2 Guarantee to be issued for a ten (10) year period

.3 Covers materials and workmanship, without penalty for depreciation.

.4 Extended coverage for the project scope shown, up to the full original value of this contract for the duration of the Guarantee period.

.5 Guarantee must provide written assurance to a building Owner against leaks arising from failure of materials, or against the failure of workmanship performed by bonded installer.

.6 Guarantee must furnish the Owner with an established claims process by which claims for material for workmanship failure may be duly processed and expedited.

PART 2 PRODUCTS

2.1 Performance Criteria

.1 Provide system with products to achieve 10 year product warranty certificate.

.2 Compatibility between components of roofing system is essential. Provide written declaration to Departmental Representative stating that materials and components, as assembled in system, meet this requirement.

.3 CSA A123.21 compliant roof assembly with respect to wind uplift resistance.

2.2 Membrane System General

.1 Provide materials meeting requirements to satisfy conditions of Guarantee as per Part 1.10.2

2.3 Membrane System over Insulation

.1 Cap sheet membrane and cap sheet flashing to: CGSB 37-GP-56M, polyester reinforcing fibres and SBS to ASTM D6164.
.1 Cap sheet membrane composed of a composite reinforcement and SBS modified bitumen, top face covered with UV protective granules and underface with thermofusible film with fire resistive additives.
.2 Cap sheet membrane properties: to CGSB 37-GP-56M.

.1 Thickness: 4.0 mm.
.2 Strain energy (longitudinal/transversal): 10 / 10 kN/m.
.3 Breaking strength (longitudinal/transversal): 18 / 16 kN/m.
.4 Ultimate elongation (longitudinal/transversal): 60/65 %.
.5 Tear resistance: 75 N.
.6 Cold bending at -30 degrees C: No cracking.
.7 Plastic flow: 105 degrees C.
.8 Static puncture resistance: 420.
.9 Dimensional Stability: -0.8 / -0.2 %.

.2 Base sheets:
.1 SBS membrane in compliance with CAN/CGSB 37.56-M (9th draft), with polyester reinforced elastomeric bitumen. Underface and top face with thermofusible plastic film.
.2 Base sheet membrane properties: to CGSB 37-GP-56M.
.1 Thickness: 3.3 mm.
.2 Strain energy (longitudinal/transversal): 9 / 7 kN/m.
.3 Breaking strength (longitudinal/transversal): 17 / 12.5 kN/m.
.4 Ultimate elongation (longitudinal/transversal): 60/65 %.
.5 Tear resistance: 60 N.
.6 Cold bending at -30 degrees C: No cracking.
.7 Plastic flow: 105 degrees C.
.8 Static puncture resistance: 420.
.9 Dimensional Stability: -0.3 / -0.3 %.

.3 Flame stop membrane:
.1 Description: Self-adhesive membrane composed of a reinforced glass mat and SBS modified bitumen designed to prevent flames from penetrating into empty spaces and openings while installing heat-welded membranes.

2.4 Protectionboard

.1 Glass mat gypsum panel roof board: fire resistant, moisture and mould resistant to ASTM C1177/C1177M.

2.5 Insulation

.1 Tapered and Flat: Closed-cell polyisocyanurate (polyiso) foam core integrally bonded to inorganic coated glass facers; thickness as indicated on Drawings of largest panels practical, having square edges, minimum LTTR RSI 1.04/25 mm; conforming to ULC S704, Type 3, Class 2, to a tolerance not exceeding 3 mm from nominal size in any dimension.

.2 Between stud framing: fibrous mineral slag wool, un-faced, thickness as required to fill stud spaces up to minimum 90%.

.3 Insulation boards: high density fibrous mineral slag wool, screw-through attachment method, moisture absorption to be less than 0.05% by volume in accordance with ASTM C1104.

2.6 Vapour Retarder and Primer

.1 Manufactured Self Adhesive Air/Vapour Barrier: Self-adhesive vapour barrier membrane composed of SBS modified bitumen with thermoplastic polymers and high density polyethylene film and as follows:
.1 Properties:

.1 Thickness: Minimum 0.8 mm.
.2 Cold Bending: -35°C
.3 Static Puncture: 400 N.
.4 Membrane Breaking Strength (MPa): MD=75, XD=98.
.5 Water Vapour Permeance: 0.92 ng/Pa·s·m2 to ASTM E96.

.2 Primer: designed to enhance adhesion of self-adhesive membranes, proprietary material by membrane manufacturer.

2.7 Adhesive

.1 Insulation Adhesive: low-rise two-part polyurethane adhesives specifically formulated for installation of plastic insulation to roofing materials:

2.8 Accessories

.1 Plumbing, electrical, and roof anchor stack flashings to be fabricated from spun aluminum conforming to CSA B272.

.2 Flashing and sheet metal in accordance with Section 07 62 00 – Sheet Metal Flashing and Trim.

.3 Waterproofing Mastic: Black, solvent based mastic containing SBS modified bitumen, fibres and mineral fillers.

.4 Torches: Use only torches designed for torching roofing material and acceptable to manufacturer.

PART 3 EXECUTION

3.1 Quality of Work

.1 Examination, prepare and perform roofing Work in accordance with Roofing Manufacturer's Specification Manual and RCABC Roofing Practices Manual.

.2 Work shall meet conditions for CSA A123.21 and to requirements of manufacturer’s suggestions for wind uplift for this specific geographic location, building height, building dimensions and exposure.

3.2 Examination of Roof Decks

.1 Verification of Conditions:
.1 Roofing Inspector shall verify deck conditions including parapets, construction joints, roof drains, plumbing vents and ventilation outlets to determine readiness to proceed.

.2 Evaluation and Assessment:
.1 Prior to beginning of work ensure:
.1 Decks are firm, straight, smooth, dry, free of snow, ice or frost, and swept clean of dust and debris.
.2 Curbs have been built.
.3 Roof drains have been installed at proper elevations relative to finished roof surface.
.4 Plywood and lumber nailer plates have been installed to deck, walls and parapets as indicated.

.3 Do not install roofing materials during rain or snowfall.

3.3 Protection of In-Place Conditions

.1 Cover walls, walks and adjacent work where materials hoisted or used.

.2 Use warning signs and barriers. Maintain in good order until completion of Work.

.3 Clean off drips and smears of bituminous material immediately.

.4 Dispose of rain water off roof and away from face of building until roof drains or hoppers installed and connected.

.5 Protect roof from traffic and damage. Comply with precautions deemed necessary by Construction Manger and Roofing Inspector.

.6 At end of each day's work or when stoppage occurs due to inclement weather, provide protection for completed Work and materials out of storage.

3.4 Wood Installation

.1 Install wood material as indicated on drawings and in accordance with RCABC or pre-approved alternate equivalent agency’s requirements.

3.5 Vapour Retarder Installation

.1 Apply primer to substrate at the rate recommended by manufacturer.

.2 Beginning at the bottom of the slope, without adhering the membrane, unroll onto the substrate for alignment. Do not immediately remove the silicone release sheet.

.3 Peel back one end of silicone release sheet and adhere this part of membrane to the substrate. Peel back remaining release sheet at a 45º angle to avoid wrinkles in membrane.

.4 If membrane is not properly aligned, do not try to adjust it. Instead, cut the roll and start again, making sure that it is properly aligned and that it overlaps end of misaligned piece by 150 mm.

.5 Overlap adjacent membranes by 75 mm. Overlap end laps by 150 mm. Stagger end laps by at least 300 mm.

3.6 Insulation Installation

.1 Insulation: adhesive application:
- .1 Apply in minimum 2 layers. Maximum thickness of one layer; 75 mm.
- .2 Adhere insulation using manufacture’s recommended adhesive.
- .3 Place boards in parallel rows with ends staggered, and in firm contact with one another.
- .4 Cut end pieces to suit.
- .5 Apply adhesive as per manufacturers requirements listed on technical data sheets.

3.7 Protectionboard Installation

.1 Adhere product in accordance with manufacturer’s written instructions.

.2 Apply flame stop material at joints.

3.8 Thermofusible Base Sheet Installation

.1 Rolls to be unrolled and allowed to relax fifteen (15) minutes prior to installation.

.2 Unroll base sheet at drain level with first side lap lined up with drain centre (parallel to roof edge).

.3 Torch base sheet entirely onto prepared substrate. Overlap side laps by 75 mm. along lines provided for this purpose, and overlap end laps by 150 mm. Stagger end joints by a minimum of 300 mm.

.4 Torch sufficiently and continuously to avoid wrinkles, air pockets or fishmouths. In cold weather, adjust welding time to obtain homogenous seam (it may be necessary to slow down in certain cases.)

.5 Cut off corners at end laps to be covered by the next roll.

.6 Base sheet flashing: extend 200 mm from vertical upturn.

3.9 Cap Sheet Application

.1 Rolls to be unrolled and allowed to relax fifteen (15) minutes prior to installation

.2 Once base sheet is applied and no defects are apparent, proceed with cap sheet installation.

.3 Begin with double-selvedge starter roll. If starter roll is not used, side laps covered in granules must be degranulated by embedding side laps in torch-heated bitumen over a 75 mm. width.

.4 Unroll cap sheet at drain. Carefully align first side lap (parallel to roof edge).

.5 Weld cap sheet onto base sheet with torch recommended by membrane manufacturer. During application, simultaneously melt both designated contact surfaces so a bead of bitumen is apparent as cap sheet unrolls.

.6 Avoid overheating.

.7 Make sure joints between the two layers are staggered by at least 300 mm.

.8 Overlap cap sheet side laps by 75 mm. and end laps by 200 mm. Cut off corners at end laps to be covered by next roll. All overlap surfaces must be degranulated.

.9 Complete perfect welds between two membranes. Leave no zone unwelded. In cold weather, adjust welding time to obtain homogenous seam (it may be necessary to slow down in certain cases.)

.10 Cap sheet flashing: extend 150 mm from vertical upturn.

.11 Once cap sheet is installed, carefully check all overlapped joints.

.12 During installation, take care to avoid excessive bitumen bleed-out at joints.

.13 Roof penetrations:

- .1 Install roof drain pans, vent stack covers and other roof penetration flashings and seal to membrane in accordance with manufacturer's recommendations and details.
- .2 Tapered insulation drain sumps: install minimum 600 mm x 600 mm area at drains with minimum 2% slope.

3.10 Flashings

.1 Flashing work in accordance with RCABC Roofing Practices Manual.

.2 Complete installation of flashing base sheet stripping prior to installing membrane cap sheet.

.3 Torch base and cap sheet onto substrate in 1 metre wide strips.

.4 Lap flashing base sheet to membrane base sheet minimum 150 mm and seal by torch welding.

.5 Lap flashing cap sheet to membrane cap sheet 250 mm minimum and torch weld.

.6 Provide 75 mm minimum side lap and seal.

.7 Properly secure flashings to their support, without sags, blisters, fishmouths or wrinkles.

3.11 Roof Penetrations

.1 Install roof drain pans, vent stack covers and other roof penetration flashings and seal to membrane in accordance with manufacturer's recommendations and details.

.2 Strip-in type roof penetration flashings are only permitted for use with single pipe roof penetrations, must incorporate properly fitted settlement caps, and be a minimum height of 200 mm (8") above finished roof surfaces.

.3 Installed to minimum 200 mm (8") in height above top of finished surfacing.

3.12 Field Quality Control

.1 Inspection of roofing application will be carried out by RCABC certified or pre-approved alternate equivalent inspection company to satisfy requirements of 3rd Party Guarantee as indicated in Part 1.10.2 of this section.

.2 Request and coordinate schedule of inspections with inspection company.

.1 Minimum twice during progress of Work at 25% and 60% complete.

.2 Upon completion of Work, after cleaning is carried out.

.3 Obtain reports within three days of review and submit.

3.13 Cleaning

.1 Progress Cleaning: clean in accordance with Section 01 01 50 - General Instructions.

.2 Remove bituminous markings from finished surfaces.

.3 In areas where finished surfaces are soiled caused by work of this section, consult manufacturer of surfaces for cleaning advice and complying with their documented instructions.

.4 Repair or replace defaced or disfigured finishes caused by work of this section.

END OF SECTION

PART 1 GENERAL

1.1 Related Requirements

.1 Section 02 07 50 – Cutting and Patching

.2 Section 06 10 00 – Rough Carpentry

.3 Section 07 52 00 - Modified Bituminous Membrane Roofing

.4 Section 07 92 00 - Sealants

1.2 References

.1 American Society for Testing and Materials International (ASTM)
  .1 ASTM A792/A792M-10(2015), Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.

.2 Canadian Standards Association (CSA International)
  .1 CSA B111-74(R2003), Wire Nails, Spikes and Staples.

.3 Roofing Contractor's Association of British Columbia (RCABC):
  .1 Roofing Practices Manual

.4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
  .1 Architectural Sheet Metal Manual, 7th Edition.

1.3 Action and Informational Submittals

.1 Provide submittals in accordance with Section 01 01 50 - General Instructions.

.2 Product Data:
  .1 Submit manufacturer's printed product literature for sheet metal flashing systems materials, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:
  .1 Submit shop drawings showing proposed method of shaping, forming, jointing, fastening, and application of flashing and sheet metal work.

.4 Samples:
  .1 Submit duplicate,100 x 100 mm samples of each type of sheet metal material, finishes and colours.

1.4 Quality Assurance

.1 General: Fabricate and install sheet metal flashing and trim in accordance with SMACNA's Architectural Sheet Metal Manual, and to the RCABC Roofing Practices Manual.

.2 Fabricator: minimum five (5) years recent experience shop fabricating sheet metal flashing.

.3 Installer: minimum five (5) years recent experience installing sheet metal flashing on low slope roofing applications.

1.5 Delivery, Storage and Handling

.1 Deliver, store and handle materials in accordance with Section 01 01 50 - General Instructions.

1.6 Waste Management and Disposal

.1 Separate and recycle waste materials in accordance with Section 01 01 50 - General Instructions.

PART 2 PRODUCTS

2.1 Sheet Metal Materials

.1 Aluminum-zinc alloy coated steel sheet: to ASTM A792/A792M, commercial quality (CS), grade 275 with AZ150 galvalume coating and as follows:
- .1 Base Metal Thickness: 0.61 mm.
- .2 Finish:
  - .1 Flashing:PVDF/Kynar coating
- .3 Colour: to be selected by Departmental Representative from manufacturer's standard range.

2.2 Accessories

.1 Isolation coating: alkali resistant bituminous paint.

.2 Plastic cement: to CAN/CGSB 37.5.

.3 Sealants: as specified in section 07 92 00.

.4 Cleats: of same material, and temper as sheet metal, minimum 50 mm wide. Thickness 0.81 mm.

.5 Fasteners: stainless steel series 316.

.6 Washers: of same material as sheet metal, 1 mm thick with rubber packings.

.7 Touch-up paint: as recommended by prefinished material manufacturer.

2.3 Fabrication

.1 Fabricate metal flashings and other sheet metal work in accordance with applicable details in RCABC Roofing Practices Manual and as indicated.

.2 Fabricate for concealed fastening methods.

.3 Form pieces in 2400 mm maximum lengths.
- .1 Make allowance for expansion at joints.

.4 Form joints with S-Lock seams.

.5 Hem exposed edges on underside 12 mm.
- .1 Mitre and seal corners with sealant.

.6 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.

.7 Apply isolation coating to metal surfaces to be embedded in concrete or mortar.

2.4 Metal Flashings

.1 Form flashings, copings and fascia to profiles indicated.

2.5 Scuppers

.1 Form scuppers from prefinished sheet metal of same type as flashings.

2.6 Galvalume Pipe Rain Water Leaders

.1 Form from sheet metal to shapes and sizes as indicated on drawings.

PART 3 EXECUTION

3.1 Manufacturer's Instructions

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

3.2 Installation

.1 Install sheet metal work in accordance with RCABC Roofing Practices Manual.

.2 Use concealed fastenings except where approved before installation.

.3 Counterflash bituminous flashings at intersections of roof with vertical surfaces and curbs.
.1 Flash joints using standing seams forming tight fit over hook strips, as detailed.

.4 Lock end joints and seal.

.5 Install surface mounted reglets true and level, and seal top of reglet with sealant.

.6 Insert metal flashing into reglets to form weather tight junction.

.7 Turn top edge of flashing into recessed reglet or mortar joint minimum of 25 mm. Lead wedge flashing securely into joint.

3.3 Cleaning

.1 Progress Cleaning: clean in accordance with Section 01 01 50 - General Instructions.

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

.3 Leave work areas clean, free from grease, finger marks and stains.

End of Section

Part 1 GENERAL

1.1 Intent

.1 This Section includes through penetration firestopping and smokeseal systems for penetrations through the following fire resistance rated assemblies, including both empty openings and openings containing penetrating items:

.1 Wall and partitions.

.2 Smoke barriers.

.3 Construction enclosing compartmentalized areas.

.2 This specification section provides requirements for Rated Systems or systems requiring Engineered Judgements:

.1 Use of materials that have not been tested in a system or that are not capable of obtaining an engineered judgement will not be acceptable for use on this Project.

.2 Materials having only a ULC label will not be acceptable for use on this Project, unless supporting documentation is provided indicating its use in a listed assembly.

1.2 Related Sections

.1 Division 22 Plumbing

.2 Division 23 Heating, Ventilation & Air Conditioning

1.3 References

.1 American Society for Testing and Materials (ASTM)

.1 ASTM E119-16, Standard Test Methods for Fire Tests of Building Construction and Materials.

.2 ASTM A653/A653M-15e1, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.3 ASTM E814-13a, Standard Test Method for Fire Tests of Penetration Firestop Systems.

.4 ASTM A1008/A1008M-15, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.

.5 ASTM E1966-15, Standard Test Method for Fire-Resistive Joint Systems.

.6 ASTM E2174-14b, Standard Practice for On-Site Inspection of Installed Fire Stops.

.7 ASTM E2307-15b, Standard Test Method for Determining Fire Resistance of Perimeter Fire Barrier Systems Using Intermediate-Scale, Multi-story Test Apparatus.

.8 ASTM E2393-10a(2015), Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.3 National Fire Protection Agency (NFPA)

.1 NFPA 251, Standard Methods of Tests of Fire Endurance of Building Construction and Materials, 2006 Edition.

.4 Underwriter's Laboratories of Canada (ULC)

.1 ULC Guide No. 40 U19-1998, Firestop Systems.

.2 CAN/ULC S101-14, Standard Methods of Fire Endurance Tests of Building Construction and Materials.

.3 CAN/ULC S102-11, Standard Method of Tests for Surface Burning Characteristics of Building Materials and Assemblies.

.4 CAN4 S114-05, Standard Method of Test for Determination of Non-Combustibility in Building Materials.

.5 CAN/ULC-S115-11, Standard Method of Fire Tests of Firestop Systems.

.6 CAN/ULC S702-09-AM1, Standard for Thermal Insulation Mineral Fibre for Buildings, Includes Amendment 1(January 2012).

.7 ULC S702.2-10, Mineral Fibre Thermal Insulation for Buildings, Part 2: Application Guidelines.

.8 List of Equipment and Materials.

.5 Underwriters Laboratories Inc. (UL)

.1 ANSI/UL 1479, Standard for Fire Test of Through-Penetration Firestops.

1.4 Administrative Requirements

.1 Pre-Installation Meetings: convene pre-installation meeting one week prior to beginning work of this Section, with contractor's representative, Departmental Representative, and Consultant in accordance with Section 01 01 50 – General Instructions, Project Meetings to:

.1 Verify project requirements.

.2 Review installation and substrate conditions.

.3 Co-ordination with other building subtrades.

.4 Review manufacturer's installation instructions and warranty requirements.

1.5 Submittals

.1 Provide submittals in accordance with Section 01 01 50 – General Instructions, Submittal.

.1 Not later than 30 working days following Award of Contract, submit a schedule listing surfaces or components to which firestopping and smokeseals is to be applied, and indicating the firestopping and smokeseals system and materials required and detailing installation.

.2 Where possible determine thickness to be applied from tests of assemblies identical to the assembly to be protected, conducted in accordance with ULC S-101, ASTM E119, ULI 1479, NFPA 251, and ASTM E814.

.3 Determine system from available engineering studies, or correspondence with the labelling agency indicating the effect of the differences on the fire separation of the assembly. Confirm acceptance of system by authorities having jurisdiction in writing.

.4 Where the assembly includes conditions that do not correspond to those included in any previously tested assembly and for which no relevant engineering information is available use the same system and material as would be required for a tested assembly with similar conditions.

.2 Submit product data in accordance with Section 01 01 50 – General Instructions, Submittals:

.1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Provide two copies of WHMIS MSDS - Material Safety Data Sheets in accordance with WHMIS acceptable to Labour Canada, and Health and Welfare Canada.

.3 Quality assurance submittals: submit following in accordance with Section 01 01 50 – General Instructions, Quality Control.

.1 Test reports: in accordance with CAN-ULC-S101 for fire endurance and CAN-ULC-S102 for surface burning characteristics.

.1 Submit certified test reports from approved independent testing laboratories, indicating compliance of applied fire stopping with specifications for specified performance characteristics and physical properties.

.2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.3 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, and cleaning procedures.

.4 Manufacturer's Field Reports: submit to manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.

1.6 Quality Assurance

.1 Qualifications:

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

.2 Use materials and methods of determining required thickness of application that have the full acceptance of authority having jurisdiction.

.3 Use materials tested to CAN/ULC-S115. Assemblies containing the materials shall be in accordance with assemblies tested and approved by agencies acceptable to authority having jurisdiction.

.4 Source Responsibility: Obtain through penetration firestop and joint systems, for each kind of penetration and construction condition indicated, from a single source of installation responsibility.

.5 Delegated Design Professional: Use a professional engineer, registered in the province of the Work and familiar with installations of similar scope and complexity to design firestopping and smokeseals.

1.7 Delivery, Storage And Handling

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle materials in accordance with Section 01 01 50 – General Instructions, Common 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, and ULC markings.

.2 Storage and Protection:

.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.

.3 Use stock before its expiration date.

1.8 Waste Management and Disposal

.1 Separate waste materials for recycling in accordance with Section 01 01 50 – General Instructions, Waste Management and Disposal.

1.9 Project Conditions

.1 Install firestopping and smokeseals materials only when the areas in which they are scheduled are closed-in and protected from dampness.

.2 Environmental Limitations: Install firestopping and smokeseals systems when ambient or substrate temperatures are within temperature and moisture limits permitted by firestopping and smokeseals system manufacturers or when substrates are not wet due to rain, frost, condensation, or other causes.

.3 Ventilate firestopping and smokeseals systems in accordance with manufacturer's written instructions by natural means or forced air circulation where natural means are not adequate.

Part 2 PRODUCTS

2.1 Performance/Design Criteria

.1 Delegated Design Requirements: Design firestopping and smokeseals required by the Contract Documents to withstand fire ratings indicated and in accordance with requirements of the Building Code, and as described in Section 01 35 00.

.2 Performance Requirements: Manufacturer shall design proprietary assemblies to withstand the listed ratings in accordance with the Building Code, Underwriters Laboratories Canada, and authorities having jurisdiction, and as follows:

.1 Provide through penetration firestop and joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain existing fire resistance rating:

.1 Fire resistance rated load bearing walls, including partitions, with fire protection rated openings.

.2 Fire resistance rated non-load bearing walls, including partitions, with fire protection rated openings.

.3 Fire resistance rated floor assemblies.

.2 F-Rated Systems: Provide through penetration firestop systems with F-ratings indicated, as determined by ULC S115 or ASTM E814.

.3 T-Rated Systems: For the following conditions, provide through penetration firestop systems with T-ratings indicated, as well as F-ratings, as determined per by ULC S115 or ASTM E814, where systems protect penetrating items exposed to potential contact with adjacent materials:

.1 Penetrations located outside wall cavities.

.2 Penetrations located outside fire resistive shaft enclosures.

.3 Penetrations located in construction containing fire protection rated openings.

.4 Penetrating items larger than 100 mm diameter nominal pipe or 100 cm^2 in overall cross sectional area.

.4 Firestopping and Smokeseals Systems Exposed To View: Systems exposed to view, traffic, moisture, and physical damage; provide products that after curing do not deteriorate when exposed to these conditions both during and after construction, and as follows:

.1 Provide moisture resistant through penetration firestop systems for piping penetrations for plumbing and wet pipe sprinkler systems.

.2 Provide firestopping and smokeseals systems not requiring removal of insulation for penetrations involving insulated piping.

.3 Provide products with flame spread ratings of less than 25 and smoke developed ratings of less than 50 for firestopping and smokeseals and joint systems exposed to view.

.5 Fire Resistance of Joint Systems: Assembly ratings and movement capabilities indicated, but with assembly ratings not less than that equalling or exceeding existing fire resistance rating.

2.2 Firestopping and Smokeseals: General

.1 Compatibility: Provide firestopping and smokeseals systems that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating firestopping and smokeseals systems, under conditions of service and application, as demonstrated by firestopping and smokeseals system manufacturer based on testing and field experience, and as follows:

.1 Service penetration assemblies: certified by ULC in accordance with ULC S115 and listed in ULC Guide No. 40 U19.

.2 Service penetration firestopping and smokeseals components: certified by ULC in accordance with ULC S115 and listed in ULC Guide No. 40 U19.13, under the Label Service of ULC.

.3 Fire resistance rating of installed firestopping and smokeseals assembly not less than the existing fire resistance rating.

.4 Firestopping and Smokeseals at openings intended for ease of re-entry such as cables: elastomeric seal; do not use cementitious or rigid seal at such locations.

.5 Firestopping and Smokeseals at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control: elastomeric seal; do not use a cementitious or rigid seal at such locations. Exemption to fire dampers.

.2 Accessories: Provide components for each firestopping and smokeseals systems that are needed to install fill materials. Use only components specified by firestopping and smokeseals system manufacturer and approved by the qualified testing and inspecting agency for firestopping and smokeseals systems indicated. Accessories include, but are not limited to, the following items:

.1 Permanent forming, damming and backing materials, including the following:

.1 Slag or rock wool fibre insulation.

.2 Sealants used in combination with other forming, damming or backing materials to prevent leakage of fill materials in liquid state.

.3 Fire-rated form board.

.4 Fillers for sealants.

.2 Temporary forming materials.

.3 Substrate primers.

.4 Collars.

.5 Steel sleeves.

.6 Primers: to manufacturer's recommendation for specific material, substrate, and end use.

.7 Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.

.8 Metal fire stop: Commercial galvanized steel, to ASTM A1008/A1008M, zinc coating 260 g/m^2, minimum metal core thickness 0.912 mm.

.9 Labels: Peel-and-stick labels printed with the following information:

.1 ATTENTION: FIRE RATED ASSEMBLY. DO NOT MODIFY

.2 Name of firestopping manufacturer

.3 Names of products used

.4 Hour Rating of Assembly

.5 Manufacturers standard detail number, or Engineered Judgement identifier; ULC or $_cUL_{US}$ Number

.6 Date of installation

.7 Name of installing Subcontractor

.8 Contact telephone number for repair or replacement of firestopping materials.

2.3 Fill Materials

.1 General:

.1 Provide firestopping and smokeseals systems containing the types of fill materials indicated in the Firestopping and Smokseals System Schedule below by reference to the types of materials described in this Article. Fill materials are those referred to in directories of the referenced testing and inspecting agencies as fill, void, or cavity materials.

.2 Firestopping and smoke seal systems shall be tested in accordance with ULC S115, and be comprised of asbestos-free materials and systems capable of maintaining an effective barrier against flame, smoke and gases, and not to exceed opening sizes for which they are intended for its fire resistance ratings.

.2 Cast-in-Place Firestopping and Smokeseals Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

.3 Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.

.4 Firestopping and Smokeseals Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrating item.

.5 Cable Penetration Devices: Premanufactured intumescent blocks, consisting of a system of inserts and adjustable cores; or premanufactured fire rated cable pathway systems.

.6 Intumescent Composite Sheets: Rigid panels consisting of aluminum foil faced elastomeric sheet bonded to galvanized steel sheet.

.7 Intumescent Putties: Non-hardening dielectric, water resistant putties containing no solvents, inorganic fibres, or silicone compounds.

.8 Intumescent Spray Foam: Expanding spray-in-place intumescent foam sealant.

.9 Intumescent Wrap Strips: Single component intumescent elastomeric sheets with aluminum foil on one side.

.10 Mortars: Pre-packaged, dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a non-shrinking, homogeneous mortar.

.11 Pillows/Bags: Reusable, heat expanding pillows/bags consisting of glass fibre cloth cases filled with a combination of mineral fibre, water insoluble expansion agents and fire retardant additives.

.12 Silicone Foams: Multi-component, silicone based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.

.13 Silicone Sealants: Moisture curing, single component, silicone based, neutral curing elastomeric sealants of grade indicated below:

.1 Grade for Horizontal Surfaces: Pourable (self levelling) formulation for openings in floors and other horizontal surfaces.

.2 Grade for Vertical Surfaces: non-sag formulation for openings in vertical and other surfaces.

2.4 Accessories

.1 Primers: to manufacturer's recommendation for specific material, substrate, and end use.

.2 Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.

.3 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.

.4 Metal fire stop: Commercial galvanized steel, to ASTM A1008/A1008M, zinc coating 260 g/m^2, minimum metal core thickness 0.95 mm (20 ga.).

2.5 Mixing

.1 For those products requiring mixing before application, comply with firestopping and smokeseals system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

Part 3 EXECUTION

3.1 Manufacturer's Instructions

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

3.2 Examination

.1 Examine surfaces, components, materials to receive firestopping and smokeseals material; report any conditions which would detrimentally affect the application of the material or the proper firestopping and smokeseals of the system.

.2 Commence Work when conditions of surfaces and the working conditions are suitable.

.3 Where penetration sealants or caulking are required, ensure all service lines are in place, tested and approved.

.4 Verify all proper blocking, framing (using non-combustible materials) are properly installed and prepared to receive firestopping and smokeseals. Notify Departmental Representative in writing of any deficiencies affecting the proper performance of the firestopping and smokeseals, do not proceed until deficiencies are corrected.

3.3 Preparation

.1 Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials.

.1 Ensure that substrates and surfaces are clean, dry and frost free.

.2 Prepare surfaces in contact with fire stopping materials and smoke seals to manufacturer's instructions.

.3 Maintain insulation around pipes and ducts penetrating fire separation without interruption to vapour barrier.

.4 Prime surfaces as required.

.5 Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.

3.4 Installation

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

.2 Apply firestopping and smokeseals materials/systems to maintain the fire separations in the project as indicated on drawings.

.3 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.

.4 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.

.5 Tool or trowel exposed surfaces to neat finish.

.6 Remove excess compound promptly as work progresses and upon completion.

3.5 Field Quality Control

.1 Inspections: notify Departmental Representative when ready for inspection and prior to concealing or enclosing fire stopping materials and service penetration assemblies.

.1 Cut tests may be made at random by the Departmental Representative. Frequency of cut tests shall be determined by the Departmental Representative, but will not be more than 1% of total length of firestopping and smokeseals.

.2 Make all necessary repairs and correct all deficiencies noted after completion of cut tests.

.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, twice during progress of Work at 25% and 60% complete.

3.6 Cleaning

.1 Proceed in accordance with Section 01 01 50 – General Instructions, Cleaning.

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

.3 Remove temporary dams after initial set of fire stopping and smoke seal materials.

3.7 Schedule

.1 Design and provide through penetration firestopping and smokeseals as follows for:

.1 Systems for Metallic Pipes, Conduit, or Tubing: Select one or more of the following fill materials:

.1 Intumescent putty.

.2 Intumescent foam blocks or boards.

.3 Intumescent spray foam.

.2 Systems for Non-metallic Pipe, Conduit, or Tubing: Select one or more of the following fill materials:

.1 Intumescent putty.

.2 Intumescent wrap strips.

.3 Firestopping and Smokeseals device.

.4 Intumescent spray foam.

.3 Re-enterable and Cable Managed Systems for Electrical, and Data and Communications Cables.

.4 Systems for Electrical, and Data and Communications Cables: Select one or more of the following fill materials:

.1 Intumescent putty.

.2 Intumescent foam blocks or boards.

.3 Intumescent spray foam.

.5 Systems for Insulated Pipes: Select one or more of the following fill materials:

.1 Intumescent putty.

.2 Intumescent wrap strips.

.3 Intumescent foam blocks or boards.

.4 Intumescent spray foam.

.6 Systems for Miscellaneous Electrical Penetrations: Select one or more of the following fill materials:

.1 Intumescent putty.

.2 Intumescent foam blocks or boards.

.3 Intumescent spray foam.

.7 Systems for Miscellaneous Mechanical Penetrations: Select one or more of the following fill materials:

.1 Intumescent foam blocks or boards.

.2 Intumescent spray foam.

END OF SECTION

Part 1 GENERAL

1.1 Related Sections

.1 Section 02 07 50 – Cutting and Patching

.2 Section 05 50 00 – Metal Fabrications

.3 Section 07 62 00 – Sheet Metal Flashing and Trim

.4 Division 23 – Heating, Ventilation & Air Conditioning

.5 Division 26 - Electrical

1.2 References

.1 American Society for Testing and Materials International, (ASTM)

.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 C920-14, Standard Specification for Elastomeric Joint Sealants.

.4 ASTM C1193-13, Standard Guide for Use of Joint Sealants.

.5 ASTM C1330-02(2013), Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants.

.6 ASTM D2240-05(2010), Standard Test Methods for Rubber Property, Durometer Hardness.

.2 Canadian General Standards Board (CGSB)

.1 CGSB 19-GP-5M-84, Sealing Compound, One Component, Acrylic Base, Solvent Curing (incorporating Amendment No. 1).

.2 CAN/CGSB-19.13-M87, Sealing Compound, One-component, Elastomeric, Chemical Curing.

.3 CGSB 19-GP-14M, Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing.

.4 CAN/CGSB-19.13-M87, Sealing Compound, One-Component, Elastomeric, Chemical Curing.

.5 CAN/CGSB-19.17-M90, One-Component Acrylic Emulsion Base Sealing Compound.

.6 CAN/CGSB-19.24-M90, Multi-component, Chemical Curing Sealing Compound.

.3 Department of Justice Canada (Jus)

.1 Canadian Environmental Protection Act, 1999 (CEPA).

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.5 Transport Canada (TC)

.1 Transportation of Dangerous Goods Act, 1992 (TDGA).

1.3 Submittals

.1 Submit product data in accordance with Section 01 01 50 – General Instructions, Submittals.

.1 Submit manufacturer's instructions, printed product literature, specifications and data sheet. Indicate the product characteristics, performance criteria, physical size, finish and limitations on following:

.1 Caulking compound

.2 Primers

.3 Sealing compound, each type, including compatibility when different sealants are in contact with each other.

.4 Manufacturers Sample Warranty

.2 Submit WHMIS MSDS - Material Safety Data Sheets. WHMIS MSDS acceptable to Labour Canada and Health and Welfare Canada for sealants. Indicate VOC content.

.3 Submit manufacturer's installation instructions for each product used.

.4 When required by Departmental Representative, submit test certificates from an approved Canadian materials testing laboratory indicating that sealants meet the requirements of the CGSB standards specified, and that the tests have been conducted in accordance with ASTM D2240.

.2 Submit samples in accordance with Section 01 01 50 – General Instructions, Submittals Procedures.

.1 Provide colour samples of the actual sealants for approval; painted or printed colour charts are not acceptable.

1.4 Quality Assurance

.1 Caulking shall be performed by a caulking contractor with successful experience in Work of similar size and complexity.

.2 Before performing Work of this Section, submit the names of proposed materials. If specified using CGSB Standards, indicate Qualification Number.

1.5 Delivery, Storage, And Handling

.1 Deliver, handle, store and protect materials in accordance with Section 01 01 50 – General Instructions, Common Product Requirements.

.2 Deliver containers to site sealed in original factory packaging, labelled with manufacturer's name and address.

.3 Store materials in a clean, dry, and heated area in accordance with manufacturer's instructions.

.4 Replace defective or damaged materials with new.

1.6 Waste Management and Disposal

.1 Separate waste materials for recycling in accordance with Section 01 01 50 – General Instructions, 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 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional and Municipal regulations.

.5 Unused sealant material must not be disposed of into sewer system, into streams, lakes, onto ground or in other location where it will pose health or environmental hazard.

.6 Divert unused joint sealing material from landfill to official hazardous material collections site approved by Departmental Representative.

.7 Empty plastic joint sealer containers are not recyclable. Do not dispose of empty containers with plastic materials destined for recycling.

.8 Fold up metal banding, flatten, and place in designated area for recycling.

1.7 Project Conditions

.1 Environmental Limitations:

.1 Only proceed with installation of joint sealants under following conditions:

.1 When ambient and substrate temperature conditions are within limits permitted by joint sealant manufacturer or are above 4.4 degrees C.

.2 When 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 Only proceed with installation of joint sealants where joint widths are more than those allowed by sealant manufacturer for applications indicated.

.3 Joint-Substrate Conditions:

.1 Only proceed with installation of joint sealants after contaminants capable of interfering with adhesion are removed from joint substrates.

.2 Substrate must be clean, dry, and frost free.

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.

1.9 Warranty

.1 Contractor hereby warrants that caulking work will not leak, crack, crumble, melt, shrink, run, lose adhesion or stain adjacent surfaces in accordance with General Conditions, but for three (3) years.

.2 Provide Warranty for sealants to include in maintenance manuals as specified in Section 01 01 50 – General Instructions, Operations and Maintenance Data Manuals.

Part 2 PRODUCTS

2.1 Sealant Materials

.1 Do not use caulking that emits strong odours, contains toxic chemicals or is not certified as mould resistant in air handling units.

.2 When low toxicity caulks are not possible, confine usage to areas which offgas to exterior, are contained behind air barriers, or are applied several months before occupancy to maximize offgas time.

.3 Unless otherwise specified, VOC content limits of sealants shall be in accordance with the following:

.1 Architectural Materials:

.1 Sealants: VOC content limit 250 g/L.

.2 Sealant Primers for Non-Porous Surfaces: VOC content limit 250 g/L.

.3 Sealant Primers for Porous Surfaces: VOC content limit 775 g/L.

.2 All Other Applications:

.1 Sealants: VOC content limit 420 g/L.

.2 Sealant Primers: VOC content limit 750 g/L.

.4 Where sealants are qualified with primers use only these primers.

2.2 Sealant Material Types

.1 Acrylic latex one part: to ASTM C834.

.2 Urethane one part: Non-sag to ASTM C920.

.3 Acoustical butyl sealant: to ASTM C919.

.4 Security sealant: rigid, two component, high-solids, high-modulus epoxy resin.

.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 Joints with very low movement and to be painted over: acrylic.

.2 Exterior flashing joints: Urethanes one part.

.3 Penetrations of pipe and electrical wiring: acoustical butyl sealant.

.4 Security sealant: apply to locations as indicated on drawings.

2.4 Accessories

.1 Primer: Non-staining type in accordance with sealant manufacturer’s written recommendations.

.2 Joint Cleaner: Non-corrosive and non-staining type, compatible with joint forming materials and sealant, in accordance with sealant manufacturer’s written recommendations.

2.5 Colours

.1 Colours: To match adjacent materials, to be selected from manufacturer’s standard colour range.

Part 3 EXECUTION

3.1 Protection

.1 Protect installed Work of other trades from staining or contamination.

3.2 Inspection

.1 Carefully inspect surfaces, materials to receive sealants and verify they are physically capable of retaining sealant installation in accordance with manufacturer's written instructions.

.2 Verify that fillers and backing provided under other Sections properly installed.

.3 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.4 Proceed with installation only after unacceptable conditions have been remedied.

3.3 Surface Preparation

.1 Prepare surfaces in accordance with manufacturer’s instructions.

.2 Examine joint sizes and conditions to establish correct depth to width relationship for installation of backup materials and sealants.

.3 Maintain workmanship of highest quality in accordance with best trade practice.

.4 Ensure that joint forming materials are compatible with sealant.

.5 Clean bonding joint surfaces of harmful matter substances including dust, rust, oil grease, and other matter which may impair Work. Wire brush loose materials and other foreign matter which might impair adhesion of sealant.

.6 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.

.7 Use air stream to blow out dirt and water from crevices.

.8 Ensure joint surfaces are dry and frost free.

.9 Prime all porous material (e.g. wood, masonry, concrete, ceramic or paver tile, etc).

.10 Prime other joints when recommended by manufacturer. Use a brush that will reach all parts of the joints. Mask adjoining surfaces with tape prior to priming to prevent staining.

3.4 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.

3.5 Backup Material

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

.2 Use backer rod as specified, to limit depth of sealant and to act as bond breaker at back of joint.

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

.4 Where depth of joint does not permit the use of backer rod apply paper masking tape to back of joint to act as bond breaker.

.5 Ensure that no joints are formed which are bonded on adjacent sides where there is any possibility of movement.

3.6 Mixing

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

3.7 Application

.1 Apply sealant in strict accordance with manufacturer's written instructions.

.2 Mask edges of joint where irregular surface or sensitive joint border exists to provide neat joint.

.3 For joints where movement is possible, apply backer rod to achieve a joint depth of one half the joint width but not less than 9 mm; for joints larger than 25 mm use a depth of 13 mm.

.4 Apply sealant using gun with proper size nozzle.

.5 Form surface of sealant smooth, free from ridges, wrinkles, sags, or air pockets and imbedded impurities. Neatly tool surface to a slight concave appearance.

.6 Ensure bead is solid, filling entire space between sides and bedding material, exerting sufficient pressure to obtain maximum bond, by allowing sealant to bulge out in advance of nozzle.

.7 Tool sealants to achieve air tight joints, and tool exposed surfaces before skinning begins to give slightly concave shape. Use wet tools as required.

.8 Apply sealant within recommended temperature ranges. Consult manufacturer when sealant cannot be applied within recommended temperature range.

.9 Seal gaps between fixtures and walls.

.10 Seal gaps between surface-mounted electrical boxes and walls.

.11 Remove excess compound promptly as work progresses and upon completion.

.12 Curing

.1 Cure sealants in accordance with sealant manufacturer's written instructions.

.2 Do not cover up sealants until proper curing has taken place.

3.8 Clean Up

.1 Clean adjacent surfaces immediately and leave Work neat and clean.

.2 Remove excess and droppings, using recommended cleaners as work progresses.

.3 Remove masking tape after initial set of sealant.

.4 On porous surfaces allow sealant to cure overnight, and remove excess by light wire brushing.

.5 Progress Cleaning: clean in accordance with Section 01 01 50 - General Instructions.

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

.6 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 01 50 - General Instructions.

3.9 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 07 92 00 – Sealants

.2 Section 09 91 99 – Painting for Minor Works

1.2 References

.1 ASTM International
- .1 ASTM C475-02, 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 C1178/C1178M-08, Standard Specification for Glass Mat Water-Resistant Gypsum Backing Board.
- .7 ASTM C1396/C1396M-09a, Standard Specification for Gypsum Wallboard.
- .8 ASTM E580/E580M-16, Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions.

.2 Association of the Wall and Ceilings Industries International (AWCI)
- .1 AWCI Levels of Gypsum Board Finish-97.

.3 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 01 50 - General Instructions.

.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 Quality Assurance

.1 Perform Work to ASTM C754 and AWCC/WCI Specifications Standards Manual, latest edition.

.2 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five (5) years documented experience.

.3 Installer Qualifications: Company specializing in performing the work of this section with minimum five (5) years documented experience and Certified Wall and Ceiling Installer in the Red Seal trade.

.4 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.

.5 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 Deliver, store and handle materials in accordance with Section 01 01 50 - General Instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
- .1 Store gypsum board assemblies materials level 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 Protect prefinished aluminum surfaces with strippable coating. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather.
- .6 Replace defective or damaged materials with new.

1.6 Waste Management and Disposal

.1 Separate and recycle waste materials in accordance with Section 01 01 50 - General Instructions.

1.7 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 Performance/Design Criteria for Suspended Gypsum Board Ceilings

.1 Maximum deflection: 1/360th of span to ASTM C635 deflection test.

.2 Seismic Response Characteristics: based on a full uniform ceiling load acceleration in accordance with ASTM E580/E580M; ceilings areas less than 13m² and surrounded by walls connected to structure above do not require seismic restraints.

2.2 Materials

.1 Abuse resistant board: high density, paperless gypsum panels with cellulose fibre reinforced facers and reinforcing fiber mesh to ASTM C1629/C1629M and ASTM C1278/C1278M and as follows:
- .1 Thickness: 16 mm.
- .2 Surface Abrasion: Level 1 classification in accordance with ASTM C1629.
- .3 Indentation Resistance: Level 1 classification in accordance with ASTM C1629.
- .4 Soft Body Impact Resistance: Level 3 classification in accordance with ASTM C1629.
- .5 Hard Body Impact Resistance: Level 3 classification in accordance with ASTM C1629.

.2 Steel drill screws: to ASTM C1002.

.3 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.

.4 Sealants: in accordance with Section 07 92 00 - Sealants.

.5 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 Departmental Representative.
- .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 Erection

.1 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 Support light fixtures by providing additional ceiling suspension hangers within 150 mm of each corner and at maximum600 mm around perimeter of fixture.

.4 Install work level to tolerance of 1:1200.

.5 Frame with furring channels, perimeter of openings for access panels, light fixtures, diffusers, grilles.

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 at 300 mm on centre.
  .1 Single-Layer Application:
    .1 Apply gypsum board on ceilings prior to application of walls to ASTM C840.
    .2 Apply gypsum board vertically or horizontally, providing sheet lengths that will minimize end joints.
  .2 Double-Layer Application:
    .1 Install gypsum board for base layer and exposed gypsum board for face layer.
    .2 Apply base layer to ceilings prior to base layer application on walls; apply face layers in same sequence. Offset joints between layers at least 250 mm.
    .3 Apply base layers at right angles to supports unless otherwise indicated.
    .4 Apply base layer on walls and face layers vertically with joints of base layer over supports and face layer joints offset at least 250 mm with base layer joints.

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

.3 Install casing beads around perimeter of suspended ceilings.

.4 Install casing beads where gypsum board butts against surfaces having no trim concealing junction and where indicated. Seal joints with sealant.

.5 Construct control joints of preformed units set in gypsum board facing and supported independently on both sides of joint.

.6 Provide continuous polyethylene dust barrier behind and across control joints.

.7 Locate control joints where indicated and at changes in substrate construction. When control joints are not indicated install approximate 10 m spacing on long corridor runs, at approximate 15 m spacing on ceilings.

.8 Install control joints straight and true.

.9 Install expansion joint straight and true.

.10 Splice corners and intersections together and secure to each member with 3 screws.

.11 Install access doors to electrical and mechanical fixtures specified in respective sections.
.1 Rigidly secure frames to furring or framing systems.

.12 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.

.13 Gypsum Board Finish: finish gypsum board walls and ceilings to following levels in accordance with AWCI Levels of Gypsum Board Finish:
.1 Level of finish: Level 4 throughout.

.14 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.

.15 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.

.16 Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surface of board.

.17 Completed installation to be smooth, level or plumb, free from waves and other defects and ready for surface finish.

.18 Mix joint compound slightly thinner than for joint taping.

.19 Allow skim coat to dry completely.

.20 Remove ridges by light sanding or wiping with damp cloth.

3.5 Cleaning

.1 Progress Cleaning: clean in accordance with Section 01 01 50 - General Instructions.
.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 01 50 - 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 References

.1 American National Standards Institute (ANSI)/Ceramic Tile Institute (CTI)

.1 ANSI/CTI (Ceramic) A108/A118/A136.1-2013, Specification for the Installation of Ceramic Tile - A Collection of 20 ANSI/CTI A108 Series Standards on Ceramic Tile Installation: A108.1A-C, 108.4 -.13, A118.1-.10, ANSI A136.1.

.2 CTI (Ceramic) A118.3-2013, Specifications for Chemical Resistant, Water Cleanable Tile-Setting and Grouting Epoxy and Water Cleanable Tile Setting Epoxy Adhesive (included in ANSI A108.1-2013).

.3 CTI (Ceramic) A118.4-2012, Specifications for Latex Portland Cement Mortar (included in ANSI A108.1-2013).

.4 CTI (Ceramic) A118.5-1999, Specification for Chemical Resistant Furan Resin Mortars and Grouts for Tile Installation (included in ANSI A108.1-2013).

.5 CTI (Ceramic) A118.6-2010, Specification for Ceramic Tile Grouts (included in ANSI A108.1-2013).

.2 American Society for Testing and Materials International (ASTM)

.1 ASTM C144-11, Standard Specification for Aggregate for Masonry Mortar.

.2 ASTM C207-06(2011), Standard Specification for Hydrated Lime for Masonry Purposes.

.3 ASTM C979/C979M-16, Standard Specification for Pigments for Integrally Coloured Concrete.

.3 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-75.1-M88, Tile, Ceramic.

.4 Canadian Standards Association (CSA International)

.1 CSA-A3000-13, Cementitious materials compendium (Consists of A3001, A3002, A3003, A3004 and A3005), Includes Update No. 1 (2014), Update No. 2 (2014).

.5 International Organization for Standardization (ISO)

.1 ISO 13007:2014, Classifications for Adhesives and Grouts.

.6 South Coast Air Quality Management District (SCAQMD), California State

.1 SCAQMD Rule 1168-05, Adhesives and Sealants Applications.

.7 Tile Council of North America (TCNA)

.1 2015 TCNA Handbook for Ceramic, Glass, and Stone Tile Installation.

.8 Terrazzo Tile and Marble Association of Canada (TTMAC)

.1 Tile Specification Guide 09 30 00, 2012-2014, Tile Installation Manual.

.2 Hard Surface Maintenance Guide.

1.2 Administrative Requirements

.1 Preconstruction Meeting: Arrange a preconstruction meeting in accordance with Section 01 01 50 – General Instructions, Project Meetings attended by Contractor, Departmental Representative, and tile installer to discuss the following:

.1 Substrate and backing surfaces flatness requirements.

.2 Installation techniques associated with specified materials.

.3 Compatibility between specified materials and between adjacent materials.

.4 Concerns arising from site conditions.

.5 Concerns of installers or suppliers arising from as-constructed conditions.

1.3 Submittals

.1 Submit product data in accordance with Section 01 01 50 – General Instructions, Submittals Procedures:

.1 Include manufacturer's information on:

.1 Ceramic tile, marked to show each type, size, and shape required.

.2 Mortar and grout.

.2 Submit samples in accordance with Section 01 01 50 – General Instructions, Submittals Procedures:

.1 Tile: Submit actual tile samples illustrating colour, texture, size and pattern for each type of tile specified.

.2 Grout: Submit manufacturer’s full range of colours available for each type of grout specified.

.3 Adhere tile samples to 11 mm thick plywood and grout joints to represent project installation.

1.4 Quality Assurance

.1 Conform to requirements of Terrazzo, Tile and Marble Association of Canada (TTMAC), Tile Specification Guide 09 30 00, 2012-2014, Tile Installation Manual.

.2 Obtain each type of tile material required from single source. For colour consistency, ensure the supplier has capacity to provide products from the same production run, dye lot, calibre and batch number.

.3 Obtain setting and grouting materials from one manufacturer to ensure compatibility.

.4 Installer Qualifications: Specializing in tile work having minimum of 5 years successful documented experience with work comparable to that required for this project. Installer must be registered as a member in good standing with the Terrazzo, Tile and Marble Association of Canada.

1.5 Delivery, Storage and Handling

.1 Deliver materials in containers with labels legible and intact and grade-seals unbroken.

.2 Store materials so as to prevent damage or contamination.

.3 Store materials in a dry area, protected from freezing, staining and damage.

.4 Store cementitious materials on a dry surface.

1.6 Waste Management and Disposal

.1 Separate and recycle waste materials in accordance with Section 01 01 50 – General Instructions, Waste Management and Disposal.

1.7 Site Conditions

.1 Surfaces for tile installation must be clean, dimensionally stable, cured, level, plumb and free of contaminants such as oil, sealers and curing compounds.

.2 Maintain air temperature and structural base temperature at ceramic tile installation area above 12 degrees C for 48 hours before, during, and 48 hours after, installation. Tile and setting material stored at same conditions 48 hours before and 7 days after application.

.3 Do not install tiles at temperatures less than 12 degrees C or above 38 degrees C.

.4 Do not apply epoxy mortar and grouts at temperatures below 15 degrees C or above 25 degrees C.

PART 2 PRODUCTS

2.1 Materials

.1 Factory blend tile that exhibits colour variations within the ranges selected and package so tile units taken from one package show the same range in colours as those taken from other packages.

.2 Provide tile products manufactured in accordance with CAN/CGSB 75.1 or ANSI A108.1 as appropriate to the Basis-of-Design Materials.

2.2 Tile Materials

.1 Wall Tile: to CAN/CGSB-75.1, and as follows:

.1 Colour, Finish, and Size: to be selected by Departmental Representative.

2.3 Mortar and Adhesive Materials

.1 Mortar to be of the following properties unless otherwise specified:

.1 Cement: Grey meeting requirements of CSA A3000.

.2 Sand: to ASTM C144, passing 16 mesh.

.3 Hydrated lime: to ASTM C207, Type N.

.4 Latex additive: formulated for use in cement mortar and thin set bond coat.

.5 Water: potable and free of minerals and chemicals which are detrimental to mortar and grout mixes.

.6 Mortars and Adhesives:

.1 Maximum VOC limit 65 g/L to SCAQMD Rule 1168.

.2 Thin Set Mortar: single-component, modified, non-sagging, dry-set lightweight cement mortar with polymer and complying with ANSI A118.4, A118.11 and ISO 13007 C2TES1P1.

2.4 Grout

.1 Colouring Pigments:

.1 Pure mineral pigments, limeproof and nonfading, complying with ASTM C979.

.2 Colouring pigments to be added to grout by manufacturer.

.3 Job coloured grout are not acceptable.

.4 Use in Commercial Cement Grout, Dry-Set Grout, and Latex Cement Grout.

.2 Ready-to-Use Grout: Professional-grade, ready-to-use colour consistent quartz aggregate, for use with grout joints 1.5 to 12 mm.

.1 Colour: Colours to match materials, confirm colour with Departmental Representative prior to ordering.

.2 Performance Requirements:

.1 Chemical Resistance: pass ASTM C267

.2 Vertical Sag in Joints: pass ANSI A118.3; no noticeable change in joint shape.

.3 Cleanability: passes ANSI A118.3

.4 Compressive Strength: 33.9 MPa when tested to ANSI A118.6

.5 Hardness at 72 hours (Shore A): 85

.3 Grout:

.1 Maximum VOC limit 65 g/L to SCAQMD Rule 1168.

2.5 Accessories

.1 Sealant: in accordance with Section 07 92 00 - Joint Sealants.

.1 Sealants: maximum VOC limit 250 g/L to SCAQMD Rule 1168.

2.6 Cleaning Compounds

.1 Specifically designed for cleaning masonry and concrete and which will not prevent bond of subsequent tile setting materials including patching and leveling compounds and elastomeric waterproofing membrane and coat.

.2 Materials containing acid or caustic material are not acceptable.

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 Protect surrounding work from damage or disfiguration arising from work of this Section.

.2 Surfaces: Thoroughly clean substrate surfaces receiving tile finishes to remove grease, oil or dust films, and other contaminants affecting bond of materials within bonding systems and as follows:

.1 Clean back of each tile before installation to remove surface contaminants and cutting residue, firing release dust and other debris detrimental to bond and final surface appearance.

.3 Surface Levelling: apply self levelling compound to make backing surfaces flat and true to tolerances in plane listed in performance requirements above and as required by TTMAC.

3.3 Workmanship

.1 Do tile work in accordance with TTMAC Tile Installation Manual except where specified otherwise.

.2 Apply tile or backing coats to clean and sound surfaces.

.3 Back Buttering: Obtain minimum 95% mortar coverage in accordance with applicable requirements for back buttering of tile in referenced TTMAC and ANSI A108 series of tile installation standards for the following applications:

.1 Tile having tiles 305 mm or larger in any direction.

.2 Tile having tiles with raised or textured backs.

.3 All porcelain tiles with more than 20% of the tile backs covered with "white firing release" shall be "back buttered" so that 100% of the back is covered with adhesive mortar rated for C627, Extra Heavy Duty rating.

.4 Maintain uniform joint appearance. Cut edges smooth and even. Do not split tiles.

.5 Maximum surface tolerance 1:800.

.6 Make joints between tile uniform, plumb, straight, true, even and flush with adjacent tile. Confirm joint width with Departmental Representative. Ensure sheet layout not visible after installation. Align patterns.

.7 Lay out tiles so perimeter tiles are minimum 1/2 size.

.8 Sound tiles after setting and replace hollow-sounding units to obtain full bond.

.9 Allow minimum 24 hours after installation of tiles, before grouting.

.10 Clean installed tile surfaces after installation and grouting cured.

.11 Install prefabricated control and movement joints in tile Work in accordance with detail 301EJ from TTMAC Installation Manual to suit installation indicated.

3.4 Sealer and Protective Coating

.1 Apply manufacturer’s recommended sealer in strict accordance with manufacturer's written instructions for the specific tile type being sealed.

.2 Apply sealer to tiles before grouting in cases of absorbent biscuit tiles and again after completion and cleaning of grouting process.

3.5 Cleaning

.1 Proceed in accordance with Section 01 01 50 – General Instructions, Cleaning.

END OF SECTION

PART 1 GENERAL

1.1 Summary

.1 Provide labour, materials, tools and other equipment, services and supervision required to complete interior painting preparation.

.2 Surface preparation for this section will be limited specific pre-treatments noted in this section or as specified in the Master Painters Institute (MPI) Painting Specification Manual.

1.2 References

.1 The Master Painters Institute (MPI):

.1 Existing Surfaces: Interior Maintenance Repainting Manuals.

.2 The Society for Protective Coatings (SSPC):

.1 Surface Preparation Guidelines

1.3 Quality Assurance

.1 Conform to the standards contained in the MPI Manual.

.2 Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in service and in performance.

1.4 Environmental Requirements

.1 Conform to MPI Manual and manufacturer’s requirements.

PART 2 PRODUCTS

2.1 Materials

.1 Materials shall be the highest quality product of an approved manufacturer listed in the MPI Manual and shall be compatible with other coating materials.

PART 3 EXECUTION

3.1 Preparation of Surfaces

.1 Prepare surfaces in accordance with MPI Manual requirements. Refer to the Manual for specific surface preparation requirements for each substrate material.

3.2 Restoration

.1 Clean and re-install all hardware items that were removed before painting operations were undertaken, ensuring that tagged or labelled items are returned to the exact position from which they were removed.

END OF SECTION

PART 1 GENERAL

1.1 Summary

.1 Work of this section includes the following:
- .1 Modify existing roof anchor equipment for building maintenance and fall restraint system, to suit the new mechanical system.
- .2 Engineering by Sub-Contractor.
- .3 Re-Certification by a Structural Engineer registered in Province of BC.

1.2 Related Requirements

.1 Section 01 35 00 – Delegated Design

1.3 References

.1 American Society for Testing and Materials (ASTM)
- .1 ASTM A276-10, Standard Specification for Stainless Steel Bars and Shapes
- .2 ASTM A484/A484M-11, Standard Specification for General Requirements for Stainless Steel Bars, Billets, and Forgings
- .3 ASTM A999/A999M-11, Standard Specification for General Requirements for Alloy and Stainless Steel Pipe
- .4 ASTM D1056-07, Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber
- .5 ASTM D2000-12, Standard Classification System for Rubber Products in Automotive Applications
- .6 ASTM F593-02(2008), Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
- .7 ASTM F594-09e1, Standard Specification for Stainless Steel Nuts
- .8 ASTM F887-11, Standard Specifications for Personal Climbing Equipment

.2 American National Standards Institute (ANSI):
- .1 ANSI Z359.1-2007, Safety Requirements for Personal Fall Arrest Systems, Subsystems and Components

.3 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB 1.40-2000, Anticorrosive Structural Steel Alkyd Primer

.4 Canadian Standards Association (CSA)
- .1 CAN/CSA S16-09, Design of Steel Structures, Includes Update No.1 (2010), Update No. 2 (2010)
- .2 CAN/CSA S136-07, North American Specification for the Design of cold Formed Steel Structural Members, Include Update No. 1 (2009), Update No. 2 (2010)
- .3 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding
- .4 CSA W55.3-08, Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings
- .5 CSA W59-03 (2008), Welded Steel Construction (Metal Arc Welding)
- .6 CSA Z259.12-11, Connecting Components for Personal Fall Arrest Systems (PFAS)

.5 Canadian Institute of Steel Construction (CISC)
- .1 Fundamentals of Structural Shop Drafting, 5th Edition, 1995

.2 CISC Code of Standard Practice, 7th Edition
.3 Handbook Of Steel Construction, 10th Edition

.6 Roofing Contractor's Association of British Columbia (RCABC)
.1 Roof Practices Manual

.7 The Society for Protective Coatings (SSPC)/National Association of Corrosion Engineers (NACE International)
.1 Coating Materials Guidelines
.2 Surface Preparation Guidelines: SSPC-SP6/NACE No. 3, Commercial Blast Cleaning
.3 Application, Inspection and Quality Control Guidelines

.8 WorkSafeBC, OHS - regulation - Part II, Fall Protection

1.4 Administrative Requirements

.1 Coordination: Provide setting diagrams, templates, instructions and directions for installation of components supplied by this section to other Subcontractors, and necessary for the completion of work of this Section:
.1 Inspect existing installed system.
.2 Familiar with the proposed mechanical system shown on the drawings.
.3 Coordinate design of modification with the Departmental Representative.

.2 Pre-installation Meeting: Convene pre-modification meetings prior to beginning work of this Section with Contractor, Departmental Representative, manufacturer's representative, and other components of the Work affected by work of this Section to:
.1 Discuss coordination issues, attachment requirements and use of fall restraints during the construction period.
.2 Meet a minimum of six (6) weeks prior to beginning work of this Section, so that coordination issues affecting work of this section, or other Trade Contractors can be accounted for and corrected prior to any installation of materials.

.3 Include cost of retaining a BC-registered Structural Engineer in bid price.

1.5 Action and Informational Submittals

.1 Provide submittals in accordance with Section 01 01 50 - General Instructions.

.2 Provide information as follows:
.1 Provide product data for each type of product specified.
.2 Provide Work Plan Drawings showing individual primary suspension line and safety life line anchors used for support of exterior maintenance equipment and personnel.
.3 Provide shop drawings using CISC standard drafting practices; detailing fabrication of steel components including, but not limited to, the following:
.1 Indicate complete layout and configuration of system, locations, and all other components and accessories.
.2 Indicate design, fabrication details, plans, elevations, hardware and installation details, including details of cuts, connections, splices, camber, holes, and other pertinent data.
.3 Show interface with adjacent materials.
.4 Show locations of maintenance equipment and fall restraint anchors, configurations, dimensions, attachment details, and components required for complete system complying with provisions of this Section.

.5 Shop drawings shall be signed and sealed by a professional engineer qualified in the province of the Work, and who was responsible for their preparation.
.6 Shop drawings shall include restrictive and non-restrictive working usage notes and general safety requirements.

.3 Field Review Reports: provided by professional engineer providing Schedules S-B and S-C.

.4 Schedules from trade contractor's Engineer:
.1 Provide Schedules S-B and S-C to Departmental Representative (CRP - Coordinating Registered Professional).

.5 Submit reduced plastic laminated as-built roof plan drawing indicating layout and location of anchors and tie-offs, and safe works and usage requirements that will be posted near roof access points in sufficient quantities for each access point to the roof or equipment access locations.

.6 Submit the following for inclusion in operations and maintenance manuals:
.1 Special procedures, and conditions requiring maintenance during the operational stage for materials specified in this Section.
.2 Safety Inspection Log Books required for yearly inspections.
.3 Provide on-site orientation and demonstration to Owner's key personnel, and suggestions for incorporating safe work practices into the Owner's Safe Work Practices Policy.
.4 List of accessory equipment, product data, and samples that can be used with the installed anchoring system; submittal does not imply purchase by Owner.

1.6 Quality Assurance

.1 Regulatory Requirements:
.1 Conform with WorkSafeBC regulations.
.2 Conform with additional requirements of CSA Z91 and CAN/CSA Z259 Series for standards relating to requirements of this Section, except where in conflict with WorkSafeBC.

.2 Manufacturer shall be a company specializing in the design and installation of permanent safety tie-back and life line anchor, horizontal life line systems, and exterior maintenance and window washing equipment systems having a minimum of five (5) years of experience.

.3 Manufacturer shall provide $5,000,000.00 of specific product liability insurance for all aspects of their installation, design, and failure of the safety anchors and their installation.

.4 Manufacturers shall comply with applicable CWB standards for classification of work being performed including, but not limited to, the following:
.1 Welding inspection: to CSA W178.
.2 Resistance welding: to CSA W55.3.
.3 Fusion welding: to CSA W59.
.4 Welding qualifications: to CSA W47.1

.5 Installing Subcontractors, if different than fabricator, shall have completed welding work similar in material, design, and extent to that indicated for this Project; with a record of successful in service performance; having welders certified by CWB for classification of work being performed; and having the same certifications as required by CSA and CWB for the fabricator and manufacturer.

1.7 Delivery, Storage and Handling

.1 Deliver, store and handle materials in accordance with Section 01 01 50 - General Instructions.

.2 Deliver materials with manufacturer's original protective packaging and identifying labels intact.

.3 Store products in an area protected from and construction activities.

1.8 Waste Management and Disposal

.1 Separate and recycle waste materials in accordance with Section 01 01 50 - General Instructions.

PART 2 PRODUCTS

2.1 Design Requirements

.1 Engineer and re-certify existing fall restraint system sufficient for gaining access to exterior building surfaces that meets the requirements of the WorkSafeBC using a professional engineer registered in British Columbia, and as follows:

- .1 Fall Restraint System: Roof top maintenance system permitting free movement of persons over roof areas as required by CSA Z91 and ASME A39.1, and other standards referenced in above; where differences occur, the more restrictive requirement shall prevail.
- .2 Upright Anchors: re-certify existing anchors.
- .3 Horizontal Lifeline Systems: Modify existing horizontal cable lifeline system to suit the new mechanical system.
- .4 Re-certify existing structural connections to roof deck and install additional reinforcement as required; submit load requirements to the Departmental Representative for their use in design the primary structures.
- .5 Re-certify existing connections to supporting structural framing and install additional reinforcement as required to resist pullout force and reinforce deck against damage and carry pull out force back to structural framing; submit load requirements to the Departmental Representative for their use in design the primary structures.

.2 Sub-Contractors' engineer shall design and verify the installed system, any modification or additional anchor requirements, devices, and equipment required to complete the building maintenance system.

2.2 Materials and Finishes

.1 All components exposed to weather shall be in Stainless Steel.

PART 3 EXECUTION

3.1 Examination

.1 Verify conditions as satisfactory to receive work of this Section.

.2 Beginning work constitutes acceptance of existing conditions.

.3 Verify layout of roof fall restraint anchors and that structural connections are suitable for work of this Section.

3.2 Preparation

.1 Supervise and assist in setting of anchorage devices required for installation of work of this Section, but which do not form a part of the work of this Section.

3.3 Installation

.1 Modify existing horizontal lifeline system in accordance with manufacturer's written instructions and provisions of the Contract Documents, under the supervision of structural engineer employed by manufacturer.

.2 The manufacturer's engineer shall coordinate their activities with, and notify the Departmental Representative where conflicts arise, or where site conditions require a modification to the engineered design indicated on the shop drawings.

.3 Cooperate and sequence with mechanical and roofing trades.

3.4 Field Quality Control

.1 Provide field review by manufacturer as follows:
- .1 Provide field inspection and testing upon completion by manufacturer's technical representative.
- .2 Note deficiencies and promptly make written report to Contractor, Owner and Departmental Representative.
- .3 Issue Letter of Compliance and certifications of system issued by a qualified professional engineer registered in the province of the Work.
- .4 Complete inspection log book to certify the system for use; turn-over to Owner's representative.

.2 Owner will require a complete commissioning of the fall restraint system in accordance with the Owners commissioning plan.

3.5 Adjusting

.1 Repair or replace defective installations not conforming with provisions of Contract Documents.

3.6 Training of Owner's Personnel

.1 Train Owner's personnel in the use of the system.

3.7 Cleaning

.1 Progress Cleaning: clean in accordance with Section 01 01 50 - General Instructions.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1 Section 01 01 50 General Instructions

.2 Section 23 05 00 Common Work Results – Mechanical

1.2 References

.1 American National Standards Institute/National Fire Prevention Association (ANSI/NFPA)

.1 ANSI/NFPA 13, Installation of Sprinkler Systems.

.2 ANSI/NFPA 25, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.3 Underwriter's Laboratories of Canada (ULC).

.4 Fire Commissioner of Canada FC 403, “Sprinkler System”.

1.3 Samples

.1 Submit samples of following:

.1 Each type of sprinkler head.

.2 Signs.

1.4 Design Requirements

.1 Design automatic wet and dry pipe fire suppression sprinkler systems in accordance with required and advisory provisions of NFPA 13, by hydraulic calculations for uniform distribution of water over design area.

.2 The “Authority Having Jurisdiction” is Fire Protection Engineering Services of Human Resources and Skills Development Canada (HRSDC).

.3 Design and provide each system to give full consideration to blind spaces, piping, electrical equipment, ducts, and other construction and equipment in accordance with detailed shop drawings.

.4 Locate sprinkler heads in consistent pattern with ceiling grid, lights, and air supply diffusers.

.5 Devices and equipment for fire protection service: ULC approved for use in sprinkler systems.

.6 Design systems for earthquake protection for buildings in seismic zone applicable.

.7 Location of Sprinkler Heads:

.1 Locate heads in relation to ceiling and spacing of sprinkler heads not to exceed that permitted by NFPA 13.

.2 Uniformly space sprinklers on branch.

.8 Water Distribution:

.1 Make distribution uniform throughout the area in which sprinkler heads will open.

.9 Water Supply:

.1 Base hydraulic calculations on static and residual pressures indicated on drawings. For design purpose, the available water supply pressures shall be de-rated by a 10% safety factor.

1.5 Submittals

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 01 50 – General Instructions.

.2 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 01 05 – General Instructions.

.2 Shop Drawings:

.1 Submit shop drawings in accordance with Section 01 01 50 - General Instructions.

.2 Shop drawings: submit drawings stamped sealed and signed by professional engineer registered or licensed in Province of B.C. Indicate:

.1 Materials.

.2 Finishes.

.3 Method of anchorage

.4 Number of anchors.

.5 Supports.

.6 Reinforcement.

.7 Assembly details.

.8 Accessories.

.3 Drawings: Sprinkler heads and piping system layout.

.1 Prepare detail working drawings of system layout in accordance with NFPA 13 using full size contract drawings.

.2 Show data essential for proper installation of each system.

.3 Show details, plan view, elevations, and sections of systems supply and piping.

.4 Show piping schematic of systems supply, devices, valves, pipe, and fittings.

.4 Design Data:

.1 Calculations of sprinkler system design.

.2 Indicate type and design density of each system.

.3 Assurance of Professional Design and Commitment for Field Review.

.1 Provide Assurance commitment letters (Schedules B-1 and B-2) at the commencement of the project, in accordance with the building code and for Building Permit application.

.2 Provide Assurance of Professional Field Review and Compliance (Schedule C-B) at the completion of the project.

.4 Closeout Submittals:

.1 Submit maintenance and engineering data for incorporation into manual specified in Section 01 01 50 - General Instructions in accordance with ANSI/NFPA 20.

.2 Manufacturer's Catalog Data, including specific model, type, and size for:

.1 Pipe and fittings.

.2 Sprinkler heads.

.3 Pipe hangers and supports.

.4 Mechanical couplings.

.3 Field Test Reports:

.1 Preliminary tests on piping system.

.2 Formal tests and inspections

.4 Records:

.1 As-built drawings of each system.

.1 After completion, but before final acceptance, submit complete set of as-built drawings (prints) of each system for record purposes.

.2 Submit drawings in AutoCAD and PDF digital file versions with title block similar to full size contract drawings.

.5 Operation and Maintenance Manuals:

.1 Provide maintenance data for incorporation into manual specified in Section 01 01 50 - General Instructions.

.2 Provide detailed hydraulic calculations including summary sheet, and Contractors Material and Test Certificate for aboveground piping and other documentation for incorporation into manual specified in Section 01 01 50 - General Instructions in accordance with ANSI/NFPA 13.

1.6 Quality Assurance

.1 Qualifications:

.1 Installer: company or person specializing in sprinkler systems with documented experience.

.2 All work shall be carried out by Sprinkler Pipe Fitters who carry a "Certificate of Qualification" for this trade as issued by the B.C. Province Ministry of Labor.

.2 Health and Safety:

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

.3 Inspections and Tests:

.1 All inspections, examinations and tests required by the "Authorities and Agencies having jurisdiction" specified shall be arranged and paid for by the fire protection contractor, as necessary to obtain complete and final acceptance of the fire protection system.

.2 Provide Contractor's Material and Test Certificates and all required test papers as may be requested by all parties having jurisdiction and duly witnessed by Departmental Representative, showing proof of:

.1 Underground hydrostatic test of 1400 kPa (200 PSI).

.2 Flushing of underground main through 100mm (4") drain pipe.

.3 Hydrostatic test of overhead piping @ 1400 kPa (200 PSI).

.4 Verification of all alarm and trouble devices installed under this contract.

.3 Provide the services of the Professional Engineer who designed the fire protection systems for “Field Review” of the installation. Construction period review reports shall be submitted during the construction period.

.4 If welding is required, the Contractor shall submit a copy of the welder's certification to the Departmental Representative for record purposes prior to starting work.

1.7 Maintenance

.1 Extra Materials:

.1 Provide maintenance materials in accordance with Section 01 01 50 – General Instructions.

.2 Provide spare sprinklers and tools as required by ANSI/NFPA 13.

1.8 Delivery, Storage and Handling

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 01 50 - General Instructions.

.2 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/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Division 01 – General Requirements.

PART 2 PRODUCTS

2.1 Pipe, Fittings & Valves

.1 Pipe:

.1 Piping shall meet or exceed one of the following standards:

.1 Black and Hot-Dipped Galvanized Welded and Seamless Steel Pipe – ASTM A795

.2 Welded and Seamless Steel Pipe – ANSI/ASTM A53

.3 Wrought Steel Pipe – ANSI B36.19M

.4 Elec.-Resistance Welded Steel Pipe – ASTM A135

.2 All thickness for pressures up to 2070 kPa (300 psi) shall be as follows:

.1 Joined by shop welding or roll grooving:

.1 Up to and incl. 125mm (5”) – Schedule 10

.2 150mm (6”) – 3.40mm (0.134)

.3 200mm, 250mm (8”, 10”) – 4.78mm (0.188”)

.2 Joined by threaded fittings or cut grooves:

.1 up to 200mm (8”) – Schedule 40

.2 200mm (8”) and larger – Schedule 30

.2 Fittings and joints to ANSI/NFPA 13:

.1 Ferrous: screwed, welded, flanged or roll grooved.

.2 Copper tube: screwed, soldered, brazed.

.3 System piping 50mm (2") and smaller shall be Schedule 40 and joined with threaded fittings in accordance with NFPA 13. Larger sizes shall be Schedule 10 and joined by welding or groove joining methods in accordance with NFPA 13.

.4 All grooved products shall be of one manufacturer. All grooved end fittings shall be of "full flow" design and manufactured from ductile iron conforming to ASTM A-536. Grooved coupling shall be designed with angle bolt pads to provide a rigid joint except where flexibility is required. "Flush cap" or "flush seal" gaskets shall be used with couplings in dry pipe systems.

.5 Cast iron floor and ceiling plates with set screws shall be provided whenever pipe passes through walls, floors and partitions. In finished areas, plates shall be chrome plated.

.3 Valves:

.1 ULC listed for fire protection service.

.2 Up to NPS 2: bronze, screwed ends, O. S. & Y. gate.

.3 NPS 2 1/2 and over: cast iron, flanged or roll grooved ends, indicating butterfly valve; OS & Y gate.

.4 Swing check valves.

.5 Ball drip.

.6 All water supply and zone isolation valves shall be monitored with tamper switches. Electric wiring for control and alarm components will be provided Under Division 26.

.7 Valves controlling water supply and alarm shut-off shall be of O. S. & Y. type with rising stem or approved gear operated butterfly valves with supervisory switch. Where a grooved piping system is installed, grooved end isolation/control valves may be used. Valves shall be supervised by a factory installed double throw/double pole switch.

.8 All O. S. & Y. gate vales shall be monitored with tamper switches. Electric wiring for control and alarm components shall be provided under Division 26.

.4 Pipe hangers:

.1 ULC listed for fire protection services.

.2 Hanger standards shall conform to Section 3-10 of NFPA 13. Use "C" clamps complete with lock nuts and restraining straps. Hangers shall be supplied and installed in accordance with NFPA 13. C-type clamps used to attach hangers to the building structure shall be equipped with lock nuts and retaining straps.

.3 Sway bracing shall be installed as per Section 3-5.3.5 of NFPA 13.

2.2 Sprinkler Heads

.1 General: to ANSI/NFPA 13 and ULC listed for fire services.

.2 All sprinklers in suspended ceiling areas shall be chrome finish recessed type with chrome flush type escutcheon plates. All sprinklers in open ceiling areas shall be of brass finish upright or pendent types. All sidewall sprinklers shall be chrome finish horizontal type.

.3 Sprinkler shall be protected from mechanical injury by standard guards where necessary. The proximity of sprinklers to heating units shall be taken into consideration in determining the temperature rating.

.4 Adjacent to each sprinkler alarm valve, provide one (1) 12-sprinkler capacity Underwriters approved cabinet complete with various type and temperatures of sprinklers in ratio to the numbers installed of each type along with a standard sprinkler wrench.

2.3 Pipe Sleeves

.1 Provide pipe sleeves where piping passes through walls, floors, and roofs.

.2 Secure sleeves in position and location during construction.

.3 Provide sleeves of sufficient length to pass through entire thickness of walls, floors, and roofs.

.4 Provide 2.5 cm minimum clearance between exterior of piping and interior of sleeve or core-drilled hole.

.1 Firmly pack space with mineral wool insulation.

.2 Seal space at both ends of sleeve or core-drilled hole with [plastic waterproof cement which will dry to firm but pliable mass, provide mechanically adjustable segmented elastomeric seal.

.3 In fire walls and fire floors, seal both ends of pipe sleeves or core-drilled holes with ULC listed fill, void, or cavity material.

.5 Sleeves in Masonry and Concrete Walls, Floors, and Roofs:

.1 Provide hot-dip galvanized steel, ductile-iron, cast-iron sleeves.

.2 Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in core-drilled hole are completely grouted smooth.

.6 Sleeves in Other than Masonry and Concrete Walls, Floors, and Roofs:

.1 Provide 0.61 mm thick galvanized steel sheet.

2.4 Escutcheon Plates

.1 Provide split hinged type metal plates for piping passing through walls, floors, and ceilings in exposed spaces.

.2 Provide polished chromium-plated finish on copper alloy plates in finished spaces.

.3 Provide paint finish on metal plates in unfinished spaces.

2.5 Spare Parts Cabinet

.1 For storage of maintenance materials, spare sprinkler heads and special tools.

.2 Construct to sprinkler head manufacturer’s standard.

2.6 Inspector’s Test Connection

.1 Locate inspector's test connection at hydraulically most remote part of each system, provide test connections approximately 3m above floor for each sprinkler system or portion of each sprinkler system equipped with alarm device.

.2 Provide test connection piping to location where discharged without property damage.

.3 Provide discharge orifice of same size as corresponding sprinkler orifice.

2.7 Signs

.1 Attach properly lettered and approved metal signs to each valve and alarm device to ANSI/NFPA 13.

.2 Permanently fix hydraulic design data nameplates to riser of each system.

PART 3 EXECUTION

3.1 Manufacturer’s Instruction

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

3.2 Above Ground Piping Systems

.1 Provide fittings for changes in direction of piping and for connections.

.1 Make changes in piping sizes through tapered reducing pipe fittings, bushings will not be permitted.

.2 Perform welding in shop; field welding will not be permitted.

.3 Conceal piping in areas with suspended ceiling.

3.3 Pipe Installation

.1 Install piping straight and true to bear evenly on hangers and supports. Do not hang piping from plaster ceilings.

.2 Keep interior and ends of new piping and existing piping thoroughly cleaned of water and foreign matter.

.3 Keep piping systems clean during installation by means of plugs or other approved methods. When work is not in progress, securely close open ends of piping to prevent entry of water and foreign matter.

.4 Inspect piping before placing into position.

.5 Install spare parts cabinet as indicated.

.6 Valve identification:

.1 Identify drain valve and auxiliary valves.

3.4 Disinfection

.1 Disinfect new piping.

.2 Fill piping systems with solution containing minimum of 50 parts per million of chlorine and allow solution to stand for minimum of 24 hours.

.3 Flush solution from systems with clean water until maximum residual chlorine content is not greater than 0.2 part per million or residual chlorine content of domestic water supply.

.4 Obtain at least two consecutive satisfactory bacteriological samples from piping, analyzed by certified laboratory, and submit results prior to piping being placed into service.

3.5 Field Painting

.1 Clean, pre-treat, prime, and paint new systems including piping, conduit, hangers, supports, miscellaneous metalwork, and accessories.

.2 Apply coatings to clean, dry surfaces, using clean brushes.

.3 Clean surfaces to remove dust, dirt, rust, and loose mill scale.

.4 Immediately after cleaning, provide metal surfaces with 1 coat of pretreatment primer applied to minimum dry film thickness of 0.3 ml, and one coat of zinc chromate primer applied to minimum dry film thickness of 1.0 ml.

.5 Shield sprinkler heads with protective covering while painting is in progress.

.6 Upon completion of painting, remove protective covering from sprinkler heads.

.7 Remove sprinkler heads which have been painted and replace with new sprinkler heads.

.8 Provide primed surfaces with following:

.1 Piping in Finished Areas:

.1 Provide primed surfaces with 2 coats of paint to match adjacent surfaces.

.2 Provide valves and operating accessories with 1 coat of red alkyd gloss enamel applied to minimum dry film thickness of 1.0 mil.

.3 Provide piping with 50 mm wide red enamel bands self-adhering red plastic bands spaced at maximum of 6 m intervals throughout piping systems.

.2 Piping in Unfinished Areas:

.1 Finish painting not required in spaces above suspended ceilings, crawl spaces, pipe chases, mechanical equipment room, and spaces where walls or ceiling are not painted or not constructed of a pre- finished material.

.2 Provide piping with 50 mm wide red enamel bands self-adhering red plastic bands spaced at maximum of 6 m intervals.

3.6 Field Quality Control

.1 Site Test, Inspection:

.1 Perform test to determine compliance with specified requirements in presence of Departmental Representative.

.2 Test, inspect, and approve piping before covering or concealing.

.3 Preliminary Tests:

.1 Hydrostatically test each system at 200 psig for a 2 hour period with no leakage or reduction in pressure.

.2 Flush piping with potable water in accordance with NFPA 13.

.3 Piping above suspended ceilings: tested, inspected, and approved before installation of ceilings.

.4 Test alarms and other devices.

.5 Test water flow alarms by flowing water through inspector's test connection. When tests have been completed and corrections made, submit signed and dated certificate in accordance with NFPA 13.

.4 Formal Tests and Inspections:

.1 Do not submit request for formal test and inspection until preliminary test and corrections are completed and approved.

.2 Submit written request for formal inspection at least 15 days prior to inspection date.

.3 Repeat required tests as directed.

.4 Correct defects and make additional tests until systems comply with contract requirements.

.5 Furnish appliances, equipment, instruments, connecting devices, and personnel for tests.

.6 Authority of Jurisdiction will witness formal tests and approve systems before they are accepted.

.7 Altered and relocated sprinkler system to be inspected and tested in conformance with NFPA 125.

3.7 Placing in Service

.1 When the entire fire protection system has been completed to the satisfaction of the Departmental Representatives and when operating and maintenance instructions have been provided, the Fire Protection Contractor shall, in the presence of the Departmental Representative, demonstrate the complete operation and maintenance required to the operating personnel. A complete operational test conducted on the entire installation for the purpose of verification of compliance with all applicable standards and codes shall be carried out.

.2 Three copies of a complete operating manual shall be provided, which must include the following:

- .1 Detailed instructions for the normal maintenance of all installed equipment including operational procedures, frequency of operational checks, service instructions and troubleshooting instructions.
- .2 Valve schedule for all valves including location, service type and normal position for all systems.
- .3 Schematic showing the location of each excess pressure pump breaker, inspectors test valves, low point drains and flow switches where applicable.
- .4 Warranties and certificates.
- .5 Manufacturer's operating and maintenance manuals.
- .6 Description of the operation of each system and the function of each piece of equipment.
- .7 Lubrication schedule for all lubricated equipment including recommended lubricants.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1 Section 01 01 50 General Instructions

.2 Section 23 05 05 Installation of Pipework

.3 Section 23 07 19 Thermal Insulation for Piping

1.2 References

.1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers International (ASME).

.1 ANSI/ASME B16.15, Cast Bronze Threaded Fittings, Classes 125 and 250

.2 ANSI/ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.

.3 ANSI/ASME B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

.4 ANSI/ASME B16.24, Cast Copper Alloy Pipe Flanges and Flanged Fittings, Class 150, 300, 400, 600, 900, 1500 and 2500.

.2 American Society for Testing and Materials International, (ASTM).

.1 ASTM A 307 Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength

.2 ASTM B 88M, Standard Specification for Seamless Copper Water Tube (Metric).

.3 American Water Works Association (AWWA).

.1 AWWA C111, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

.4 Canadian Standards Association (CSA International).

.1 CSA B242, Groove and Shoulder Type Mechanical Pipe Couplings.

.5 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).

.1 MSS-SP-70, Cast Iron Gate Valves, Flanged and Threaded Ends.

.2 MSS-SP-71, Cast Iron Swing Check Valves, Flanged and Threaded Ends.

.3 MSS-SP-80, Bronze Gate, Globe, Angle and Check Valves.

.6 National Sanitation Foundation (NSF).

.1 NSF 61, Drinking Water System Components.

1.3 Submittals

.1 Submittals in accordance with Section 01 01 50 - General Instructions.

.2 Provide maintenance data for incorporation into manual specified in Section 01 01 50 – General Instructions.

1.4 Health and Safety

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

1.5 Waste Management and Disposal

.1 Separate waste materials for reuse and recycling in accordance with Division 1 – General Requirements.

.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 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.

.5 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan

.6 Fold up metal banding, flatten and place in designated area for recycling.

1.6 Quality Assurance

.1 All potable water system components shall conform to NSF Standard 61.

PART 2 PRODUCTS

2.1 Piping

.1 Domestic hot, cold and hot recirculation water systems, within building.

.1 Above ground: copper tube, hard drawn, type L: to ASTM B 88M to NPS 4 size.

.2 Buried or embedded: copper tube, soft annealed, type K: to ASTM B 88M, in long lengths and with no buried joints.

2.2 Fittings

.1 Bronze pipe flanges and flanged fittings, Class 150 and 300: to ANSI B16.24.

.2 Cast bronze threaded fittings, Class 125 and 250: to ANSI/ASME B16.15.

.3 Cast copper, solder type: to ANSI B16.18.

.4 Wrought copper and copper alloy, solder type: to ANSI/ASME B16.22.

.5 NPS 2 to NPS 4: roll grooved to CSA B242.

2.3 Joints

.1 Rubber gaskets, 1.6mm thick: to ANSI/AWWA C111/A21.11.

.2 Bolts, nuts, hex head and washers: to ASTM A307, heavy series.

.3 Solder: 95/5 tin copper alloy or brazing.

.4 Teflon tape: for threaded joints.

.5 Grooved couplings: designed with angle bolt pads to provide rigid joint, complete with EPDM flush seal gasket.

.6 Dielectric connections between dissimilar metals: dielectric fitting to ASTM F492, complete with thermoplastic liner.

2.4 Gate Valves

.1 NPS2 and under, soldered:

.1 Rising stem: to MSSSP-80, Class 125, 860 kPa, bronze body, screw-in bonnet, solid wedge disc.

.2 NPS2 and under, screwed:

.1 Rising stem: to MSSSP-80, Class 125, 860 kPa, bronze body, screw-in bonnet, solid wedge disc.

.3 NPS2-1/2 and over, in mechanical rooms, flanged:

.1 Rising stem: to MSSSP-70, Class 125, 860 kPa, flat flange faces, cast-iron body, OS & Y bronze trim.

.4 NPS2-1/2 and over, other than mechanical rooms, flanged:

.1 Non-rising stem: to MSSSP-70, Class 125, 860 kPa, flat flange faces, cast- iron body, bronze trim, bolted bonnet.

2.5 Globe Valves

.1 NPS2 and under, soldered:

.1 To MSSSP-80, Class 125, 860 kPa, bronze body, renewable composition disc, screwed over bonnet.

.2 Lockshield handles: as indicated.

.2 NPS2 and under, screwed:

.1 To MSSSP-80, Class150, 1MPa, bronze body, screwed over bonnet, renewable composition disc.

.2 Lockshield handles: as indicated.

2.6 Swing Check Valves

.1 NPS 2 and under, soldered:

.1 To MSSSP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, re-grindable seat.

.2 NPS2 and under, screwed:

.1 To MSSSP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, re-grindable seat.

.3 NPS2-1/2 and over, flanged:

.1 To MSSSP-71, Class 125, 860 kPa, cast iron body, flat flange faces, renewable seat, bronze disc, bolted cap.

2.7 Ball Valves

.1 NPS2 and under, screwed:

.1 Class150.

.2 Bronze body, chrome plated brass ball, PTFE Teflon adjustable packing, brass gland and PTFE Teflon seat, steel lever handle.

.2 NPS2 and under, soldered:

.1 To ANSI B16.18, Class150.

.2 Bronze body, chrome plated brass ball, PTFE Teflon adjustable packing, brass gland and PTFE Teflon seat, steel lever handle, with NPT to copper adaptors.

2.8 Drain Valves

.1 Drain valves shall be provided with cap and chain.

.2 Drain and hose valves 20mm (3/4”) and smaller:

.1 Sediment Faucets.

.2 Ball valves.

2.9 Plumbing Piping

.1 Water supply piping under concrete slabs or in walls shall be encased in standard weight flexible polyethylene pipe one size larger than copper tubing. All joints to be wrapped in plastic wrapping tape.

2.10 Dielectric Unions

.1 Insulating dielectric unions and flange unions shall be installed when adapting between dissimilar metallic pipe for domestic water supply piping, and domestic water storage tanks. Elsewhere, unions and adaptors for copper piping shall be cast brass pressure fittings.

2.11 Expansion Joints

.1 Domestic and industrial water: Annular close pitch corrugated metal hose with Type 316L stainless steel butt welded tube. Type 304 single stainless steel outer brain, flanged, welded or screwed ends. Suitable for 1034 kPa (150 psi) working pressure and 50mm traverse.

2.12 Strainers

.1 NPS 2 and under: Full pipeline size, 250 lb. SWP bronze, with screwed ends and a removable plug type screen retainer.

.2 NPS 2-1/2 and over: Full pipeline size, 250 lb. SWP semi-steel, with flanged ends and a bolted screen retainer.

PART 3 EXECUTION

3.1 Installation

.1 Install in accordance with Canadian Plumbing Code and local authority having jurisdiction.

.2 Cut square, ream and clean tubing and tube ends, clean recesses of fittings and assemble without binding.

.3 Assemble all piping using fittings manufactured to ANSI standards.

.4 Install tubing close to building structure to minimize furring, conserve headroom and space. Group exposed piping and run parallel to walls.

.5 Install CWS piping below and away from HWS and HWR and all other hot piping so as to maintain temperature of cold water as low as possible.

.6 Connect to fixtures and equipment in accordance with manufacturer's instructions unless otherwise indicated.

.7 Buried tubing:

.1 Lay in well compacted washed sand in accordance with AWWA Class B bedding.

.2 Bend tubing without crimping or constriction. Minimize use of fittings.

.8 When grooved fittings are used, contractors shall provide proof of training on site by the mechanical coupling manufacturer, or manufacturer's representative prior to the start of installation.

3.2 Valves

.1 Isolate equipment, fixtures and branches with gate or 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 Test pressure: greater of 1.5 times the maximum system operating pressure or 860 kPa.

3.4 Pre- Start-Up Inspections

.1 Systems to be complete, prior to flushing, testing and start-up.

.2 Verify that system can be completely drained.

.3 Ensure that pressure booster systems are operating properly.

.4 Ensure that air chambers, expansion compensators are installed properly.

3.5 Disinfection

.1 Flush out, disinfect and rinse system to requirements of authority having jurisdiction and approval of Departmental Representative.

.2 Upon completion, provide laboratory test reports on water quality for Departmental Representative's approval.

3.6 Performance Verification

.1 Timing: Starts after:

.1 Pressure and leakage tests and disinfection completed, and certificate of completion has been issued by authority having jurisdiction.

.2 Procedures:

.1 Verify that flow rate and pressure meet Design Criteria.

.2 Adjust pressure regulating valves while withdrawal is maximum and inlet pressure is minimum.

.3 Sterilize HWS and HWR systems for Legionella control.

.4 Verify performance of temperature controls.

.5 Verify compliance with safety and health requirements.

.6 Check for proper operation of water hammer arrestors. Run one outlet for 10 seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor or re-charge air chambers. Repeat for outlets and flush valves.

.7 Confirm water quality consistent with supply standards, verifying that no residuals remain as a result of flushing and/or cleaning.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1 Section 01 01 50 General Instructions

.2 Section 23 05 00 Common Work Results for Mechanical

.3 Section 23 05 05 Installation of Pipework

1.2 References

.1 American Society for Testing and Materials International, (ASTM).

.1 ASTM B 32, Specification for Solder Metal.

.2 ASTM B 306, Specification for Copper Drainage Tube (DWV).

.3 ASTM C 564, Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

.2 Canadian Standards Association (CSA International).

.1 CAN/CSA-B70, Cast Iron Soil Pipe, Fittings and Means of Joining.

.2 CAN/CSA-B125, Plumbing Fittings.

1.3 Submittals

.1 Submittals in accordance with Section 01 01 50 - General Instructions.

.2 Provide maintenance data for incorporation into manual specified in Section 01 01 50 – General Instructions.

1.4 Health and Safety

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

1.5 Waste Management and Disposal

.1 Separate waste materials for reuse and recycling in accordance with Division 01 – General Requirements.

.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 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.

.5 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan

.6 Fold up metal banding, flatten and place in designated area for recycling.

PART 2 PRODUCTS

2.1 Copper Tube and Fittings

.1 Above ground sanitary storm and vent, Copper Type DWV to: ASTM B 306.

.1 Fittings.

.1 Cast brass: to CAN/CSA-B125.

.2 Wrought copper: to CAN/CSA-B125.

.2 Solder: tin-lead, 50:50, type 50A or lead free, tin-copper alloy 95:5, type TA to ASTM B 32.

2.2 Cast Iron Piping and Fittings

.1 Buried sanitary storm and vent, cast iron (minimum NPS 2) to: CAN/CSA-B70.

.1 Joints.

.1 Mechanical joints.

.1 Neoprene or butyl rubber compression gaskets: to ASTM C 564 or CAN/CSA-B70.

.2 Stainless steel clamps.

.2 Above ground sanitary storm and vent: Cast iron to CAN/CSA-B70.

.1 Joints.

.1 Mechanical joints.

.1 Neoprene or butyl rubber compression gaskets with stainless steel clamps.

2.3 ABS Piping

.1 Drainage piping under the building, provided that such piping does not pass through any fire separations, may be as follows, at the contractor's option:

.1 Underground sanitary drainage piping under building, 150mm in diameter and smaller shall be certified to the current version of CSA B181.1, ABS Drain, Waste and Vent Pipe and Fittings. Piping shall be solid wall in construction. Cell core piping is not acceptable.

PART 3 EXECUTION

3.1 Installation

.1 In accordance with Section 23 05 05 - Installation of Pipework.

.2 Install in accordance with Canadian Plumbing Code, Provincial Plumbing Code and local authority having jurisdiction.

.3 Install buried pipe on 150 mm bed of clean washed sand, shaped to accommodate hubs and fittings, to line and grade as indicated. Backfill with 150 mm of clean washed sand.

.4 Install above ground piping parallel and close to walls and ceilings to conserve headroom and space, and to grade as indicated.

3.2 Testing

.1 Pressure test buried systems before backfilling.

.2 Hydraulically test to verify grades and freedom from obstructions.

3.3 Performance Verification

.1 Cleanouts:

- .1 Ensure accessible and that access doors are correctly located.
- .2 Open, cover with linseed oil and re-seal.
- .3 Verify that cleanout rods can probe as far as the next cleanout, at least.

.2 Test to ensure traps are fully and permanently primed.

.3 Storm water drainage:

- .1 Verify domes are secure.
- .2 Ensure weirs are correctly sized and installed correctly.
- .3 Verify provisions for movement of roof system.
- .4 Ensure that fixtures are properly anchored, connected to system and effectively vented.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1 Read Division 1 General Instructions in conjunction with these specifications. Division 1 and this section shall form a part of and shall apply to all Mechanical Sections. The most stringent requirements of this and other Mechanical Sections must be adhered to.

.2 The Mechanical work shall consist of the supply and installation of complete and operable mechanical systems and shall include all necessary labour, plant, materials, and incidentals for the work involved as listed in the following division sections:

.1	Section 21	Fire Supression
.2	Section 22	Plumbing
.3	Section 23	Heating, Ventilation & Air Conditioning
.2	Section 25	Integrated Automation

1.2 Submittals

.2 Submittals: in accordance with Section 01 01 50 - General Instructions.

.3 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 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 In addition to transmittal letter referred to in Section 01 01 50 - General Instructions: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

.5 Closeout Submittals:

- .2 Provide operation and maintenance data for incorporation into manual specified in Section 01 01 50 – General Instructions.
- .3 Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative before final inspection.
- .4 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 Color coding chart.

.5 Maintenance data to include:

.1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.

.2 Data to include schedules of tasks, frequency, tools required and task time.

.6 Performance data to include:

.1 Equipment performance verification test results.

.2 Special performance data as specified.

.7 Approvals:

.1 Submit 2 copies of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless directed by Departmental Representative.

.2 Make changes as required and re-submit as directed by Departmental Representative.

.8 Additional data:

.1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.

.9 Site records:

.1 Departmental Representative will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.

.2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.

.3 Use different color waterproof ink for each service.

.4 Make available for reference purposes and inspection.

.10 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 Departmental Representative for approval and make corrections as directed.

.4 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.

1.3 Regulations

.1 Comply with most stringent requirements of NBC, Provincial and Municipal regulations and by-laws, specified standards, codes and this specification. Practices contained in these standards or standards suggested or recommended by reference organizations, are to be taken as minimum requirements.

.2 Furnish certificates confirming work installed conforms to requirements of authorities having jurisdiction.

.3 The “Authority Having Jurisdiction” is Fire Protection Engineering Services of Human Resources and Skills Development Canada (HRSDC).

.4 Drawings and specifications should not conflict with these Regulations but where there are apparent discrepancies, notify the Departmental Representative in writing and obtain clarifications before proceeding with the work.

1.4 Quality Assurance

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

1.5 Definitions

.1 Definitions used in this Division will have the following meaning:

.1 "Concealed": pipes, ducts, etc., in trenches, chases, furred spaces, pipe shafts, or hung ceilings.

.2 “Exposed": regarding insulation and painting of piping, ducts, etc., will mean that they are not "concealed", as defined herein.

.3 "Piping": includes, in addition to pipe, all fittings, valves, hangers, other accessories which comprise a system.

.4 "Provide": to supply and install, complete and ready for use.

1.6 Drawings

.1 Drawings:

.1 Are not intended to show structural details or architectural features.

.2 Are not to be scaled.

.3 Except where dimensioned, indicate general mechanical layouts only.

.2 Provide field (shop) drawings to indicate relative position of various services when required by Departmental Representative and obtain approval before commencing work.

1.7 Maintenance

.1 Furnish spare parts in accordance with Section 01 01 50 – General Instructions as indicated in the detailed product specification clauses.

.2 Provide access doors for concealed expansion joints, traps, strainers, cleanouts, balance dampers, fire dampers, other parts requiring accessibility for operating and maintenance.

.3 In suspended panel ceilings, use panel in place of access door; provide in such panel a button or other means of identification and easy removal when necessary.

1.8 Delivery, Storage and Handling

.1 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 01 50 – General Instructions.

PART 2 PRODUCTS

2.1 Access Doors

.1 Access door size shall be as indicated and where not indicated, make 305mm x 406mm [12" x 16"] minimum or 610mm x 457mm [24" x 18"] where persons have to enter. For acoustical ceilings, conform to architectural panel pattern.

.2 Unless otherwise indicated, access doors shall be hinged, flush type, steel framed panel, 14 gauge minimum, satin finished galvanized steel or type 304 stainless steel, with anchor straps for wet areas, washrooms, and all walls finished in ceramic tile.

.3 Hinges shall be concealed, spring hinge to allow door to open 175°. Locking devices shall be flush cam type, master key operated, doors and frames shall have prime coated rust inhibiting paint, unless made of stainless steel.

.4 Where doors are required in fire rated walls, access doors shall be uninsulated and for all fire rated ceilings and walls where maximum temperature rise limitation is applicable, shall be insulated. All fire rated access doors shall have Warnock Hersey or ULC listed 2 hour fire rating and shall be installed in accordance with NFPA 80 and manufacturer's installation instructions.

PART 3 EXECUTION

3.4 Co-ordination

.1 Co-ordinate work with work of other sections to avoid conflict.

.2 Locate distribution systems, equipment, and materials to provide minimum interferences and maximum usable space.

.3 Where interference occurs, Departmental Representative shall approve relocation of equipment and materials, regardless of installation sequence.

3.5 Cleaning

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

3.6 Cutting and Patching

.1 Make arrangements with General Contractor for all cutting and patching in this work.

.2 Minimize cutting and patching. Set sleeves and mark openings in concrete or masonry.

3.7 Waterproofing

.1 Where any work pierces waterproofing including waterproofing concrete, the method of installation shall be as approved by the Departmental Representative before the work is done. Supply and install all necessary sleeves, caulking, roof curbs, and flashing required and make the openings watertight.

3.8 Protection of Work

.1 Protect equipment and material during construction from the weather, moisture, dust, painting, plastering and physical damage. Clean and return to "as new" condition.

.2 Mask or grease and cover machined surfaces. Firmly secure covers over equipment openings and open ends of piping, conduit and ductwork as work progresses. Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

.3 Any equipment that has operating parts, bearings or machined surfaces that show signs of rusting, pitting or physical damage will be rejected.

.4 Refinish damaged or marred factory finishes to the satisfaction of the Departmental Representative, using equal quality materials.

3.9 Field Quality Control

.1 Site Tests: conduct following tests in accordance with Section 01 01 50 - General Instructions and submit report as described in PART 1 - SUBMITTALS.

.2 Manufacturer's Field Services:

.1 Where specified, 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.

3.10 Demonstration

.1 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 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 Use operation and maintenance manual and as-built drawings as part of instruction materials.

.4 Instruction duration time requirements as specified in appropriate sections, but shall in no way be less than four (4) hours for the plumbing systems, four (4) hours for the mechanical systems (with the EMCS training time specified separately) and four (4) hours for the fire protection systems.

END OF SECTION

PART 1 GENERAL

1.1 Use of Systems

.1 Use of new permanent heating and ventilating systems for supplying temporary heat or ventilation is permitted only under the following conditions:

- .1 Entire system is complete, pressure tested, cleaned, flushed out.
- .2 Specified water treatment system has been commissioned, water treatment is being continuously monitored.
- .3 Building has been closed in, areas to be heated/ventilated are clean and will not thereafter be subjected to dust-producing processes.
- .4 There is no possibility of damage from any cause.
- .5 Supply ventilation systems are protected by filters, which shall be inspected daily, changed every week or more frequently as required.
- .6 Return systems have approved filters over all openings, inlets, outlets.
- .7 All systems will be:
  - .1 operated as per manufacturer's recommendations or instructions.
  - .2 operated by Contractor.
  - .3 monitored continuously by Contractor.
- .8 Warranties and guarantees are not thereby relaxed.
- .9 Regular preventive and all other manufacturers recommended maintenance routines are performed by Contractor at his own expense and under supervision of Departmental Representative.
- .10 Before static completion, entire system to be refurbished, cleaned internally and externally, restored to "as- new" condition, filters in air systems replaced.

.2 Filters referred to herein are over and above those specified elsewhere in this specification.

.3 Exhaust systems are not included in any approvals for temporary heating ventilation.

PART 2 PRODUCTS

2.1 Not Used

.1 Not Used.

PART 3 EXECUTION

3.1 Not Used

.1 Not Used.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1 Section 01 01 50 General Instructions

.2 Section 23 05 00 Common Work Results – Mechanical

.3 Section 23 08 02 Cleaning and Start-up of Mechanical Piping Systems

1.2 References

.1 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.181, Ready-Mixed Organic Zinc-Rich Coating.

1.3 Waste Management and Disposal

.1 Separate and recycle waste materials in accordance with Division 01 - General Requirements.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.

.4 Divert unused metal materials from landfill to metal recycling facility approved by Departmental Representative.

PART 2 PRODUCTS

2.1 Not Used

.1 Not Used

PART 3 EXECUTION

3.1 Connections to Equipment

.1 In accordance with manufacturer's instructions unless otherwise indicated.

.2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.

3.2 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, or components.

3.3 Pipework Installation

.1 Protect openings against entry of foreign material.

.2 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.

.3 Assemble piping using fittings manufactured to ANSI standards.

.4 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.

.5 Install concealed pipework to minimize furring space, maximize headroom, conserve space.

.6 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 chain operators on valves NPS 2-1/2 and larger where installed more than 2400mm above floor in Mechanical Rooms.

.7 Install dielectric coupling between dissimilar metals.

3.4 Sleeves

.1 General: Install where pipes pass through masonry, concrete structures, fire rated assemblies, and elsewhere as indicated.

.2 Material: Schedule 40 black steel pipe.

.3 Construction: Foundation walls and where sleeves extend above finished floors to have annular fins continuously welded on at mid-point.

.4 Sizes: 6 mm minimum clearance between sleeve and un-insulated pipe or between sleeve and insulation.

.5 Installation:

.1 Concrete, masonry walls, concrete floors on grade: Terminate flush with finished surface.

.2 Other floors: Terminate 25mm above finished floor.

.6 Sealing:

.1 Foundation walls and below grade floors: Fire retardant, waterproof non-hardening mastic.

.2 Elsewhere: Provide space for firestopping. Maintain fire rating integrity.

.3 Sleeves installed for future use: Fill with lime plaster or other easily removable filler.

.4 Ensure no contact between copper pipe or tube and sleeve.

3.5 Escutcheons

.1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.

.2 Construction: One piece type with set screws. Chrome or nickel plated brass or type 302 stainless steel.

.3 Sizes: Outside diameter to cover opening or sleeve. Inside diameter to fit around pipe.

3.6 Cleaning of Piping Systems

.1 Before start-up, clean interior of piping systems in accordance with requirements of Section 23 08 02 - 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.

3.7 Pressure Testing of Equipment and Pipework

.1 Advise Departmental Representative 48 hours minimum prior to performance of pressure tests.

.2 Pipework: Test as specified in relevant sections.

.3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time.

.4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.

.5 Pay costs for repairs or replacement, retesting, and making good. Departmental Representative to determine whether repair or replacement is appropriate.

.6 Conceal work only after approval and certification of tests by Departmental Representative.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1 Section 01 01 50 — General Instructions

.2 Section 23 05 00 — Common Work Results – Mechanical

1.2 References

.1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)

.1 ASHRAE 90.1, Energy Code for Buildings Except Low-Rise Residential Buildings.

.2 Electrical Equipment Manufacturers' Advisory Council (EEMAC)

.3 Workplace Hazardous Material Information System (WHMIS)

1.3 Section Includes

.1 Electrical work to conform to Division 26 including the following:

.1 Supplier and installer responsibility is indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.

.2 Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50 V which are related to control systems specified in Division 23. Refer to Division 26 for quality of materials and workmanship.

1.4 Shop Drawings

.1 Submit shop drawings in accordance with Section 01 01 50 - General Instructions.

1.5 Closeout Submittals

.1 Provide maintenance data for motors, drives and guards for incorporation into manual specified in Section 01 01 50 - General Instructions.

1.6 Waste Management and Disposal

.1 Separate and recycle waste materials in accordance with Division 01 - General Requirements.

.2 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.

.3 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.4 Dispose of packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

PART 2 PRODUCTS

2.1 General

.1 Motors to be high efficiency, in accordance with local Hydro company standards and the requirements of ASHRAE 90.1.

2.2 Motors

.1 Provide motors for mechanical equipment as specified.

.2 Motors under 373 W (1/2 HP): speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120V, unless otherwise specified or indicated.

.3 Motors 373 W (1/2 HP) and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40°C, 3 phase, 208V, unless otherwise specified or indicated.

2.3 Belt Drives

.1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.

.2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise specified.

.3 For motors under 7.5 kW (10HP): standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.

.4 For motors 7.5 kW (10HP) and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.

.5 Correct size of sheave to be determined during commissioning.

.6 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.

.7 Motor slide rail adjustment plates to allow for centre line adjustment.

2.4 Drive Guards

.1 Provide guards for unprotected drives.

.2 Guards for belt drives:

- .1 Expanded metal screen welded to steel frame.
- .2 Minimum 1.2mm thick sheet metal tops and bottoms.
- .3 38mm dia holes on both shaft centres for insertion of tachometer.
- .4 Removable for servicing.

.3 Provide means to permit lubrication and use of test instruments with guards in place.

.4 Install belt guards to allow movement of motors for adjusting belt tension.

.5 Guard for flexible coupling:

- .1 "U" shaped, minimum 1.6 mm thick galvanized mild steel.
- .2 Securely fasten in place.
- .3 Removable for servicing.

.6 Unprotected fan inlets or outlets:

- .1 Wire or expanded metal screen, galvanized, 19 mm mesh.
- .2 Net free area of guard: not less than 80% of fan openings.
- .3 Securely fasten in place.
- .4 Removable for servicing.

PART 3 EXECUTION

3.1 Installation

.1 Fasten securely in place.

.2 Make removable for servicing, easily returned into, and positively in position.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1	Section 01 01 50	General Instructions
.2	Section 01 91 00	Commissioning
.3	Section 23 05 00	Common Work Results – Mechanical
.4	Section 23 05 13	Common Motor Requirements for HVAC Equipment
.5	Section 23 08 00	Commissioning of Mechanical Systems

1.2 References

.1 ANSI/UL 508 Industrial Control Equipment

.2 Electrical Equipment Manufacturers' Advisory Council (EEMAC)

.3 Workplace Hazardous Material Information System (WHMIS)

1.3 Section Includes

.1 Electrical work to conform to Division 26 including the following:

.1 Supplier and installer responsibility is indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.

.2 Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50 V which are related to control systems specified in Division 23. Refer to Division 26 for quality of materials and workmanship.

1.4 Shop Drawings

.1 Submit shop drawings in accordance with Section 01 01 50 - General Instructions.

1.5 Closeout Submittals

.1 Provide maintenance data for motors, drives and guards for incorporation into the manual specified in Section 01 01 50 - General Instructions.

1.6 Waste Management and Disposal

.1 Separate and recycle waste materials in accordance with Division 01 - General Requirements.

.2 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.

.3 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.4 Dispose of packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

1.7 Warranty:

.1 The VFD shall be warranted by the manufacturer for a period of 36 months from date of shipment. The warranty shall include parts, labor, travel costs and living expenses incurred by the manufacturer to provide factory authorized on-site service. The warranty shall be provided by the VFD manufacturer.

PART 2 PRODUCTS

2.1 General

.1 Furnish complete Variable Frequency Drives (VFD's), as specified herein, for mechanical equipment where noted on drawings, equipment schedules, or specifications.

.2 All standard and optional features shall be included within the VFD enclosure, unless otherwise specified. VFD shall be housed in a metal NEMA 1 enclosure, or other NEMA type according to the installation and operating conditions at the job site. The VFD's UL listing shall allow mounting in plenum or other air handling compartments. If a NEMA 12 enclosure is required for the plenum rating, the manufacturer must supply a NEMA 12 rated VFD.

.3 The VFD shall convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of three-phase AC motors. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor magnetization current suitable for centrifugal pump and fan control and to eliminate the need for motor de-rating.

.4 With the motor's rated voltage applied to the VFD input, the VFD shall allow the motor to produce full rated power at rated amps, RMS fundamental volts, and speed without using the motor's service factor. VFDs utilizing sine weighted/coded modulation (with or without 3rd harmonic injection) must provide data verifying that the motors will not draw more than full load current during full load and full speed operation.

.5 The VFD shall include an input full-wave bridge rectifier and maintain a fundamental power factor near unity regardless of speed or load.

.6 The VFD and options shall be tested to ANSI/UL Standard 508. The complete VFD, including all specified options, shall be assembled by the manufacturer, which shall be UL-508 certified for the building and assembly of option panels. Assembly of the option panels by a third-party panel shop is not acceptable. The appropriate UL stickers shall be applied to both the VFD and option panel, in the case where these are not contained in one panel. When these VFDs are to be located in Canada, CSA or C-UL certifications shall apply. Both VFD and option panel shall be manufactured in ISO 9001 certified facilities.

.7 The VFD shall have DC link reactors on both the positive and negative rails of the DC bus to minimize power line harmonics. VFDs without DC link reactors shall provide a minimum 3% impedance line reactor.

.8 The VFD's full load amp rating shall meet or exceed NEC Table 430-150. The VFD shall be able to provide full rated output current continuously, 110% of rated current for 60 seconds and 160% of rated current for up to 0.5 second while starting.

.9 The VFD shall be able to provide full torque at any selected frequency from 28 Hz to base speed to allow driving direct drive fans without de-rating.

.10 An automatic energy optimization selection feature shall be provided standard in the VFD. This feature shall automatically and continually monitor the motor's speed and load and adjust the applied voltage to maximize energy savings and provide up to an additional 3% to 10% energy savings.

.11 Input and output power circuit switching shall be able to be accomplished without interlocks or damage to the VFD. Switching rate may be up to 1 time per minute on the input and unlimited on the output.

.12 An automatic motor adaptation test algorithm shall measure motor stator resistance and reactance to optimize performance and efficiency. It shall not be necessary to run the motor or de-couple the motor from the load to run the test.

.13 Galvanic and/or optical isolation shall be provided between the VFD's power circuitry and control circuitry to ensure operator safety and to protect connected electronic control equipment from damage caused by voltage spikes, current surges, and ground loop currents. VFDs, not including either galvanic or optical isolation on both analog I/O and discrete I/O, shall include additional isolation modules.

.14 VFD shall minimize the audible motor noise through the use of an adjustable carrier frequency. The carrier frequency shall be automatically adjusted to optimize motor and VFD efficiencies while reducing motor noise.

.15 Interface Features:

.1 Hand/Start, Off/Stop and Auto/Start selector switches shall be provided to start and stop the VFD and determine the speed reference.

.2 The VFD shall be able to be programmed to provide a 24 V DC output signal to indicate that the VFD is in Auto/Remote mode.

.3 The VFD shall provide digital manual speed control. Potentiometers are not acceptable.

PART 3 EXECUTION

3.1 Installation

.1 Install per manufacturer's instructions.

.2 Install required safety labels.

3.2 Start-up Service

.1 The manufacturer shall provide start-up commissioning of the VFD and its optional circuits by a factory certified service technician who is experienced in start-up and repair services. Sales personnel and other agents who are not factory certified shall not be acceptable as commissioning agents. Start-up services shall include checking for verification of proper operation and installation for the VFD, its options and its interface wiring to the building automation system.

.2 Commissioning:

.1 In accordance with Section 01 91 00 – Commissioning, and Section 23 08 00 – Commissioning of Mechanical Systems.

END OF SECTION

PART 1 GENERAL

1.1 Section Includes

.1 Materials and installation for thermometers and pressure gauges in piping systems.

1.2 Related Sections

.1	Section 01 01 50	General Instructions
.2	Section 23 05 00	Common Work Results – Mechanical
.3	Section 23 05 53	Mechanical Identification

1.3 References

.1 American Society of Mechanical Engineers (ASME).

.1 ASME B40.Grade 1A, Pressure Gauges and Gauge Attachments.

.2 ASME B40.200, Thermometers, Direct Reading and Remote Reading.

.2 Canadian General Standards Board (CGSB).

.1 CAN/CGSB-14.4, Thermometers, Liquid-in-Glass, Self Indicating, Commercial/Industrial Type.

.2 CAN/CGSB-14.5, Thermometers, Bimetallic, Self-Indicating, Commercial / Industrial Type.

1.4 Submittal

.1 Submittals in accordance with Section 01 01 50 – General Instructions.

.2 Submit shop drawings and product data.

1.5 Health and Safety

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

1.6 Waste Management and Disposal

.1 Separate waste materials for reuse and recycling in accordance with Division 01 - General Requirements.

.2 Collect, separate and place in designated containers for packaging in accordance with Waste Management Plan.

.3 Fold up metal banding, flatten and place in designated area for recycling.

.4 Place materials defined as hazardous or toxic waste in designated containers.

.5 Ensure emptied containers are sealed, labelled and stored safely for disposal away from children.

PART 2 PRODUCTS

2.1 General

.1 Design point to be at mid-point of scale or range.

.2 Ranges: as indicated.

2.2 Direct Reading Thermometers

.1 Industrial, digital, variable angle type.

.1 Display: LCD, operate on 35 lux of illumination. No external power needed. Display in Celsius or Fahrenheit with switch.

.2 Casing: High impact ABS plastic.

.3 Stem: adjustable angle.

.4 Socket: comply with industrial standard dimension, fully interchangeable with liquid-in-glass thermometers.

2.3 Thermometer Wells

.1 Copper pipe: copper or bronze.

.2 Steel pipe: brass or stainless steel.

2.4 Pressure Gauges

.1 100 mm [4.0”] dial type: to ASME B40.100, Grade 1A, phosphor bronze bourdon tube having 1.0% accuracy full scale unless otherwise specified.

.1 Casing: Stainless Steel.

.2 Reading: S.I., or S.I./Imperial.

.3 Range: indicate mid-scale under normal operating conditions.

.2 Provide:

.1 Snubber for pulsating operation.

.2 Diaphragm assembly for corrosive service.

.3 Gasketted pressure relief back with solid front.

.4 Bronze stop cock.

PART 3 EXECUTION

3.1 General

.1 Install so they can be easily read from floor or platform. If this cannot be accomplished, install remote reading units.

.2 Install between equipment and first fitting or valve.

3.2 Thermometers

.1 Install in wells on piping. Provide heat conductive material inside well.

.2 Install in locations as indicated.

.3 Install wells as indicated for balancing purposes.

.4 Use extensions where thermometers are installed through insulation.

3.3 Pressure Gauges

.1 Install in locations as indicated.

.2 Use extensions where pressure gauges are installed through insulation.

END OF SECTION

PART 1 GENERAL

1.1 Related Section

.1	Section 01 01 50	General Instructions
.2	Section 23 05 00	Common Work Results – Mechanical
.3	Section 23 05 48	Vibration & Seismic Control for Ductwork, Piping and Equipment

1.2 References

.1 Sheet Metal and Air Conditioning Contractors National Association (SMACNA):

.1 Seismic Restraint Manual, Guidelines for Mechanical Systems.

.2 American National Standards Institute / American Society of Mechanical Engineers (ANSI / ASME):

.1 ANSI / ASME B31.1, Power Piping, (SI Edition).

.3 American Society for Testing and Materials (ASTM):

.1 ASTM A 125, Specification for Steel Springs, Helical, Heat-Treated.

.2 ASTM A 307, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.

.3 ASTM A 563, Specification for Carbon and Alloy Steel Nuts.

.4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS):

.1 MSS SP58, Pipe Hangers and Supports - Materials, Design and Manufacture.

.2 MSS SP69, Pipe Hangers and Supports - Selection and Application.

.3 MSS SP89, Pipe Hangers and Supports - Fabrication and Installation Practices.

.5 National Plumbing Code.

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 all 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 to be in accordance with MSS SP58.

.2 Performance Requirements:

.1 Design supports and hangers to withstand seismic events as specified Section 23 05 48 – Vibration & Seismic Control for Ductwork, Piping and Equipment.

1.4 Submittals

.1 Submittals: in accordance with Section 01 01 50 - General Instructions.

.2 Submit shop drawings and product data for following items:

.1 Bases, hangers and supports.

.2 Connections to equipment and structure.

.3 Structural assemblies.

.3 Quality assurance submittals: submit following in accordance with Section 01 01 50 - General Instructions.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.4 Closeout Submittals:

.1 Provide maintenance data for incorporation into manual specified in Section 01 01 50 – General Instructions.

1.5 Quality Assurance

.1 Health and Safety:

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

1.6 Delivery, Storage and Handling

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 01 50 - General Instructions.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Division 01 - General Requirements.

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 after manufacture.

.2 Use electro-plating galvanizing process.

.3 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 to MSS SP69.

.3 Hanger rods: threaded rod material to MSS SP58.

.1 Ensure that hanger rods are subject to tensile loading only.

.2 Provide linkages where lateral or axial movement of pipework is anticipated.

.4 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.

.5 Hanger rod attachment: material to MSS SP58.

.1 Use expansion anchor on existing concrete structure.

.6 Adjustable clevis: material to MSS SP 69, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.

.1 Ensure "U" has hole in bottom for rivetting to insulation shields.

PART 3 EXECUTION

3.1 Installation

.1 Install in accordance with:

.1 Manufacturer's instructions and recommendations.

.2 Vibration Control Devices:

.1 Install on piping systems per Section 23 05 48 – Vibration and Seismic Controls for HVAC Ductwork, Piping and Equipment.

.3 Clevis plates:

.1 Attach to concrete with 4 minimum concrete inserts, one at each corner.

.4 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations. Supporting piping from underside of light weight roof deck (without concrete) is not permitted.

3.2 Hanger Spacing

.1 HVAC piping: in accordance with table below.

.2 Plumbing piping: in accordance with the most stringent requirements of the table below as well as the following:

.1 National. Plumbing Code.

.2 Authority Having Jurisdiction.

.3 Pipe hanger rods shall be sized in accordance to SMACNA Seismic Restraint Manual based on Seismic Hazard Level (SHL). For SHL, see Section 23 05 48 – Vibration and Seismic Controls for HVAC Ductwork, Piping and Equipment.

MAXIMUM HANGER SPACING						
PIPE DIA. NPS	STEEL SCH.40	COPPER L,K Hard Drawn	CAST.I STD.	GLASS	ABS/PVC	PEX
1/2	1.8 m [6'-0"]	1.8 m [6'-0"]			1.2 m [4'-0"]	0.8 m [2'-6"]
3/4 & 1	2.4 m [8'-0"]	2.4 m [8'-0"]			1.2 m [4'-0"]	0.8 m [2'-6"]
1-1/4	2.4 m [8'-0"]	3.0 m [10'-0"]			1.2 m [4'-0"]	0.8 m [2'-6"]
1-1/2 & 2	2.4 m [8'-0"]	3.0 m [10'-0"]	3.0 m [10'-0"]		1.2 m [4'-0"]	0.8 m [2'-6"]
2-1/2, 3, 4 & 5	2.4 m [8'-0"]	3.0 m [10'-0"]	3.0 m [10'-0"]	2.4 m [8'-0"]	1.2 m [4'-0"]	0.8 m [2'-6"]
6 & 8	3.0 m [10'-0"]	3.0 m [10'-0"]	3.0 m [10'-0"]	2.4 m [8'-0"]	1.2 m [4'-0"]	0.8 m [2'-6"]

3.3 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.

3.4 Horizontal Movement

.1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.

.2 Where horizontal pipe movement is less than 13mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

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.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1 Section 01 01 50 — General Instructions

.2 Section 23 05 00 — Common Work Results – Mechanical

1.2 References

.1 National Building Code of Canada (NBC)

.2 Sheet Metal and Air Conditioning Contractors National Association (SMACNA)

.1 Seismic Restraint Manual, Guidelines for Mechanical Systems.

1.3 Shop Drawings

.1 Submit shop drawings in accordance with Section 01 01 50 - General Instructions.

.2 Provide vibration isolation systems shop drawings complete with performance and product data. Shop drawings shall demonstrate compliance with the National Building Code and shall bear the seal of a Professional Engineer.

.3 Provide detailed drawings of all seismic restraint systems for ductwork, piping and equipment.

1.4 Waste Management and Disposal

.1 Separate and recycle waste materials in accordance with Division 01 - General Requirements.

.2 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.

.3 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.4 Dispose of packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

PART 2 PRODUCTS

2.1 Vibration Isolation System – General

.1 Performance of vibration isolation systems shall be designed by manufacturer specializing in vibration isolation materials and devices.

.2 Size and shape of bases type shall be coordinated with submitted equipment.

.3 Products shall of the same manufacturer unless otherwise noted.

2.2 Elastomeric Pads

.1 Type EP1 - neoprene waffle or ribbed; 9 mm [3/8”] minimum thick; 50 durometers; maximum loading 350 kPa [50 psi].

.2 Type EP2 - rubber waffle or ribbed; 9 mm [3/8”] minimum thick; 30 durometer natural rubber; maximum loading 415 kPa [60 psi].

.3 Type EP3 - neoprene-steel-neoprene; 9 mm [3/8”] minimum thick neoprene bonded to 1.71 mm [16 gauge] steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 350 kPa [50 psi].

.4 Type EP4 - rubber-steel-rubber; 9 mm [3/8”] minimum thick rubber bonded to 1.71 mm [16 gauge] steel plate; 30 durometer natural rubber, waffle or ribbed; holes sleeved with isolation washers; maximum loading 415 kPa [60 psi].

2.3 Hangers

.1 Color coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30° arc without metal to metal contact.

.2 Type H1 - neoprene - in-shear, molded with rod isolation bushing which passes through hanger box.

.3 Type H2 - stable spring, elastomeric washer, cup with molded isolation bushing which passes through hanger box.

.4 Type H3 - stable spring, elastomeric element, cup with molded isolation bushing which passes through hanger box.

.5 Type H4 - stable spring, elastomeric element with pre-compression washer and nut with deflection indicator.

2.4 Acoustic Barriers for Anchors and Guides

.1 Acoustic barriers: between pipe and support, consisting of 25 mm [1”] minimum thick heavy duty duck and neoprene isolation material.

2.5 Flexible Pipe Connectors

.1 Inner corrugated hose: stainless steel.

.2 Outer braid: Braided wire mesh stainless steel outer jacket.

.3 Type of end connection: threaded for 50mm [2”] or smaller; flange for 65mm [2-1/2”] or larger.

.4 Operating conditions:

.1 Working pressure: 1379 kPa [200 psi].

.2 Working temperature: 4540 °C [850 °F].

2.6 Seismic Control Measures

.1 General:

.1 Design anchorage and attachment methods for all systems and/or equipment as specified herein.

.2 Seismic control systems to work in all directions.

.3 Fasteners and attachment points to resist same maximum load as seismic restraint.

.4 Drilled or power-driven anchors and fasteners not permitted.

.5 No equipment, equipment supports or mounts to fail before failure of structure.

.6 Supports of cast iron or threaded pipe not permitted.

.7 Seismic control measures not to interfere with integrity of firestopping.

.8 For equipment mounted on housekeeping pad, specify the minimum distance between anchor bolt and edge of housekeeping pad.

.2 Static equipment:

.1 Anchor equipment to equipment supports. Anchor equipment supports to structure.

.2 Seismic restraints:

.1 Cushioning action to be gentle and steady.

.2 Shall never reach metal-like stiffness.

.3 Vibration isolated equipment:

.1 Seismic control measures not to jeopardize noise and vibration isolation systems. Provide 6 to 9mm clearance during normal operation of equipment and systems between seismic restraint and equipment.

.2 Provide seismic restraints in addition to vibration isolation system to resist complete isolator unloading.

.4 Piping systems:

.1 Provide seismic restraints for all piping in accordance to the latest edition of SMACNA Seismic Restraint Manual as described below:

.1 All compressed air piping NPS 1 or larger.

.2 Seismic restraints may be omitted for the following conditions:

.1 All piping suspended by individual hangers 305mm [12”] or less in length, as measured from the top of the pipe to the bottom of the structural support for the hanger.

.3 To be compatible with requirements for anchoring and guiding of piping systems.

.4 Wet weight of piping shall be to be used for designing seismic restraint systems.

.5 Small pipes may be rigidly secured to larger pipes for restraint purposes, but not reverse.

.6 Where cable is used for restraining vibration isolated piping systems, install cable with sufficient slack to avoid short-circuiting of vibration isolators.

.5 Ductwork systems:

.1 Provide seismic restraints for all ductwork in accordance to the latest edition of SMACNA Seismic Restraint Manual as described below:

.1 All rectangular ducts with cross sectional areas 0.56m^2 [6 ft^2] and larger.

.2 All round ducts with diameters 711 mm [28”] and larger.

.2 Seismic restraints may be omitted for the following conditions:

.1 All ductwork suspended by hangers 305mm [12”] or less in length, as measured from the top of the duct to the bottom of the structural support for the hanger.

.6 Bracing methods:

.1 Approved by Departmental Representative.

.2 Structural angles or channels.

.3 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.

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 Seismic control measures to meet requirements of NBC.

.2 Install vibration isolation equipment in accordance with manufacturer’s instructions and adjust mountings to level equipment.

.3 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.

.4 Where isolation is bolted to floor use vibration isolation rubber washers.

.5 Block and shim level bases so that ductwork and piping connections can be made to rigid system at operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

3.3 Field Quality Control

.1 Provide the services of the Professional Engineer(s) who designed the restraint systems for "Field Review" of the installed components, and submit the following to the Departmental Representative:

.1 Assurance commitment letter, signed and sealed; provided at the commencement of the project.

.2 Signed and sealed shop drawings of seismic restraints for equipment, piping and ductwork; provided prior to installation.

.3 Typewritten inspection reports; provided during the construction period.

.4 Schedule C-B, signed and sealed; provided after performing “Field Review”.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1 Section 01 01 50 General Instructions

.2 Section 23 05 00 Common Work Results – Mechanical

1.2 References

.1 Canadian Gas Association (CGA)

.1 CSA/CGA B149.1, Natural Gas and Propane Installation Code.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.60, Interior Alkyd Gloss Enamel.

.2 CAN/CGSB-24.3, Identification of Piping Systems.

.3 National Fire Protection Association (NFPA)

.1 NFPA 13, Standard for the Installation of Sprinkler Systems.

.2 NFPA 14, Standard for the Installation of Standpipe and Hose Systems.

1.3 Submittals

.1 Product Data:

.2 Submittals: in accordance with Section 01 01 50 - General Instructions.

.3 Product data to include paint color chips, other products specified in this section.

.4 Samples:

.1 Submit samples in accordance with Section 01 01 50 - General Instructions.

.2 Samples to include nameplates, labels, tags, lists of proposed legends.

1.4 Quality Assurance

.1 Quality assurance submittals: submit following in accordance with Section 01 01 50 - General Instructions.

.2 Health and Safety:

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

1.5 Delivery, Storage, and Handling

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 01 50 - General Instructions.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 01 50 - General Instructions.

.2 Dispose of unused paint and coating material at official hazardous material collections site approved by Departmental Representative.

.3 Do not dispose of unused paint and coating material into sewer system, into streams, lakes, onto ground or in locations where it will pose health or environmental hazard.

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 Colors:

.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, matte finish, with square corners, letters accurately aligned, and machine engraved into core.

.3 Sizes:

.1 Conform to following table:

	Sizes (mm)	No. of Lines	Height of Letters (mm)
1	10 x 50	1	3
2	13 x 75	1	5
3	11 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 Identification for the Preventive Maintenance Support System (PMSS):

.1 Use arrangement of Main identifier, Source identifier, Destination identifier.

.2 Equipment in Mechanical Room:

.1 Main identifier: Size #9.

.2 Source and Destination identifiers: Size #6.

.3 Terminal cabinets, control panels: Size #5.

.3 Equipment elsewhere: Sizes as appropriate.

2.3 Piping Systems Governed by Codes

.1 Identification:

.1 Natural gas and propane: to CSA/CGA B149.1.

.2 Sprinklers: to NFPA 13.

2.4 Identification of Piping Systems

.1 Identify contents by background Color marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.

.2 Pictograms:

.1 Where required: Workplace Hazardous Materials Information System (WHMIS) regulations.

.3 Legend:

.1 Block capitals to sizes and Colors listed in CAN/CGSB 24.3.

.4 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.

.5 Extent of background Color marking:

.1 To full circumference of pipe or insulation.

.2 Length to accommodate pictogram, full length of legend and arrows.

.6 Materials for background Color 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 [plastic-coated cloth] [vinyl] with protective over-coating, 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.

.7 Colors and Legends:

.1 Where not listed, obtain direction from Departmental Representative.

.2 Colors for legends, arrows: to following table:

Background Color:	**Legend, arrows:**
Yellow	BLACK
Green	WHITE
Red	WHITE

.3 Background Color marking and legends for piping systems:

Contents	Background Color Marking	Legend
Hot water heating supply	Yellow	HEATINGSUPPLY
Hot water heating return	Yellow	HEATINGRETURN
Domestic hot water supply	Green	DOM.HWSUPPLY
Domestic HW recirculation	Green	DOM.HWCIRC
Domestic cold water supply	Green	DOM.CWS
Storm water	Green	STORM
Sanitary	Green	SAN
Plumbing vent	Green	SAN.VENT
Natural gas and propane	to Codes	

Fire protection water	Red	FIREPROT.WTR
Sprinklers	Red	SPRINKLERS

2.5 Identification Ductwork Systems

.1 50 mm high stenciled letters and directional arrows 150 mm long x 50 mm high.

.2 Colors: back or coordinated with base Color to ensure strong contrast.

2.6 Valves, Controllers

.1 Plastic tags with 12 mm stamped identification data.

.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.

2.7 Controls Components Identification

.1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.

.2 Inscriptions to include function and (where appropriate) fail-safe position.

2.8 Language

.1 Identification in English.

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 CSA registration plates as required by respective agency.

.3 Identify systems, equipment to conform to the 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 boiler rooms, equipment rooms, galleries, tunnels: 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, galleries, 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 where directed by Departmental Representative. Provide one copy (reduced in size if required) in each operating and maintenance manual.

.3 Number valves in each system consecutively.

3.7 Cleaning

.1 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 General

.1 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.

1.2 Qualifications of TAB Company

.1 Testing and balancing shall be performed by an agency that specializes in this type of work. Provide proof that the agency has successfully completed five projects of similar size and scope

.2 All work shall be performed by persons with proven ability and thoroughly versed in the type of testing and balancing. Submit names, complete with experience, record and references for review by the Departmental Representative prior to work being carried out.

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 installed equipment and systems so as 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 installed 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 be to satisfaction of authority having jurisdiction.

.2 TAB of existing equipment already in operation.

1.5 Co-Ordination

.1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule so as 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 Pre-TAB Review

.1 Review contract documents before project construction is started.

.2 Review specified standards and report to Departmental Representative in writing all proposed procedures which vary from standard.

.3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

1.7 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.

1.8 Operation of Systems during TAB

.1 Operate systems for length of time required for TAB and as required by Departmental Representative for verification of TAB reports.

1.9 Start of TAB

.1 Notify Departmental Representative 7 days prior to start of TAB.

.2 Start TAB when building is essentially completed, including:

- .1 Installation of ceilings, doors, windows, other construction affecting TAB.
- .2 Application of weather-stripping, sealing, caulking.
- .3 All pressure, leakage, other tests specified elsewhere Division 23.
- .4 All provisions for TAB installed and operational.

.3 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:

- .1 Proper thermal overload protection in place for electrical equipment.
- .2 Air systems:
  - .1 Filters in place, clean.
  - .2 Duct systems clean.
  - .3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.
  - .4 Correct fan rotation.
  - .5 Fire, smoke, volume control dampers installed and open.
  - .6 Coil fins combed, clean.
  - .7 Access doors, installed, closed.
  - .8 Outlets installed, volume control dampers open.
- .3 Liquid systems:
  - .1 Flushed, filled, vented.
  - .2 Correct pump rotation.
  - .3 Strainers in place, baskets clean.
  - .4 Isolating and balancing valves installed open.
  - .5 Calibrated balancing valves installed, at factory settings.
  - .6 Chemical treatment systems complete, operational.

1.10 Application Tolerances

.1 Do TAB to following tolerances of design values:

- .1 HVAC systems: plus 5%, minus 5%.
- .2 Hydronic systems: plus, or minus 10%.

1.11 Accuracy Tolerances

.1 Measured values to be accurate to within plus or minus 2% of actual values.

1.12 Instruments

.1 Prior to TAB, submit to Departmental Representative list of instruments to be used together with serial numbers.

.2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.

.3 Calibrate within 3 months of TAB. Provide certificate of calibration to Departmental Representative.

1.13 Submittals

.1 Submit, prior to commencement of TAB:

.2 Proposed methodology and procedures for performing TAB if different from referenced standard.

1.14 Preliminary TAB Report

.1 Submit for checking and approval of 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.

1.15 TAB Report

.1 Format to be in accordance with Associated Air Balance Council Manual.

.2 TAB report to show results in SI units and to include:

.1 Project record drawings.

.2 System schematics.

.3 Submit a digital PDF version and six (6) copies of TAB Report to Departmental Representative for verification and approval, in English in D-ring binders, complete with index tabs.

1.16 Verification

.1 Reported results subject to verification by Departmental Representative.

.2 Provide manpower and instrumentation to verify up to 30% of reported results.

.3 Number and location of verified results to be at discretion of Departmental Representative.

.4 Bear costs to repeat TAB as required to satisfaction of Departmental Representative.

1.17 Settings

.1 After TAB is completed to satisfaction of 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. Markings not to be eradicated or covered in any way.

1.18 Completion of TAB

.1 TAB to be considered complete when final TAB Report received and approved by Departmental Representative.

1.19 Air Systems

.1 Standard: TAB to be to most stringent of this section or TAB standards of ASHRAE.

.2 Measurements: to include, but not limited to, following as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop, temperatures (dry bulb, wet bulb, dew point, duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.

.3 Locations of equipment measurements: To include, but not be limited to, following as appropriate:

.1 Inlet and outlet of dampers, filter, coil, humidifier, fan, other equipment causing changes in conditions.

.2 At controllers, controlled device.

.4 Locations of systems measurements to include, but not be limited to, following as appropriate: Main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

1.20 Water Systems (HVAC):

.1 Water circulating systems shall be balanced by means of balancing fittings and tabulated results shall include the following:

.1 Differential head across all circulating pumps.

.2 Flow and return water temperature to supply and return header for all zones.

.3 Water temperature supplied to and returning from each coil and heating element.

.2 Contractor shall arrange with balancing technician to have water flow through radiation elements checked prior to installation of radiation enclosure.

1.21 Domestic Hot Water Systems

.1 Meet requirements as specified for liquid systems.

.2 Locations of equipment measurements: To include, but not be limited to, following as appropriate: Inlet and outlet of heaters, tank, pump, circulator, at controllers, controlled device.

.3 Locations of systems measurements to include, but not be limited to, following as appropriate: main, main branch, branch, sub-branch.

1.22 Other TAB Requirements

.1 Air terminal units:

.1 Check individually for correct operation and factory calibration of air volumes at "maximum" and "minimum" settings. Where calibration or adjustment is found to be necessary it shall be carried out as part of the balancing procedure. The mechanical contractor and the Departmental Representative shall be informed of the extent of recalibration required.

.2 Testing of Fire Dampers & Fire Stop Flaps:

.1 Conduct a "trip" test on all fire dampers and fire stop flaps to ensure that fire mechanisms function correctly and that dampers attain a fully closed position when tripped.

.2 Send a copy of test results tabulating the fire damper location, size, and date of trip test, to the Departmental Representative for record purposes. Copies shall also be inserted in Equipment Maintenance Manuals.

.3 Dampers and Flaps which fail to function correctly shall be re-tested after corrective action has been completed. Any fusible links damaged when conducting tests shall be replaced by this Contractor. A signed and dated test label shall be attached to each fire damper upon completion of test and resetting of fire damper.

1.23 CAD Drawings

.1 CAD drawing files of the heating and ventilating tender drawings will be made available to the Balancing Contractor if requested. An "Authorization to use CAD Drawing File" agreement restricting the use of the CAD files to the preparation of the project balancing reports must be signed prior to obtaining the files.

PART 2 PRODUCTS

2.1 Not Used

.1 Not used.

PART 3 EXECUTION

3.1 Not Used

.1 Not used.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1	Section 01 01 50	General Instructions
.2	Section 23 05 00	Common Work Results - Mechanical
.3	Section 23 05 29	Hangers and Supports for HVAC Piping and Equipment
.4	Section 23 33 50	Thermaduct

1.2 References

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

- .1 ANSI/ASHRAE/IESNA 90.1; Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 American Society for Testing and Materials International, (ASTM)

- .1 ASTM B 209M, Specification for Aluminum and Aluminum Alloy Sheet and Plate (Metric).
- .2 ASTM C 335, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
- .3 ASTM C 411, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
- .4 ASTM C 449/C 449M, Standard Specification for Mineral Fiber- Hydraulic-Setting Thermal Insulating and Finishing Cement.
- .5 ASTM C 547, Specification for Mineral Fiber Pipe Insulation.
- .6 ASTM C 553, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
- .7 ASTM C 612, Specification for Mineral Fiber Block and Board Thermal Insulation.
- .8 ASTM C 795, Specification for Thermal Insulation for Use with Austenitic Stainless Steel.
- .9 ASTM C 921, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

.3 Canadian General Standards Board (CGSB)

- .1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.4 Thermal Insulation Association of Canada (TIAC): National Insulation Standards.

.5 Underwriters Laboratories of Canada (ULC)

- .1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.
- .2 CAN/ULC-S701, Thermal Insulation Polystyrene, Boards and Pipe Covering.

.6 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

- .1 Material Safety Data Sheets (MSDS).

1.3 Definitions

.1 For purposes of this section:

.1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.

.2 "EXPOSED"-will mean "not concealed" as defined herein.

.2 TIAC Codes:

.1 CRD: Code Round Ductwork,

.2 CRF: Code Rectangular Finish.

1.4 Submittals

.1 Submittals: in accordance with Section 01 01 50 - General Instructions.

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 01 50 - General Instructions. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 01 50 - General Instructions.

.3 Shop Drawings:

.1 Submit shop drawings in accordance with Section 01 01 50 - General Instructions.

.4 Quality assurance submittals: submit following in accordance with Section 01 01 50 - General Instructions.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

1.5 Quality Assurance

.1 Qualifications:

.1 Installer: specialist in performing work of this Section and have at least 3 years successful experience in this size and type of project, qualified to standards of TIAC.

.2 Health and Safety:

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

1.6 Delivery, Storage and Handling

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 01 50 - General Instructions.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.3 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.2 Storage and Protection:

.1 Protect from weather, construction traffic.

.2 Protect against damage.

.3 Store at temperatures and conditions required by manufacturer.

.3 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Division 01 – General Requirements.

.2 Place excess or unused insulation and insulation accessory materials in designated containers.

.3 Divert unused metal materials from landfill to metal recycling facility approved by Departmental Representative.

.4 Dispose of unused adhesive material at official hazardous material collections site approved by Departmental Representative.

PART 2 PRODUCTS

2.1 Fire and Smoke Rating

.1 In accordance with CAN/ULC-S102:

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.2 Insulation

.1 Mineral fibre as specified herein includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C 335.

.3 TIAC Code C-1: Rigid mineral fibre board to ASTM C 612. Provide factory applied vapour retarder jacket to CGSB 51-GP-52Ma as scheduled in PART 3 of this Section.

.4 TIAC Code C-2: Mineral fibre blanket to ASTM C 553. Provide factory applied vapour retarder jacket to CGSB 51-GP-52Ma as scheduled in PART 3 of this section.

.1 Mineral fibre: to ASTM C 553.

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: to ASTM C 553.

.5 Evidence shall be provided to the Departmental Representative on the site of ULC listings of all products being used. Duct insulation adhesives and coatings shall be non-toxic as defined by WCB Regulations.

2.3 Jackets

.1 Canvas:

.1 [220] gm/m² cotton, plain weave, treated with dilute fire-retardant lagging adhesive to ASTM C 921.

.2 Lagging adhesive: Compatible with insulation.

.2 Aluminum foil laminate:

.1 Multi-layer aluminum foil laminate; highly puncture and resistant, non- permeable vapour barrier for complete moisture protection. Inhibits mold growth. UL listed.

.2 Total thickness: 0.20 mm.

.3 Substrate thickness: 0.15 mm sheet.

.4 Finish: Aluminum, stucco embossed.

.5 Adhesive: cold weather acrylic adhesive.

2.4 Accessories

.1 Vapour retarder lap adhesive:

.1 Water based, fire retardant type, compatible with insulation.

.2 Indoor Vapour Retarder Finish:

.1 Vinyl emulsion type acrylic, compatible with insulation.

.3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C 449.

.4 Outdoor Vapour Retarder Mastic:

.1 Vinyl emulsion type acrylic, compatible with insulation.

.2 Reinforcing fabric: Fibrous glass, untreated 305 g/m².

.5 Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum.

.6 Contact adhesive: quick-setting

.7 Facing: 25 mm stainless steel hexagonal wire mesh stitched on one face of insulation.

.8 Fasteners: 2 mm diameter pins with 35 mm square clips, length to suit thickness of insulation.

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 Pre-Installation Requirement

.1 Pressure testing of ductwork systems complete, witnessed and certified.

.2 Surfaces clean, dry and free from foreign material.

3.3 Installation

.1 Install in accordance with TIAC National Standards.

.2 Apply materials in accordance with manufacturer's instructions and as indicated.

.3 Use two layers with staggered joints when required nominal thickness exceeds 75 mm.

.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

.1 Hangers, supports to be outside vapour retarder jacket.

.5 Supports, Hangers in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

.1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.

.6 Fasteners: At 300 mm oc in horizontal and vertical directions, minimum two rows each side.

.7 Refer to specification 23 33 50 for all insulated ductwork exposed to weather. Ducts exposed to weather which are not insulated, or finish painted, shall be coated with two applications of bitumastic waterproofing compound to prevent corrosion.

3.4 Duct Insulation Schedules

.1 Insulation types and thicknesses: Conform to following table:

	TIAC Code	Vapour Retarder	Thickness (mm)
Rectangular, cold, dual temperature supply air ducts	C-1	Yes	50
Round, cold, dual temperature supply air ducts	C-2	Yes	50
Rectangular, warm air ducts	C-1	No	25
Round, warm air ducts	C-2	No	25
Supply, return and exhaust ducts exposed in space being served			None
Outside air ducts to mixing plenum	C-1	Yes	25
Exhaust ducts between dampers and louvers	C-1	No	25
Rectangular ducts outside	See specification 23 33 50		
Acoustically lined ducts			None

.2 Finish: Conform to following table:

	TIAC Code	
	Rectangular	Round
Indoor, concealed	None	None
Indoor, exposed within mechanical room	CRF/1	CRD/2
Indoor, exposed elsewhere	CRF/2	CRD/3
Outdoor, exposed to precipitation	See specification 23 33 50	
Outdoor, elsewhere	See specification 23 33 50	

3.5 Cleaning

.1 Proceed in accordance with Division 01 – General Requirements.

.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 Related Sections

.1	Section 01 01 50	General Instructions
.2	Section 23 05 00	Common Work Results - Mechanical
.3	Section 23 05 05	Installation of Pipe Work.
.4	Section 23 05 29	Hangers and Supports for HVAC Piping and Equipment

1.2 References

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

.1 ANSI/ASHRAE/IESNA 90.1; Energy Standard for Buildings except Low-Rise Residential Buildings.

.2 American Society for Testing and Materials (ASTM):

.1 ASTM B 209M, Specification for Aluminum and Aluminum Alloy Sheet and Plate [Metric].

.2 ASTM C 335, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.

.3 ASTM C 411, Test Method for Hot-Surface Performance of High- Temperature Thermal Insulation.

.4 ASTM C 449/C449M, Standard Specification for Mineral Fiber- Hydraulic-Setting Thermal Insulating and Finishing Cement.

.5 ASTM C 534, Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

.6 ASTM C 795, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

.7 ASTM C 921, Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.3 Manufacturer's Trade Associations

.1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards.

.4 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S102, Surface Burning characteristics of Building Materials and Assemblies.

1.3 Definitions

.1 For purposes of this section:

.1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.

.2 "EXPOSED"-will mean "not concealed" as defined herein.

.2 TIAC Codes:

.1 CRF: Code Rectangular Finish.

.2 CPF: Code Piping Finish.

1.4 Submittals

.1 Submittals: in accordance with Section 01 01 50 – General Instructions.

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 01 50 - General Instructions. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 01 50 – General Instructions.

.3 Shop Drawings:

.1 Submit shop drawings in accordance with Section 01 01 50 - General Instructions.

.4 Quality assurance submittals: submit following in accordance with Section 01 01 50 - General Instructions.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

1.5 Quality Assurance

.1 Qualifications:

.1 Installer: specialist in performing work of this Section, and have at least 3 years successful experience in this size and type of project, qualified to standards of TIAC.

.2 Health and Safety:

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

1.6 Delivery, Storage and Handling

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 01 50 - General Instructions.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.3 Deliver materials to site in original factory packaging, labeled with manufacturer's name, address.

.2 Storage and Protection:

.1 Protect from weather, construction traffic.

.2 Protect against damage.

.3 Store at temperatures and conditions required by manufacturer.

.3 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 01 50 - General Instructions.

.2 Place excess or unused insulation and insulation accessory materials in designated containers.

.3 Divert unused metal materials from landfill to metal recycling facility approved by Departmental Representative.

.4 Dispose of unused adhesive material at official hazardous material collections site approved by Departmental Representative.

PART 2 PRODUCTS

2.1 Fire and Smoke Rating

.1 In accordance with CAN/ULC-S102:

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.2 Insulation

.1 Mineral fibre as specified herein includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C335.

.3 TIAC Code A-1: Rigid molded mineral fibre without factory applied vapour retarder jacket.

.1 Mineral fibre: to CAN/CGSB-51.9.

.2 Maximum "k" factor: to CAN/CGSB-51.9.

.4 TIAC Code A-3: Rigid molded mineral fibre with factory applied vapour retarder jacket.

.1 Mineral fibre: to CAN/CGSB-51.9.

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: to CAN/CGSB-51.9.

.5 TIAC Code C-2: Mineral fibre blanket faced [with] [without] factory applied vapour retarder jacket (as scheduled in PART 3 of this section).

.1 Mineral fibre: to CAN/ULC-S702.

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: to CAN/ULC-S702.

.6 TIAC Code A-6: Flexible unicellular tubular elastomer.

.1 Insulation: flexible closed-cell elastomer to ASTM C534.

.2 Jacket: to CGSB 51-GP-52Ma. Required for outdoor application.

.3 Maximum "k" factor: 0.27.

.4 Vapour transmission: 0.08 perm-inch.

.5 To be certified by manufacturer to be free of potential stress corrosion cracking corrodants.

.7 To be formaldehyde free, low VOC; resists mold and mildew.

.8 Evidence shall be provided to the Departmental Representative on the site of ULC listings of all products being used. Duct insulation adhesives and coatings shall be non-toxic as defined by WCB Regulations.

2.3 Insulation Securement

.1 Tape: Self-adhesive, aluminum, reinforced, 50mm wide minimum.

.2 Contact adhesive: Quick setting.

.3 Canvas adhesive: Washable.

.4 Tie wire: 1.5mm diameter stainless steel.

.5 Bands: Stainless steel, 19mm wide, 0.5mm thick.

2.4 Cement

.1 Thermal insulating and finishing cement:

.1 To CAN/CGSB-51.12.

.2 Hydraulic setting or Air drying on mineral wool, to ASTM C 449.

2.5 Vapour Retarder Lap Adhesive

.1 Water based, fire retardant type, compatible with insulation.

2.6 Indoor Vapour Retarder Finish

.1 Vinyl emulsion type acrylic, compatible with insulation.

2.7 Outdoor Vapour Retarder Finish

.1 Vinyl emulsion type acrylic, compatible with insulation.

.2 Reinforcing fabric: Fibrous glass, untreated 305 g/m.

2.8 Jackets

.1 Polyvinyl Chloride (PVC):

.1 One-piece molded type and sheet to CGSB 51-GP-53M with pre-formed shapes as required.

.2 Colors: White.

.3 Minimum service temperatures: 20°C [68°F].

.4 Maximum service temperature: 65°C [150°F].

.5 Moisture vapour transmission: 0.02 perm.

.6 Fastenings:

.1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
.2 Tacks.
.3 Pressure sensitive vinyl tape of matching Color.

.2 Canvas:

.1 220 and 120 gm/m cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.

.2 Lagging adhesive: Compatible with insulation.

.3 Aluminum foil laminate

.1 Multi-layer aluminum foil laminate; highly puncture and resistant, non- permeable vapour barrier for complete moisture protection. Inhibits mold growth. UL listed.

.2 Total thickness: 0.20 mm.

.3 Substrate thickness: 0.15 mm sheet.

.4 Finish: Aluminum, stucco embossed.

.5 Adhesive: cold weather acrylic adhesive.

PART 3 EXECUTION

3.1 Pre-Installation Requirement

.1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.

.2 Surfaces to be clean, dry and free from foreign material.

3.2 Installation

.1 Install in accordance with TIAC National Standards.

.2 Apply materials in accordance with manufacturer's instructions and this specification.

.3 Use two layers with staggered joints when required nominal wall thickness exceeds 75mm.

.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

.1 Hangers, supports to be outside vapour retarder jacket.

.5 Supports, hangers:

.1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.3 Removable, Pre-fabricated, Insulation and Enclosures

.1 Application: At expansion joints, valves, primary flow measuring elements flanges and unions at equipment.

.2 Design: To permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.

.3 Insulation:

.1 Insulation, fastenings and finishes: same as system.

.2 Jacket: PVC.

3.4 Installation of Elastomeric Insulation

.1 Insulation to remain dry at all times. Overlaps to manufacturer's instructions. Ensure tight joints.

.2 Provide vapour retarder as recommended by manufacturer.

3.5 Piping Insulation Schedules

.1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.

.2 TIAC Code: A-1.

.1 Securements: SS Bands at 300mm on centre.

.2 Seals: lap seal adhesive, lagging adhesive.

.3 Installation: TIAC Code 1501-H.

.3 TIAC Code: A-3.

.1 Securements: SS Bands at 300mm on centre.

.2 Seals: VR lap seal adhesive, VR lagging adhesive.

.3 Installation: TIAC Code: 1501-C.

.4 TIAC Code: A-6.

.1 Seals: lap seal adhesive, lagging adhesive.

.2 Installation: TIAC Code: 1501-CA; per manufacturer's recommendation.

.5 TIAC Code: C-2 with vapour retarder jacket.

.1 Insulation securements: SS Bands at 300mm on centre.

.2 Seals: lap seal adhesive, lagging adhesive.

.3 Installation: TIAC Code: 1501-C.

.6 Thickness of insulation to be as listed in following table.

.1 Run-outs to individual units and equipment not exceeding 4000mm long.

.2 Do not insulate exposed run-outs to plumbing fixtures, chrome plated piping, valves, fittings.

Application	**Temp ℃**	**TIAC Code**	**Run out**	**To NPS1**	**1 ¼-2**	**2 ½-4**	**5-6**	**8 & over**
Hot Water Heating	60-94	A-1	25	38	50	50	50	50
Hot Water Heating	< 59	A-1	25	25	38	38	38	38
Domestic HWS/RECIRC		A-1	25	25	38	38	38	38
Domestic CWS		A-3	25	25	25	25	25	25
Refrigerant (hot gas, liquid, suction)	< 4	A-6	25	25	38	38	38	38
RWL and RWP		C-2	25	25	25	25	25	38
Cooling Coil Condensate Drain		A-3	25	25	25	25	25	25

.7 Finishes:

.1 Exposed indoors: Canvas and/or PVC jacket.

.2 Exposed in mechanical rooms: Canvas and/or PVC jacket.

.3 Concealed, indoors: ASJ, no further finish.

.4 Exposed outdoors: Aluminum jacket.

3.6 Cleaning

.1 Proceed in accordance with Section 01 01 50 – General Instructions.

.2 fUpon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1 Section 01 91 00 Commissioning

.2 Section 23 05 93 Testing, Adjusting and Balancing for HVAC

1.2 Quality Assurance

.1 The commissioning of mechanical systems shall be executed in accordance with the intent of ASHRAE Standard 1 “Guideline for Commissioning of HVAC Systems”

1.3 References

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

.1 ANSI/ASHRAE 202: Commissioning Process for Buildings and Systems.

.2 Canadian Standards Association (CSA)

.1 CSA Z320: Building Commissioning.

1.4 General

.1 Commissioning of the mechanical systems, including the HVAC, and Plumbing and Drainage Systems, shall be carried out by an independent Commissioning Agent acceptable to the Departmental Representative with technicians specifically trained in commissioning procedures.

.2 The Mechanical Subcontractor shall retain a Commissioning Agent, who shall be active in the commissioning process and actively encourage his own forces and subtrades to work together to achieve optimum system performance for the mechanical systems in a timely manner. Refer to Commissioning Authority Plan for responsibilities of Commissioning Agent.

.3 It is not intended that this work shall, in any way, replace normal factory start-up service for equipment or relieve the Contractor or his sub-trades of their responsibility for providing first-class installation in satisfactory working order.

.4 As part of the final commissioning report, submit a Certificate stating that the commissioning procedures have been completed, that complete factual reports have been distributed and that directions have been given to the Contractor to correct faults and omissions and finally, that follow-up testing, after the correction of faults and omissions has been completed and recorded.

.5 Be responsible for the performance and commissioning of all equipment supplied under the Sections of Division 21, 22, 23. Commissioning is the process of advancing the installation from the stage of static completion to full working order in accordance with the contract documents and design intent. It is the activation of the completed installation.

.6 In consultation with the General Contractor, ensure that sufficient time is allowed and fully identified on the construction schedule for the proper commissioning of all mechanical systems.

1.5 Commissioning and Demonstration

.1 Submit a schedule for the commissioning phase of the work. This schedule shall show:

.1 Equipment start-up schedule.

.2 Submission dates for the various documents required prior to substantial completion.

.3 Timing of the commissioning, testing, balancing, and demonstration process.

.2 Commissioning is concluded when the air and water system is balanced and the installation is in full working order and acceptable for use. The work shall include the following:

.1 Balancing of the air systems as specified in this section.

.2 Set up air diffusers, registers and grilles for optimum distribution/comfort.

.3 Plug all air pressure and flow measuring holes.

.4 Adjust vibration isolators and earthquake restraints for optimum performance.

.5 Verification and certification of the sealing of all HVAC penetrations through fire separations (rated & non-rated) and sound separations. Forms in Section 23 08 02 shall be used for this purpose.

.6 Verification of water tightness of all roof and exterior wall penetrations.

.7 Verification that coil drain pan operates.

.8 Set up all automatic control valves/dampers and automatic temperature control devices.

.9 Set up and test all alarm and protective devices.

.10 EMCS:

.1 Commissioning of EMCS is primarily responsible by Controls Contractor. Refer to Section 25 05 01 EMCS General Instructions.

.2 The Commissioning Agent shall assign one person experienced and qualified in commissioning control systems through practical experience and a comprehensive knowledge of the interactive nature of HVAC systems and DDC controls **to verify** the performance of the control systems by conducting random tests of the control sequences until the Commissioning Agent is satisfied that the controls are performing according to the intended control sequences.

.3 The Controls Contractor shall loan a current copy of all control software/devices needed for full access to the control system, at no charge to the Commissioning Agent. The software/devices shall be returned to the Controls Contractor in good working order at the completion of the commissioning process, or the Commissioning Agent must reimburse the Controls Contractor for the purchase price of the material.

.3 In addition to the piping, equipment and systems listed above provide commissioning of all plumbing and fire protection piping, equipment and systems including the following:

.1 Domestic cold water including PRV setpoint.

.2 Domestic hot water and recirculation including temperature set points.

.3 Domestic tempered water including setpoints.

.4 Sanitary waste and venting.

.5 Plumbing fixtures including adjustments of all flush valves, electronic sensors, solenoid valves, and setting temperature limit stops on shower valves.

.6 Compressed air system.

.7 Double-Interlocked Electric/Pneumatic Release Preaction Valve (DIPV) fire protection system.

.4 At the conclusion of commissioning, demonstrate the operation of the systems to the Departmental Representative. For demonstration and instruction to Operating staff requirements, refer to this section of the specification and also to section 25 05 01 EMCS: General Instructions.

.5 The verification process shall include the demonstration of the following:

.1 The ease of access that has been provided throughout for servicing coils, motors, drives, control dampers and damper operators.

.2 Location of and opening and closing of all access panels.

.3 Operation of all automatic control dampers and automatic temperature control devices.

.4 Operation of all alarm and protective devices.

.5 Operation of all equipment and systems under each mode of operation, and failure.

.6 At the completion of commissioning, testing, balancing and demonstration submit the following to the Departmental Representative:

.1 A letter certifying that all work specified under this contract is complete, clean and operational in accordance with the specification and drawings.

.2 Completed copies of all commissioning check lists plus copies of start-up reports from specialty contractors and vendors.

.3 “As-Built” record drawings, as specified.

.4 A list of all alarm and protective devices tested, with the final operating settings.

.7 Training

.1 During "Substantial Performance" review, the Mechanical Contractor, Control Sub-contractor, and other Sub-contractors designated by the Departmental Representative shall provide training to the operating personnel in the proper operation and maintenance of all systems and equipment installed under the contract.

.2 It shall be the Mechanical Contractor's responsibility to have the specified equipment manuals prepared, previously approved by the Departmental Representative, and ready for presentation at this meeting.

.3 Convene the meeting with the aforementioned parties at the time called for in the substantial performance review. The arrangements shall include written notices to all the parties concerned. Should the equipment manuals, or system installation not be complete and operable at the proper time, he shall then convene the operating instruction meeting at a later date and pay any additional costs including time and traveling expenses for the personnel involved which are attributable to the delay.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1 Section 01 91 00 Commissioning

.2 Section 23 05 93 Testing, Adjusting and Balancing for HVAC

1.2 Potable Water Systems

.1 When cleaning is completed, and system filled:

.1 Verify performance of equipment and systems as specified elsewhere in Division 22.

.2 Check for proper operation of water hammer arrestors. Run one outlet for 10 seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor or recharge air chambers. Repeat for each outlet and flush valve.

.3 Confirm water quality consistent with supply standards, verifying that no residuals remain as a result of flushing and/or cleaning.

1.3 Wet Sprinkler System

.1 Cleaning, testing, start-up, performance verification of equipment, systems, components, and devices is specified elsewhere in Division 21.

1.4 Sanitary and Storm Drainage Systems

.1 Buried systems: Perform tests prior to back-filling. Perform hydraulic tests to verify grades and freedom from obstructions.

.2 Ensure that traps are fully and permanently primed.

.3 Ensure that fixtures are properly anchored, connected to system.

.4 Operate flush valves, tank and operate each fixture to verify drainage and no leakage.

PART 2 PRODUCTS

2.1 Not Used

.1 Not Used.

PART 3 EXECUTION

3.1 Not Used

.1 Not Used.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1	Section 01 01 50	General Instructions
.2	Section 23 05 00	Common Work Results-Mechanical
.3	Section 23 05 93	Testing Adjusting and Balancing for HVAC
.4	Section 23 25 00	HVAC Water Treatment Systems

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 01 50 - General Instructions. Include product characteristics, performance criteria, and limitations.

.2 Quality assurance submittals: submit following in accordance with Section 01 01 50 - General Instructions.

.1 Instructions: submit manufacturer's installation instructions.

1.4 Quality Assurance

.1 Health and Safety:

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

1.5 Delivery, Storage, and Handling

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse recycling in accordance with Division 01 - General Requirements.

PART 2 PRODUCTS

2.1 Cleaning Solutions and Chemicals

.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.

.4 Cleaning solutions shall be provided by the supplier of chemicals for water treatment under Section 23 25 00 – HVAC Water Treatment Systems.

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 of Hydronic Systems

.1 Timing:

.1 Systems to be 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, orifice plates, pitot tubes, flow metering valves only after cleaning is certified as complete by water treatment specialist. Install cross upstream per manufacturer's recommendation. Install plugs in unused connections.

.4 Cleaning procedures:

.1 Provide detailed report outlining proposed cleaning procedures at least 4 weeks prior to proposed starting date. Report to include:

.1 Cleaning procedures, flow rates, elapsed time.

.2 Chemicals and concentrations to be used. Include Material Safety Data Sheets (MSDS).

.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 to be used to ensure water will not damage systems or equipment.

.5 Conditions at time of cleaning of systems:

.1 Systems to be free from construction debris, dirt and other foreign material.

.2 Control valves to be operational, fully open to ensure that terminal units can be cleaned properly.

.3 Strainers to be clean prior to initial fill.

.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 System:

.1 Fill system with water, ensure air is vented from system.

.2 Provide drain connections to drain system in one hour. All drains for chemical treatment shall be piped to the nearest floor drain. After initial flushing has been completed, clean all strainer screens.

.3 System pumps may be used for circulating cleaning solution provided that pumps are dismantled and inspected, worn parts repaired with new gaskets and seals install. Submit used seals.

.4 Add cleaners and chemicals to closed systems at concentration levels recommended by the Chemical Specialist.

.5 For heating hot water systems, apply heat while circulating, raise temperature slowly to 70°C [158°F] and maintain at 70°C [158°F] for a minimum of 12 hours. Remove heat and continue to circulate until temperature is below 38°C [100°F].

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 Commission water treatment systems as specified in Section 23 25 00 - HVAC Water Treatment Systems.

.7 Check water level in expansion tank with cold water with circulating pumps OFF and again with pumps ON.

.8 Repeat with water at design temperature.

.9 Check pressurization to ensure proper operation and to prevent water hammer, flashing, cavitation. Eliminate water hammer and other noises.

.10 Bring system up to design temperature and pressure slowly over a 48 hour period.

.11 Perform TAB as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.12 Adjust pipe supports, hangers, springs as necessary.

.13 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.

.14 Re-tighten bolts, etc. using torque wrench, to compensate for heat-caused relaxation. Repeat several times during commissioning.

.15 Check operation of drain valves.

.16 Adjust valve stem packings as systems settle down.

.17 Fully open all balancing valves (except those that are factory-set).

.18 Check operation of over-temperature protection devices on circulating pumps.

.19 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.

3.4 Cleaning

.1 Proceed in accordance with Division 01 - General Requirements.

.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 Related Sections

.1	Section 01 01 50	General Instructions
.2	Section 23 05 00	Common Work Results - Mechanical
.3	Section 23 05 05	Installation of Pipework
.4	Section 23 05 93	Testing, Adjusting and Balancing for HVAC
.5	Section 23 08 01	Performance Verification of Mechanical Piping
.6	Section 23 08 02	Cleaning and Start-up of Mechanical Piping Systems

1.2 References

.1 American Society of Mechanical Engineers (ASME).

- .1 ASME, Boiler and Pressure Vessel Code.

.2 American Society for Testing and Materials, (ASTM).

- .1 ASTM A 47/A 47M, Specification for Ferritic Malleable Iron Castings.
- .2 ASTM A 278M, Specification for Gray Iron Castings for Pressure- Containing Parts for Temperatures up to 650 degrees F (345 degrees C).
- .3 ASTM A 516/A 516M, Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service.
- .4 ASTM A 536, Specification for Ductile Iron Castings.
- .5 ASTM B 62, Specification for Composition Bronze or Ounce Metal Castings.

.3 Canadian Standards Association (CSA International).

- .1 CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code.

1.3 Submittals

.1 Submit shop drawings in accordance with Section 01 01 50 - General Instructions.

.2 Closeout Submittals:

- .1 Submit maintenance data in accordance with Section 01 01 50 – General Instructions.

1.4 Quality Assurance

.1 Health and Safety.

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

1.5 Delivery Storage and Handling

.1 Waste Management and Disposal.

- .1 Separate waste materials for reuse and recycling in accordance with Division 01 - General Requirements.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal packaging material 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 Automatic Air Vent

.1 Disc vent: with built-in check valve, NPT 1/8 connection. Rated at 345 kPa [50 PSI] working pressure.

.2 Float vent: brass body, stainless steel float, NPT 3/4 connection, with built-in check valve. Rated at 1,034 kPa [150 PSI] working pressure and 121°C [250°F] operating temperature.

.3 High capacity vent: cast iron body, stainless steel float and NPS 3/4 connection. Rated at 1,034 kPa [150 PSI] working pressure and 121°C [250°F] operating temperature.

2.2 Combination Low Pressure Relief and Reducing Valve

.1 Adjustable pressure setting: 206 kPa [30 PSI] relief, 55 to 172 kPa [8 to 25 PSI] reducing.

.2 Low inlet pressure check valve.

.3 Removable strainer.

2.3 Strainer

.1 NPS 1/2 to 2: Y-type, bronze body to ASTM B 62, screwed connections, 304 stainless steel screen with 20 mesh perforations.

.2 NPS 2 1/2 to 12: Y-type, cast iron body to ASTM A 126 Class B, flanged connections, 304 stainless steel screen with 20 mesh perforations.

.3 NPS 2 to 12: T-type, cast iron body to ASTM A126 Class B, flanged connections, 304 stainless steel screen with 0.063 perforations for NPS 2 to 4, and 0.125 perforations for NPS 6 and larger.

.4 Working pressure: 1,034 kPa [150 PSI].

.5 Provide blow-down valve with capped hose adapter fitting and chain.

PART 3 EXECUTION

3.1 General

.1 Install as indicated and to manufacturer's recommendations.

.2 Run drain lines and blow off connections to terminate above nearest drain.

.3 Maintain proper clearance to permit service and maintenance.

.4 Should deviations beyond allowable clearances arise, request and follow Departmental Representative's directive.

.5 Check shop drawings for conformance of all tappings for ancillaries and for equipment operating weights.

3.2 Strainer

.1 Install in horizontal or down flow lines.

.2 Ensure clearance for removal of basket.

.3 Install ahead of each pump unless suction diffuser is provided.

.4 Install ahead of each automatic control valve and as indicated.

3.3 Air Vents

.1 Install at high points of systems.

.2 Install gate valves at the inlet of float vents and high capacity float vents.

.3 Applications:

.1 Disc vent: radiators and convectors.

.2 Float vent: pipe mains.

.3 High capacity vent: air separator.

3.4 Pressure Safety Relief Valve

.1 Run discharge pipe to terminate above nearest drain.

3.5 Performance Verification

.1 In accordance with Section 23 08 01 - Performance Verification of Mechanical Piping.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1	Section 01 01 50	General Instructions
.2	Section 23 05 00	Common Work Results - Mechanical
.3	Section 23 05 05	Installation of Pipework
.4	Section 23 05 93	Testing, Adjusting and Balancing for HVAC
.5	Section 23 08 01	Performance Verification of Mechanical Piping
.6	Section 23 08 02	Cleaning and Start-up of Mechanical Piping Systems

1.2 References

.1 American Society of Mechanical Engineers (ASME).

- .1 ASME B16.1, Cast Iron Pipe Flanges and Flanged Fittings.
- .2 ASME B16.3, Malleable Iron Threaded Fittings.
- .3 ASME B16.5, Pipe Flanges and Flanged Fittings.
- .4 ASME B16.9, Factory-Made Wrought Buttwelding Fittings.
- .5 ASME B18.2.1, Square and Hex Bolts and Screws (Inch Series).
- .6 ASME B18.2.2, Square and Hex Nuts (Inch Series).

.2 American Society for Testing and Materials International, (ASTM).

- .1 ASTM A 47/A47M, Standard Specification for Ferritic Malleable Iron Castings.
- .2 ASTM A 53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
- .3 ASTM A 536, Standard Specification for Ductile Iron Castings.
- .4 ASTM B 61, Standard Specification for Steam or Valve Bronze Castings.
- .5 ASTM B 62, Standard Specification for Composition Bronze or Ounce Metal Castings.
- .6 ASTM E 202, Standard Test Method for Analysis of Ethylene Glycols and Propylene Glycols.

.3 American Water Works Association (AWWA).

- .1 AWWA C111, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

.4 Canadian Standards Association (CSA International).

- .1 CSA B242, Groove and Shoulder Type Mechanical Pipe Couplings.
- .2 CAN/CSA W 48, Filler Metals and Allied Materials for Metal Arc Welding (Developed in cooperation with the Canadian Welding Bureau).

.5 Manufacturer's Standardization of the Valve and Fittings Industry (MSS).

- .1 MSS-SP-67, Butterfly Valves.
- .2 MSS-SP-70, Cast Iron Gate Valves, Flanged and Threaded Ends.
- .3 MSS-SP-71, Cast Iron Swing Check Valves Flanged and Threaded Ends.
- .4 MSS-SP-80, Bronze Gate, Globe, Angle and Check Valves.
- .5 MSS-SP-85, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.3 Submittals

.1 Submit shop drawings in accordance with Section 01 01 50 - General Instructions.

1.4 Quality Assurance

.1 Health and Safety.

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

1.5 Delivery Storage and Handling

.1 Waste Management and Disposal.

.1 Separate waste materials for reuse and recycling in accordance with Division 01 - General Requirements.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.

.4 Fold up metal and plastic banding, flatten and place in designated area for recycling.

1.6 Maintenance

.1 Extra Materials.

.1 Provide following spare parts:

.1 Valve seats: one for every ten valves, each size. Minimum one.

.2 Discs: one for every ten valves, each size. Minimum one.

.3 Stem packing: one for every ten valves, each size. Minimum one.

.4 Valve handles: two of each size.

.5 Gaskets for flanges: one for every ten flanges.

PART 2 PRODUCTS

2.1 Pipe

.1 Steel pipe: to ASTM A53/A53M, Grade B, as follows:

.1 To NPS 10: Schedule 40.

.2 NPS 12 and over: 10 mm [3/8”] wall thickness.

2.2 Pipe Joints

.1 NPS 2 and under: screwed fittings to ANSI/ASME B1.20.1.

.2 NPS 2-1/2 and over: welding fittings and flanges to ANSI/ASME D1.1, ANSI/ASME Section 9 and CAN/CSA W48.

.3 Pipe thread: taper.

.4 Flanges: weld neck, raised face to AWWA C111.

.5 Orifice flanges: slip-on, raised face.

.6 Flange gaskets: to AWWA C111.

.7 Bolts and nuts: to ASME B18.2.1 and ASME B18.2.2.

.8 Nipples: extra heavy black steel.

2.3 Fittings

.1 Screwed fittings: malleable iron, to ASME B16.3, Class 150.

.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 A 47/A47M and ASME B16.3.

2.4 Valves

.1 Gate valves: to MSS-SP-70 and MSS-SP-80:

.1 NPS 2 and under: Class 150 to MSS-SP80. Rising stem, threaded, union bonnet and solid wedge. Body, bonnet and wedge shall be of bronze ASTM B-62. Stem shall be of dezincification-resistant silicon bronze ASTM B-371 or low-zinc alloy B-99.

.2 NPS 2-1/2 and over: Class 150 to MSS-SP70. OS&Y, flanged, bolted bonnet, solid wedge, iron body, bronze trimmed, with body and bonnet conforming to ASTM A126 Class B cast iron.

.2 Drain valves:

.1 Ball type, Class 150 to MSS-SP-110, 2-piece cast bronze body, threaded, full port, anti-blowout stem, stainless steel ball and stem, 20mm [3/4"] hose connection with cap and chain.

.3 Swing check valves:

.1 NPS 2 and under: Class 150 to MSS-SP-80. Swing type, Y-pattern, threaded, bronze body to ASTM B-62, renewable TFE seat and disc, regrinding type, dezincification-resistant.

.2 NPS 2-1/2 and over: Class 125 to MSS-SP-71. Swing type, flanged, cast iron to ASTM A126 Class B, renewable bronze seat disc.

.4 Silent check valves:

.1 NPS 2 and under: Class 125 to MSS-SP-80. Inline lift type, threaded, bronze body to ASTM B-584, TFE disc, stainless steel stem, spring, disc holder and seat screw, dezincification-resistant.

.2 NPS 2-1/2 and over: Class 125 to MSS-SP-71. Globe style, flanged, cast iron to ASTM A126 Class B, renewable bronze seat (bonded with Buna-N) and disc, stainless steel spring.

.5 Ball valves:

.1 NPS 2 and under: Class 150 to MSS-SP-110. Cast bronze, 2-piece body, threaded, full port, anti-blowout stem, 316 stainless steel stem and ball (vented), TFE packing, RTFE thrust washers and seat rings, 50mm [2"] extended blowout stem for insulated piping, lever handle with position indicator.

2.5 Strainer

.1 Description: Y-type with strainer baskets of material and perforations suitable for steam or water service, as required. Figure numbers of manufacturers are listed to indicate the types selected for design, performance and standard of quality.

.2 NPS 2 and under: Full pipeline size, 250 lb. SWP bronze, with screwed ends and a removable plug type screen retainer.

.3 NPS 2-1/2 and over: Full pipeline size, 250 lb. SWP semi-steel, with flanged ends and a bolted screen retainer.

.4 Screens: Stainless steel or monel screen with 20 mesh screen opening.

.5 Provide a blowdown valve with a drain line to discharge above an approved receptor on the blowdown connection of the strainer. Where strainers occur above ceilings, provide a blowdown valve with NPS 3/4 capped hose adapter fitting.

2.6 Dielectric Coupling

.1 NPS 2 and under: Screwed, Schedule 40 electro zinc plated ASTM A120/A53 casing with inert self-cleaning thermoplastic liner, 300 PSI WP at 225°F.

.2 NPS 2-1/2 and over: Flanged with isolation gaskets, washers and sleeves, 300 lb. WOG.

2.7 Balancing Fittings, for TAB:

.1 Sizes: Calibrated balancing valves, as specified this section.

.2 NPS 2 and under: Globe type, Y-pattern, bronze body, EPDM O-ring and NPT connections.

.3 Flow measuring valve shall be fitted with meter readout ports with check valves and caps, digital handwheel with memory stop indicator, NPS 20 hose connection, and a nameplate bearing manufacturer's name and calibrated nameplate.

.4 Furnished with preformed rigid polyurethane insulation.

PART 3 EXECUTION

3.1 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 where ever 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 and 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.

.7 Install dielectric couple between dissimilar metals.

3.2 Valve Installation

.1 Install rising stem valves in upright position with stem above horizontal.

.2 Install isolation valves at branch take-offs and to isolate each piece of equipment, and as indicated.

.3 Install check valves on discharge of pumps and as indicated. Provide silent check valves in vertical pipes with downward flow and swing check valves horizontal pipes.

.4 Install chain operators on valves NPS 2-1/2 and over where installed more than 2400mm [8'-0"] above finished floor in mechanical room(s).

3.3 Cleaning, Flushing, & Start-Up

.1 In accordance with Section 23 08 02 - Cleaning and Start-Up of Mechanical Piping Systems.

3.4 Testing

.1 Test system in accordance with Section 23 08 01 - Performance Verification – Mechanical Piping Systems.

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.

3.6 Performance Verification

.1 In accordance with Section 23 08 01 - Performance Verification of Mechanical Piping.

END OF SECTION

PART 1 GENERAL

1.1 Section Includes

.1 Materials, equipment selection, installation and start up for hydronic system pumps.

1.2 Related Sections

.1	Section 01 01 50	General Instructions
.2	Section 01 91 00	Commissioning
.3	Section 23 05 13	Common Motor Requirements for HVAC Equipment
.4	Section 23 05 48	Vibration & Seismic Controls for HVAC Piping & Equipment
.5	Section 23 08 00	Commissioning of Mechanical Systems

1.3 References

.1 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE).

.1 Standard 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 Electrical Equipment Manufacturers Advisory Council (EEMAC).

.3 Canadian Standards Association (CSA International).

.1 CAN/CSA-B214, Installation Code for Hydronic Heating Systems.

.4 National Electrical Manufacturers Association (NEMA).

.1 NEMA MG 1, Motors and Generators.

1.4 Submittals

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 01 50 - General Instructions. Include product characteristics, performance criteria, and limitations.

.2 Shop Drawings:

.1 Submit shop drawings and product data in accordance with Section 01 01 50 - General Instructions.

.3 Submit manufacturer's detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories and controllers.

.4 Submit product data of pump curves for review showing point of operation.

.5 Indicate piping, valves and fittings shipped loose by packaged equipment supplier, showing their final location in field assembly.

.6 Closeout Submittals:

.1 Provide operation and maintenance data for incorporation into manual specified in Section 01 01 50 – General Instructions.

1.5 Health and Safety

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

1.6 Waste Management and Disposal

.1 Separate waste materials for reuse and recycling in accordance with Section 01 01 50 - General Instructions.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Separate for reuse and recycling and place in designated containers in accordance with Waste Management Plan.

.5 Fold up metal banding, flatten and place in designated area for recycling.

1.7 Extra Materials

.1 Provide maintenance materials in accordance with Section 01 01 50 – General Instructions.

.2 Furnish following spare parts:

.1 One pump seal and casing gasket for each size and type of pump.

PART 2 PRODUCTS

2.1 Equipment Selection

.1 Do component selection and sizing to CAN/CSA-B214.

2.2 In-Line Circulator

.1 Volute: cast iron, radially split, with flanged connection.

.2 Impeller: cast bronze.

.3 Shaft: alloy steel with copper or bronze sleeve bearing, integral thrust collar.

.4 Seal assembly: mechanical.

.5 Coupling: flexible self-aligning.

.6 Design pressure: 860 kPa (125 psi).

2.3 Vertical In-Line Pump

.1 Volute: cast iron, radially split, with tapped openings for draining and gauge connections, complete with vent line or internally flushed. Provide base ring tapping for floor mounted support as specified herein. Flanged connections.

.2 Impeller: cast bronze, enclosed type, dynamically balanced, keyed to shaft and secured in place.

.3 Shaft: alloy steel or stainless steel with bronze sleeve bearing, integral thrust collar.

.4 Seal assembly: mechanical.

.5 Coupling: closed coupled. Split coupled where noted.

.6 Design pressure: 1,200 kPa (175 psi).

.7 Provide floor mounted support for pumps with 10 HP motor and larger.

PART 3 EXECUTION

3.1 Installation

.1 Do Work in accordance with CAN/CSA-B214.

.2 In-line circulators: install as indicated by flow arrows. Support at inlet and outlet flanges or unions and per manufacturer's recommendation. Install with bearing lubrication points accessible.

.3 Vertical in-line pump: provide support for pipe elbows, suction diffuser and pump discharge combination valve at pump suction and discharge. Install floor mounted support where specified in this Section.

.4 Ensure that pump body does not support piping or equipment. Provide stanchions or hangers for this purpose. Refer to manufacturer's installation instructions for details.

.5 Pipe drain tapping to floor drain.

.6 Install volute venting pet cock in accessible location.

.7 Check rotation prior to start-up.

.8 Install pressure gauge test cocks.

3.2 Start-Up

.1 General

.1 In accordance with Section 01 91 00 - Commissioning (CX) Plan, Section 23 08 00 – Commissioning of Mechanical Systems, and supplemented as specified herein.

.2 In accordance with manufacturer's recommendations.

.2 Procedures:

.1 Before starting pump, check that cooling water system over-temperature and other protective devices are installed and operative.

.2 After starting pump, check for proper, safe operation.

.3 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.

.4 Check base for free-floating, no obstructions under base.

.5 Run-in pumps for 12 continuous hours.

.6 Verify operation of over-temperature and other protective devices under low- and no-flow condition.

.7 Eliminate air from scroll casing.

.8 Adjust water flow rate through water-cooled bearings.

.9 Adjust flow rate from pump shaft stuffing boxes to manufacturer's recommendation.

.10 Adjust alignment of piping and conduit to ensure true flexibility at all times.

.11 Eliminate cavitation, flashing and air entrainment.

.12 Adjust pump shaft seals, stuffing boxes, glands.

.13 Measure pressure drop across strainer when clean and with flow rates as finally set.

.14 Replace seals if pump used to degrease system or if pump used for temporary heat.

.15 Verify lubricating oil levels.

3.3 Performance Verification

.1 General

.1 In accordance with Section 01 91 00 - Commissioning (CX) Plan, Section 23 08 00 – Commissioning of Mechanical Systems, and supplemented as specified herein.

.2 Exclusions:

.1 This paragraph does not apply to small in-line circulators.

.3 Assumptions: these PV procedures assume that:

.1 Manufacturer's performance curves are accurate.

.2 Valves on pump suction and discharge provide tight shut-off.

.4 Net Positive Suction Head (NPSH):

.1 Application: measure NPSH for pumps which operate on open systems and with water at elevated temperatures.

.2 Measure using procedures prescribed in the Standard.

.3 Where procedures do not exist, discontinue PV, report to Departmental Representative and await instructions.

.5 Multiple Pump Installations - Series and Parallel:

.1 Repeat PV procedures specified above for pump performance and pump BHP for combinations of pump operations.

.6 Mark points of design and actual performance at design conditions as finally set upon completion of TAB.

.7 Commissioning Reports: In accordance with Section 01 91 00 - Commissioning (CX) Plan, Section 23 08 00 – Commissioning of Mechanical Systems, reports supplemented as specified herein. Reports to include:

.1 Record of point(s) of actual performance at maximum and minimum conditions and for single and parallel operation as finally set at completion of commissioning on pump curves.

.2 Pump performance curves (family of curves).

END OF SECTION

PART 1 GENERAL

1.1 Summary

.1 Section Includes:

.1 Materials, components, equipment and chemicals for installation of complete HVAC water treatment system.

1.2 Related Sections

.1 Section 01 01 50 General Instructions

.2 Section 23 05 00 Common Work Results-Mechanical

.3 Section 23 08 02 Cleaning & Startup of Mechanical Piping Systems

1.3 References

.1 American Society of Mechanical Engineers (ASME)

.1 ASME Boiler and Pressure Vessel Code, Section VII.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.4 Submittals

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 01 50 - General Instructions. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 01 50 - General Instructions.

.2 Shop Drawings:

.1 Submit shop drawings in accordance with Section 01 01 50 - General Instructions.

.3 Quality assurance submittals: submit following in accordance with Section 01 01 50 - General Instructions.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.4 Closeout Submittals:

.1 Submit operation and maintenance data for incorporation into manual specified in Section 01 01 50 – General Instructions.

.2 Include following:

.1 Log sheets as recommended by manufacturer.

1.5 Quality Assurance

.1 Health and Safety:

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

1.6 Delivery, Storage, and Handling

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse recycling in accordance with Division 01 - General Requirements.

PART 2 PRODUCTS

2.1 Manufacturer

.1 Equipment, chemicals, service provided by one supplier.

2.2 Shipping/Feeding Chemical Containers

.1 High density molded polyethylene, with liquid level graduations, cover.

2.3 Chemicals

.1 Closed System Treatment (Hot Water, Chilled Water): Use a Borated Nitrite- Molybdate based corrosion inhibitor. Maintain levels at 200 to 400ppm. The use of Nitrite only, Molybdate only or Sulphite will not be accepted.

.2 Cleaning solutions: as indicated in Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

.3 Provide one year supply.

PART 3 EXECUTION

3.1 Manufacturer's Instructions

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

3.2 Cleaning of Mechanical System

All New and Existing hot water heating piping must be chemically treated. Provide water treatment chemicals and execute heating water treatment process for all heating piping as specified.

.1 Provide copy of recommended cleaning procedures and chemicals for approval by Departmental Representative.

.2 Thoroughly flush mechanical systems and equipment with approved cleaning chemicals designed to remove deposition from construction such as pipe dope, oils, loose mill scale and other extraneous materials. Chemicals to inhibit corrosion of various system materials and be safe to handle and use.

.3 During circulation of cleaning solution, periodically examine and clean filters and screens and monitor changes in pressure drop across equipment.

.4 Drain and flush system[s] until alkalinity of rinse water is equal to make-up water. Refill with clean water treated to prevent scale and corrosion during system operation.

.5 Disposal of cleaning solutions to be approved by authority having jurisdiction.

3.3 Water Treatment Services

.1 Provide water treatment monitoring and consulting services for period of one year after system start-up. Service to include:

.1 Initial water analysis and treatment recommendations.

.2 System start-up assistance.

.3 Operating staff training.

.4 Visit plant every 30 days during period of operation and as required until system stabilizes and advise on treatment system performance.

.5 Provide necessary recording charts and log sheets for one year operation.

.6 Provide necessary laboratory and technical assistance.

.7 Provide clear, concise, written instructions and advice to operating staff.

3.4 Field Quality Control

.1 Start-Up

.1 Start up water treatment systems in accordance with manufacturer's instructions.

.2 Commissioning

.1 Commissioning Agency: to be installing water treatment sub-contractor.

.2 Timing:

.1 After start-up deficiencies rectified.

.2 After start-up and before TAB of connected systems.

.3 Pre-commissioning Inspections: verify:

.1 Presence of test equipment, reagents, chemicals, details of specific tests performed, and operating instructions.

.2 Suitability of log book.

.3 Currency and accuracy of raw water analysis.

.4 Required quality of treated water.

.4 Commissioning procedures - applicable to Water Treatment Systems:

.1 Establish, adjust as necessary and record automatic controls and chemical feed rates.

.2 Monitor performance continuously during commissioning of connected systems and until acceptance of project.

.3 Establish test intervals, regeneration intervals.

.4 Record on approved report forms commissioning procedures, test procedures, dates, times, quantities of chemicals added, raw water analysis, treated water analysis, test results, instrument readings, adjustments made, results obtained.

.5 Establish, monitor and adjust automatic controls and chemical feed rates as necessary.

.6 Visit project at specified intervals after commissioning is satisfactorily completed to verify that performance remains as set

during commissioning (more often as required until system stabilizes at required level of performance).

.7 Advise Departmental Representative in writing on matters regarding installed water treatment systems.

.5 Commissioning procedures - Closed Circuit Hydronic Systems:

.1 Analyze water in system.

.2 Based upon an assumed rate of loss approved by Departmental Representative, establish rate of chemical feed.

.3 Record types, quantities of chemicals applied.

.6 Training:

.1 Commission systems, perform tests in presence of, and using assistance of, assigned O&M personnel.

.2 Train O&M personnel in softener regeneration procedures.

.7 Certificates:

.1 Upon completion, furnish certificates confirming satisfactory installation and performance.

.8 Commissioning Reports:

.1 To include system schematics, test results, test certificates, raw and treated water analyses, design criteria, other data required by Departmental Representative.

.9 Commissioning activities during Warranty Period:

.1 Check out water treatment systems on regular basis and submit written report to Departmental Representative.

3.5 Cleaning

.1 Proceed in accordance with Division 01 - General Requirements.

.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 Related Sections

.1	Section 01 01 50	General Instructions
.2	Section 23 05 00	Common Work Results-Mechanical
.3	Section 23 05 93	Testing Adjusting and Balancing for HVAC

1.2 Waste Management and Disposal

.1 Separate and recycle waste materials in accordance with Division 01 - General Requirements.

.2 Dispose of unused cleaning solutions at official hazardous material collections site approved by the Departmental Representative.

.3 Do not dispose of unused cleaning solutions into sewer system, into streams, lakes, onto ground or in other locations where it will pose health or environmental hazard.

.4 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.5 Dispose of packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

1.3 Scope

.1 All air systems installed by this contract shall be cleaned by a Cleaning Contractor.

.2 The Cleaning Contractor shall visit the site in the case of existing systems or shall review the drawings and specifications of new systems, in order to be fully acquainted with the scope of work and requirements before tendering. No consideration will be granted for any misunderstanding of work to be done resulting from failure to visit the site or inspect the contract documents.

.3 The following air systems shall be cleaned, as applicable:

- .1 Relief
- .2 Supply
- .3 Return
- .4 Exhaust
- .5 Air Conditioning

.4 All components within each system shall be thoroughly cleaned to the Departmental Representative's satisfaction and shall include but not be limited to the following:

- .1 Intake exhaust and relief louvres
- .2 Bird screens
- .3 Auto dampers
- .4 Filter frames
- .5 Coils
- .6 Fans & motors - complete assembly
- .7 All plenum surfaces
- .8 Terminal heating/cooling coils
- .9 Supply air grilles, registers and diffusers
- .10 Ductwork
- .11 Mixing boxes, air terminal units
- .12 Return, exhaust and relief air grilles and diffusers.

1.4 Qualifications

.1 Cleaning shall be performed by a cleaning service company with high capacity cleaning equipment designed specifically for the work involved, executed by personnel specifically trained for the application.

PART 2 PRODUCTS

2.1 Cleaning Equipment

.1 Cleaning shall generally by high capacity power vacuum.

.2 High pressure compressed air, wire brushing, and/or non-toxic solvent cleaning shall be used where dirt or scale cannot be removed otherwise.

PART 3 EXECUTION

3.1 Cleaning HVAC Systems

.1 The Cleaning Contractor shall provide access as required for the work and shall reseal and make good any duct or insulation damaged in the process of this work.

.2 Remove cheesecloth from grilles, etc., let over from the temporary use of the air systems.

.3 Air systems must not be shut down without prior approval from the Departmental Representative.

.4 The Cleaning Contractor shall be responsible for removing and replacing filter media. In new buildings this Contractor will remove the temporary filters and replace with new after cleaning the systems. In existing buildings this Contractor may re-use existing filter media (cleaned if possible) or new media will be provided by the Departmental Representative.

.5 The Cleaning Contractor shall mark balancing damper positions before cleaning and return them to their original position when cleaning is completed unless the system is to be balanced.

.6 Re-install any grilles, registers and diffusers which may have been removed for cleaning purposes.

3.2 Report

.1 After completion of the work, the Contractor shall provide four copies of a certificate stating that all systems have been cleaned as specified and that all access panels for all cleaning openings are in place. This certificate shall be placed in the Operating and Maintenance Manuals.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1	Section 01 01 50	General Instructions
.2	Section 23 05 00	Common Work Results - Mechanical
.3	Section 23 07 13	Thermal Insulation for Ducting

1.2 References

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).

.2 American Society for Testing and Materials (ASTM)

.1 ASTM A 480/A 480M-2003c, Standard Specification for General Instructions for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.

.2 ASTM A 635/A 635M, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.

.3 ASTM A 653/A 653M, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.

.3 Department of Justice Canada (Jus).

.1 Canadian Environmental Protection Act (CEPA).

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS).

.1 Material Safety Data Sheets (MSDS).

.5 National Fire Protection Agency (NFPA)

.1 NFPA 90A, Installation of Air Conditioning and Ventilating Systems.

.2 NFPA 90B, Installation of Warm Air Heating and Air Conditioning Systems.

.3 NFPA 91, Standard for Exhaust System for Air Conveying of Vapours, Gases, Mists, and Non-combustible Particle Solids.

.6 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

.1 SMACNA HVAC Duct Construction Standards, Metal and Flexible.

.2 SMACNA HVAC Duct Leakage Test Manual.

.3 IAQ Guideline for Occupied Buildings Under Construction.

.7 Transport Canada (TC).

.1 Transportation of Dangerous Goods Act (TDGA).

1.3 Submittals

.1 Submit shop drawings and product data in accordance with Section 01 01 50 - General Instructions.

.2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets for the following:

.1 Sealants.

.2 Adhesive

.3 Duct tape.

.4 Duct liners.

1.4 Quality Assurance

.1 Certification of Ratings:

.1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

.2 Health and Safety:

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

1.5 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 Division 01 General Requirements.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.

.4 Separate for reuse and recycling and place in designated containers in accordance with Waste Management Plan.

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

.6 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.

.7 Fold up metal and plastic banding, flatten and place in designated area for recycling.

PART 2 PRODUCTS

2.1 Seal Classification

.1 Classification as follows:

Pressure Class	Maximum Pressure (Pa)	SMACNA Seal Class
High Pressure	1,000	[A]
Medium Pressure	750	[B]
Low Pressure	500	[B]

.2 Seal classification:

.1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant.

.2 Class B: longitudinal seams, transverse joints and connections made airtight with sealant.

2.2 Ductwork - General

.1 Duct dimension noted on drawings are clear inside dimensions. Insulation thickness shall be as noted on the drawings.

.2 All seams, joints and raw edges shall be sealed and covered with glassfab.

.3 Insulation shall be applied with mechanical fasteners and suitable adhesives. Duct insulation adhesive and coatings shall be non-toxic as defined by WCB Regulations.

.4 Round duct: with spiral seams. Sections shall be joined with a RT1 slip joint, screw fastened and sealed with no visible duct sealant to interfere with finish painting.

.5 Exposed round duct shall be installed in a neat workmanlike manner parallel to building walls and roof with no sags or misalignment and shall be true and round.

.6 Ductwork downstream of low-pressure single duct air terminal units shall be constructed to 500 Pa low pressure duct.

.7 Ductwork upstream of single duct air terminal units shall be constructed to 1,000 Pa high pressure duct.

.8 Ductwork connected to the exhaust fan serving the cross draft exhaust hood shall be constructed to 1,000 Pa high pressure duct.

2.3 Fittings

.1 Fabrication: to SMACNA. Fittings shall be 2 gauges heavier than connecting ductwork.

.2 Radius elbows:

.1 Rectangular: Centre-line radius equal to 1.5 times width of duct, with single thickness turning vanes.

.2 Round: Centre-line radius equal to 1.5 times diameter. 5-gore for 300mm [12”] and larger; die-stamped for 254mm [10”] and smaller.

.3 Mitered elbows, rectangular:

.1 To 400mm [16”]: with single thickness turning vanes.

.2 Over 400mm [16”]: with double thickness turning vanes.

.4 Branches:

.1 Rectangular main and branch: 45° entry on branch.

.2 Round main and branch: enter main duct at 45° or with conical connection. The use of spin-in collars is not acceptable.

.5 Transitions:

.1 Diverging: 20° maximum angle.

.2 Converging: 30° maximum angle.

.6 Offsets: full radius elbows.

.7 Obstruction deflectors: maintain full cross-sectional area.

.8 Elbows in autoclave exhaust shall be un-vaned, smooth radius construction with centre- line equal to 1.5 times width of duct.

2.4 Galvanized Steel

.1 Lock forming quality: to ASTM A 653, Z90 zinc coating.

.2 Thickness, fabrication and reinforcement: to SMACNA.

.3 Joints: to SMACNA.

.4 Applications:

.1 All supply and exhaust ductwork unless otherwise noted.

2.5 Hangers and Supports

.1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct. Maximum size duct supported by strap hanger: 500mm [20”].

.2 Hangers, hanger configuration and attachment to structure: to SMACNA.

2.6 Duct Liner

.1 Fibrous glass duct liner: air stream side faced with FSK facing.

.2 Rigid:

.1 Use on flat surfaces.

.2 25mm [1”] or 50mm [2”] thick fibrous glass rigid board duct liner.

.3 Density: 36 kg/m³ [2.2 lb/ft^3].

.4 Thermal resistance: RSI-0.76 [R-4.3] for 25mm [1”], RSI-1.53 [R-8.7] 50mm [2”].

.3 Flexible:

.1 Use on round or oval surfaces.

.2 25mm [1”] or 50mm [2”] thick fibrous glass blanket duct liner as indicated.

.3 Density: 24 kg/m³ [1.5 lb/ft^3].

.4 Thermal resistance: RSI-0.74 [R-4.2] for 25mm [1”], RSI-1.47 [R-8.3] 50mm [2”].

.4 Fasteners shall be weld pins with metal retaining clips and square head.

.5 Flame and smoke ratings:

.1 In accordance with CAN/ULC-S102:

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.7 Sealant

.1 Oil resistant, polymer-based duct sealant. Temperature range of -23°C to 65°C [-10°F to 150°F]. ULC listed and comply with NFPA 90A and NFPA 90B.

.2 Flame and smoke ratings:

.1 In accordance with CAN/ULC-S102:

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.8 Adhesive

.1 Water-based vinyl copolymer adhesive. Temperature range of -23°C to 71°C [-10°F to 160°F]. ULC listed and comply with NFPA 90A and NFPA 90B. Adhesive shall be non- toxic as defined by W.C.B. Regulations.

.2 Flame and smoke ratings:

.1 In accordance with CAN/ULC-S102:

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.9 Duct Tape System

.1 Two-part system combined of treated woven fibreglass tape and liquid sealant/adhesive. ULC listed and comply with NFPA 90A and NFPA 90B.

.2 Flame and smoke ratings:

.1 In accordance with CAN/ULC-S102:

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

PART 3 EXECUTION

3.1 General

.1 Do work in accordance with NFPA 90A, NFPA 90B, ASHRAE, SMACNA, and as indicated.

.2 Do not break continuity of insulation vapour barrier with hangers or rods.

.3 Support risers in accordance with SMACNA.

.4 Install breakaway joints in ductwork on sides of fire separation.

.5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.

.6 Manufacture duct in lengths and diameter to accommodate installation of acoustic duct lining.

.7 All openings in ductwork shall be sealed with temporary duct cover during construction. Failure to maintain duct cleanliness will require the inside of all air ducts, plenums and equipment in the air stream to be cleaned with an industrial vacuum cleaner before system balancing is started.

.8 Apply protective galvanize coating to galvanized ductwork and accessories which have been welded.

.9 Apply duct sealer to all joints of metal ducts, connections to diffusers, plenums and flexible duct.

.10 Provide medium pressure duct for the following:

.1 Ductwork serving systems with air terminal units, extending from the air handling unit discharge to the inlet of air terminal units.

.2 As indicated.

.11 The use of plastic duct tape is not permitted.

.12 Thermal insulation to Section 23 07 13 – Thermal Insulation for Ducting.

3.2 Hangers

.1 Strap hangers: Install in accordance with SMACNA.

.2 Rectangular duct: Extend strap hanger down on both sides of duct, turn under bottom 25mm [1”] minimum. On each strap provide two sheet metal screws on the side and one in the bottom.

.3 Angle hangers: complete with locking nuts and washers.

.4 Hanger spacing: to SMACNA.

.5 Seismic restraint to Section 23 05 48 – Vibration and Seismic Controls for Ductwork, Piping and Equipment.

3.3 Ductwork exposed to Weather

.1 All ductwork exposed to weather shall have watertight seams.

.2 Exposed ducts which are not insulated or finished with paint shall be coated with two applications of bitumastic waterproofing compound to prevent corrosion.

.3 Supports for ductwork exposed to weather and miscellaneous metals exposed to weather shall be electro-galvanized or hot dip galvanized steel, or coated with two applications of bitumastic waterproofing compound

3.4 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.

.2 In addition to adhesive, install weld pins not less than 2 rows per surface and not more than 425mm on centres.

.2 Line inside of ducts where indicated.

.3 Duct dimensions, as indicated, are clear inside duct lining.

.4 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.

.5 Replace damaged areas of liner.

.6 Protect leading and trailing edges of duct sections with sheet metal nosing having 15mm [1/2”] overlap and fastened to duct.

.7 Provide 50mm [2”] liner for ductwork exposed to weather which is not insulated

3.5 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.

3.6 Cleaning

.1 Perform cleaning operations as specified in Section 01 01 50 – General Instructions, Section 23 31 10 – Cleaning of Mechanical Duct Systems and in accordance with manufacturer's recommendations.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1 Section 01 01 50 General Instructions

.2 Section 23 05 00 Common Work Results - Mechanical

1.2 References

.1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

.1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible

.2 National Fire Protection Association (NFPA)

.1 NFPA 90A, Installation of Air Conditioning and Ventilating Systems.

.2 NFPA 90B, Installation of Warm Air Heating and Air Conditioning Systems.

.3 Underwriter's Laboratories of Canada (ULC)

.1 CAN/ULC-S110, Fire Tests for Air Ducts.

.2 UL 181, Factory Made Air Ducts and Connectors.

1.3 Submittals

.1 Submittals in accordance with Section 01 01 50 - General Instructions.

.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.

.6 Manufacturer's Field Reports: manufacturer's field reports specified.

.7 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 01 50 – General Instructions.

1.4 Quality Assurance

.1 Health and Safety:

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

1.5 Delivery, Storage and Handling

.1 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Division 01 - General Requirements.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan (WMP).

.4 Separate for reuse and recycling and place in designated containers in accordance with Waste Management Plan (WMP).

.5 Divert unused materials from landfill to recycling facility as approved by Departmental Representative.

PART 2 PRODUCTS

2.1 General

.1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.

2.2 Flexible Duct

.1 General:

.1 UL-181 listed and labeled as Class I air duct and complies with NFPA 90A and 90B.

.2 Non-metallic, Insulated:

.1 Constructed of CPE liner duct permanently bonded to a spring steel wire helix and with factory applied fibreglass insulation, lower permeability vapour barrier and laminate jacket for low and medium pressure systems.

.2 Maximum rated pressure: 1,000Pa [4” w.g.] positive, 250Pa [1” w.g.] negative.

.3 Operating temperature: -29 to 121 °C [-20 to 250 °F].

.4 Thermal resistance: RSI-0.74 [R-4.2].

.5 Application: cold air supply duct.

.3 Non-metallic, un-insulated:

.1 Constructed of supporting helix of coated spring steel wire permanently bonded to a coated woven fiberglass.

.2 Maximum rated pressure: 2,500Pa [10” w.g.] positive, 250Pa [1” w.g.] negative.

.3 Operating temperature: -18 to 121 °C [-0 to 250 °F].

.4 Application: warm air supply duct.

2.3 Flexible Duct Connectors

.1 Frame: galvanized sheet metal frame 0.66mm [24 gauge] thick with fabric clenched by means of double locked seams.

.2 Fabric:

.1 Indoor: Fire resistant, self extinguishing, neoprene coated fibreglass fabric, temperature rated at -40°C to 90°C [-40°F to 200°F], thickness of 0.63mm [0.025”].

.2 Outdoor: Fire resistant, self extinguishing, DuPont Hypalon coated fibreglass fabric, temperature rated at -40°C to 120°C [-40°F to 250°F], thickness of 0.61mm [0.024"].

2.4 Access Doors in Ducts

.1 Non-insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6mm [24 gauge] thick complete with sheet metal angle frame.

.2 Insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6mm [24 gauge] thick complete with sheet metal angle frame and 25mm [1"] thick rigid fibreglass 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 Doors over 1000 mm: piano hinge and two handles operable from both sides.

2.5 Turning Vanes

.1 Factory-made, single or double thickness as specified elsewhere, with trailing edge. Vanes shall be constructed of same material as duct, 0.55mm [26 gauge].

.2 Rails shall be fabricated of same material as duct, 0.66m [24 gauge]. Vanes shall be attached to rails using fasteners.

2.6 Instrument Test Ports

.1 Alloy casting with screw-in cap, neoprene gasket, 18 mm [3/4"] inside diameter opening for pitot tube or velometer.

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 Duct

.1 Provide flexible duct connecting air outlets as indicated. Flexible duct with integral volume damper is not acceptable.

.2 Install flexible duct fully extended, without tight bends and kinks. The radius at the centre-line shall not be less than one duct diameter. Do not install in compressed state.

.3 Length of flexible duct shall within 1,500mm to 2,100mm (5'-0" to 7'-0").

.4 Provide support for flexible duct at 1,200mm (4'-0") on centre. Maximum permissible sag is 42 mm/m (1/2 inch per foot) of spacing between support. A connection to a rigid duct or equipment shall be considered a support joint.

.5 Sheet metal strap for flexible duct support shall be minimum 38mm (1- 1/2") wide.

.6 Sheet metal collars to which the flexible ducts are attached shall be minimum 50mm (2") in length.

.7 Repair torn or damaged vapour barrier jackets approved duct tape. If the internal core is penetrated, replace the flexible duct.

.8 Do not use flexible duct for connecting mixing box and air terminal unit inlets.

.2 Flexible Duct Connectors

.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: 100mm [4"].

.3 Minimum distance between metal parts when system in operation: 75mm [3"].

.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.

.3 Access Doors in Ducts

.1 Size:

.1 610mm x 1520 mm [24"x60"] for person size entry.

.2 460mm x 460 mm [18"x18"] for service.

.3 300mm x 200mm [12"x8"] for cleaning.

.4 As indicated.

.2 Locations:

.1 Fire dampers and smoke dampers.

.2 Control dampers.

.3 Devices requiring maintenance.

.4 Required by code.

.5 Reheat coils.

.6 On both sides of turning vanes.

.7 At the base of all duct risers.

.8 At 12,000m [40'-0"] intervals in all duct systems, and 6,000mm [20'-0"] intervals in horizontal exhaust ducts for cleaning purposes.

.5 Instrument Test Ports

.1 Install in accordance with manufacturer's instructions.

.2 Locate to permit easy manipulation of instruments.

.3 Locations:

.1 For traverse readings:

.1 Ducted inlets to roof and wall exhausters.

.2 Inlets and outlets of other fan systems.

.3 Main and sub-main ducts.

.4 And as indicated.

.2 For temperature readings:

.1 At outside air intakes.

.2 In mixed air applications in locations.

.3 At inlet and outlet of coils.

.4 Downstream of junctions of two converging air streams of different temperatures.

.5 And as indicated.

.5 Turning Vanes

.1 Install in accordance with manufacturer's recommendations.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1 Section 01 01 50 General Instructions

.2 Section 23 05 00 Common Work Results – Mechanical

1.2 References

.1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

.1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible

.2 SMACNA – Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems.

.2 Underwriters Laboratories of Canada (ULC)

.1 CAN4-S112, Fire Test of Fire Damper Assemblies.

.2 CAN4-S112.2, Fire Test of Ceiling Firestop Flap Assemblies.

.3 ULC-S505, Fusible Links for Fire Protection Service.

.3 National Fire Protection Agency (NFPA)

.1 NFPA 90A, Installation of Air Conditioning and Ventilating Systems.

1.3 Submittals

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 01 50 - General Instructions. Include product characteristics, performance criteria, and limitations.

.1 Indicate the following:

.1 Volume dampers.

.2 Remote control damper regulators.

.3 Fire dampers.

.4 Fire stop flaps.

.5 Smoke dampers.

.6 Backdraft dampers.

.7 Relief dampers.

.2 Quality assurance submittals: submit following in accordance with Section 01 01 50 - General Instructions.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

1.4 Quality Assurance

.1 Health and Safety Requirements:

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

1.5 Delivery, Storage and Handling

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 01 50 - General Instructions.

.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 01 50 - General Instructions.

1.6 Extra Materials

.1 Provide maintenance materials in accordance with Section 01 01 50 – General Instructions.

.2 Provide following:

.1 Six (6) fusible links for each type of fire damper.

PART 2 PRODUCTS

2.1 General

.1 Manufacture to SMACNA standards.

2.2 Single Blade Volume Dampers

.1 Blade: Of same material as duct. Two gauges heavier than duct but not less than 0.6mm [24 gauge], stiffened.

.2 Maximum dimension: 305mm [12”] height for rectangular ducts.

.3 Axles: 9.5mm [3/8”] continuous square rod up to 457mm [18”] wide duct, and 13mm [1/2”] continuous square rod up to 1,219mm [48”] wide duct.

.4 Linkage: shaft extension with locking quadrant and position indicator.

.5 Bearings: bronze oilite.

.6 Frame: of the same material as duct. Complete with angle stop for rectangular duct.

2.3 Multi-Bladed Volume Dampers

.1 Opposed blades: 1.2mm [18 gauge] of same material as adjacent duct, stiffened.

.2 Maximum blade width: 150mm [6”].

.3 Axles: 9.5mm [3/8”] or 13mm [1/2”] continuous square rod.

.4 Bearings: bronze oilite.

.5 Linkage: shaft extension with locking quadrant and position indicator.

.6 Frame: 51mm [2”] or 40 x 13 x 3 mm [1-1/2”x1/2”x1/8”] structural or roll-formed channel, complete with angle stop.

2.4 Remote Control Damper Regulators

.1 Cable controlled damper regulator for concealed ceiling applications.

.2 Cable: 1.4mm [0.054] stainless steel Bowden cable encapsulated in 1.6mm [1/16”] flexible galvanized spiral wire sheath.

.3 Control kit: die-cast aluminum housing with 76mm [3”] diameter chrome-plated cover, with steel rack and pinion gear drive converting rotary motion to push-pull motion.

.4 Provide hardware kit for damper by others.

2.5 Fire Dampers

.1 Arrangement B, ULC listed and labelled, meeting requirements of provincial fire authority and NFPA 90A. Fire damper assemblies to be fire tested in accordance with CAN4-S112. Factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.

.2 Frame and integral sleeve shall be of same material as duct with mounting angles furnished by the damper manufacturer. Sleeve thickness to SMACNA and NFPA-90A.

.3 Top hinged: offset, round or square, interlocking blade type and sized to maintain full duct cross section.

.4 Fusible link: 74°C [165°F], replaceable. Gravity-operated for vertical installation and spring-actuated for horizontal installation.

.5 40 x 40 x 3 mm [1-1/2" x 1-1/2" x 1/8"] retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.

2.6 Fire Stop Flaps

.1 To be ULC listed and labelled and fire tested in accordance with CAN4-S112.2.

.2 Construct of same material as duct, minimum 1.5 mm thick with 1.6 mm thick non-asbestos ULC listed insulation and corrosion-resistant pins and hinges.

.3 Flaps to be held open with fusible link conforming to ULC-S505 and close at [74] °C [or as indicated].

2.7 Smoke Dampers

.1 Class I leakage rate, with airfoil blades, pressure sensitive blade edge and jamb seals for low leakage, concealed linkage. Both damper and actuator shall be ULC listed and labelled.

.2 Constructed frame and blades of same material as duct.

.3 Operation: Normally open position. Damper shall close upon detection of smoke or from remote alarm signaling device.

2.8 Backdraft Dampers

.1 Multi-blade, gravity-operated, center pivoted, constructed of same material as duct with nylon bearings.

2.9 Relief Dampers

.1 Multi-blade, insulated, counter-weight, centre pivoted, constructed of same material as duct with brass bearings, set to open at 12.4 Pa [0.05 in. w.g.] static pressure unless otherwise noted.

PART 3 EXECUTION

3.1 General

.1 Install where indicated.

.2 Install in accordance with recommendations of SMACNA and manufacturer's instructions.

.3 Seal multiple damper modules with silicon sealant.

3.2 Volume Damper

.1 For supply, return and exhaust systems, locate balancing dampers in each branch duct.

.2 Run-outs to registers and diffusers: install single blade damper located as close as possible to main ducts.

.3 All dampers to be vibration free.

.4 Attach fluorescent tape to regulator handle for concealed volume dampers.

.5 Provide remote control damper regulator for volume dampers above inaccessible ceiling where ceiling access panel is not provided, and as indicated.

3.3 Fire Dampers

.1 Install in accordance to Part 3, Sub-section 3.1.8 of the National Building Code.

.2 Provide fire damper where duct penetrates through fire-rated floor, wall, or fire separation.

.3 Provide fire stop flap at fire-rated ceiling assembly.

.4 Provide access door per Section 23 33 00 – Air Duct Accessories.

3.4 Smoke Dampers

.1 Provide smoke dampers in the supply and return air streams if the air handling system:

.1 serves more than one storey.

.2 serves more than one suite in a storey.

.2 Coordinate with Division 26 for power and Division 28 for interlock/interfacing.

.3 Provide access door per Section 23 33 00 – Air Duct Accessories.

3.5 Field Quality Control

.1 Tests:

.1 Tests to cover period of not less than 2 days and demonstrate that system is functioning as specified.

END OF SECTION

PART 1 GENERAL

1.1 Summary

.1 Section includes:

.1 Outdoor ducts and fittings, both horizontal and vertical.

.2 This section does not include:

.1 Air passages rated over a continuous internal static pressure of 10" w.g. positive, 10” negative, or with test pressure rating over: 10" w.g. startup and 10" w.g. negative (as documented on product labeling).

1.2 Submittals

.1 Product data: For each type of product indicated.

.2 Shop drawings: Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work including.

.1 Duct layout indicating sizes and pressure classes.

.2 Elevation of top of ducts.

.3 Dimensions of main duct runs from building grid lines.

.4 Fittings.

.5 Penetrations through fire-rated and other partitions.

.3 Coordination Drawings: Plans, drawn to scale, showing coordination general construction, building components, and other building services.

1.3 Quality Assurance

.1 Installer Qualifications:

.1 Product shall be installed per the current manufacturer’s Installation Manual by competent trained field mechanics who demonstrate competence in the HVAC industry.

1.4 Specification Compliance

.1 Duct Leakage Class, follow SMACNA Leakage Class 3 or less.

.2 Product shall incorporate a fortified inner liner compliant to UL (C-UL) 181 Standard for Safety Listed, Class 1 system, with included testing and passing the following:

.1 Test for Surface Burning Characteristics

.2 Flame Penetration Test

.3 Burning Test

.4 Mold Growth and Humidity Test

.5 Low Temperature Test and High Temperature Test

.6 Puncture Test

.7 Static Load Test

.8 Impact Test

.9 Pressure Test and Collapse (negative pressure) Test

.10 High Temperature and Humidity for 90 days

.11 Cone Calorimeter

.12 ASTM E2257 Standard Test Method for Room Fire Test of Wall and Ceiling Materials and Assemblies

.13 ASTM E 84 tested, Tunnel Test, Does not exceed 25 flame spread, 50 smoke developed.

.14 DW144, Class B

.15 NRTL product approval, (Subpart S of 29 CFR Part 1910, OSHA)

.16 ASTM C 423 noise reduction

.17 ASTM E 96/E 96M Procedure A for permeability

.18 ASTM C 1071 for erosion

.19 ASTM C 518: 2004, Standard Test Method for Steady–State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus

.20 UL 723, Test for Surface Burning Characteristics of Building Materials

.21 NFPA Compliance:

.1 NFPA 90A, "Installation of Air Conditioning and Ventilating Systems"

.2 NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems"

.3 NFPA 255, “Standard Method of Test of Surface Burning Characteristics of Building Materials

.3 Product outer shell shall be a UV stable 1000 micron high impact resistant titanium infused vinyl with included testing as following;

.1 UL-94 Flammability V-0

.2 ASTM D-638 Tensile Strength of 6250 psi

.3 ASTM D-790 Flexible Strength of 11,000 psi

.4 ASTM D-4226 Drop Impact Resistance

.5 ASTM D-4216 Cell Classification

1.5 Product Delivery and Storage

.1 Prevent objectionable aesthetic damage to the outer surface of duct segments during transport and storage.

.2 Store duct segments under cover and protect from excessive moisture prior to installation.

PART 2 PRODUCTS

2.1 Rectangular Duct and Fittings

.1 The panel shall be manufactured of CFC-free closed cell rigid thermoset resin thermally bonded on both sides to a factory applied .001" (25 micron) aluminum foil facing reinforced with a fiberglass scrim. An added UV stable, IR reflective 1000-micron high impact resistant titanium infused vinyl is factory bonded using a full lamination process. The lamination process shall permanently bond the vinyl clad to the outer surfaces of the phenolic foam panel to provide a zero-permeability water tight barrier and to form a structurally insulated panel (SIP) in which to form duct segments. Processes that do not employ a full lamination process are not acceptable. Self-applied adhesives such as tapes, caulks or cladding that incorporate pressure sensitive or spray adhesives are not acceptable.

.2 The thermal conductivity shall be no greater than 0.146BTU • in/Hr •ft2•℉ (.018W/m•℃), the thermal conductivity shall be no greater than 0.146BTU • in/Hr •ft2•℉ (.018W/m•℃)

.3 The density of the foam shall not be less than 3.5 pcf (56 Kg/m3) with a minimum compressive strength of 28 psi (.2 MPa).

.4 The standard panel is (31 mm) thickness panel with R-8.1 (1.5 RSI) shall be utilized unless indicated otherwise on the print.

.1 Maximum Temperature: Continuous rating of 185 degrees F (70 deg C) inside ducts or ambient temperature surrounding ducts.

.2 Maximum Thermal Conductivity: 0.146 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

.3 Permeability: 0.00 perms maximum when tested according to ASTM E 96/E 96M, Procedure A.

.4 Antimicrobial Agent: Additive for antimicrobial shall not be used but instead, raw product must pass UL bacteria growth testing.

.5 Noise-Reduction Coefficient: 0.05 minimum when tested according to ASTM C 423, Mounting A.

.6 Required Markings: All interior duct liner shall bear UL label and other markings required by UL 181 on each full sheet of duct panel; UL ratings for internal closure materials.

.7 All insulation materials shall be closed cell with a closed cell content of >90%.

.8 R-value:

.1 1 3/16 inch (31 mm) Thick Panel: 8.1 R

.2 1 ¾ (45 mm) Thick Panel: 12 R

.3 2 3/8” Double wall (62 mm) Thick Panel: 16.2 R

.4 3” Double wall (76 mm) Thick Panel: 20.1 R

.5 3.5” Double wall (100 mm) Thick Panel 24 R

.9 Pressure Class design must be specified prior to fabrication. Product can provide ductwork constructed to the following pressure classes:

.1 2” w.g.

.2 4” w.g.

.5 Closure Materials:

.1 V-Groove Adhesive: Silicone (interior only).

.2 UV stable 1000 micron high impact resistant titanium infused vinyl (exterior).

.1 Factory manufactured seamless corners for zero perms.

.2 Cohesive bonded over-lap at corner seam covers for zero perms.

.3 Water resistant titanium infused welded vinyl seams.

.4 Mold and mildew resistant.

.3 Polymeric Sealing System:

.1 Structural Membrane: Aluminum scrim with woven glass fiber with UV stable vinyl clad applied

.2 Minimum Seam Cover Width: 2 7/8” inches (75 mm)

.3 Sealant: Low VOC.

.4 Color: White (colors, matched by architect optional).

.5 Water resistant.

.6 Mold and mildew resistant.

.4 Duct Connectors.

.1 Factory manufactured galvanized 4-bolt flange.

.6 Outdoor Cladding

.1 Product outdoor Installations: Duct segments shall incorporate UV stable 1000 micron high impact resistant titanium infused vinyl which is introduced during the manufacturing process.

.7 Flange coverings

.1 Flanges are field sealed airtight before flange covers are installed. Flange covering consists of the following:

.1 Foam tape insulation with molded 39 mil covers.

.2 Air gap (heating only application) with molded 39 mil covers.

.8 Reinforcement

.1 Product shall provide designed and built with adequate reinforcement to both; withstand air pressure forces from within the duct from blower pressure and shall be built to handle expected snow load for the location where the product is being installed. Product manufacturer will employ a manufacturer's reinforcement system when both specified static pressure and duct sizes dictate the need. This is a factory installed system and no field installation of the reinforcement system is required.

.9 Weight

.1 Product shall provide low weight stresses on the building framing and support members. Assembled product shall have a weight of 0.86 lbs. per square foot to maximum weight of 2.7 lbs. per square foot (depending on R-value and reinforcement requirement). Hangers and tie-downs are to be detailed in the product's Contractor Installation Manual for review prior to installation but not exceeding 13' for duct girth <84" and 8' for duct girth >85" between hangers and designed to carry the weight and wind load of the ductwork.

.2 Contractor's seismic engineer shall review the outdoor duct supplier's "Contractor Installation Manual" for compliance with the wind load requirements prescribed by the National Building Code.

PART 3 EXECUTION

3.1 Shop Fabrication

.1 Certification:

.1 Ducts shall be detailed and fully factory manufactured by an authorized product's facility system. All fabrication labor will be certified "yellow label" building trade professionals, compliant to SMWIA and SMACNA labor guidelines (work preservation observed).

.2 Fabrication:

.1 Fabricated joints, seams, transitions, reinforcement, elbows, branch connections, access doors and panels, and damage repairs according to manufacturer's written and detailed instructions.

.2 Fabricated 90-degree mitered elbows to include turning vanes.

.3 Fabricated duct segments in accordance with manufacturer's written details.

.4 Duct Fittings shall include 6 inches of connecting material, as measured, from last bend line to the end of the duct. Connections on machine manufactured duct may be 4 inches.

.5 Fabricated duct segments utilizing v-groove method of fabrication. Factory welded or cohesively bonded seams will apply to fully manufactured ductwork and fittings. Internal seams will be supplied with an unbroken layer of low VOC silicone or bonding (for paint shop applications). Each duct segment will be factory supplied with either aluminum grip pro-file or pre-insulated duct connectors in accordance with manufacturer's detailed submittal guide. Applied duct reinforcement to protect against side deformation from both positive and negative pressure per manufacturer's design guide based on specified ductwork size and system pressure.

.6 Designed and fabricated duct segments and fittings will be in accordance with "SMACNA Phenolic Duct Construction Standards" latest edition.

.7 Both positive and negative ductwork and fittings shall be constructed to incorporate a UL Listed as a Class 1 air duct to Standard for Safety UL 181 liner with an exterior clad for permanent protection against water intrusion.

.8 Duct shall be constructed to exceed requirements for snow and wind loads.

3.2 Duct Installation

.1 Duct segments shall be installed per the product's Contractor Installation Manual by competent HVAC installers.

.2 Install ducts and fittings to comply with manufacturer's installation instructions as follows:

.1 Install ducts with fewest possible joints.

.2 Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

.3 Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

.4 Protect duct interiors from the moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

.5 Use prescribed duct support spacing as described in this specification and manufacturer's recommendations.

.3 Air Leakage: Duct air leakage rates to be in compliance with "SMACNA HVAC Air Duct Leakage Test Manual" latest version per applicable leakage class based on pressure.

3.3 Hanger and Support Installation

.1 Contractor to ensure that the ductwork system is properly and adequately supported per the product's Contractor Installation Manual.

.1 Ensure that the chosen method is compatible with the specific ductwork system requirements per product's installation detail drawings. Pre-installation should be provided prior to work commencement by installing contractor for approval.

.2 Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

.2 Supports on straight runs of ductwork shall be positioned at centers not exceeding 13 feet (3.96 m) for duct sections when fabricated in 13 foot (3.96 m) lengths with duct girth less than 84". Larger duct sizes and short segments with duct girth greater than 84" are to be supported at 8 foot centers or less, in accordance with the product's Contractor Installation Manual provided prior to work commencement.

.3 Ductwork shall be supported at changes of direction, at branch duct connections, tee fittings, parallel under turning vanes and all duct accessories such as dampers, etc.

.4 The load of such accessories to the ductwork shall be neutralized by the accessory support.

3.4 Field Quality Control

.1 Inspection: Arrange for manufacturer's representative to inspect completed installation and provide written report that installation complies with manufacturer's written instructions.

.1 Remove and replace duct system where inspection indicates that it does not comply with specified requirements.

.2 Perform additional testing and inspecting, at the Contractor's expense, to determine compliance of replaced or additional work with specified requirements.

3.5 Duct Schedule

.1 Outdoor Ducts and Fittings:

.1 Product’s Rectangular Ducts and Fittings:

.1 Minimum Panel Thickness: 31 mm

.2 Cladding: minimum 0.038 inch

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1	Section 01 01 50	General Instructions
.2	Section 01 91 00	Commissioning
.3	Section 23 05 13	Common Motor Requirements for HVAC Equipment
.4	Section 23 05 48	Vibration & Seismic Controls for HVAC Piping & Equipment
.5	Section 23 08 00	Commissioning of Mechanical Systems
.6	Section 23 33 00	Air Duct Accessories

1.2 References

.1 Air Conditioning and Mechanical Contractors (AMCA)

- .1 AMCA Publication 99-2003, Standards Handbook.
- .2 AMCA 300, Reverberant Room Method for Sound Testing of Fans.
- .3 AMCA 301, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

.2 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)

- .1 ANSI/AMCA 210, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

.3 Canadian General Standards Board (CGSB)

- .1 CAN/CGSB 1.181, Ready-Mixed Organic Zinc-Rich Coating.

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, HP, 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.
- .5 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210.

1.4 Submittals

.1 Product Data:

- .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 01 50 - General Instructions. Include product characteristics, performance criteria, and limitations.

.2 Shop Drawings:

.1 Submit shop drawings and product data in accordance with Section 01 01 50 - General Instructions.

.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 and sheaves details.

.5 Quality assurance submittals: submit following in accordance with Section 01 01 50 - General Instructions.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.6 Closeout Submittals:

.1 Provide operation and maintenance data for incorporation into manual specified in Section 01 01 50 – General Instructions.

1.5 Quality Assurance

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

1.6 Delivery, Storage and Handling

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 01 50 – General Instructions.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.3 Waste Management and Disposal:

.2 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Division 01 - General Requirements.

PART 2 PRODUCTS

2.1 Fans General

.1 Motors:

.1 In accordance with Section 23 05 13 - Common Motors Requirements for HVAC Equipment supplemented as specified herein.

.2 For use with variable speed controllers where specified.

.3 Sizes as specified.

.2 Accessories and hardware: as specified.

.3 Scroll casing drains: as indicated.

.4 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.

.5 Vibration isolation: to Section 23 05 48 - Vibration and Seismic Controls for Ductwork Piping and Equipment.

.6 Flexible connections: to Section 23 33 00 - Air Duct Accessories.

2.2 Downblast or Upblast Centrifugal Fans

.1 Fan wheels:

.1 aluminum construction.

.2 Maximum operating speed of centrifugal fans not more than 50% of first critical speed.

.3 Air foil or backward inclined blades, as indicated.

.2 Bearings: heavy duty grease lubricated ball or roller self aligning type with oil retaining, dust excluding seals and a certified minimum rated life (L50) of 200,000 hours.

.3 Housings:

.1 Volute with inlet cones: fabricated steel for wheels 300 mm or greater, steel, for smaller wheels, braced, and with welded supports.

.2 For horizontally and vertically split housings provide flanges on each section for bolting together, with gaskets of non-oxidizing non-flammable material.

.3 Provide bolted or latched airtight access doors with handles.

.4 Provide belt driven sets with adjustable motor bed plate and variable pitch driver sheave.

2.3 Cabinet Fans – General Purpose

.1 Fan characteristics and construction: as centrifugal fans.

.2 Cabinet hung single wheel with centrifugal fan in factory fabricated casing complete with vibration isolators and seismic control measures, motor and other accessories as noted.

.3 Fabricate casing of zinc coated or phosphate treated steel of 18 gauge reinforced and braced for rigidity. Provide removable panels for access to interior. Paint uncoated, steel parts with corrosion resistant paint to CAN/CGSB 1.181.

2.4 In-Line Centrifugal Fans

.1 Characteristics and construction: as for centrifugal fan wheels.

.2 Provide AMCA arrangements 1 or 9 as indicated with stiffened flanges, smooth rounded inlets, and stationary guide vanes.

2.5 Single Width Centrifugal Fans

.1 Welded aluminum scroll housing, backward inclined wheel, inlet cone and pedestal, providing a Spark A resistance rating.

.2 Bearings: heavy duty grease lubricated ball or roller self aligning type with oil retaining, dust excluding seals and a certified minimum rated life (L50) of 200,000 hours.

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 and Seismic Controls for Ductwork, 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 in Section 23 05 48 – Vibration and Seismic Controls for Ductwork, Piping and Equipment.

3.4 Field Quality Control

.1 Commissioning:

.1 In accordance with Section 01 91 00 – Commissioning, and Section 23 08 00 – Commissioning of Mechanical Systems.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1 Section 01 01 50 — General Instructions

.2 Section 23 05 00 — Common Work Results – Mechanical

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 Submittals

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 01 50 - General Instructions. 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 01 50 - General Instructions.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

1.4 Quality Assurance

.1 Health and Safety Requirements: 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 in accordance with Section 01 01 50 - General Instructions.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Division 01 – General Requirements.

1.6 Maintenance

.1 Extra Materials:

.1 Provide maintenance materials in accordance with Section 01 01 50 – General Instructions.

.2 Include:

.1 Keys for volume control adjustment.

.2 Keys for air flow pattern adjustment.

PART 2 PRODUCTS

2.1 General

.1 Size as indicated.

.2 Capacity, pressure drop, terminal velocity, throw, noise level, neck velocity shall conform to intended performances of specified materials.

.3 Frames:

.1 Full perimeter gaskets.

.2 Plaster frames where set into plaster or gypsum board and as specified on architectural reflected ceiling plans.

.3 Concealed fasteners.

.4 Where balancing damper is scheduled, damper shall be of opposed bladetype.

.5 Diffusers, grilles and registers in areas with high humidity shall be of aluminum construction.

.6 Provide neck transition as required.

2.2 Manufactured Units

.1 Grilles, registers and diffusers of same generic type, product of one manufacturer.

2.3 Supply, Return, Exhaust, and Transfer Grilles and Registers

.1 Exhaust grille, Type EG-1: fixed louvre, steel, 32 mm border, steel, 45 degree deflection, 19mm blade spacing, front blades parallel to long dimension, surface mount, countersunk screw holes c/w oval-head screws. Finish: white powder coat finish.

.2 Supply grille, Type SG-1: fixed louvre, steel, 32 mm border, steel, 45 degree deflection, 19mm blade spacing, front blades parallel to long dimension, surface mount, countersunk screw holes c/w oval-head screws. Finish: white powder coat finish.

PART 3 EXECUTION

3.1 Manufacturer's Instructions

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

3.2 Installation

.1 Install in accordance with manufacturers instructions.

.2 Install with security screws in countersunk holes where fastenings arevisible.

.3 Paint matte black behind all diffusers, grilles and registers so that no metallic part will be visible from the exposed side.

.4 Provide security joint sealant on all maximum security grilles.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1 Section 01 01 50 General Instructions

.2 Section 23 05 00 Common Work Results – Mechanical

1.2 References

.1 American Society for Testing and Materials International (ASTM)

.1 ASTM E 90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

.2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

.3 Air Movement and Control Association (AMCA)

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.

1.4 Submittals

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 01 50 - General Instructions. Include product characteristics, performance criteria, and limitations.

.1 Indicate following:

.1 Pressure drop.

.2 Face area

.3 Free area.

.4 Beginning point of water penetration.

.2 Quality assurance submittals: submit following in accordance with Section 01 01 50 - General Instructions.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.3 Test Reports:

.1 Submit certified data from independent laboratory substantiating acoustic and aerodynamic performance to ASTM E 90.

1.5 Quality Assurance

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

1.6 Delivery, Storage and Handling

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 01 50 – General Instructions.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Division 01 General Requirements.

PART 2 PRODUCTS

2.1 Roof Ventilator Hoods

.1 Application: exhaust fan vent and outdoor air intake vent

.2 General: Spun aluminum gravity roof ventilator, heavy gauge aluminum wind band with rolled bead construction. Rigid galvanized steel internal components with bird screen. Heavy-gauge aluminum curb cap with spun venturi.

2.2 Louvres

.1 Louvres shall have free areas as scheduled, be of formed galvanized steel sections and have all welded assemblies. Fitted with screw fastened galvanized 19mm (3/4”) mesh, 18 gauge bird-screen on interior. Louvre flanges shall be suitable for type of construction encountered, caulked and weather-tight.

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 In accordance with manufacturer's and SMACNA recommendations.

.2 Reinforce and brace as indicated.

.3 Anchor securely into opening. Seal with caulking around to ensure weather tightness.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL AIR HANDLING UNITS TESTING AND STANDARDS:

.1 Unit shall be completely factory assembled and tested prior to shipment and shall have the approval of one of the following agencies: Underwriters' Laboratories (UL), Electrical Testing Laboratories (ETL) or Canadian Standards Association (CSA). The air handler shall bear an appropriate label certifying that the unit has been designed and manufactured in strict accordance with the UL 1995 Standard for air handling equipment. If the manufacturer cannot provide an ETL/UL sticker on the air handler, it will be the sole responsibility of the contractor to arrange for local ETL or UL approval and labeling.

.2 The Unit Electrical Panel(s) shall be built in strict accordance to NEC Standards and shall bear an appropriate label certifying compliance with UL Standard 508A.

.3 The air handling equipment manufacturer shall provide single source responsibility for all components for the unit whether specifically manufactured by the unit manufacturer or obtained outside and installed in the equipment with the exception of consumable items such as filters, fan belts, etc., or as specifically warranted by the product manufacturer such as motors, VFD's, etc.

.4 The attached schedules, tables and specifications are to be used as the selection criteria for the air handling equipment to include Air Flow Rates, External Static Pressures and Water Flow Rates. The following are to be equaled or bettered: Coil Face velocities and Filter Face Velocities. The following are to be met within 5% of specified values: internal air pressure drops.

.5 Additional Testing and Quality Assurance as explained in individual component / item sections in the following paragraphs of this specification.

1.2 SUBMITTALS:

.1 Submit shop drawings with product data.

.2 Shop drawings shall indicate assembly weights, unit dimensions, required clearances, construction details, and field connection details.

.3 Product data shall indicate dimensions, weights, capacities, ratings, fan performance to include fan curves, motor electrical characteristics to include motor technical data sheets, coil capacities to include performance printouts with pressure drops (water & air), vibration isolation, filter data sheets to include pressure drops, gauges and finishes.

.4 Clearly identify any variations from contract documents.

.5 Provide space on cover document for contractor and architect/engineer review stamps.

.6 Revise & resubmit submittals as required.

1.3 OPERATION AND MAINTENANCE DATA:

.1 Submit installation, start-up and Operation & Maintenance Data.

.2 Include instructions for rigging, lifting, bearing lubrication, filter replacement, motor and drive replacement, and wiring diagram.

.3 Include a recommended spare parts list customized to each unit complete with appropriate tag #, serial and / or part numbers along with a description to clearly identify the items.

1.4 CABINET:

.1 Casing Construction: Walls and roof to be 2-inch "Double Wall" construction as indicated in the specification for each section of the unit. Cabinet is with a minimum 16-gauge G90 galvanized perforated inner panel and a minimum 20-gauge G90 galvanized, outer liner for double walls. Panels to be of standing seam construction with seams turned outward to provide a smooth flush interior. Panels to be screwed together on maximum 8" centers with minimum 5/16" zinc plated screws sealed with a continuous bead of 3M540 caulking applied between the matching panel seams prior to assembly, and with a final bead following assembly on both the exterior and interior panel seams to produce an air tight unit. Wall to base skin and wall to roof panel seams shall be continuously caulked to assure leak-proof integrity of the unit housing. AHU unit housing shall be constructed to prevent conditioned air bypass or mitigation through unit walls, roof and floor around any interior partition or component blank-off walls such as for filters, coils or fan bulkheads. At the discretion of the design engineer, the manufacturer may be required to perform casing leak testing. The standard leakage rate air handlers is 1% of design volume and if required can reach 0.5% leakage rate with a purchased unit specific leakage test. Leakage tests are in accordance with ASTM E779-87: Standard Test Method for Determining Air Leakage Rate by Fan Pressurization. The standard test pressure is defined as 1.5 times the operating static pressure. Operating static pressure is defined as the static pressure that a section will see under operation. For instance, a unit with a total static pressure of 10"w.c. could be split 6"w.c. negative and 4" w.c. positive. Such testing will be performed at the manufacturer's facility. At the sole discretion of the design engineer, such testing shall be witnessed by an owner's representative. A certified test report of such testing shall be included in the O&M Manuals provided at the time of shipment of the equipment.

.2 Insulation: Wall & Ceiling panels to be insulated as follows:

.1 Perforated Liner: Fiberglass mat-faced insulation with a thermal conductivity (k) of .23 $Btu{\cdot}in/(hr{\cdot}ft2{\cdot}°F)$ @ 75 °F mean temperature.

.2 Octave bands 125 250 500 1k 2k 4k 8k

.3 Absorption Coefficient .18 .64 .99 1.02 1.01 1.04 1.05 (k: 0.26 @ 2 in.)

.4 All cut edges of the board insulation shall be completely enclosed by the unit panels. A finish bead of caulking will be applied over all foil to panel seams and/or inner liners to main panel seams to completely encapsulate the insulation.

.3 Interior liners: to be minimum 20-gauge G90 exposed perforated metal throughout the unit for the walls and roof except in the cooling coil section, humidifier section and its immediate downstream plenum which will have solid 304 SS inner liners. A finish bead of caulking will be applied between the liner and the interior panel seams to completely seal the panel.

.4 Roof panels: on indoor units shall be flat with smooth exteriors the same as the side panels.

.5 Stiffeners of angle steel shall be supplied as required to maintain a casing deflection criteria of L/200 at 1.5 times the working pressure.

1.5 ACCESS DOORS:

.1 Access doors shall be (2.6") double wall construction with G-90 galvanized exterior panels and G-90 galvanized interior panel. Door jam & frame shall be constructed of extruded aluminum with continuously welded corners for rigidity. Door panels shall be insulated with 2.6" expandable urethane foam insulation completely encapsulated and sealed between the door panels and frame. Provide doors located and sized to allow for routine maintenance including motor replacement and filter replacement, electrical components and any other sections or components requiring access or maintenance.

.2 Doors shall be provided with a minimum (2) dual acting heavy duty key non-locking composite latches through 48" high, (3) latches through 72" high. Latches shall be operable from both the interior and exterior of the unit. Door latches on doors into fan sections shall be provided with a hasp or other mechanism to facilitate locking of the doors. Door hinge shall be Stainless Steel heavy duty self-aligning. Door shall be sealed with continuous hollow closed cell foam gasket.

.3 Doors to be provided with a dual high performance closed cell replaceable EPDM Sponge Rubber Seal around the entire perimeter of the door / frame.

.4 Doors shall open against static pressure unless obstructed by internal components. If obstructed by internal components on the positive sections requiring access, the doors shall open with pressure and shall be provided with a safety restraining mechanism. Doors used to access rotating equipment shall be provided with an OSHA approved safety latching mechanism requiring a tool to open and shall also have a highly visible, permanently fixed, caution sign on the exterior of the door. Doors with access to moving parts must also have locking hardware and meet current UL mechanical protection guidelines. Standard door size shall be 24" wide by 60" high unless restricted by height or section width.

.5 Doors shall be provided with double pane wire reinforced glass viewing windows as called out for on the unit drawings in the specifications. Minimum window size to be 9" x 9" with 12" x 12" provided door size permitting.

1.6 BASES:

.1 Unit bases shall be constructed from structural steel channel iron or tubing around the entire perimeter of the unit and provided with intermediate structural tubing, channel and angle iron as required to support all internal components. All tubing, channel and angle joints shall be welded. Bolted or formed channel bases are not acceptable.

.2 Base shall be provided with removable lifting lugs minimum (4) per section, properly located to assure uniform loading. Maximum spacing between lifting lugs shall be 120".

.3 Drain pans shall be 304 Stainless Steel double-walled construction with solid welded seams for complete water capture and containment. Pans under cooling coils shall extend a minimum 12" passed the leaving face of the coil in direction of airflow. All headers and return bends shall be located over the drain pan for collection of all condensate forming on headers and return bends. All coils shall be easily removable without cutting or removing any portion of the drain pan. Pans shall be insulated between the liner and the main pan. Pans shall be IAQ Double Sloping to a single drain. Drain connection shall be a minimum 1-1/4" diameter MIPS thread extending out through the channel base the same side as the coil connections unless other wised indicated on the drawings. Pans shall be provided for cooling coils, humidifiers, outside air intakes and under other components as required. Mastic coated drain pans are not acceptable as they are "non-Cleanable".

.4 All large openings (greater than one square foot) in the floor, including dampers openings, shall be covered with a removable powder coated heavy gauge steel grating bolted in place suitable for walking on which will prevent any personnel and large objects from falling through into the space below. Grating shall be capable of supporting minimum 300 pounds.

1.7 COATING:

.1 All wall, roof, interior divider walls, racks, blank-offs and the Base Structure shall be powder coated with a Polyester TGIC coating which is lead and cadmium free. Each cabinet panel, panel liner and interior partition component is to be individually coated & baked following shearing, notching, punching, & forming to provide 100% powder coverage over the entire finished piece to include the interior, exterior and all metal edges.

.2 The coating process is completed prior to assembly of the unit too unsure all joined surfaces (panel to panel joints), are covered. Spray or brush applied coatings on the exterior of the cabinet only are not acceptable. Powder Paint to have passed Salt Spray Resistance Test ASTM B 117-90 Minimum 1000 (7,000) Hours, Impact Test ASTM D 2794-90 up to 160 lbs and Humidity Resistance Test ASTM D 2247-87 Minimum 1000-hour test w/ maximum blister 1/16 in/1 mm. Color to be equipment gray, wet white (or Architect / Owner specified custom color).

1.8 FANWALL TECHNOLOGY® (FWT):

.1 Fans:

.1 Fans shall be aluminum airfoil, Class III, direct drive arrangement and shall be individually housed. Fans shall be certified by AMCA for performance. Fan shall be housed in a "cell".

.2 Fan housing or "cell" shall be constructed of aluminum or stainless steel with perforated inner liner, melamine insulation, with either solid or perforated outer panels as required by applications.

.3 Fan/motor shall be mounted within the housing on an adjustable slide rail base. Fan/motor assembly must be capable of either horizontal or vertical application.

.4 Each fan/motor assembly shall be dynamically balanced to meet AMCA standard 204-96, for fan application class BV-5, to meet or exceed a rotational imbalance Grade .55, producing a maximum rotational imbalance of .022" per second peak, filter in (.55mm per second peak, filter in). "Filter in" measurement indicates that the specified balance grade must be achieved at the submitted design operating speed for the fan(s). Fan and motor assemblies submitted for approval incorporating larger that 215T frame shall be balanced in three orthogonal planes to demonstrate compliance with the G.55 requirement with a maximum rotational imbalance of .022" per second peak filter in (.55 mm per second peak, filter in).

.2 Motors:

.1 All motors shall be standard foot mounted type, TEFC or TEAO motors selected at the specified operating voltage, RPM, and efficiency as specified or as scheduled elsewhere.

.2 Motors shall meet the requirements of NEMA MG-1 Part 30 and 31, section 4.4.2.

.3 Motors shall be manufactured by Baldor, Siemens or Toshiba. Motors shall be available in ½ HP increments as nameplate HP ratings from 1.5 HP through 12 HP.

.4 All motors shall include permanently sealed bearings and shaft grounding means to protect the motor bearings from electrical discharge machining due to stray shaft current. Motors, provided with hybrid ceramic bearings, when specified, do not require shaft grounding devices.

.3 Acoustical Performance:

.1 The AHU unit shall provide the specified acoustical performance as scheduled for the unit supply discharge opening(s), RA opening(s), and the Outside air and Exhaust air opening(s).

.2 Coplanar silencer(s) and/or sound attenuator(s) shall be provided to meet specified acoustical requirements. Sound attenuator cross sectional area shall be selected to not exceed 500 fpm. Losses from sound attenuating devices must be included in the fan performance selection.

.3 Any proposed remedy for deviations in submitted sound power levels shall be approved by a registered acoustical consultant as selected by the owner or architect. Costs for review of the proposed changes shall be borne by the contractor.

1.9 COILS:

.1 Hot Water shall be of the aluminum plate ripple fin .008" and .010", extended surface rated in accordance with ARI 410 for water, steam or ethylene/propylene glycol water mixture. The tubes shall have a minimum .020" wall thickness of seamless copper expanded into the fin collars to provide a permanent mechanical bond. No metallic or thermal bonding materials are acceptable. Return Bends shall be a minimum of one tube thickness greater than the main tubes brazed replaceable copper. "U" type shaped tubes is not acceptable. Coil headers shall be non-ferrous seamless Copper (cast iron headers are not acceptable), and provided with Schedule 40 Red Brass male pipe connections. Pipe connections shall be same end connections. Each Coils supply & return connections shall be raised / lowered a minimum 6" from the bottom / top of the coil to allow room for piping connection hookup especially between stacked coils, coils near floors & coils near roofs. Each coil shall be provided with capped ½" brass vent & drain connections extended to the exterior of the cabinet. All coils shall be drainable with capped vent and drain lines plumbed to the cabinet exterior. Coils shall be counter flow design with connections either left or right hand as specified. The use of internal restrictive devices such as turbolater springs or ribbons to obtain turbulent construction is not acceptable.

.2 Coil casings shall be minimum 16 gauge galvanized, with formed 3/4" flanges on all sides of the coil with the tube sheets having pressed or extruded tube holes. The coil casing shall be reinforced so that the maximum unsupported length is 60". The reinforcements shall be of the same material as the casing. Both ends of the coil to be sealed off from the main air stream by full height blank off's on both the entering air and leaving air sides. Blank off's to be the same material as the coil casing. Headers and return bends to be further insulated with a closed cell neoprene gasket the full height & width of the coil casing to reduce condensation.

.3 All coils are tested and rated in accordance with the Air Conditioning and Refrigeration Institute (ARI) Standard 410 and certified in accordance with the ARI certification program. All tubes shall be tested at a minimum 315 PSIG and all assemblies tested under water at 315 PSIG for a minimum of 5 minutes and rated for 315 PSIG working pressures. Individual tube and core tests before installation of header are not considered satisfactory. Hydrostatic tests alone will not be acceptable.

.4 Stacked coils: Mounted with integral stacking flanges on the coil. Racks to be designed to allow coil removal through the roof of the unit if required. All coils to be removable from either side of the unit by easily removable end panels. Individual end panels to be supplied for each coil on the Supply & Return side of the cabinet to allow single coil piping breakdown for coil removal.

.5 Coil Supply & Return piping connections extending through the cabinet wall shall be sealed by caulking on the exterior of the casing. The escutcheon plate shall have a rolled collar around the pipe opening to protect the pipe and be equipped with an "O" ring rubber gasket between the collar and the pipe to prevent chaffing and provide an air tight seal around the opening.

1.10 FILTERS:

.1 Filters shall be arranged for Face, Rear or side loading as indicated on the detail drawings. Face loading is preferred where space allows. Face or rear loading to be in gasketed Universal Holding Frames. The filter rack assemblies shall be blanked off to the sides, roof and floor and properly sealed to minimize filter bypass.

.2 Each filter bank to be provided with a Dwyer Series 2000 Magnehelic Air Filter Gauge with adjustable signal flag. Gauges to be flush mounted. Exterior unit gauges to be covered with a weatherproof enclosure to protect the gauge and prevent hazing of the glass.

.3 Provide walk-in filter access sections upstream / downstream of each filter rack with adequate space for filter service.

.4 Filter banks to be sized so maximum filter face velocity does not exceed 500 fpm.

1.11 LIGHTS/CONTROL WIRING:

.1 Provide vapor proof 23-watt Compact Fluorescent marine type light fixtures in each accessible section complete with a protective metal cage and sealed glass enclosure. Lights to be wired to a common switch mounted in a weatherproof box adjacent to the fan access door complete with a convenience outlet. Power shall be 120v/1/60.

.2 All wiring to lights, switches and outlet(s) shall be in conduit and internal to the unit. No external conduit runs for the lights are allowed.

.3 Air handler manufacturer shall allow a minimum 1.5" clearance above the entire width of each interior bulk headers (coils, filters, fan blank off, etc.). This will be to allow wiring of any 110v or 24v runs internally to the unit as required by the controls contractor and reduce the number penetrations of the exterior panels.

.4 If the unit requires splitting, junction boxes shall be furnished at each section to allow the electrical contractor to make final connections in the field. Wiring to be clearly labeled at junction points to facilitate reconnection.

1.12 SOUND POWER LEVELS:

.1 The sound power level at the air handling unit discharge, air intake (return air and / or OSA intake), and casing radiated shall not exceed the values given in the table shown below, when the unit is operating at maximum design airflow and static Pressure.

Maximum Octave Band sound Power Level in dB RE 10E-12 watts
Unit Tag # **FC-Z3**

Octave Bands Center Freq.	63	125	250	500	1k	2k	4k	8k
Bare Fan Inlet	68	65	79	72	69	67	65	64
Bare Fan Outlet	73	70	82	74	75	73	69	67

.2 It shall be the option of the contractor to provide a quieter fan, acoustical lining, sound traps or other sound attenuating devices within the air handling unit to supplement the design in order to meet the specified levels above.

.3 The air handling units sound power data shall be submitted for approval. The submittal shall include a complete description of the methods and procedures used to develop the sound power levels being submitted.

.4 It shall be the option to have the air handler sound measured. All tests shall be in accordance with ISO-9614-2; Determination of Sound Power Levels of Noise Source Using Sound Intensity - Part 2: Measurement by Scanning and AMCA DCS 320; Laboratory Method for Sound Testing of Fans Using Sound Intensity.

1.13 CLEANING AND WRAPPING FOR SHIPMENT:

.1 Unit shall be cleaned: swept & vacuumed clean.

.2 Cleaned units shall be wrapped in stretch wrap, then translucent poly plastic, and then shrink wrap plastic. Wrapped units shall be shipped on appropriate truck or equipment.

1.14 DELIVERY, STORAGE & HANDLING:

.1 Unit shall ship with all openings securely covered with wood and / or nylon reinforced plastic wrap and to be watertight. Each unit will be covered by a tarp and securely strapped down on an open flatbed truck.

.2 Units must be stored in a clean dry area and protected from the weather and construction traffic. Carefully follow manufacturers' storage instructions if installation does not immediately follow arrival at the job site.

.3 Follow manufacturers rigging guidelines for movement and installation of equipment.

1.15 WARRANTY:

Limited Warranty

Unless otherwise agreed in writing signed by Seller: (a) Seller warrants: (i) All Products (excluding software and spare parts) manufactured by Seller will conform to the specifications and submittals provided by Seller and will be free of defects in material and workmanship ("Defects") for 12 months following start-up or 18 months following ship date, whichever occurs first, under normal use and regular service and maintenance, if installed and maintained pursuant to Seller's instructions. For warranty purposes, start-up occurs when the equipment (or any portion thereof) is started for operation regardless of when the building may be ready for operation. Products that include required start-up by Seller will not be warranted hereunder unless Seller (or its authorized representative) performs the start-up. If Seller requires a completed start-up form and such form has not been received by Seller within six (6) months from shipment, then start-up will be deemed to have occurred on the ship date. New spare parts will be free of Defects for 12 months following ship date. Buyer must notify Seller of any Defect promptly upon discovery and if such notification occurs within the applicable warranty period, Seller shall remedy such Defect by, at Seller's option, adjustment, repair or replacement of Products or any affected portion of Products, or providing a refund of the portion of the purchase price attributable to the defective portion of the Product. Buyer assumes all responsibility and expense for removal, reinstallation and freight charges (both for return and delivery of new parts). Buyer must grant Seller access to the premises at which Products are located at all reasonable times so that Seller can evaluate any Defect and make repairs or replacements on site. Repaired or replaced portions of Products are warranted until the later of the end of the warranty period applicable to the defective portion of Products repaired or replaced; or 30 days following the completion of the repair or ship date of the replacement parts; and (ii) Services will be of workmanlike quality. If Buyer notifies Seller of any nonconforming Services within 30 days after Services are completed, Seller shall re-perform, if able to be cured, those Services directly affected by such failure, at its sole expense. Buyer's sole remedy for such nonconforming Services is limited to the cost of re-performing the Services.

(b) Buyer is responsible for disassembly and re-assembly of non-Seller supplied products. Seller does not warrant and shall have no obligation with respect to any Products that: (i) have been repaired or altered by someone other than Seller or Seller's authorized representative; (ii) have been subject to misuse, abuse, neglect, intentional misconduct, accident, Buyer or third party negligence, unauthorized modification or alteration, use beyond rated capacity, a Force Majeure Event, or improper, or a lack of, maintenance; (iii) are comprised of materials provided by, or designed pursuant to instructions from,

Buyer; (iv) have failed due to ordinary wear and tear; (v) have been exposed to adverse operating or environmental conditions including but not limited to contaminants, corrosive agents, chemicals or minerals, (vi) were manufactured or furnished by others and which are not an integral part of a product manufactured by Seller, or (vii) have not been fully paid for by Buyer. Refrigerants, fluids, oils and expendable items such as filters are not covered by this Limited Warranty. If Seller has relied upon any specifications, information, representations or descriptions of operating conditions or other data supplied by Buyer or its agents to Seller in the selection or design of Products, and actual operating conditions or other conditions differ, any warranties or other provisions contained herein that are affected by such conditions will be null and void.

(c) Buyer is solely responsible for determining the fitness and suitability of Products for the use contemplated by Buyer. Buyer shall ensure that (i) the Products are used only for the purposes and in the manner for which they were designed and supplied, (ii) all persons likely to use or come into contact with the Products receive appropriate training and copies of applicable instructions and documentation supplied by Seller, (iii) all third parties who use or may be affected by or rely upon the Products are given full and clear warning of any hazards associated with them or limitations of their effectiveness and that safe working practices are adopted and complied with, (iv) any warning notices displayed on the Products are not removed or obscured, (v) any third party to whom the Products are supplied agrees not to remove or obscure such warning notices. Buyer assumes all responsibility for any loss, damage, or injury to persons or property arising out of, connected with, or resulting from the use of Products, either alone or in combination with other Products or components.

(d) If Software is Licensed: Seller warrants that the Seller-originated software included within Products

("Seller Software"), when properly installed, will substantially conform to the applicable functions specified in its documentation for a period of 30 days following its ship date. If any failure to conform to this warranty occurs during such 30-day period, Seller shall, upon prompt written notice of the specific non-conformity from Buyer, correct such nonconformity by repair or replacement, FOB Seller's facility (EXW per INCOTERMS 2010 for international shipments), of the defective program or refund Buyer's purchase price applicable to the defective program. Seller has no obligation for Seller Software failures resulting from: (i) unauthorized modification of the Seller Software; (ii) Buyer or third party supplied software, or interfacing or integration with Buyer or third party supplied software. The foregoing warranty does not apply to software originating from third parties ("Third Party Software"). To the extent applicable and authorized by the Third Party Software supplier, Seller hereby assigns to Buyer any warranties provided by such suppliers. Seller provides Third Party Software "as is," without any warranties, express or implied. Seller has no obligation for Third Party Software failures.

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SOFTWARE WILL BE UNINTERRUPTED OR ERROR FREE, OR THAT ANY DEFECT OR MALFUNCTION IN THE SOFTWARE IS CORRECTABLE OR WILL BE CORRECTED. THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE REMEDIES FOR ANY AND ALL CLAIMS ARISING FROM OR RELATED TO PRODUCTS AND SERVICES. All warranty claims must be received by Seller on or before the end of the applicable warranty period.

Limitation of Remedy and Liability. Seller's total liability under the Agreement, whether in law, equity, contract, infringement, negligence, strict liability or other otherwise, shall not exceed one-half the price paid by Buyer under the Agreement for the Product or Services giving rise to the claim. Under no circumstances shall Seller be liable for special, incidental, indirect, punitive or consequential damages for any reason. "Consequential damages" includes, without limitation, loss of anticipated profits; business interruption; loss of use, revenue, reputation or data; costs incurred, including without limitation, costs for capital, fuel or power; loss or damage to property or equipment; and environmental clean-up. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to Buyer. Any action arising under or relating to the Agreement, (whether based in law, equity, contract, infringement, negligence, strict liability, other tort or otherwise), must be commenced within one year after the date of shipment or delivery of Product or Services. Seller assumes no obligation or liability for technical advice given or not given, or results obtained. Seller has set its prices and entered into the Agreement in reliance upon the limitations of liability and other terms and conditions specified herein, which allocate the risk between Buyer and Seller and form a basis of this bargain between the parties.

END OF SECTION

PART 1 GENERAL

1.1 Summary

.1 This section includes Air-to-Air Energy Core Ventilators for outdoor installation.

1.2 Submittals

.1 Product Data: For each type or model include the following:

.1 Energy core performance data for both summer and winter operation.

.2 Motor ratings, electrical characteristics, motor, and fan accessories.

.3 Material types and gauges of all component pieces and assemblies.

.4 Dimensioned drawings for each type of installation, showing isometric and plan views, to include location of attached ductwork and service clearance requirements.

.5 Estimated gross weight of each installed unit.

.6 Installation, Operating and Maintenance manual (IOM) for each model.

1.3 Quality Assurance

.1 Source Limitations: Obtain unit with all appurtenant components or accessories from a single manufacturer.

.2 For the actual fabrication, installation, and testing of work under this section, use only thoroughly trained and experienced workers completely familiar with the items required and with the manufacturer's current recommended methods of installation.

.3 Product Options: Drawings must indicate size, profiles and dimensional requirements of Energy Recovery Units and are to be based on the specific system indicated.

.4 Certifications:

.1 Entire unit shall be ETL Certified per U.L. 1812 and bear an ETL sticker.

.2 Energy Core shall be AHRI Certified per Standard 1060.

1.4 Coordination

.1 Coordinate size and location of all building penetrations required for installation of each unit and associated plumbing and electrical systems.

.2 Coordinate sequencing of construction of associated HVAC, electrical supply, roofing contractor.

1.5 Extra Materials

.1 Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

.1 Filters: Two (2) set(s) of MERV 8 (for exhaust air) and two (2) sets of MERV 13 (for outdoor air) disposable filters for each unit.

PART 2 PRODUCTS

2.1 Manufactured Units

.1 Unit shall be fully assembled at the factory and consist of an insulated metal cabinet, outdoor air intake weatherhood with metal mesh filters, energy core, motorized intake damper, motorized return damper, sensors, curb assembly, frost control, economizer control, bypass damper, filter assembly for intake and exhaust air, supply air blower assembly, exhaust air blower assembly and an electrical control center. All specified components and internal accessories factory installed and tested and prepared for single-point high voltage connection.

2.2 Cabinet

.1 Materials: Formed double wall insulated metal cabinet, fabricated to permit access to internal components for maintenance.

.1 Outside casing: 18 gauge, galvanized (G90) steel meeting ASTM A653 for components that do not receive a painted finish.

.2 Internal assemblies: 18 gauge, galvanized (G90) steel except for motor supports which shall be minimum 14 gauge galvanized (G90) steel.

.2 Access doors shall be hinged.

.3 Shall have factory-installed duct flanges on all duct openings.

.4 Cabinet Insulation: Comply with NFPA 90A and NFPA 90B and erosion requirements of UL 181.

.1 Materials: Fiberglass insulation. If insulation other than fiberglass is used, it must also meet the Fire Hazard Classification shown below.

.1 Thickness: 1 inch (25 mm)

.2 Fire Hazard Classification: Maximum flame spread of 25 and smoke developed of 50, when tested in accordance with ASTM C 411.

.3 Location and application: Full coverage of entire cabinet exterior to include walls, roof and floor of unit. Insulation shall be of semi-rigid type and installed between inner and outer shells of all cabinet exterior components.

.5 Energy Core: Energy core shall be of total enthalpy and shall be removable from the cabinet. The core media shall be a corrugated [fiber][polymer] membrane in a galvanized steel framework and can be removable for servicing. The energy core is to have a five-year warranty. Performance criteria are to be as specified in AHRI Standard 1060.

.6 Supply Air and Exhaust Air blower assemblies: Blower assemblies consist of an electric motor and a direct driven blower. Assembly shall be mounted on heavy gauge galvanized rails and further mounted on 1.125-inch-thick neoprene vibration isolators.

.7 Control panel /connections: Energy Core Ventilator shall have an electrical control center where all high and low voltage connections are made. Control center shall be constructed to permit single-point high voltage power supply connections

.8 Frost control: Electric Preheater.

.9 Economizer Control: Bypass Damper

.10 Motorized Dampers: Motorized dampers of low leakage type shall be factory installed.

.11 Curb Assembly: A curb assembly made of 14 gauge galvanized steel shall be provided by the factory for assembly and installation as part of this division. The curb assembly shall provide perimeter support of the entire unit. Curb assembly shall enclose the underside of the unit and shall be sized to fit into a recess in the bottom of the unit. Contractor shall be responsible for coordinating with roofing contractor to ensure curb unit is properly flashed to provide protection against weather/moisture penetration. Contractor shall provide and install appropriate insulation for the curb assembly.

2.3 Blower

.1 Blower section construction, Supply Air and Exhaust Air: Direct drive motor and blower shall be assembled with neoprene vibration isolation devices.

.2 Blower assemblies: Shall be statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and horsepower.

.3 Centrifugal blower housing: Formed and reinforced steel panels to make curved scroll housing with shaped cutoff.

.4 Mixed flow plenum blower (fan) wheels: Aluminum construction where the wheel cone and fan inlet will be matched and shall have precise running tolerances for maximum performance and operating efficiency.

.5 Blower performance shall be factory tested for flow rate, pressure, power, air density, rotation speed and efficiency. Ratings are to be established in accordance with AMCA 210, “Laboratory Methods of Testing Fans for Rating”.

2.4 Motors

.1 General: Blower motors greater than ¾ horsepower shall be “NEMA Premium™” unless otherwise indicated. Minimum compliance with EPAct minimum energy-efficiency standards for single speed ODP and TEFC enclosures is not acceptable. Motors shall be heavy-duty, permanently lubricated type to match the fan load and furnished at the specified voltage, phase and enclosure. Drives shall be sized for a minimum of 150% of driven horsepower and pulleys shall be fully machined cast-type, keyed and fully secured to the fan wheel and motor shafts. Electric motors of ten horsepower or less shall be supplied with an adjustable drive pulley.

.2 Motors shall be 60 cycle, 3 phase 575 volts.

2.5 Unit Controls

.1 The unit shall be constructed so that it can be controlled by a factory-supplied controller or it can be monitored and controlled by a Building Management System (BMS). This unit shall be controlled by a factory-installed microprocessor programmable controller (DDC) that is connected to various optional sensors.

.2 Unit shall incorporate a DDC controller with integral LCD screen that provides text readouts of status, operating settings, and alarm conditions. DDC controller shall have a built-in keypad to permit operator to access read-out screens and change settings without the use of ancillary equipment, devices, or software. DDC controllers that require the use of equipment or software that is not factory-installed in the unit are not acceptable. Alarm readouts consisting of flashing light codes are not acceptable. Owner-specified ventilating conditions can be input by means of pushbuttons.

.1 Operating protocol: The microprocessor shall be factory-programmed for BACnet MSTP for monitoring of the unit’s status.

.3 Variable Frequency Drive (VFD): Unit shall have factory installed variable frequency drive for modulation of the blower motors. The VFDs shall be factory-programmed for unit-specific requirements and shall not require additional field programming to operate.

.4 Sensors

.1 Dirty Filter Sensors

.2 Temperature Sensors- OAI, OAD

2.6 Filters

.1 MERV 13 disposable pleated filters shall be provided in the intake air stream and MERV 8 filters in the exhaust air stream.

PART 3 EXECUTION

3.1 Examination

.1 Prior to start of installation, examine area, and conditions to verify correct location for compliance with installation tolerances and other conditions affecting unit performance. See unit IOM.

.2 Examine roughing-in of electrical and HVAC services to verify actual location and compliance with unit requirements. See unit IOM.

.3 Proceed with installation only after all unsatisfactory conditions have been corrected.

3.2 Installation

.1 Installation shall be accomplished in accordance with these written specifications, project drawings, manufacturer's installation instructions as documented in manufacturer's IOM, best practices, and all applicable building codes.

3.3 Connections

.1 In all cases, industry best practices shall be incorporated. Connections are to be made subject to the installation requirements shown above.

.1 Duct installation and connection requirements are specified in Division 23 of this document.

.2 Electrical installation requirements are specified in Division 26 of this document.

3.4 Field Quality Control

.1 Manufacturer's Field Service: Engage an authorized service representative to inspect field assembled components and equipment installation, to include electrical and piping connections. Report results to Departmental Representative in writing. Inspection must include a complete startup checklist to include (as a minimum) the following: Completed start-up checklists as found in manufacturer's IOM.

3.5 Start-Up Service

.1 Engage an authorized service representative to perform startup service. Clean entire unit and install clean filters. Measure and record electrical values for voltage and amperage. Refer to Division 23 "Testing, Adjusting, and Balancing" and comply with provisions therein.

3.6 Demonstration and Training

.1 Engage an authorized service representative to train owner's maintenance personnel to adjust, operate, and maintain the entire unit.

END OF SECTION

PART 1 GENERAL

1.1 Halocarbons

.1 Comply with all of:

.1 Federal Halocarbon Regulations 2003;

.2 *Environmental Code of Practice for Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems* (the Environment Canada "Refrigeration Code of Practice") Cat. No.: En14-207/2015E-PDF. April 2015.

.2 Work on Halocarbon Systems includes installation, servicing, leak testing or charging of a refrigeration system or an air-conditioning system or doing any other work on the system that may result in the release of a halocarbon.

.3 All work on Halocarbon Systems shall be carried out only by a "Certified Person" as defined by the Federal Halocarbon Regulations 2003.

.1 Provide copies of all technicians' certificates to the Departmental Representative.

.4 Halocarbons listed under Item 1 through 10 of Schedule 1 of Federal Halocarbon Regulations, 2003 (SOR/2003-289) are not acceptable refrigerants.

.5 Document **all** work on Halocarbon Systems using CSCs halocarbon form "**Information Required for Refrigeration Systems at Federal Correctional Facilities**". Obtain the latest form from Departmental Representative. Affix the completed form to equipment, and submit a copy of the form to Departmental Representative.

.6 Comply with the following timelines:

.1 Upon delivery of halocarbon-containing equipment to site, submit the following information to Departmental Representative within 24 hours of service;

.1 Make

.2 Model

.3 Serial number

.4 Type of halocarbon

.5 Halocarbon charging capacity of system (kg or lbs)

.6 Factory Halocarbon Charge (kg or lbs)

.7 Cooling capacity (kW, Btuh, or Tons)

.2 Leak-test factory-charged halocarbon-containing equipment containing over 10kg of refrigerant in accordance with the Refrigeration Code of Practice within one week of equipment delivery to site.

.3 Leak-test field-charged halocarbon-containing equipment in accordance with Section 4.4 of the Refrigeration Code of Practice at the time of field charging of system.

.4 For all work on Halocarbon Systems, submit forms to Departmental Representative within 48 hours of work.

.5 For release of halocarbons >10 kg and <100 kg, submit forms to Departmental Representative within 24 hours of discovery of release.

.6 For release or potential release of halocarbons > 100 kg, submit forms to Departmental Representative **immediately**.

.7 Conduct annual leak tests of halocarbon-containing equipment with 19kW (5.4 tons) or greater cooling capacity in accordance with the Federal Halocarbon Regulations, 2003 until such time as Interim Certificate of Completion is issued.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1 Section 01 01 50 General Instructions

.2 Section 23 05 00 Common Work Results – Mechanical

1.2 References

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.2 Air Conditioning & Refrigeration Institute (ARI)

.1 ARI 410-20, Forced-Circulation Air-Cooling and Air-Heating Coils.

1.3 Submittals

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 01 50 - General Instructions. Include product characteristics, performance criteria, and limitations.

.2 Shop Drawings:

.1 Submit shop drawings in accordance with Section 01 01 50 - General Instructions.

.2 Indicate the following:

.1 Equipment, capacity, piping, and connections.

.3 Quality assurance submittals: submit following in accordance with Section 01 01 50 - General Instructions.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.4 Closeout Submittals:

.1 Provide maintenance data for incorporation into manual specified in Section 01 01 50 – General Instructions.

1.4 Quality Assurance

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

1.5 Delivery, Storage and Handling

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 01 50 - General Instructions.

.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Division 01 – General Requirements.

PART 2 PRODUCTS

2.1 General

.1 General: air coil certified by ARI 410.

.2 Applications: hydronic or direct expansion (DX), as scheduled.

.3 Capacity, pressure drop, dimensions as scheduled.

.4 Maximum air velocity:

.1 Heating: 3.0 m/s (600 FPM).

.5 Maximum operating pressure:

.1 Hydronic: 1,724 kPa (250 psi)

.6 Factory tested at 2,172 kPa (315 psi) air pressure under water.

2.2 Construction

.1 Tube: NPS 5/8 O.D., 0.51mm (0.02") thick seamless copper with 0.64 (0.025") thick bends. Water velocity selected at less than 1.2 m/s (4 ft/s).

.2 Fins: 0.2mm (0.008") thick aluminum, mechanically bonded to tubes. Fin spacing shall not exceed 14 fins per inch.

.3 Header: seamless copper with die formed collars for brazing coil tubes, vent and drain connection.

.4 Casing: minimum 1.6mm (16 gauge) channel construction with flanges punched for mounted. Galvanized steel for heating coils and type 304 stainless steel for cooling coils. Provide intermediate tube support at 1,200mm (48") interval.

.5 Connections: red brass, MPT connections.

.6 Hydronic and DX coils shall have connections on the same side of header.

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 manufacturer's instructions.

.2 Install in accordance with piping layout.

.3 Arrange coils for counter-flow of air and fluid.

.4 Provide space for cleaning, servicing or removal of all coils.

.5 For hydronic coils with vertical headers, arrange water entry at bottom to facilitate air removal.

.6 Clean finned tubes and comb straight.

.7 Provide unions at coil connections.

.8 Provide dielectric fittings at dissimilar metal.

.9 Clean finned tubes and comb straight.

3.3 Cleaning

.1 Proceed in accordance with Section 01 01 50 – General Instructions.

.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 Scope of work:

.1 Provide complete linear or modular heat radiant panel system, as specified and detailed.

.2 Layout & dimensions: Refer to Architectural and Mechanical drawings.

.3 Details: Refer to Architectural and Mechanical detail drawings.

.4 Schedules: Refer to Mechanical schedules.

1.2 Submittals

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 01 50 – General Instructions. Include product characteristics, performance criteria, and limitations.

.2 Shop Drawings:

.1 Submit shop drawings in accordance with Section 01 01 50 – General Instructions.

.2 Drafting and drawing standards to be to the manufacturer’s standard issue.

.1 ACAD base plans for the following systems are to be provided for use by the manufacturer in preparation of the shop drawings.

.1 Architectural reflected ceiling plans.

.2 Mechanical HVAC piping and terminal unit plans

.2 Where building design has been completed using BIM, extracted AutoCAD plans are to be provided:

.3 Indicate:

.1 Plan drawings:

.1 Reflected ceiling plan panel map, with indication of inter-connecting panels and sails, in a given array

.2 Indication of supply and return piping locations for each radiant panel, sail and/or circuit

.2 Details of manufacturing:

.1 Internal and external construction details and standard dimensions

.2 Materials of construction details

.3 Details of integration with adjoining work

.4 Standard water connection locations and sizes

.5 Recommended mounting details

.6 Flexible hose details

.3 Performance schedules:

.1 Room design parameters:

.1 Temperatures – Summer/Winter room design temperature(s), as applicable.

.2 Summary of sensible and latent loads for each space served, as applicable.

.3 Minimum ventilation requirements, as applicable

.2 Heating water temperatures:

.1 Supply and Return working fluid temperatures, as applicable, with confirmation of turbulent flow within each copper coil circuit, in heating performance.

.4 Equipment schedules:

.1 Panel type(s)

.2 Coil passes.

.3 Coil circuits.

.4 Heating sensible capacity, per panel, and/or circuit.

.5 Working fluid pressure drop summary, per panel and/or circuit.

.6 Individual panel and sail details and copper serpentine clearances, for all panel types with integrated factory co-ordinated penetrations, and associated copper serpentine(s)

.7 Working fluid flow rates for water.

.3 Samples:

.1 Submit sample paint chips with shop drawing submission.

.4 Quality assurance submittals: submit the following, in accordance with Section 01 01 50 – General Instructions.

.1 Instructions: submit manufacturer's installation operation, and maintenance manual for all panel types.

.5 Closeout Submittals:

.1 Submit maintenance data for incorporation into manual specified in Section 01 01 50 – General Instructions.

.2 5-year warranty against paint colour discolouration.

1.3 Quality Assurance and References

.1 Manufacturer Qualifications: Single manufacturer with a minimum of ten (10) years' experience in the engineering and manufacture of radiant heating and cooling panels and sails for projects of similar size and scope.

.2 Field or in-situ manufacturing of radiant heating and cooling panels is not acceptable.

.3 Heating performance:

.1 Comply with the Building Services Research and Information Association (B.S.R.I.A) test standard BS 3528:1977.

.4 Acoustics:

.1 Perforated cooling panel: rated in compliance with ASTM C 423.

.5 Standards:

.1 ASTM B 209/B209M: 2004 – Standard specification for aluminum and aluminum alloy sheet and plate.

.2 ASTM B251: Standard specification for general requirements for wrought seamless copper and copper-alloy tubing.

.3 ASTM B280: Standard specification for seamless copper tube for air conditioning, and refrigeration field service.

.4 ASTM B743: Standard specification for seamless copper tube in coils.

.5 ASTM B813: Specification for liquid and paste fluxes for soldering of copper and copper alloy tube.

.6 ASTM B828-16: Standard practice for making capillary joints by soldering of copper and copper alloy tube and fittings.

.7 ASTM C 423: Standard test method for sound absorption and sound absorption coefficients by the reverberation room method.

.8 UL 723 / ASTM E84: Test method for surface burning characteristics of building materials.

.9 ISPM-15: International Standards for Phytosanitary Measures – 15.

.10 NFPA 90A and 90B

.11 UL Guide No. 40 U8.3. Card R3711

.12 CAN/ULC S102-M88 Standard

1.4 Delivery, Storage, and Handling

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 01 50 – General Instructions.

.2 Protect all materials from the elements including during storage and installation.

PART 2 PRODUCTS

2.1 Capacity

.1 Heating performance based on:

.1 Entering fluid temperature: 180.0˚F [82.2˚C]

.2 Leaving fluid temperature: 160.0˚F [71.1˚C]

.3 Mean fluid temperature: 170.0˚F [76.7˚C]

.4 Heating fluid: Water

.5 Room air temperature (Dry Bulb): 70.0˚F [21.1˚C]

.2 Heating performance shall be achieved at the specified water flow rates and temperatures. Changes to temperatures and/or flow rates to achieve the specified performance will be noncompliant to the specified requirements and will not be acceptable.

2.2 General Discription

.1 Each radiant panel to consist of:

.1 Painted aluminum or steel radiant panel pan, or extruded aluminum assembly.

.2 Mechanically attached or integrated aluminum heat conductive rails.

.3 Copper heat transfer coil(s).

.4 Heat transfer paste at all interface boundaries.

.5 Insulation: As specified and as required to meet radiant panel acoustic and/or thermal requirements.

.6 Cross bracing, as required for rigidity.

.7 5/8” (16mm) O.D. water connections, suitable for compression, brazed, or push on fittings.

2.3 Materials Common to All Panels

.1 Copper heat transfer coil tubing:

.1 Copper tubing alloy shall be C12200 or approved equal.

.2 All copper tubes are to be fabricated of continuous level-wound copper tubing, of nominal external diameter and wall thickness equal to 0.625" [16mm], and 0.020" [0.5mm] respectively.

.3 All copper serpentines to be continuous and supplied without sweat or brazed return bends.

.4 Panels with soldered or brazed fittings shall include testing certification reports, to ensure the copper circuits are free of leaks.

.5 The maximum respective working and proof system pressures shall not exceed: 150psi [1034 kPa] working pressure, 225psi [1551 kPa] proof pressure.

.6 Brazed connections shall be used with higher working temperatures and/or pressures. i.e. Temperatures >150˚F [65.5˚C] and working pressures >150 psi [1034kPa].

.7 All headers shall be manufactured and brazed to the copper circuit by the panel manufacturer. Size and location as indicated on the schedule provided with the shop drawings. No terminal distribution circuit shall exceed 5' w.c. [1244 Pa].

.8 Copper circuits shall be mechanically fastened to the heat conductive rails using spring steel clips, with cadmium plating finish, to protect the copper tubing from galvanic corrosion. Each clip shall be placed at intervals not to exceed 14" [355mm] centre-to-centre, to ensure adequate compression of the copper coil for proper heat transfer between the working fluid and the panel.

.9 Copper coils shall not be soldered to any radiant panel.

.10 Copper mill certificates to be supplied by the manufacturer, upon request.

.2 Thermally conductive heat paste:

.1 Thermally conductive heat paste shall be applied between all mechanical boundaries (i.e. aluminum conductive rails to metal sheet where applicable, and between all copper tubing and aluminum conductive raceways).

.2 Minimum thermal conductivity shall be no less than 0.657 W/m*K.

.3 Heat conductive paste shall not dry or harden.

.3 Paint:

.1 All panels to have projected-view surfaces painted with heat-inhibited, polyester powder paint, with low-gloss finish.

.2 Paint shall yield a minimum 500-hour salt-spray corrosion resistant finish.

.3 Unless noted otherwise in the specific panel section below, all panels shall be supplied in the manufacturer's standard "off-white" paint colour. Manufacturer's paint code PX 622 W457.

.4 A 5 year warranty against discolouration is to be supplied in writing, to installing contractor, for inclusion within the Closeout Submittals. See Section 01 01 50 – General Instructions.

.5 Manufacturer shall submit a paint chip sample, for architectural approval, with the shop drawing submission.

.6 Silver and metallic paints are not permitted for use with radiant panels.

2.4 Security Panels

.1 Construct security panels of 10 Ga. 0.138" [3.5mm] thick, A120 galvaneal steel plate. Maximum individual panel length shall be 120" [3048mm]. Maximum panel width shall be 36" [914mm].

.2 Aluminum heat conductive rails: shall be stud welded to the plate steel to create a thermal bridge between the panel, and the circulated fluid. Heat conductive rails

.3 Heat conductive paste equivalent to Nuovo shall be used between the heat conductive rails, and the copper tubing to maximize the thermal bridging between the copper coils, and the security panel(s).

.4 All panels to be painted

.5 Security screws shall be painted and supplied with the panels for installation.

.6 Provide panel widths, lengths, and performance, as described within the equipment schedule.

.7 Panel dimensions shall be based on site measurements performed by the panel manufacturer's representative. The panel manufacturer shall allow for expansion of panels before the final cut.

.8 No site length-cutting, or penetrating, shall be permitted, without written factory approval.

.9 Supply all end caps and joiner strips by panel manufacturer, as required. End caps and joiner strips shall be painted to match the radiant panels.

.10 Insulation:

.1 Panels shall ship with factory installed 1" [24mm] thick, fiberglass insulation blanket; formaldehyde-free fiber glass duct wrap.

.2 Insulation blanket shall be fabricated by folding 1" [25mm] thick insulation to create the blanket, and all edges taped, to prevent the release of fiberglass.

.3 Each blanket shall be mechanically fastened to the panel with insulation pins, and held in place using clips to cover each pierced hole and to prevent tear-out.

.4 Refer to plans for insulation details.

.5 Insulation shall comply with the following standards:

.1 ASTM E-84

.2 NFPA 90A, 90B

.3 UL 723

.4 UL Guide No. 40 U8.3. Card R3711

.5 CAN/ULC S102-M88 Standard

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 General Installation

.1 Install in accordance with manufacturer's instructions.

.2 Install in accordance with piping layout and reviewed shop drawings.

.3 Coordinate installation with the work of other trades working in the ceiling area to achieve a neat and well-coordinated installation.

.4 Provide for pipe movement during normal operation.

.5 Connection to supply, return piping as per mechanical specification section 23 21 16.

.6 The hydronic system shall be tested as per specification section 23 08 01.

.7 To prevent formicary corrosion, do not over-flux soldered and/or brazed joints.

.8 All fittings, hoses, and inter-connecting piping shall be supplied and installed by the installing contractor.

.9 Coils supplied for use with cooling applications and/or low temperature heating applications (<150oF [65.5oC]) using push-on style hoses, shall include either a factory installed brass reinforcement sleeve, or standardized “pig-tail” extension with 0.040” [1.0mm] wall thickness, to support the use of push-on styles hoses. Standardized extensions must be brazed to the panel/sail piping. Sweat connection of the extensions are not acceptable.

.10 Applications using high temperature water, i.e. >150oF [65.5oC], or working pressures greater than 150 psi [1034 kPa] shall use only threaded fittings which have been brazed to the coils.

.11 Maintain sufficient clearance to permit performance of service maintenance.

.12 Protect installed work from damage caused by subsequent construction activity on-site.

.13 Support radiant sails independently from ceiling systems. Contractor to provide all required mounting hardware.

.14 Contractor shall provide all required seismic restraint systems.

.15 Install each radiant sail level and unless otherwise indicated parallel and perpendicular to the building lines.

.16 Suspend each unit using structural steel supports and/or threaded rod or aircraft cable to the building structure as detailed or specified.

.17 Soft annealed wire, as used in ceiling systems, shall NOT be used to suspend any mechanical equipment.

.18 Concrete threaded fittings shall not penetrate structure without prior written approval.

.19 No additional integrated components (i.e. lighting, loud speaker system, fire protection piping, etc.) shall be mounted to any radiant terminal unit except where indicated in the shop drawings or with written approval from the consultant. Integrated components are to be independently supported.

.20 Minimum mounting recommendations listed above shall NOT supersede local code or seismic restraint requirements. Submit to consultant for review proposed mounting method in writing, prior to the commencement of equipment suspension, to the building structure.

3.3 Shipping Crates:

.1 All equipment to ship within skeletonized wooden crates, to protect equipment from shipping and handling damage.

.2 All lumber packaging shall comply with the Canadian and International Wood Packaging Certification Program for pest free compliance, pursuant to the International Standard for Phytosanitary Measures: ISPM 15.

.3 Packing paper shall be applied to all panels and/or radiant sails within the crate;- to protect the finished surfaces from transportation and handling damage.

.4 All crates to be wrapped in air / water type barrier, to protect crate contents from dust and dirt accumulation.

3.4 Startup and Commissioning

.1 Clean, flush and refill piping distribution loops prior to connecting panels or sails.

.2 Remove all wrapping and packaging material from the radiant panels or sails, immediately prior to commissioning.

.3 Clean the installed units per manufacturer's instructions, prior to turnover. Make good any damage to like new condition or replace as directed.

.4 Refer to manufacturer's recommendation for repair and maintenance of painted finishes.

.5 Balance all loops across each beam or zone for equal flow resistance based on actual loop lengths and total manifold flow.

.6 Follow manufacturer's instructions relative to storage, handling, and equipment protection during construction.

.7 No degreasing of the distribution piping shall be permitted through any panel.

.8 Performance failures and equipment replacement costs shall be borne by the installing contractor, should any degreasing solution be determined to have been circulated within any distribution circuit.

3.5 Cleaning

.1 Proceed in accordance with Section 01 01 50 – General Instructions.

.2 Upon completion and verification of performance of installation, remove surplus materials, rubbish, tools and equipment.

.3 Refer to manufacturer's recommendation for repair and maintenance of painted finishes.

END OF SECTION

AIR HANDLING UNITS								
Mark		HRV-1		HRV-2		FC-Z3	
Service		2nd Floor Corridor		1st Floor Corridor		Ex. Admin. Areas	
Outdoor Air	Supply Fan Air Flow - L/s (cfm)	991	2,100	991	2,100	838	1775
	Supply Fan External S.P. - Pa (in w.g.)	288	1.15	288	1.15	313	1.25
	Supply Fan Size/Type	DD, Mixed Flow		DD, Mixed Flow		HPF-A100 size 16	
	Supply Fan RPM	2,038		2,038		1,903	
	Supply Fan BHP | Horsepower	0.62	1.0	0.62	1.0	1.03	2.0
Exhaust Air	Return Fan Air Flow - L/s (cfm)	1,251	2,650	1,251	2,650		n/a
	Return Fan External S.P. - Pa (in w.g.)	313	1.25	313	1.25		n/a
	Return Fan Size/Type	DD, Mixed Flow		DD, Mixed Flow		n/a	
	Return Fan RPM	2,425		2,425		n/a	
	Return Fan BHP | Horsepower	1.23	2	1.23	2		n/a
Hydronic Heating Coil	Rows | Fins per Inch		n/a		n/a	1	8
	Air Flow - L/s (cfm)		n/a		n/a	838	1,775
	Face Area - m^2 (sq. ft)		n/a		n/a	0.7	7.81
	Face Velocity - m/s (FPM)		n/a		n/a	1.2	227
	Air P.D. - Pa (in w.g.)		n/a		n/a	5	0.02
	Ent. Air Temp - ℃ (℉)		n/a		n/a	12.8	55.0
	Lvg. Air Temp - ℃ (℉)		n/a		n/a	29.6	85.2
	Capacity - kW (MBH)		n/a		n/a	17.0	58.2
	Water Flow - L/s (gpm)		n/a		n/a	0.24	3.9
	Water P.D. - kPa (ft.)		n/a		n/a	0.7	0.2
Power		208/3/60		208/3/60		208/3/60	
Electrical - FLA | MCA | MOP		- | 44.5 | 45		- | 44.5 | 45		2 HP	
Minimum Outdoor Air - L/s (cfm)						110	233
Respective Air Stream Filter Area - m^2 (sq. ft.)		1.0	11.1	1.0	11.1	1.0	10.42
Weight - kg (lbs.)		523	1,150	523	1,150	890	1,959
Notes		1 - 11 inclusive		1 - 11 inclusive		6, 12 - 16 inclusive	

Refer to specification for accessories not scheduled.
Refer to drawings for installation details.
Static pressures noted are external to the unit. Fan total pressure to include all cabinet effects as well as an allowance of 75 Pa (0.35" w.g.) for dirty filters. Motors to be sized so normal operating load is not more than 90% of rated motor capacity.

1. Complete with OA/SA fan and RA/EA fan VFDs with single point power to unit.
2. Complete w/ polymer membrane energy recovery core. See performance on separate schedule
3. Unit shall be no more than 2057mm (81.0") L x 1524mm (60.0") W x 1171mm (46.1") H
4. Complete with 50mm (2") thick MERV13 outdoor & MERV8 exhaust filters, cw/ filter switches.
5. Galvanized finish double wall chassis construction w/ 25mm (1") thick R4 Fiberglass insulation.
6. Complete with factory wired non-fused disconnect switch.
7. Complete with hinged access doors and 356mm (14") high factory roof curb.
8. Microprocessor unit controls, outdoor air intake and discharge sensors, BACNet MSTP.
9. Complete with bypass damper for economizer control, based on temperature.
10. Complete with 4.1 kW electric preheater for frost control.
11. Complete with low leakage outdoor air damper and no return air damper.
12. See electrical drawings for supply air duct smoke detector(s), interlocked to shut down unit.
13. Complete with supply fan VFD with single point power to unit, 100mm (4") thick MERV14 filter.
14. Galvanized finish double wall chassis construction w/ 50mm (2") thick Fiberglass insulation.
15. Performance for HWS of 71.1˚C [160˚F] entering coil and HWR of 54.4˚C [130˚F] leaving coil.
16. Unit provided with knockdown construction, allowing it to be assembled on site and final wire connections to electrical panel by contractor per mfr's recommendations, prior to start-up.
17. Provided with one (1) vapor proof 13W CFL switched and powered separately.

ENERGY RECOVERY						
Mark	HRV-1		HRV-2			
SUPPLY PRE-FILTERS						
Type	50mm (2") MERV13		50mm (2") MERV13			
Weight - kg (lbs)						
Face Velocity - m/s (FPM)	0.96	189	0.96	189		
EXHAUST PRE-FILTERS						
Type	50mm (2") MERV8		50mm (2") MERV8			
Weight - kg (lbs)						
Face Velocity - m/s (FPM)	1.21	239	1.21	239		
ENERGY WHEEL PERFORMANCE						
Supply Air - L/s (CFM)	991	2,100	991	2,100		
Total Supply Air P.D. - Pa (in.wg.)	427	1.71	427	1.71		
Summer Effectiveness	63%		63%			
SUMMER Supply Air						
Entering Air Temperature DB - °C (°F)	28.9	84.0	28.9	84.0		
Entering Air Temperature WB - °C (°F)	20.0	68.0	20.0	68.0		
Leaving Air Temperature DB - °C (°F)	25.3	77.5	25.3	77.5		
Leaving Air Temperature WB - °C (°F)	18.1	64.6	18.1	64.6		
WINTER Supply Air						
Entering Air Temperature DB - °C (°F)	-11.7	11.0	-11.7	11.0		
Entering Air Temperature WB - °C (°F)	-13.0	8.6	-13.0	8.6		
Leaving Air Temperature DB - °C (°F)	12.9	55.2	12.9	55.2		
Leaving Air Temperature WB - °C (°F)	6.4	43.6	6.4	43.6		
Exhaust Air - L/s (CFM)	1251	2650	1251	2650		
Total Exhaust Air P.D. - Pa (in.wg.)	592	2.37	591.5	2.37		
Winter Effectiveness	67%		67%			
SUMMER Exhaust Air						
Entering Air Temperature DB - °C (°F)	23.9	75.0	23.9	75.0		
Entering Air Temperature WB - °C (°F)	16.9	62.4	16.9	62.4		
Leaving Air Temperature DB - °C (°F)	26.8	80.2	26.8	80.2		
Leaving Air Temperature WB - °C (°F)	18.5	65.3	18.5	65.3		
WINTER Exhaust Air						
Entering Air Temperature DB - °C (°F)	22.2	72.0	22.2	72.0		
Entering Air Temperature WB - °C (°F)	14.4	57.9	14.4	57.9		
Leaving Air Temperature DB - °C (°F)	2.9	37.2	2.9	37.2		
Leaving Air Temperature WB - °C (°F)	1.6	34.8	1.6	34.8		

Effectiveness measured as per ASHRAE 90.1 OA Enthalpy Recovery Ratio

HYDRONIC SECURITY RADIANT PANELS

Mark	RP-1.SS		RP-1.01		RP-1.02		RP-1.03	
Location	1st Floor Shower (South)		1st Floor Cell 01		1st Floor Cell 02		1st Floor Cell 03	
Panel Length - mm (in.)	3048	120	3048	120	3048	120	3048	120
Panel Width - mm (in.)	406	16	406	16	406	16	406	16
Capacity - W (Btu/hr)	551	1880	551	1880	551	1880	551	1880
Notes	1, 2, 3, 4, 6		1, 2, 3, 4, 6		1, 2, 3, 4, 6		1, 2, 3, 4, 6	

Mark	RP-1.04		RP-1.05		RP-1.06		RP-1.07	
Location	1st Floor Cell 04		1st Floor Cell 05		1st Floor Cell 06		1st Floor Cell 07	
Panel Length - mm (in.)	3048	120	3048	120	3048	120	3048	120
Panel Width - mm (in.)	406	16	406	16	406	16	406	16
Capacity - W (Btu/hr)	551	1880	551	1880	551	1880	551	1880
Notes	1, 2, 3, 4, 6		1, 2, 3, 4, 6		1, 2, 3, 4, 6		1, 2, 3, 4, 6	

Mark	RP-1.08		RP-1.09		RP-1.10		RP-1.11	
Location	1st Floor Cell 08		1st Floor Cell 09		1st Floor Cell 10		1st Floor Cell 11	
Panel Length - mm (in.)	3048	120	3048	120	3048	120	3048	120
Panel Width - mm (in.)	406	16	406	16	406	16	406	16
Capacity - W (Btu/hr)	551	1880	551	1880	551	1880	551	1880
Notes	1, 2, 3, 4, 6		1, 2, 3, 4, 6		1, 2, 3, 4, 6		1, 2, 3, 4, 6	

Mark	RP-1.12		RP-1.L		RP-1.13		RP-1.14	
Location	1st Floor Cell		Laundry		1st Floor Cell		1st Floor Cell	
Panel Length - mm (in.)	3048	120	3048	120	3048	120	3048	120
Panel Width - mm (in.)	406	16	406	16	406	16	406	16
Capacity - W (Btu/hr)	551	1880	551	1880	551	1880	551	1880
Notes	1, 2, 3, 4, 6		1, 2, 3, 4, 6		1, 2, 3, 4, 6		1, 2, 3, 4, 6	

Mark	RP-1.15		RP-1.16		RP-1.17		RP-1.18	
Location	1st Floor Cell 15		1st Floor Cell 16		1st Floor Cell 17		1st Floor Cell 18	
Panel Length - mm (in.)	3048	120	3048	120	3048	120	3048	120
Panel Width - mm (in.)	406	16	406	16	406	16	406	16
Capacity - W (Btu/hr)	551	1880	551	1880	551	1880	551	1880
Notes	1, 2, 3, 4, 6		1, 2, 3, 4, 6		1, 2, 3, 4, 6		1, 2, 3, 4, 6	

Mark	RP-1.19		RP-1.20		RP-1.21		RP-1.22	
Location	1st Floor Cell 19		1st Floor Cell 20		1st Floor Cell 21		1st Floor Cell 22	
Panel Length - mm (in.)	3048	120	3048	120	3048	120	3048	120
Panel Width - mm (in.)	406	16	406	16	406	16	406	16
Capacity - W (Btu/hr)	551	1880	551	1880	551	1880	551	1880
Notes	1, 2, 3, 4, 6		1, 2, 3, 4, 6		1, 2, 3, 4, 6		1, 2, 3, 4, 6	

Mark	RP-1.23		RP-1.24		RP-1.25			
Location	1st Floor Cell 23		1st Floor Cell 24		1st Floor Cell 25			
Panel Length - mm (in.)	3048	120	3048	120	3048	120		
Panel Width - mm (in.)	406	16	406	16	406	16		
Capacity - W (Btu/hr)	551	1880	551	1880	551	1880		
Notes	1, 2, 3, 4, 6		1, 2, 3, 4, 6		1, 2, 3, 4, 6			

Mark	RP-2.01A		RP-2.01B		RP-2.02		RP-2.03	
Location	2nd Floor Interview 01		2nd Floor Interview 01		2nd Floor Cell 02		2nd Floor Cell 03	
Panel Length - mm (in.)	3048	120	914	36	1626	64	1219	48
Panel Width - mm (in.)	406	16	406	16	762	30	1016	40
Capacity - W (Btu/hr)	551	1880	165	564	551	1880	551	1880
Notes	1, 2, 3, 4, 6		1, 2, 3, 5, 6		1, 2, 3, 5, 6		1, 2, 3, 5, 6	

Mark	RP-2.04		RP-2.05		RP-2.SS		RP-2.06	
Location	2nd Floor Cell 04		2nd Floor Cell 05		2nd Floor Shower (South)		2nd Floor Cell 06	
Panel Length - mm (in.)	3048	120	3048	120	1626	64	3048	120
Panel Width - mm (in.)	406	16	406	16	762	30	406	16
Capacity - W (Btu/hr)	551	1880	551	1880	551	1880	551	1880
Notes	1, 2, 3, 4, 6, 7		1, 2, 3, 4, 6, 7		1, 2, 3, 5, 6		1, 2, 3, 4, 6, 7	

Mark	RP-2.07		RP-2.08		RP-2.09		RP-2.10	
Location	2nd Floor Cell 07		2nd Floor Cell 08		2nd Floor Cell 09		2nd Floor Cell 10	
Panel Length - mm (in.)	3048	120	3048	120	3048	120	3048	120
Panel Width - mm (in.)	406	16	406	16	406	16	406	16
Capacity - W (Btu/hr)	551	1880	551	1880	551	1880	551	1880
Notes	1, 2, 3, 4, 6, 7		1, 2, 3, 4, 6, 7		1, 2, 3, 4, 6, 7		1, 2, 3, 4, 6, 7	

Mark	RP-2.11		RP-2.12		RP-2.13A		RP-2.13B	
Location	2nd Floor Cell 11		2nd Floor Cell 12		2nd Floor Cell 13		2nd Floor Cell 13	
Panel Length - mm (in.)	3048	120	3048	120	3048	120	914	36
Panel Width - mm (in.)	406	16	406	16	406	16	406	16
Capacity - W (Btu/hr)	551	1880	551	1880	551	1880	165	564
Notes	1, 2, 3, 4, 6, 7		1, 2, 3, 4, 6, 7		1, 2, 3, 4, 6, 7		1, 2, 3, 5, 6, 7	

Mark	RP-2.14		RP-2.15		RP-2.16		RP-2.17	
Location	2nd Floor Cell 14		2nd Floor Cell 15		2nd Floor Cell 16		2nd Floor Cell 17	
Panel Length - mm (in.)	3048	120	3048	120	3048	120	3048	120
Panel Width - mm (in.)	406	16	406	16	406	16	406	16
Capacity - W (Btu/hr)	551	1880	551	1880	551	1880	551	1880
Notes	1, 2, 3, 4, 6, 7		1, 2, 3, 4, 6, 7		1, 2, 3, 4, 6, 7		1, 2, 3, 4, 6, 7	

Mark	RP-2.SN		RP-2.18		RP-2.19		RP-2.20	
Location	2nd Floor Shower (North)		2nd Floor Cell 18		2nd Floor Cell 19		2nd Floor Cell 20	
Panel Length - mm (in.)	1626	64	3048	120	3048	120	3048	120
Panel Width - mm (in.)	762	30	406	16	406	16	406	16
Capacity - W (Btu/hr)	551	1880	551	1880	551	1880	551	1880
Notes	1, 2, 3, 5, 6		1, 2, 3, 4, 6, 7		1, 2, 3, 4, 6, 7		1, 2, 3, 4, 6, 7	

Mark	RP-2.21		RP-2.22		RP-2.23		RP-2.24	
Location	2nd Floor Cell 21		2nd Floor Cell 22		2nd Floor Cell 23		2nd Floor Cell 24	
Panel Length - mm (in.)	3048	120	3048	120	3048	120	3048	120
Panel Width - mm (in.)	406	16	406	16	406	16	406	16
Capacity - W (Btu/hr)	551	1880	551	1880	551	1880	551	1880
Notes	1, 2, 3, 4, 6, 7		1, 2, 3, 4, 6, 7		1, 2, 3, 4, 6, 7		1, 2, 3, 4, 6, 7	

Mark	RP-2.25A		RP-2.25B					
Location	2nd Floor Cell 25		2nd Floor Cell 25					
Panel Length - mm (in.)	3048	120	914	36				
Panel Width - mm (in.)	406	16	406	16				
Capacity - W (Btu/hr)	551	1880	165	564				
Notes	1, 2, 3, 4, 6, 7		1, 2, 3, 5, 6, 7					

Notes:

1. Multiple radiant panels served by a control valve controlled by DDC, and wall mounted temperature sensor.
2. Ceiling radiant panels shall be recess mounted. Contractor shall measure the distance between the existing structural flutes, with the intention for the radiant panel to utilize the full distance between the flutes.
3. White electrostatic polyester powder coat finish, & 25mm (1") thick foil-backed batt insulation above panel.
4. Radiant panel length shall be the full length available within the room, between the flutes, with dimensions confirmed in field by contractor before ordering.
5. Radiant panel length shall be as specified, with contractor providing custom 3.5mm (10 SWG) thick sheet metal end plate(s) security fastened and caulked, preventing access to space above radiant panels.
6. Radiant panel heat output based on entering water temperature of 71.1˚C [160˚F] and 21˚C [70˚F] room temperature. Water flow rate is based upon 60.0˚C [140˚F] leaving water temperature (u.n.o.).
7. Contractor shall notch radiant panel to accommodate existing full height 125mm x 50mm vertical steel posts supporting the desk and bed in each room. Verify location and dimensions in field prior to shop drawing submittal.

CONTROL VALVES								
Mark	CV-1		CV-2		CV-3		CV-4	
Service	1st Floor NW RP's		1st Floor NE RP's		1st Floor SW RP's		1st Floor SE RP's	
Type	2-W Mod PICCV		2-W Mod PICCV		2-W Mod PICCV		2-W Mod PICCV	
Flow - L/s (gpm)	0.08	1.3	0.08	1.3	0.07	1.1	0.08	1.3
P.D. - kPa (psi)	13.8	2.0	13.8	2.0	13.8	2.0	13.8	2.0
Notes								

Mark	CV-HC1.E		CV-HC2.E		CV-HC2.W		CV-5	
Service	HC-1.E		HC-2.E		HC-2.W		2nd Floor NW RP's	
Type	2-W Mod PICCV		2-W Mod PICCV		2-W Mod PICCV		2-W Mod PICCV	
Flow - L/s (gpm)	0.18	2.8	0.09	1.4	0.09	1.4	0.07	1.1
P.D. - kPa (psi)	13.8	2.0	13.8	2.0	13.8	2.0	13.8	2.0
Notes								

Mark	CV-6		CV-7		CV-8		CV-FCZ3	
Service	2nd Floor NE RP's		2nd Floor SW RP's		2nd Floor SE RP's		FC-Z3	
Type	2-W Mod PICCV		2-W Mod PICCV		2-W Mod PICCV		3-W Mod	
Flow - L/s (gpm)	0.09	1.4	0.09	1.4	0.07	1.2	0.24	3.9
P.D. - kPa (psi)	13.8	2.0	13.8	2.0	13.8	2.0	6.9	1.0
Notes								

Notes

Refer to control contractor’s shop drawings for multi-port valve's piping configuration.
Heating control valves shall be spring powered to fail to full heat upon loss of power.

Valve Types:
2-W Mod PICCV : 2-way modulating pressure independent characterized control valve
2-W 2-P PICCV : 2-way 2-position pressure independent characterized control valve
2-W Mod : 2-way modulating control valve
2-W 2-P : 2-way 2-position control valve
3-W Mod : 3-way modulating control valve
3-W 2-P : 3-way 2-position control valve

PUMPS										
Mark	P-M2C-1		P-M2C-2				P-15			
Location	Basement Mech. Rm.		Basement Mech. Rm.				Basement Mech. Rm.			
Service	Secondary for RP's & HC's		Secondary for RP's & HC's				Secondary for FC-Z3			
Flow - L/sec (usgpm)	1.00	16	1.00	16			0.24	4		
Head - kPa (ft.)	75	25	75	25			66	22		
Pump Conn. Size - mm (in.)	51	2	51	2			25	1		
Horsepower	3/4		3/4				1/4			
Notes	2		2				3			

Mark										
Location										
Service										
Flow - L/sec (usgpm)										
Head - kPa (ft.)										
Pump Conn. Size - mm (in.)										
Horsepower										
Notes										

1. Pumps to be bronze construction for all domestic water applications.
2. Motor to be suitable for 208/1/60 power and EC motor with 0-10VDC input for variable flow control by DDC.
3. Motor to be suitable for 120/1/60 power, open drip proof, and 1800 rpm; unless noted otherwise.

ELECTRIC HEATERS								
Mark	EH-1		EH-2		EH-3		EH-4	
Location	GL '82' South		GL '84' South		GL '86' South		GL '88' South	
Panel Length - mm (in.)	533	21	533	21	533	21	533	21
Capacity - W (Btu/hr)	500	1706	500	1706	500	1706	500	1706
Notes	1, 2, 3, 4		1, 2, 3, 4		1, 2, 3, 4		1, 2, 3, 4	

Mark	EH-5		EH-6		EH-7		EH-8	
Location	GL '90' South		GL '92' South		GL '94' South		GL '82' North	
Panel Length - mm (in.)	533	21	533	21	533	21	533	21
Capacity - W (Btu/hr)	500	1706	500	1706	500	1706	500	1706
Notes	1, 2, 3, 4		1, 2, 3, 4		1, 2, 3, 4		1, 2, 3, 4	

Mark	EH-9		EH-10		EH-11		EH-12	
Location	GL '84' North		GL '86' North		GL '88' North		GL '90' North	
Panel Length - mm (in.)	533	21	533	21	533	21	533	21
Capacity - W (Btu/hr)	500	1706	500	1706	500	1706	500	1706
Notes	1, 2, 3, 4		1, 2, 3, 4		1, 2, 3, 4		1, 2, 3, 4	

Mark	EH-13		EH-14					
Location	GL '92' North		GL '94' North					
Panel Length - mm (in.)	533	21	533	21				
Capacity - W (Btu/hr)	500	1706	500	1706				
Notes	1, 2, 3, 4		1, 2, 3, 4					

1. Provided with manufacturer's integrated thermostat adjustable between 4.4˚C (40˚F) and 21.1˚C (70˚F).
2. Units to be compatible with 120/1 power.
3. Provide unit with standard colour "Beige".
4. Unit chassis 127mm (5") high x 89mm (3-1/2") deep.

VENTILATION FANS												
Mark	EF-K1		S-11									
Type	Upblast Centrifugal Wall Exhaust		Direct Drive Centrifugal Inline									
Location	1st Floor Kitchenette		Basement Mech. Rm.									
Air Flow - L/s (cfm)	118	250	670	1420								
External S.P. - Pa (in w.g.)	70	0.28	142	0.57								
Power Consumed	1/4 HP, 2.85 FLA		3/4 HP									
Fan RPM	845		1340									
Radiated Sones | dBA	4.3	45	4.60	48								
Weight - kg (lbs.)	23	50	34	75								
Notes	1, 2, 3, 4, 5, 6, 7		2, 3, 5, 8, 9, 10, 11, 12, 13									

Refer to specification for accessories not scheduled. Refer to drawings for installation details.

1. Compatible with 120 V / 1 Ph / 60 Hz power, and maximum 1725 RPM direct drive motor.
2. Aluminum housing, aluminum backward inclined wheel.
3. Provided with manufacturer's gravity back draft damper applicable for mounting position shown on dwgs.
4. Complete with Vari-Green EC motor and mounted potentiometer dial used for air balancing purposes.
5. UL / cUL-705 "Power Ventilators" listed.
6. Provided with baked enamel finish, selected by Departmental Representative from manufacturer's standard colors.
7. Complete with hood hasps. Configured for exhaust fan to be mounted on wall with foam seal.
8. Compatible with 208 V / 1 Ph / 60 Hz power, maximum 1725 RPM direct drive motor.
9. Two (2) bolted access panels, inlet and outlet companion duct connection flanges.
10. Vari-Green EC motor, control transformer 85-277 VAC to 24 VDC mounted & wired, 0-10VDC control
11. 25mm (1") thick insulation on inside of housing for sound attenuation purposes.
12. Spring base brackets and isolators provided by manufacturer to mount unit to floor.
13. 165 L/s (350 CFM) airflow at fan and motor minimum speed of 300 RPM with 2.0 VDC input from DDC.

HEATING COILS						
Mark	HC-1.E		HC-2.E		HC-2.W	
Area Serving	1st Floor Corridor		2nd Floor Corridor (East)		2nd Floor Corridor (West)	
Type or Model	Duct Connection		Duct Connection		Duct Connection	
Rows	to be selected		to be selected		to be selected	
Fins per Inch	to be selected		to be selected		to be selected	
Height - mm (in.)	356	14	305	12	305	12
Length - mm (in.)	1067	42	660	26	660	26
Air Flow - L/s (cfm)	991	2100	496	1050	496	1050
Air P.D. - Pa (in w.g.)	40	0.16	40	0.16	40	0.16
Face Velocity - m/s (FPM)	2.6	514	2.46	485	2.46	485
Ent. Air Temp ℃ (℉)	12.9	55.2	12.9	55.2	12.9	55.2
Lvg. Air Temp ℃ (℉)	26.7	80.0	26.7	80.0	26.7	80.0
Heating Cap. - kW (MBH)	16.6	56.5	8.3	28.3	8.3	28.3
Water Flow - L/s (gpm)	0.18	2.8	0.09	1.4	0.09	1.4
Water P.D. - kPa (ft.)	6	2.0	6	2.0	6	2.0
Notes	2, 3		2, 3		2, 3	

Mark						
Unit						
Type						
Rows						
Series or Fins per Inch						
Height - mm (in.)						
Length - mm (in.)						
Air Flow - L/s (cfm)						
Air P.D. - Pa (in w.g.)						
Ent. Air Temp ℃ (℉)						
Lvg. Air Temp ℃ (℉)						
Heating Cap. - kW (MBH)						
Water Flow - L/s (gpm)						
Water P.D. - kPa (ft.)						
Notes						

Refer to specification for accessories not scheduled. Refer to drawings for installation details. Coil Capacities are selected for entering water temperature of 71.1˚C [160˚F]. Water flow rate is based upon 11.1˚C [20˚F] temperature drop (unless noted otherwise) with a minimum flow of 0.03 L/sec [0.50 USgpm]. Maximum air pressure drop to be 40 Pa. [0.16"wc], unless noted otherwise. Maximum air velocity across coil 2.5 m/sec [500 fpm] for air flow rate of 200 L/s [424 CFM] or less, unless noted otherwise. Maximum air velocity across coil 3.0 m/sec [590 fpm] for air flow rate greater than 200 l/s [424 CFM], unless noted otherwise. Maximum water pressure drop 6 kPa. [2 ft hd], unless noted otherwise.

NOTES:
1. Heating coil sized to fit inside heating and ventilation unit.
2. Heating coil provided with casing and duct connections on inlet and outlet.
3. Heating coil controlled by DDC, and wall mounted temperature sensor.

PART 1 GENERAL

1.1 Related Sections

.1	Section 01 01 50	General Instructions
.2	Section 01 91 00	Commissioning
.3	Section 23 08 00	Commissioning of Mechanical Systems

1.2 General

.1 Provide, install, program and commission a BACnet-based DDC control system to achieve the performance specified in the following clauses.

.2 The existing DDC control system is a Delta Controls system. The proposed DDC system shall be fully compatible with the existing system in all manor, form and function, successfully integrated with the existing DDC system.

.3 Work covered by sections referred to above consist of fully operational EMCS, including, but not limited to, following:

.1 Building Controllers.

.2 Control devices as listed in I/O Summaries.

.3 Data communications equipment necessary to effect an EMCS data transmission system including gateway and LAN hardware and software for connection to incumbent BACnet network.

.4 Field control devices.

.5 Software and graphics package complete with full documentation for software and equipment for system including 1 site computers.

.6 1 site laptop PC.

.7 Complete operating and maintenance manuals and field training of operators, programmers and maintenance personnel.

.8 Acceptance tests, technical support during commissioning, full documentation.

.9 Wiring interface co-ordination of equipment supplied by others.

.10 Miscellaneous work as specified in these sections and as indicated.

1.3 Metric Reference

.1 Conform to CAN/CSA-Z234.1.

.2 Provide required adapters between Metric and Imperial components.

1.4 Standard Compliance

.1 All equipment and material to be from manufacturer's regular production, CSA certified, manufactured to standard quoted plus additional specified requirements.

.2 Where CSA certified equipment is not available submit such equipment to inspection authorities for special inspection and approval before delivery to site.

.3 Submit proof of compliance to specified standards with shop drawings and product data. Label or listing of specified organization is acceptable evidence.

.4 In lieu of such evidence, submit certificate from testing organization, approved by Departmental Representative, certifying that item was tested in accordance with their test methods and that item conforms to their standard/code.

.5 For materials whose compliance with organizational standards, codes and specifications is not regulated by an organization using its own listing or label as proof of compliance, furnish certificate stating that material complies with applicable referenced standard or specification.

1.5 Submittals

.1 Submit in accordance with Section 01 01 50 - General Requirements.

.2 Provide digital copies of schematic control diagrams for review. Each valve, actuator and instrument shall be given an identification label which will refer directly to control diagram.

.3 Provide damper shop drawings which include data such as arrangement, velocities, and static pressure drops for each system on shop drawings.

.4 Provide shop drawings including complete operating data, system drawings, wiring diagrams, and type written detailed operational description of sequences, and description and engineering data on each control system component.

.5 At completion of work, make detailed check of automatic control system and submit written report to the Departmental Representative.

.6 Provide sufficient copies of complete parts and repair manuals for binding in O&M Manuals.

.7 Provide "record" control drawings and schedules; incorporate into O&M Manuals.

.8 The submittals shall be prepared using the dynamic graphics software normally provided with system and be incorporated into the dynamic graphics system for on- line reference. Provide original, registered software disks of Windows, the Graphics Software package, the Operating System software, and the project graphic schematics, floor plan layouts, and control drawings.

1.6 Extra Materials

.1 Provide maintenance materials in accordance with Section 01 01 50 – General Instructions.

1.7 Preliminary Design Review Meeting

.1 Convene a Preliminary Design Review meeting within 45 working days of award of contract to:

.1 Undertake functional review of preliminary design documents, resolve inconsistencies.

.2 Resolve conflicts between contract document requirements and actual items (e.g.: points list inconsistencies).

.3 Review interface requirements of materials supplied by others.

.4 Review "Sequence of Operations".

.2 Contractor's programmer to attend meeting.

.3 Departmental Representative retains right to revise sequence or subsequent Control Description Logic prior to software finalization without cost to Departmental Representative.

1.8 Monitoring and Control Features

.1 Operator defined digital and analogue alarms and automatic alarm condition reporting.

.2 Direct keyboard override of all inputs and outputs, with an indication on the display for any point that is operating under keyboard override.

.3 Addition, deletion, definition and modification of all points from operator keyboard.

.4 Trend log graphing and reporting of user selected points at user defined intervals.

.5 Run time logging of digital points.

.6 Ability to accept a variety of standard analogue and digital input signals.

.7 Ability to generate a variety of standard analogue and digital output signals.

1.9 Offline Storage

.1 The DDC system shall have the capability to be taken off-line in the event of failure or for maintenance and returned to operation without the need for entering any portion of the software program manually.

.2 An off-line disk storage device shall be utilized to provide software backup and reload. Backup and verification of the entire system, with full applications software, shall be less than TWO (2) seconds per real point. Use site laptop PC for off-line storage.

1.10 Power Surge Protection

.1 The DDC system shall be protected from power line surges and voltage transients by installation of a power line filter.

1.11 Power Failure Protection

.1 The DDC system shall have automatic protection from any power failure of at least TWENTY-FOUR (24) hours duration.

.2 This protection shall at a minimum include continuous real-time clock operation and automatic system restart upon power return.

.3 Outputs shall have the option of being set to “staggered start” upon power reset.

1.12 Electrical Components, and Conduit

.1 Provide all control system components, except those supplied as part of packaged equipment controls, but including all auto sequencing devices, electric relays, safety devices and electrical interlocks required to accomplish specified sequences. Refer to the electrical motor schedule in the electrical drawings and/or specification, which delineate the limits of electrical work in Division 26 (Electrical) serving mechanical systems.

.2 Provide all control circuit transformers required for control systems and not supplied by Division 26 including line voltage power connection from indicated outlets shall be included by Division 25.

.3 All line voltage wiring shall be copper with RW90 X-Link P.E. insulation #12 minimum size. AWG wire shall be sized to meet code.

.4 Wiring is to be in conduit in all wall spaces and exposed locations as well as in pipe chases, service spaces, attics, and crawl spaces which are entered for service access. Wiring in suspended ceiling spaces does not require conduit but shall be neatly installed parallel to building lines using bridle rings. All wiring installed under this contract shall be plenum rated FT-6 or FT-4, if approved by all authorities having jurisdiction. Locate wiring away from top or bottom of ceiling joists or trusses to minimize possibility of accidental damage. Number 18 gauge wire may be used in Class 2 circuits unless voltage drops are excessive. THHN wire will not be acceptable. Twisted shielded wiring, minimum of 22 gauge wire shall be used for all DDC or co-axial communication wiring. Line voltage alternating current wiring shall not be run in the same conduit, or cabling as DDC wiring.

.5 Use 1m of flexible conduit for all connections to vibrating equipment. Use liquid tight flex cable and connections where required.

.6 The Control Contractor shall locate magnetic starters from the electrical drawings. All electrical work provided by this Contractor shall comply with all requirements of the Division 26 electrical specification, the Canadian Electrical Code and Local Codes and Ordinances.

.7 Wire all line voltage thermostats, pressure switches or aquastats for single phase equipment.

.8 Division 26 has been requested to provide specific devices, including magnetic starters supplied with 120 volt holding coils, HOA switching and space for the addition of auxiliary contacts. The Control Contractor shall provide all necessary normally open and normally closed contacts, wired to a terminal strip within the starter enclosure, required to achieve the specified control interlocking and sequencing. Manual starters for 120 volt equipment are to contain On-Off selector, external H.O.A., integral overload protection and pilot lights. The Controls Contractor shall provide control wiring interlocks from the control contacts provided on the automatic branch lines of the assembly, which will be contained within the associated Motor Control or Starter Assembly.

.9 Refer to Division 26 Specifications and Motor Schedule for the scope of work to be provided by the Electrical Contractor. Division 25 shall supply and install all components, in addition to those outlined within the Division 26 documents, as may be deemed necessary to provide all interlocks or sequences as called for elsewhere within the specifications. Include for the supply and installation of Cat 6 Ethernet, plenum rated cables from the hub location to the communications backboard. Coordinate with Division 26 and the Departmental Representative for interconnection of the hub or switch to the site network, provided by the Control Contractor.

.10 All power supplies for controls are this Contractor's responsibility unless otherwise specified in the Electrical Specifications. All control transformers to be located in fan rooms or mechanical rooms only and are to be mounted in serviceable locations.

.11 Line voltage will not be run with signal or trunk wiring or be present in the same junction box.

.12 All shielded wiring will be grounded at the BMS panels and prevented from grounding at the terminal end.

.13 Run all wiring parallel to building lines. All wiring to be installed in a neat, workmanlike manner.

.14 Support wiring independent of piping, ductwork, and equipment. Keep wiring clear of hot piping, ductwork/equipment.

.15 Identify all junction boxes with control company label.

.16 There are to be no splices in any of the control wiring except at devices or control panels.

1.13 Identification, Calibration and Programming

.1 Provide a written sequence of operation for each piece of equipment or system being controlled that does not require knowledge of DDC programming. Provide a print out of the complete data base, including program listings, inputs, outputs, controllers, virtual points, trend logs, alarm points, etc. Provide in an organized manner, separated for each panel.

.1 Procedures for daily operation of the system.

.2 Theory of operation of the equipment.

.3 Theory of operation of the control program.

.2 Mount an input/output layout sheet within each controller. This sheet shall include the name of the points connected to each controller channel.

.3 Identify all controllers and associated devices with symbols relating directly to the control diagram. Provide plastic labels for each input and output point with the following information:

.1 Point descriptor.

.2 Point type and channel number.

.3 Corresponding controller number.

.4 Program each controller immediately following installation. Setup and tune all control loops during the initial start-up of the systems. Submit a well documented print out of the controller program for review.

.5 At the time of the Departmental Representative's Demonstration and Instruction Period:

.1 Demonstrate and confirm that all systems are programmed and operating correctly. Submit trend logs, 1 week in duration, that confirm systems are operating as designed and follow the internal building loads in an energy efficient manner.

.2 Submit CD's (including back-up diskettes) containing up to date copies of the programs in each controller.

.3 Submit (4) CD's with printed PDF copies of the final programs that include all point definitions, weekly and annual schedule settings, controller setpoints and tuning parameters, and documented general control language programs. (As Built control shop drawings)

.4 Provide the original software CD's and the users manuals for all software programs provided as part of this contract. Provide one set of original disks for each notebook, laptop, and laptop computer the software has been installed on. The controls contractor shall be responsible for registering all software with the manufacturer in the Departmental Representative's name. Provide copies of the registration of all software to the Departmental Representative as part of the final inspection.

.6 Check sensor calibration and control system operation twice during the first year of operation including the first heating season and prior to the first cooling season. Include all parts and labour in service. Following each visit submit:

.1 A report indicating all work performed.

.2 Printed graphs of trend logs one week in duration with hourly samples for all analog inputs connected to each controller.

.3 Update printed and diskette copies of any changes made to programs for any controller.

.7 Provide two (2) days of on-site instruction to the Departmental Representative during the first year of operation, with at least one (1) month between each on-site instruction, scheduled as requested by the Departmental Representative, during one or more of the two (2) visits.

1.14 Controller Software

.1 Each standalone control panel shall contain a complete software development system in each panel. The software development system shall consist of a menu driven, prompted programming language containing complete libraries of control algorithms for DDC, Energy Management, and Facilities Management functions. These resident libraries of algorithms shall be drawn from for the creation of the application specific programming of each individual standalone control panel.

.2 Four user access levels shall be provided with a user access code available at each level. Each level shall permit identifiable multiple user access.

.3 Point names shall be defined using a minimum of 128 alphanumeric characters to provide an English language description of the point function.

.4 The standalone control panel shall be capable of generating sorted alarm, trend log, energy management, maintenance time remainder, and exception log reports on a prioritized basis. Segregated report generation shall be invoked by manual request, time of day, calendar, accumulated run time, or event occurrence.

.5 DDC Control:

.1 The network of standalone control panels shall individually perform setpoint reset, ramping functions, 2-position ON/OFF control, PID loop control, linear sequencing, rotating sequencing, binary sequencing, HI/LO/AVE selection, energy dead band, and thermostat controls as required to control their connected systems of equipment.

.6 Energy Management Control:

.1 The network of standalone control panels shall individually perform time of day scheduling, optimum start/stop, enthalpy optimization, trend logging, demand limiting and all control optimization strategies, such as supply air reset, and soft ramp-up, for their connected systems of equipment.

.2 Coordination of strategies involving multiple systems of equipment shall be performed by sharing of necessary data between the stand-alone control panels on the communicating network.

.7 Facilities Management Control:

.1 The Departmental Representative shall be provided the ability to read out temperatures and other values and to adjust specific items from localized, as well as remote centralized location. Every controller shall provide the following reports:

.2 Facility Diagnostics

.1 The facilities management system shall provide diagnostic reports for selected systems of equipment as specified.

.3 Alarm Occurrence Status

.1 When specified alarm conditions occur, provide a report available to printout, listing the status of specific items associated with the equipment generating the alarm. Report shall be routed through auto dial out feature to a specific printer or combination of printers. Report shall record the time the status information was taken, and shall allow operational personnel to use this information to diagnose the alarm situation.

.8 SAC and Micro Controller Trend Logs:

.1 Controllers shall be capable of storing up to twenty-five (25) full trend logs with a minimum of 200 data samples each. They shall be able to collect and store samples of the value of any system variable (i.e. temperature). The operator shall be able to create a trend log, with each trend log containing up to 4 points. The sample frequency shall be selectable for each trend log between 1 second and 24 hours. The ability to graphically display to 4 points on the screen simultaneously, print a log, or store a log on disk in an ASCII format that can be imported into a standard spreadsheet program shall be provided. This capability shall be provided for all forms of access.

.9 Network communication/controllers Trend Logs:

.1 Trend logs shall be provided to collect and store samples of the value of a point i.e., temperature. The network communication/controllers shall have sufficient memory to create and store 200 full trendlogs. Each BacNet trendlog shall be capable of monitoring 1 I/O or virtual point from any controller or combination of controllers across the network, and storing a minimum of 2000 data samples for each trended point. The sample frequency shall be selectable for each trend log between 1 second and 24 hours. The network communication/controllers shall be capable of archiving the trended data to the Host computer or dialing out to a remote trend computer and downloading the data automatically. The ability to indefinitely retain the contents of a trend log in the controller or automatically transfer the contents of a trend log to disk storage, printer or remote site and restart the log shall be provided.

.10 Host Level Trending:

.1 Shall be provided to collect and store samples of the value of any system variable (i.e. temperature Trend Logs: Shall be provided to collect and store samples of the value of any system variable. The operator shall be able to create a BACnet trend log, with each trend log containing 1 point. The sample frequency shall be selectable for each trend log between 1 second and 99 hours. The ability to link multiple single point BACnet trend logs to be displayed on an 8 point Multi-trend log for comparative analysis shall be provided. Ability to print a log, or store a log on disk in an ASCII format that can be imported into a standard spreadsheet program shall be provided. This capability shall be provided for all forms of access.

11. The Ethernet interface with the remote operator's terminal shall provide all features listed above.

1.15 Computer Graphics Software

.1 Incorporate the following standards for the required host capabilities and installed features:

.1 The host computer operator interface, network interface and graphical interface software shall be Microsoft Windows based.

.2 Provide one licensed copy of the complete HOST software package complete with operating manuals, installation manuals, setup manuals, programming manuals, and original diskettes.

.3 Host operator interface.

.2 The following functionality shall be available to the operator from either the onsite host, remote host, or Color laptop connected to anywhere on the network inside the building. These workstations shall operate as graphic interface devices. Attention must be paid to developing an interface to the system using a minimum of user keystrokes. The primary user interface must be the mouse.

Provide functionality such that any of the following may be performed simultaneously, at either workstation and in any combination, via user-sized windows.

.1 Dynamic color graphics and graphic control

.2 Alarm management and control

.3 Time of day scheduling

.4 Trend data definition and presentation

.5 Graphic definition

.6 Graphic construction

.7 Database functions

.3 Graphic generation and design:

.1 Provide a default graphic consisting of a visual overview of the entire control system. The display shall be in a tree format. Indicate the various branches of graphic access available from the tree for each mechanical system and building zone. The site plan of the facility should be used as a reference tree to show the relationship of each system to a particular building zone. Graphic links for each zone must be available to allow the user to link directly to the desired graphic or step systematically forward or backward through the tree to each graphic associated with the mechanical system. The operator must be able to return directly to the default from any level of graphic menu penetration.

.2 As a minimum, provide the following graphic screens and dynamic linking:

.1 A default graphic to be used as a central starting point for penetrating the menu of available graphic screens.

.2 Zone summary graphic. Dynamically indicate zone high select (Hsel) and low select (Lsel) temperatures, AHU supply air temperatures and setpoints, and status of the air handling units serving the zone.

.3 Dynamic graphic floor plans for each building zone, scaled appropriately to be readable from a laptop. Indicate room temperatures, architectural room number, control valve position, supply fan system serving the area, and any associated equipment such as exhaust fans, fume hoods, etc. From this screen the operator shall be able to command the control valve, adjust the room setpoint, access the graphic screen for the supply fan system, view a trend log of the room temperature, or access a graphic for associated mechanical equipment.

.4 A schematic of each mechanical system. As a minimum, each graphic will indicate all DDC I/O points and software variables associated with each system. Indicate the DDC point names, current status value, and operator priority.

All graphic screens shall be created using the same software supplied to the Departmental Representative. Provide the graphic data files in a format suitable for inclusion into the graphical operator interface and for direct loading into the graphic editor. The graphic data files shall be the sole property of the Departmental Representative.

DEFAULT GRAPHIC COLORS			
Normal On	GREEN	Text Arial 12 pt	BLACK
Heating Equipment	RED	Normal Off	BLACK
Background	WHITE	Cooling Equipment	BLUE
Ducts	BLACK	**ALARM**	**RED**
Sensors	BLUE		

.4 Graphical links:

.1 All system graphical links will be located in the upper left corner of the screen. These links will be displayed in sequential order representative of the menu tree.

1.16 Related Work

.1 The following incidental work shall be furnished by the mechanical sub-contractor under the supervision of the controls subcontractor:

.1 Installation of control dampers including duct transitions, assembly and interconnection of multiple section dampers.

.2 Supply and installation of sheet metal baffles as required to eliminate air stratification.

.3 Supply and installation of access panels for service and installation of control equipment.

.4 Installation of automatic valves, wells, flow switches, and other pipe related control devices.

PART 2 PRODUCTS

2.1 Site Laptop PC

.1 The new computer on site available for the proposed EMCS software installation shall have the following features and capacities:

- Standalone laptop computer, nominal 15” screen
- MS Windows 10, latest version
- Intel® Core ™, i5-3570 CPU at 3.40 GHz, 3401 MHz, 4Core(s) 4 logical pro. This is the minimum performance required).
- 8 GB RAM, minimum
- 500 GB nominal minimum, SSD or hard drive
- Ethernet port, full size

.2 Contractor shall confirm new computer can be used for the new EMCS software, including but not limited to network connections, fire walls, system hardening, etc.

PART 3 EXECUTION

3.1 General

.1 Check and verify location of thermostats and other exposed control sensors with plans and room details before installation. Locate thermostats and temperature sensors 1.5m above floor.

.2 Install damper motors on outside of ducts. Do not locate in outside air stream.

.3 The installation shall conform to each manufacturer's recommended procedures and to all applicable codes, statutes and ordinances.

.4 All equipment installed shall be mechanically stable and, as necessary, fixed to wall or floor. Anti-vibration mounts to be provided, if required, for the proper isolation of the equipment.

.5 Equipment shall be installed so as to allow for easy maintenance access. Equipment shall be installed such that it does not interfere in any way with access to adjacent equipment and personnel traffic in the surrounding space.

.6 Equipment shall be installed in locations providing adequate ambient conditions for its specified functioning, allowing for adequate ventilation.

.7 Permanently identify each wire, cable, conduit and tube at each terminal.

.8 Wiring and tubing shall be identified at each DDC panel by termination number. Wiring and tubing shall be identified at terminal device by termination and DDC panel numbers.

.9 All transmitters, interfaces, terminations and control relays, etc. shall be mounted in field cabinets that may be locked.

.10 Freeze protection devices shall be hard wired and also wired to alarm through DDC system.

.11 All wall mounted devices in new finished space shall be mounted on a wall box. The wall box shall be connected to the ceiling space by a conduit stub. On renovations, when sensors are mounted in existing finished walls, wiring or tubing may be fished into the walls without conduit.

3.2 Enclosure and Conduit

.1 Relays, transformers, and I/O devices and peripherals shall be installed in separate enclosures and not in the enclosures containing the controllers.

.2 All wires penetrating the enclosure that are not required to be in conduit must be neatly bundled and strapped in place.

.3 All Building Controllers will be installed in CSA rated enclosures that are complete with hinged and key-locked doors. The door will be painted and labeled suitably bearing the manufacturer's system name/logos, the controller address, and the installing contractor's contact information. This enclosure will be mounted at a height that provides easy access without the need of a ladder.

.4 A hard points list shall be affixed on the inside of the door/cover of the enclosure.

.5 The inside bottom of the enclosure shall be clean of dirt, metal shavings, and debris.

.6 Provide EMT conduit with set screw metal fittings where wiring is exposed and in all mechanical rooms. All conduit will be piped smoothly and neatly following building lines. Wiring above accessible ceilings and in wall cavities may be run free-air.

.7 Liquid-tight flexible conduit to be used for rooftop unit wiring c/w liquid-tight fittings. Provide spun aluminum roof jack where control wiring penetrates roof unless penetration is within waterproof rooftop unit curb.

.8 All junction boxes will have covers properly and firmly affixed after installation completion.

3.3 I/O Wiring

.1 All input/output device wiring will use #18-2 solid core cable with individually jacked conductors and jacketed sheath over the pair.

.2 Use plenum cable where required.

.3 All I/O wiring passing near or within the enclosure of a VFD will be shielded, with the shield terminated at the device end.

.4 All I/O wiring will be identified using Panduit adhesive wire-marker at the controller and end device ends. Description of point to include point mnemonic, point type and network location.

.5 All I/O wiring within controller enclosure shall be neat and tidy and suitably bundled and strapped or contained in plastic wire duct or equivalent.

.6 All I/O wiring that requires a transition to a different conductor to meet electrical code requirement shall be executed using a terminal strip.

.7 Low voltage I/O wiring may be mixed together within a conduit. Low and line voltages may not be mixed together within a conduit.

3.4 Power Wiring

.1 Provide power wiring and transformers and grounding to each controller and transducer as per the manufacturer's specification.

.2 Each Building Controller will have its own dedicated power supply. No other controller or I/O device will be powered from this supply.

.3 Power wiring shall not be mixed with I/O wiring in a conduit.

3.5 LAN Wiring

.1 Provide LAN wiring as per manufacturer's specification.

.2 For EIA-485 LAN wiring, use low capacitance shielded #18-2 or #22-2 cable. Ensure that each contiguous section of shield is terminated at a single point.

3.6 Control System Commissioning

.1 Upon completion of the installation of the controls system and the calibration of all sensors, this Subcontractor shall carry out all required testing, debugging, and revision of operations to suit the intent of the Sequence of Operation and to the review of the Departmental Representative.

.2 The contractor is to supply digital point and non-digital checkout data sheets for all controlled components installed in this contract, including components supplied by others. The data sheets shall indicate each component's physical installation is complete, End to End, identification, tagged, the result of the functional test, calibration deviation recorded, setpoints and set-up of each device, digital and non-digital.

.3 Each digital input or control device shall be checked by physical operation of the monitored device in the field with the result noted. Each digital output or controlled device shall be commanded or tested On/Off, Open/Close as required and the corresponding field device checked for correct operation with the result and comments noted.

.4 Each analog input or control device shall have its field values measured with a calibrated test instrument, with the deviation recorded and adjusted, if necessary, at the AI set up. The field measurement and analog point deviation must be reported. A hard copy of the set up for each digital and non-digital controller with adjustments is required. Field set up and setpoints of other devices shall be reported.

.5 Each analog output, control or controlled device shall be field tested. The physical test data sheet is to indicate each controlled device function through its range 0, 25, 50, 75, 100% and 1 to 100% as required with no leakage or bypass of the controlled medium.

.6 Submit copies of all test data sheets intended to be used to the Departmental Representative and Commissioning Authority prior to the contractor's verification at least three months before the scheduled substantial completion of the project.

.7 The controls contractor shall provide sequence of operation check sheets, to the Departmental Representative, Commissioning Agent and Commissioning Authority, in standard letter size for each DDC and non DDC system sequence. Each sequence to be verified with each item/page signed off with comments noted.

.8 The commissioning contractor is not to commence controls checks until the above documentation is received. The Temperature Control Supplier and Installer shall loan a current copy of all control software/devices needed for full access to the control system, at no charge to the Commissioning Agent. The software/devices shall be returned to the Control Supplier in good working order at the completion of the commissioning process, or the Commissioning Agent must reimburse the Temperature Control Supplier for the purchase price of the material.

.9 All documentation, tagging, identification, as-builts, software, instruction manuals, special control connection to access all devices and panels must be in place before the granting of substantial performance.

.10 The Controls Contractor shall loan a current copy of all control software/devices needed for full access to the control system, at no charge to the Commissioning Agent. The software/devices shall be returned to the Controls Contractor in good working order at the completion of the commissioning process, or the Commissioning Agent must reimburse the Controls Contractor for the purchase price of the material. The Temperature Control Supplier shall cooperate fully with the Commissioning Agent to work together to obtain a fully operating system, providing additional technicians and trades people to assist the designated commissioning person as required. Refer to Section 01 91 00 – Commissioning.

.11 The controls contractor is to provide the technicians for field checks, calibration, checkouts, and commissioning necessary for a complete and fully operational system. Provide two 2-way portable radios for the commissioning period.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1 Section 01 01 50 General Instructions

.2 Section 25 05 01 EMCS: General Instructions

1.2 References

.1 Canadian Standards Association (CSA)

.1 C22.2 No.205, Signal Equipment.

.2 Institute of Electrical and Electronics Engineers

.1 IEEE C37.90.1, Surge Withstand Capabilities Test for Protective Relays and Relays Systems.

1.3 Maintenance Procedures

.1 Provide manufacturers recommended maintenance procedures for insertion in Section 01 01 50 – General Instructions and 25 05 01 – EMCS: General Instructions.

1.4 Submittals

.1 In accordance with Section 01 01 50 – General Instructions and 25 05 01 – EMCS: General Instructions. Submit product data sheets for each product item proposed for this project.

PART 2 PRODUCTS

2.1 System Descriptions

.1 Provide a fully networked system of controllers which use LAN communications to support the distributed control features as specified herein. Each controller shall be connected directly to the LAN. Each controller shall have equal LAN access priority and shall NOT REQUIRE A SEPARATE GATEWAY or interface controller to accomplish normal, network communications.

.2 Provide a means to ensure communication integrity. At a minimum indicate for each controller in system: on-line/off-line status, residence of program or no program, the scan rate (frequency at which the controller updates all I/O and runs all programs), the number of network points imported and exported.

.3 The system will display an error message, in the event of a communication error.

.4 To prevent damage to the system, each connection to the LAN shall be provided with a means of isolation, either optically or fast-blow fuse or by some other means.

.5 Upon failure of the LAN to communicate information, each controller will retain the last legitimate value of its imported network points and continue to control the systems based on those values. Failure of any controller, or any part of a controller on the LAN, shall not affect the ability of the LAN to communicate among the remaining controllers.

.6 Each hard point and soft point shall have a user-definable, unique, system-wide logical point mnemonic. The format of the point mnemonic shall conform to the naming convention of the incumbent system.

2.2 Memory

.1 Each controller shall have enough random access memory for all of the following:

.1 Variables - ONE (1) for each hard point connected to the controller.

.2 PID Controllers - TWO (2) for each analogue output point connected to the controller.

.3 Weekly Schedules - ONE (1) for every major system connected to the controller.

.4 Annual Schedule - ONE (1) for the entire LAN.

.5 Trend Logs - ONE (1) for each pair of hard points connected to the controller with 100 samples each.

.6 Runtime Logs - ONE (1) for each digital hard and soft point.

.7 Programs - ONE (1) for each output point connected to the controller. Each program must contain enough memory for TWENTY (20) syntactically correct lines of OCL with at least four operators.

2.3 Processing Speed

.1 Scan Rate - The maximum permissible scan rate is ONE (1) second. The scan rate is defined as the time it takes to controller CPU to sample all inputs, calculate all variables, update all timers and PID controllers, check all schedules, update all trend logs and runtime logs execute all OCL programs and assign values to all outputs.

.2 Provide a peer to peer high speed local area network (LAN) capable of supporting as many controllers as required to meet the minimum point capacity of the system as specified elsewhere. The network shall permit synchronization of all real time clocks, and the automatic transferring of the value of points from one controller. All BACnet MSTP system LANs shall operate at a communication speed in excess of 76K baud. Provide Bacnet Ethernet communication backbone operating at 10 mega baud. Provide a minimum of 1 [one] BACnet Building Controller [B- BC] for each main mechanical room Network communication/controllers shall be provided in sufficient numbers and memory configurations to meet the specified operational trending and system network access and performance requirements without utilizing the Host Computer.

2.4 Building Controllers

.1 Building Controllers shall reside on the main LAN or highest level of communication.

.2 The controller shall communicate on the main LAN using either Ethernet (IEEE.802.3) with TCP/IP and/or EIA-485.

.3 In addition to main LAN communications, the controller shall support EIA-485 subLANs, PC, modem and intelligent thermostat communications.

.4 The controller shall have at least one port (other than the PC port) which can be configured to BACnet conformance class 3 using EIA-232 point-to-point communications for interface to other BACnet products.

.5 The controller must be modular in design with removable I/O device terminations on separate I/O cards for ease of expansion and replacement.

.6 Controllers will accommodate a maximum of 160 universal I/O points on board using a single address.

.7 All I/O points must be universal (i.e. user definable as digital or analogue). Dedicated analogue/digital points will not be accepted.

.8 All outputs must have optional HOA on board for easy override by non DDC users.

2.5 Local Terminal Capability

.1 The Local Operator's P.C. shall have full access to the entire system including programming and shall interface at any primary or micro controller point in the system. Provide remote floor location connections so that all points are within 50m maximum of a terminal access point. The system shall be capable of supporting multiple local operator terminals. The operator's terminal shall be capable of performing the following functions:

- continuous display of labelled, system variables
- network wide, password controlled access
- setpoint and parameter adjustment
- setting and clearing of timed and permanent overrides
- acknowledging system alarms
- standalone controller program uploads, and downloads.
- viewing alarm and exception logs
- graphical and textual display of all physical points
- graphical and textual display of trended data
- dynamic system schematics
- full system programming revisions/changes including database modifications

2.6 Remote Operator Terminal Communication

.1 Provide a TCP/IP 100 MB Ethernet interface between the EMCS and the Site's Ethernet Network. Supply and install all necessary hardware and software necessary to provide operator interface from any remote building on the site. Final connection to Ethernet network will be by the Departmental Representative.

PART 3 EXECUTION

3.1 General

.1 The installation shall conform to each manufacturer's recommended procedures and to all applicable codes, statutes and ordinances.

.2 All equipment installed shall be mechanically stable and, as necessary, fixed to wall or floor. Anti-vibration mounts to be provided, if required, for the proper isolation of the equipment.

.3 Equipment shall be installed so as to allow for easy maintenance access. Equipment shall be installed such that it does not interfere in any way with access to adjacent equipment and personnel traffic in the surrounding space.

.4 Equipment shall be installed in locations providing adequate ambient conditions for its specified functioning, allowing for adequate ventilation.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1 Section 01 01 50 — General Instructions

.2 Section 25 05 01 — EMCS: General Instructions

1.2 References

.1 American National Standards Institute (ANSI)

.1 ANSI C12.7, Requirements for Watthour Meter Sockets.

.2 ANSI/IEEE C57.13, Requirements for Instrument Transformers.

.2 National Electrical Manufacturer's Association (NEMA)

1.3 Submittals

.1 Submit shop drawings and manufacturer's installation instructions in accordance with Section 01 01 50 – General Instructions and 25 05 01 – EMCS: General Instructions.

.2 Include:

.1 Information as specified for each device.

.2 Manufacturer's detailed installation instructions.

.3 Pre-Installation Tests

.1 Submit samples at random from equipment shipped, as requested by Departmental Representative, for testing before installation. Replace devices not meeting specified performance and accuracy.

.4 Manufacturer's Instructions

.1 Submit manufacturer's installation instructions for specified equipment and devices.

1.4 Closeout Submittals

.1 Submit operating and maintenance data for inclusion in operation and maintenance manual in accordance with Section 01 01 50 – General Instructions and 25 05 01 – EMCS: General Instructions.

PART 2 PRODUCTS

2.1 General

.1 Control devices of each category to be of same type and manufacturer.

.2 External trim materials to be corrosion resistant. Internal parts to be assembled in watertight, shockproof, vibration-proof, heat resistant assembly.

.3 Operating conditions: 0 - 32 °C with 10 - 90 % RH (non-condensing) unless otherwise specified.

.4 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.

.5 Transmitters to be unaffected by external transmitters (eg. walkie talkies).

.6 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.

.7 Outdoor installations: use weatherproof construction in NEMA 3R enclosures.

.8 Devices to be installed in user occupied space must not exceed Noise Criteria (NC) of 35. Noise generated by any device must not be detectable above space ambient conditions.

2.2 Averaging Duct Sensors

.1 Shall be installed in all mixed air ducts and/or plenums, discharge air ducts and/or plenums, or any duct and/or plenum where stratification occurs.

.2 Shall have a minimum length of 1.5 meters with a duct and/or plenum cross sectional area of .75 square meters or less, and a minimum length of 6 meters for duct and/or plenum cross sectional areas in excess of .75 square meters.

.3 The sensor shall have thermistor sensing elements with a scale range lookup table in the DDC producing a linear output over its sensing range.

.4 Accuracy: plus or minus 0.05℃ at 21℃.

.5 Minimum sensing range: -40℃ to 40℃.

2.3 Duct Temperature Sensors

.1 Shall be installed in all ducts and/or plenums where stratification of the air flow does not occur.

.2 Shall have thermistor sensing elements with a scale range lookup table in the DDC producing a linear output over its sensing range.

.3 Minimum length: 203mm.

.4 Accuracy: plus or minus 0.2% over its operating range.

.5 Minimum sensing range: 4.5° C to 60℃.

2.4 Outdoor Air Temperature Sensors:

.1 Shall have 10,000 Ohm thermistor sensing elements with a scale range lookup table in the DDC producing a linear output over its sensing range.

.2 Accuracy: plus or minus 0.05℃ at 21℃.

.3 Minimum sensing range: -40℃ to 40℃

.4 Shall be complete with sun shield

.5 Install at north side of building

2.5 Immersion Sensors

.1 Shall be complete with a brass immersion well.

.2 Shall have thermistor sensing elements with a scale range lookup table in the DDC producing a linear output over its sensing range.

.3 Accuracy: plus or minus 0.05℃ at 21℃.

.4 Minimum sensing range: -40℃ to 40℃.

2.6 Room Temperature Sensors

.1 Shall have a blind cover for all applications, unless noted otherwise. Provide a secured temperature sensor for public areas.

.2 Room temperature sensors for offices shall permit occupant control of set point within a pre-defined range which is software programmable. Sensor shall display set point temperature and ambient temperature upon demand by occupant and have 4 programmable function push buttons.

.3 Shall have a thermister sensing element producing a linear output over its sensing range.

.4 Accuracy: plus or minus 0.2% over its operating range.

.5 Minimum sensing range: 4.5℃ to 35℃.

2.7 Duct Humidity Sensors

.1 Shall be ultra fast response polymer capacitance sensor, not affected by condensation, fog, high humidity, or contaminants.

.2 Shall be suitable for 12-40 VDC/12-35 VAC unregulated supply voltage and 4-20 ma 2 wire output, or field selectable 0-5 VDC/0-10 VDC output.

.3 Shall have an accuracy of plus or minus 2%/3% and a range of 0-100% RH.

.4 Shall have ABS plastic wall mount complete with blank cover with a clear Lexan guard.

2.8 Differential Pressure Sensors (DPS)

.1 Shall vary the output voltage with changes in differential pressure.

.2 End to end accuracy: not less than +1% of span including non-linearity, repeatability and hysteresis.

.3 Application: building pressurization control shall have auto-zeroing feature.

2.9 Current Sensors (CT)

.1 Shall vary the output voltage with a change in current.

.2 Provide actual analog current indication for status of all motors 1 horsepower and larger.

.3 In software provide multiple switch points to determine both motor status and belt breakage. Size for inrush and F.L.A.

.4 Provide alarm indication for high and low current.

.5 Provide digital current indication for all motors 3/4 HP and smaller by using current switches (CS) which shall open or close a contact from motor induced current to indicate motor status.

2.10 Carbon Dioxide Sensor (CDS):

.1 Shall be non-dispersive, infrared type, duct mount or wall mount as required.

.2 Accuracy: 3% or 50ppm, whichever is greater over typical conditions of 0-50C and 0-95% RH non-condensing.

.3 Shall automatically calibrate to compensate for drift.

.4 Shall have a five year calibration guarantee.

.5 Shall not require any additional software/hardware for configuration or diagnosis.

2.11 Motion Detector (MD):

.1 Shall be utilizing microwave and PIR technology plus a micro controller, using adaptive threshold technology to provide false alarm immunity.

.2 Sensor shall have electronic temperature compensation and microwave pattern shaping to match the PIR pattern.

.3 Mounting location, model and number of detectors to be in accordance with manufacturer's recommendations.

2.12 Airflow Measuring Station:

.1 Thermal dispersion airflow measuring station. Bead-in-Glass thermistors, waterproof epoxy sensor, 304 stainless steel mounting, FEP plenum rated cable, microprocessor-based with high performance A/D converter

.2 Sensor airflow accuracy: 2%

.3 Airflow operating range: 0 to 5,000 FPM

.4 Temperature operating range: -20°F to 160°F

.5 Power supply: 24VAC

.6 Output: analog, RS-485 and Ethernet (BACnet Ethernet, TCP/IP).

2.13 Control Valves and Actuators

.1 Provide automatic temperature control valves as scheduled and indicated on drawings. Sufficient clearance above control valves shall be provided to allow removal of superstructure without removing body from line. All valve stems shall be vertical. All electric valves, including zone valves, scheduled for modulating service shall be fully proportional (no floating control) suitable for 0-10 volt, or 4-20 mA input signal.

.2 Control valves, both 2 and 3 way configuration, shall have the following minimum characteristics:

.1 Body shall be brass meeting ANSI Standard B16.15 Class 250 for all valves 50 mm and smaller. Larger valves shall be cast iron, Class 125, meeting ANSI Standard B16.15.

.2 Valve stem shall be 316 stainless steel.

.3 Valves shall have brass plug, composition seat with maximum seat leakage of 0.01% of flow rating per ANSI B16.104, and equal percentage flow characteristic.

.4 Valves for terminal zone coils, fan coils and radiation shall have EPT or TFE packing material and NPT, union or flare connections.

.5 Valves for primary equipment sized 50 mm and smaller shall have screwed connections. Valves sized 65 mm and larger shall have flanged connections.

.6 Ball Valves are not acceptable for control applications.

.3 When more than one control valve is used for temperature or pressure control on a system, or equipment item they shall be sequenced. e.g. two valves on a heating coil or pressure reducing station; heating and cooling coil valves on an air handling system.

.4 Valves on hazardous services shall fail to a safe position. e.g. Valves controlling heating to domestic hot water shall fail closed to heating when not powered.

.5 Actuators shall be of the rotary or piston type for either modulating or two position control. Actuators shall be powered by an overload-proof synchronous motor. Control voltage shall be either 120 VAC, 24 VAC, 10 VDC, or 4-20 mA with spring return on power failure, where required. (ie outdoor air dampers and HVAC primary heating valves). Actuators (motors) shall have repair kits available, and be re-buildable in the field. Provide proportional actuator position feedback on all primary equipment (air handling units) to prove actuator position.

.6 All control valves shall have replaceable bonnets, and packing. The packing shall be replaceable in the field without having to remove the valve from the piping network.

.7 All control valves shall be sized to deliver the specified flow rate in the 100% open position. Control valves using a "limited stroke" to achieve the proper flow coefficient shall not be used.

2.14 Dampers and Actuators

.1 All control dampers not furnished with packaged equipment shall include an end switch, be supplied by the controls subcontractor and installed by the sheet metal subcontractor. Provide damper actuators for all dampers shown or specified.

.2 All dampers in a mixing application shall be parallel blade with direction of closing producing opposed air streams for optimal mixing. Return air dampers shall be a tight closing, low leakage type with replaceable blade and edge seals.

.3 Actuators shall be electronic, direct coupled. Control voltage shall be 0-10 VDC, or 4-20 mA with an internal spring return on power failure. Provide a 2-10 VDC proportional actuator position feedback signal on all primary equipment (air handling units, relief air and emergency generators) to prove actuator position. Actuators shall permit manual positioning of damper when actuator is not powered.

PART 3 EXECUTION

3.1 General

.1 Check and verify location of thermostats and other exposed control sensors with plans and room details before installation. Locate thermostats and temperature sensors 1.5m above floor.

.2 Install damper motors on outside of ducts. Do not locate in outside air stream.

.3 The installation shall conform to each manufacturer's recommended procedures and to all applicable codes, statutes and ordinances.

.4 Equipment shall be installed so as to allow for easy maintenance access. Equipment shall be installed such that it does not interfere in any way with access to adjacent equipment and personnel traffic in the surrounding space.

.5 All transmitters, interfaces, terminations and control relays, etc. shall be mounted in field cabinets that may be locked.

.6 Freeze protection devices shall be hard wired and also wired to alarm through DDC system.

.7 All wall mounted devices in new finished space shall be mounted on a wall box. The wall box shall be connected to the ceiling space by a conduit stub. On renovations, when sensors are mounted in existing finished walls, wiring or tubing may be fished into the walls without conduit.

3.2 Sensors

.1 Sensors provided shall be installed in accordance with the Manufacturer's prescribed procedures.

.2 Sensors shall be rigidly mounted and mountings shall be adequate for the environment within which the sensor operates.

.3 Averaging type temperature sensors shall be used wherever mixed air or stratified temperature is to be monitored. They shall be installed in a serpentine configuration with adequate provision for the mechanical protection of the sensor and such that it is supported as required along its entire length.

.4 Duct type Thermistors shall be used for the monitoring of all uniform air temperature. Length shall be such that the sensing element is installed to not less than one third of the duct width or duct diameter from the duct wall.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1 Section 25 05 01 EMCS: General Instructions

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 Sequence of Operation

.1 Optimal Start Program

.1 An optimal start program shall control the morning start-up of all air handling units as well as operation of radiant ceiling panels and heating coils to reach the "occupied" temperature set point at the required time. The calculation shall compensate for outdoor air temperature, actual indoor air setback temperature, and warm up period required, based upon past performance. Under "heating" mode of control the start up shall be delayed as long as possible. Under "cooling" mode of control, the air handler unit shall start and run on 100% outdoor air when appropriate to pre-cool the building to setpoint temperature using free cooling. The outdoor air dampers (on air handling units, not on HRV's) are to remain closed during the morning warm up period until the return air temperature is 20°C.

.2 Low Temperature Protection:

.1 All air supply systems (HRV-1, HRV-2, FC-Z3) shall be fitted with a hard wired manual reset, adjustable setting, low limit thermostat which shall stop system fans when temperatures below set point, normally 4°C, are sensed. Monitor status of all low temperature thermostats.

.3 Service Chase Electric Heaters (EH):

.1 Electric heater shall be controlled with the integral manufacturer supplied thermostat, operating 24/7. Contractor shall adjust heater setpoint to 10˚C (adjustable).

.2 Monitor the respective Service Chase temperature. Alarm to DDC if space temperature is below alarm low temperature set point of 5˚C (adjustable).

.4 Kitchenette Exhaust Fan (EF-K1):

.3 Kitchenette exhaust fan shall operate per the operating schedule (adjustable) requested by the Departmental Representative.

.5 Radiation Panels (RP), Heating Coils (HC), Control Valves (CV), Pumps (P-M2C):

.1 Modulate the ceiling radiation panel's (RP) and heating coil's (HC) control valve (CV) to maintain the respective space temperature setpoint of 21˚C (adjustable) during the Daytime scheduled hours (adjustable) and 18˚C (adjustable) during the Nighttime scheduled hours (adjustable).

.2 Alarm to DDC if space temperature is below alarm low temperature set point of 15˚C (adjustable).

.3 If hydronic pump P-M2C-1 or P-M2C-2 is activated, then alarm to DDC if space temperature is above high temperature set point of 25˚C (adjustable). The intention is NOT to alarm when the hydronic system is not operating and space temperature is too warm (during the summer months).

.4 Pumps P-M2C-1 and P-M2C-2 shall operate in duty/standby mode, with only one (1) pump operating at any given time for a week's time before switching over to the other pump for a week's time. DDC shall modulate the operating speed of the duty pump to maintain the hydronic system differential pressure setpoint (adjustable). If the duty pump fails, alarm to DDC and activate the standby pump. The duty pump shall operate when the boiler plant is operating and there's a call for heat by any of the control valves served by these pumps.

.6 Heat Recovery Ventilators (HRV):

.1 Unit shall operate per the operating schedule (adjustable), typically 24/7. Upon command to operate, factory outdoor air damper actuator is powered open, exhaust fan starts (after adjustable delay), and supply fan starts (after adjustable delay).

.2 Unit shall shut down upon activation of the fire alarm.

.3 The supply fan is modulated by the factory VFD to maintain the duct static pressure setpoint (adjustable).

.4 The exhaust fan is modulated by the factory VFD to maintain the building pressure setpoint (adjustable).

.5 The unit will operate in economizer mode when the outdoor air temperature is between 10˚C and 18˚C (adjustable), by opening the bypass damper actuator so that cool air will bypass the energy recovery core.

.6 The electric preheater is enabled when the exhaust air temperature drops below 2˚C (adjustable setpoint), cycling on and off for 10 minute intervals, until the exhaust air temperature rises above the setpoint.

.7 Alarm to DDC if supply air temperature is below alarm low temperature set point of 5˚C (adjustable).

.8 Alarm to DDC and shut down supply fan if supply duct static pressure exceeds 75% (adjustable) of the maximum allowable system and design duct pressure rating.

.9 Alarm to DDC if either supply fan or exhaust fan airflow switches are not engaged when the unit is commanded to operate.

.10 Alarm to DDC if either the temperature or pressure sensors fail.

.11 Alarm to DDC if the pressure drop across the outdoor, exhaust or supply air filters exceed the trip point (adjustable).

.7 Fan Coil (FC-Z3), Control Valve (CV), Pump (P-15), Ventilation Fan (S-11):

.1 Fan coil and ventilation fan shall operate per the operating schedule (adjustable) requested by the Departmental Representative. Both the fan coil and ventilation fans shall shut down upon activation of any of the supply or return air duct smoke detectors, or the fire alarm.

.2 Modulate the heating coil (HC) control valve (CV) to maintain the coldest zone temperature setpoint of 21˚C (adjustable) during the Daytime scheduled hours (adjustable) and 18˚C (adjustable) during the Nighttime scheduled hours (adjustable).

.3 During the Nighttime scheduled hours, the supply and ventilation fans shall cycle on/off to maintain the setpoint. During the Daytime scheduled hours, the supply and ventilation fans shall operate continuously.

.4 The mixed air dampers shall modulate to maintain the mixed air temperature setpoint by modulating the outdoor dampers when the outdoor air temperature is below 18˚C. The mixed air temperature set point shall be reset by outdoor air and further trimmed by the associated warmest zone temperature. The mixed air temperature setpoint will be reset from 10˚C - 18˚C to maximize free cooling. The outdoor dampers shall be closed to minimum position when the outdoor air temperature is above 18˚C.

.5 Each zone temperature shall modulate its own zone damper.

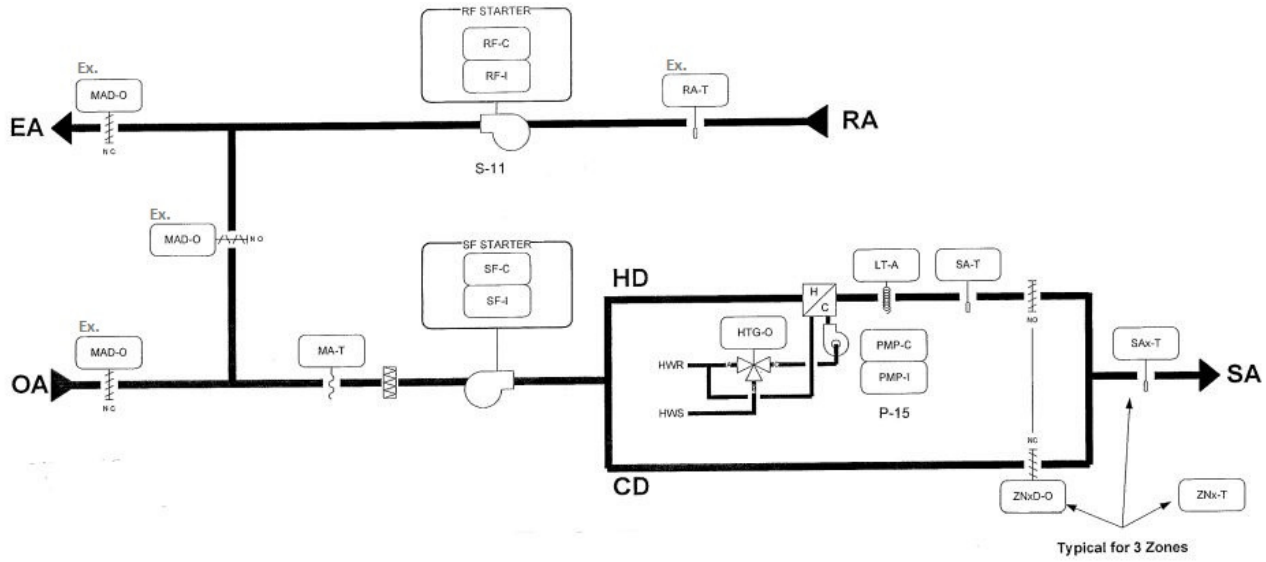
.6 Alarm to DDC if any zone temperature is below alarm low temperature set point of 15˚C (adjustable).

.7 If hydronic pump P-15 is activated, then alarm to DDC if any zone temperature is above high temperature set point of 25˚C (adjustable). The intention is NOT to alarm when the hydronic system is not operating and space temperature is too warm (during the summer months).

.8 Pump P-15 shall operate when any of the zones are scheduled to be occupied, and the coldest zone is calling for heat.

.9 Alarm to DDC if the pressure drop across the air filters exceed the trip point (adjustable).

.10 See the DDC Schematic below from the existing DDC Record drawings for fan coil FC-Z3 and ventilation fan S-11, including associated DDC controls.



3.2 Point List

.1 The following point lists are typical of the Analog and Digital output and input points required to achieve the intended sequence of operation and provide the required level of monitoring and control. They are intended to set a minimum level of acceptability. All additional points required to achieve the specified features and sequence of operation shall be provided by the control contractor.

.2

RADIANT PANEL AND SERVICE CHASE HEATING							
	POINTS				ALARM/INDICATION		
POINT DESCRIPTION	AI	AO	DI	DO	HI	LO	FAIL
OUTDOOR AIR TEMPERATURE	OTS						
CONTROL VALVE SERVING RADIANT PANELS (CV-1 TO 8)		VMA					X
SPACE TEMPERATURE SENSOR SERVING EACH CONTROL VALVE (TYP-8)	RTS				X	X	
SERVICE CHASE SPACE TEMPERATURE (TYP-14)	RTS					X	

.3 .

INDOOR AIR HANDLING UNIT (FC-Z3), VENTILATION FAN (S-11) & HYDRONIC PUMP (P-15)							
	POINTS				ALARM/INDICATION		
POINT DESCRIPTION	AI	AO	DI	DO	HI	LO	FAIL
FC-Z3 FAN (START/STOP/STAT)	CT			CR			X
S-11 FAN (START/STOP/STAT)	CT	ASD					X
RETURN, MIXED AIR AND SUPPLY DUCT TEMPERATURE SENSORS (EX. TO REMAIN)	DTS				X	X	
OUTDOOR, RETURN AND RELIEF AIR DAMPERS (EX. TO REMAIN)		DMA					X
LOW LIMIT FREEZE STAT			LTS			X	
FC-Z3 AIR FILTER STATUS	DPS				X		
MULTI-ZONE SUPPLY AIR HEADER DAMPERS (EX. TO REMAIN, TYP-3)		DMA					
PUMP P-15 SERVING FC-Z3 COIL (START/STOP/STAT)	CT			CR			X
CV-FCZ3 CONTROL VALVE		VMA					X
FC-Z3 COIL HWS/R TEMPERATURE SENSORS	WTS					X	
ZONE SPACE TEMPERATURE (EX. TO REMAIN, TYP-3)	RTS				X	X	
ZONE SUPPLY DUCT TEMPERATURE SENSOR (EX. TO REMAIN, TYP-3)	DTS				X	X	

.4 .

HEAT RECOVERY UNITS (HRV-1, HRV-2) & DUCT HEATING COILS (HC-1.E, HC-2.E, HC-2.W)							
	POINTS				ALARM/INDICATION		
POINT DESCRIPTION	AI	AO	DI	DO	HI	LO	FAIL
SPACE TEMPERATURE SENSOR SERVING EACH CONTROL VALVE (TYP-3)	RTS				X	X	
CV-HC*.* HEATING COIL CONTROL VALVE (TYP-3)		VMA					X

HEATING COIL SUPPLY DUCT SENSOR (TYP-3)	DTS				X	X	
SUPPLY AND EXHAUST FANS OF HRV (START/STOP/STAT)	CT	ASD					X
SUPPLY AND EXHAUST FILTER STATUS (TYP.2)	DPS				X		
HRV-1 AND HRV-2 BACNET POINTS	X	X	X	X			X
PUMPS P-M2C-1 & P-M2C-2	CT	VPM					X
HWS/R DIFFERENTIAL PRESSURE SENSOR SERVING PUMPS	DPS				X	X	

.5

VENTILATION FAN (EF-K1)							
	POINTS				**ALARM/INDICATION**		
POINT DESCRIPTION	**AI**	**AO**	**DI**	**DO**	**HI**	**LO**	**FAIL**
FAN (START/STOP/STAT)	CT			CR			X

NOTE: POINT COUNT IS APPROXIMATE. CONTROLS CONTRACTOR SHALL VERIFY EXACT QUANTITY AND PROVIDE ADDITIONAL POINTS AS REQUIRED TO ACHIEVE THE SEQUENCE OF OPERATION DESCRIBED IN THE CONTRACT DOCUMENT.

ATS	Averaging Temperature Sensor	DPS	Diff. Press. Switch (Analog)	OTS	Outdoor Air Temp. Sensor
ASD	Adjustable Speed Drive	DTS	Duct Temperature Sensor	POT	Potentiometer
CDS	Carbon Dioxide Sensor	R-ST	Relay Status	DHS	Duct Humidity Sensor
CS	Current Switch	ES	End Switch	RHS	Room Humidity Sensor
CR	Digital Relay	FSA	Flow sensor – Air	RTS	Room Temperature Sensor
CT	Analog Current Transformer	LTS	Low Temperature Switch	FSW	Flow sensor-Water
DCI	Dry Contact Input	MOP	Proportional A.O. (4-20 ma)	VMD	Valve Motor (Digital)
DHS	Duct Humidity Sensor	MD	Motion Detector	VPM	Variable pump
DMA	Damper Motor (Analog)	O-SW	Override Switch	WTS	Water Temperature Sensor
DMD	Damper Motor Digital			VMA	Valve Motor (Analog)

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS & SUMMARY

.1 The General Conditions, Supplements and Amendments shall govern this Section (read in conjunction with Instructions to Tenderers / Bidders). This section covers items common to all Electrical sections and is intended only to supplement the requirements of Section 01 01 50.

.2 Reference to “Electrical Divisions” shall mean all related Electrical Sections and components including Division 26 and 28 in the Master Format Specifications.

.3 Reference to “Mechanical Divisions” shall mean all related Mechanical Sections and components including Divisions 23 and 25 in the Master Format Specifications.

.4 The word "Provide" shall mean "Supply, Install and Connect" the products and services specified. "As Indicated" means that the item(s) specified are shown on the drawings.

.5 Provide materials, equipment and plant, of specified design, performance and quality; and, current models with published certified ratings for which replacement parts are readily available. Provide project management and on-site supervision to undertake administration, meet schedules, ensure timely performance, and ensure coordination, establishing orderly completion and the delivery of a fully commissioned installation.

.6 The most stringent requirements of this and other electrical sections shall govern.

.7 All work shall be in accordance with the CONTRACT Drawings and Specifications and their intents, complete with all necessary components, including those not normally shown or specified, but required for a complete installation.

.8 Provide seismic restraints for all required equipment, piping and ductwork.

.9 Connect to equipment specified in other Sections and to equipment supplied and installed by other Contractors or by the Departmental Representative. Uncrate equipment, move in place and install complete; start-up and test. Include all field assembly of loosely/separately packaged accessories.

1.2 REFERENCES

.1 Install in accordance with CSA C22.1-2018 except where specified otherwise.

.2 Comply with CSA Certification Standards, local Authorities Having Jurisdiction and Electrical Bulletins in force at time of tender submission.

.3 Comply with other applicable standards.

.4 Perform work in accordance with CSA Z462 - Workplace Electrical Safety and Worksafe BC.

1.3 DEFINITIONS

.1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

1.4 DESIGN REQUIREMENTS

.1 Operating voltages to CAN3-C235-83.

.2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

1.5 SCOPE OF WORK

.1 Contractor shall supply, install, commission and provide warranty for a complete and fully documented electrical system as per contract drawings and specified herein. The Work includes all hardware, and services necessary to provide fully functional, coordinated electrical system. Refer to Section 01 01 50 for hours of work.

.2 Coordinate with Mechanical Div. 25 for all the demolition and installation work. Ensure safety.

.3 All demolition works refer to mechanical. Electrical contractor is responsible for demolition of the electrical connections to the mechanical equipment. To identify the equipment contractor to review electrical drawing package in conjunction with the mechanical package.

.4 Scope of work

.1 Demolish Type A luminaires in corridors of first and second floors

.2 Supply and installation of Type L luminaires on first and second floors

.3 Supply and installation of Panel ‘EH’ and circuit breaker in CDP ‘M2d’ in mechanical room

.4 Supply and installation of service receptacles on roof

.5 Electrical installation of service chase heaters supplied by Mechanical. Supply and installation of disconnect switches for service chase heaters.

.6 Electrical installation of kitchen wall exhaust fan supplied by Mechanical. Supply and installation of magnetic starter and disconnect switch for kitchen wall exhaust fan.

.7 Electrical installation of HRV’s on roof.

.8 Demolish existing circuits for fan coil, fan and pump in mechanical room

.9 Electrical installation of new fan coil and fan in mechanical room. Supply and installation of disconnect switches for fan coil FC-Z3 and fan S-11.

.10 Electrical installation of three pumps in mechanical room. Supply and installation of disconnect switches for pumps P-M2C-1, P-M2C-2 and P-15.

.11 Relocate emergency light outside cell 05 on second floor

.12 Relocate luminaires in shower on main floor

.13 Re and re two luminaires in kitchen

.14 Relocate luminaires in cells 02, 03, 05A and 17 on second floor

.15 Relocate 3 interior (2 on main floor, 1 on second floor) and 2 exterior video cameras as shown on drawings. Re-locate junction boxes, conduits and extend conduits as required.

.16 Two new video cameras are to be installed on main floor. Provide new conduits and cables connecting to the existing system.

.17 All video camera work to be performed by certified contractors.

.18 Disconnect wires and remove five (5) smoke detectors. Re-install three (3) smoke detectors on active ducts of FC-Z3. Verify operation with fire alarm panel afterwards. See Mechanical Drawing M203, Note M203.4 and Section B.

.19 Relocate conduits and junction boxes as shown on drawings to make room for mechanical installation.

.5 Provide new cabling with new conduit in the bid document.

.6 Coordinate the exact location of the mechanical equipment with mechanical drawing package.

.7 Make sure no disturbance/hazard to existing equipment.

.8 Coordinate any outage in fire alarm systems with the Departmental Representative during construction. Provide a verification of the duct smoke detectors with the integrated system once it is commissioned with the new duct works.

.9 All drawings to be read in conjunction with mechanical drawings provided with the package and other disciplines drawings.

.10 Provide Quality Management (QM) services for the following:

.1 Project construction schedule

.2 Onsite testing and inspections of new and existing equipment

.3 Re-CSA certification of existing modified equipment

.4 Quality Management plan

.11 Component subsystems of the electrical system will include, but are not limited to the following:

.1 Connect exterior mechanical equipment via a system of interior surface mounted conduit. Equipment shall be connected to new panel in existing electrical distribution system.

.2 Connect interior mechanical equipment via surface mounted conduit. Equipment shall be connected to new panel in existing electrical distribution system.

.3 Provide all required motor starters, associated control wiring and local disconnect switches.

.12 Provide grounding/bonding equipment as per CEC or as indicated in the contract drawings and specifications.

.13 Provide fire stopping as required.

.14 Perform commissioning in accordance with Section 01 01 50.

.15 As-built drawings and maintenance manuals.

.16 Seismic restraint for all electrical equipment and installations. See Section 26 05 25.

1.6 SUBMITTALS

.1 Submittals to be in accordance with Section 01 01 50.

.2 Submit shop drawings, product data and samples in accordance with Section 01 01 50. The submission shall be reviewed, signed and processed as described in Section 01 01 50.

.3 Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.

.4 Where applicable, include wiring, line and schematic diagrams. Include wiring drawings or diagrams showing interconnection with work of other Sections.

.5 Content

.1 Shop drawings submitted in accordance with Section 01 01 50.
.2 Data shall be specific and technical.
.3 Identify each piece of equipment.
.4 Identify the electrical rating for each equipment.
.5 Information shall include all scheduled data.
.6 Indicate the exact proposed model number for certain equipment.
.7 Advertising literature will be rejected.
.8 The project and equipment designations shall be identified on each document.
.9 Information shall be given in S.I. units
.10 The shop drawings/product data shall include:

.1 Dimensioned construction drawings with plans and sections showing size, arrangement and necessary clearances, with all equipment weight and mounting point loads.
.2 Mounting arrangements.
.3 Detailed drawings of bases, supports and anchor bolts.
.4 Control explanation and internal wiring diagrams for packaged equipment.
.5 A written description of control sequences relating to the schematic diagrams.

.6 Format

.1 Electronic copy (PDF format).
.2 Bill of Quantities for related components, identified by model number, listed on the front cover with item identification numbers.

.7 Coordination

.1 Where electrical equipment requires support or backing by other trades or mechanical connections, the shop drawings shall also be circulated through the other "services" contractor(s) prior to submission to the Departmental Representative.

.8 Keep one copy of shop drawings and product data, on site, available for reference.

.9 Quality Control: in accordance with Section 01 01 50

.1 Provide CSA certified equipment and material. Where CSA certified equipment and/or material is not available, submit such equipment and/or material to the authority having jurisdiction for special approval before delivery to site.

.2 Submit test results of installed electrical systems and instrumentation.

.3 Submit, upon completion of Work, the electrical “load balance” report.

.10 Permits and Fees:

.1 Submit to Electrical Inspection Department, Local Fire Authorities and Supply Authority the necessary number of drawings and specifications for examination and approval prior to commencement of work. Obtain all required permits and pay all fees.

.2 Arrange for inspection of all Work by the authorities having jurisdiction. On completion of the Work, furnish final unconditional certificates of approval by the inspecting authorities.

1.7 QUALITY ASSURANCE

.1 Quality Assurance in accordance with Section 01 01 50.

.2 Qualifications: Electrical Work to be carried out by qualified, licensed electricians in accordance with authorities having jurisdiction.

.1 Employees registered in apprentices program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.

.2 Permitted activities: Determined based on training level attained and demonstration of ability to perform specific duties.

.3 Site Meetings in accordance with Section 01 01 50.

.4 Health and Safety Requirements in accordance with Section 01 01 50.

1.8 DELIVERY, STORAGE AND HANDLING

.1 Material Delivery Schedule: provide Departmental Representative with schedule within 4 weeks after award of Contract.

.2 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and/or recycling in accordance with Section 01 01 50.

1.9 SYSTEM START-UP

.1 Refer to Section 01 01 50.

.2 Instruct the Departmental Representative and operating personnel in the operation, care and maintenance of equipment.

.3 Arrange and pay for services of manufacturer's factory service Engineer to supervise start-up of installation, check, adjust, balance and calibrate components.

.4 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

1.10 OPERATING INSTRUCTIONS

.1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.

.2 Operating instructions to include following:

.1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

.2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.

.3 Safety precautions.

.4 Procedures to be followed in event of equipment failure.

.5 Other items of instruction as recommended by manufacturer of each system or item of equipment.

.3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.

.4 Post instructions where directed.

.5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.

.6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

1.11 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 01 50.

.2 Avoid using landfill waste disposal procedures when recycling facilities are available.

.3 Place materials defined as hazardous or toxic waste in designated containers.

1.12 DRAWINGS AND MEASUREMENTS

.1 Drawings are generally diagrammatic and are intended to indicate the scope and general arrangement of work and are not detailed installation drawings. Do not scale the drawings. Obtain accurate dimensions from the Architectural and Structural drawings.

.2 Consult the architectural drawings and details for exact locations of fixtures and equipment. Obtain this information from the Departmental Representative where definite locations are not indicated.

.3 Take field measurements, where equipment and material dimensions are dependent upon building dimensions.

1.13 PROJECT COORDINATION

.1 Check drawings of all trades to verify space and headroom limitations for work to be installed. Coordinate work with all trades and make changes to facilitate a satisfactory installation. Make no deviations to the design intent involving extra cost without the Departmental Representative's written approval.

.2 The drawings indicate the general location and route to be followed by the electrical services. Where details are not shown on the drawings or only shown diagrammatically, the services shall be installed in such a way as to conserve head room and interfere as little as possible with the free use of space through which they pass. Service lines shall run parallel to building lines. All services in the ceiling shall be kept as tight as possible to beams or other limiting members at high level. All electrical services shall be coordinated in elevation to ensure that they are concealed in the ceiling or structural space provided unless detailed otherwise on drawings.

.3 Work out jointly all interference problems on the site and coordinate all work before fabricating, or installing any material or equipment. Where necessary, produce interference/coordination drawings showing exact locations of electrical systems or equipment within service areas, shafts and the ceiling space. Distribute copies of the final interference/coordination drawings to the Departmental Representative and all affected parties.

.4 Contractor to read the drawings in conjunction with existing reference drawings and specifications to understand the intent of the work. Notify Departmental Representative if there is any discrepancies. No extra cost will be considered for any misunderstanding of work to be done.

.5 Ensure that all materials and equipment fit into the allotted spaces and that all equipment can be properly serviced and replaced, if and when required. Advise the Departmental Representative of space problems before installing any material or equipment. Demonstrate to the Departmental Representative on completion of the work that all equipment installed can be properly, safely serviced and replaced, if and when required.

1.14 SPRINKLER PROOF REQUIREMENTS

.1 In sprinklered rooms where electrical equipment is installed surface mounted, electrical equipment contained in these rooms to be protected by non-combustible driphoods, shields, and gasketed doors as applicable to inhibit water ingress into electrical equipment. Exposed conduits connected to equipment to utilize watertight connectors.

1.15 EQUIPMENT RESTRAINT

.1 Related Section: 26 05 25 Seismic Restraint.

.2 It is the entire responsibility of equipment manufacturers to design their equipment so that the strength and anchorage of internal components of the equipment exceeds the force level used to restrain and anchor the unit itself to the supporting structure.

1.16 WARRANTY

.1 Use of installed equipment during construction shall not shorten or alter the warranty period as specified in the Section 01 01 50.

.2 Take note of any extended warranties specified.

.3 Furnish a written warranty stating that all work executed under this Division will be free from defects of material and workmanship for a period of one year from the date of substantial performance.

.4 Promptly investigate any electrical or control malfunction, and repair or replace all such defective work and all other damages thereby which becomes defective during the time of the warranty.

1.17 EXAMINATION

.1 A site visit before the close of tender to be communicated with the Departmental Representative. No extra cost will be considered for any misunderstanding of work to be done.

.2 Examine the documents for details of work included. Obtain a written clarification in the event of conflict within the specification, between the specifications and the drawings, or in the drawings. Obtain written clarification from the Departmental Representative if work affecting the installation is not clear. Where this is not done in advance, allow in the tender sum for providing the more costly alternative.

1.18 RESPONSIBILITIES

.1 Ensure that equipment does not transmit noise and/or vibration to other parts of the building, as a result of poor installation practice.

.2 The Drawings and Specifications complement each other and what is called for by one is binding as if called for by both. If there is any doubt as to the meaning or true intent due to a discrepancy between the Drawings and Specifications, obtain a ruling from the Departmental Representative **prior** to Tender closing. Failing this, the most expensive alternative is to be allowed for.

.3 The Contractor shall advise the Departmental Representative during the Tender period of any specified material or equipment which is either no longer available from manufacturers or whose delivery is likely to exceed the requirements of the anticipated Construction Schedule. Failure of the Contractor to perform the above shall cause the Contractor to supply, at his own expense, alternate material or equipment as selected by the Departmental Representative at a later date. Alternatively, the Contractor shall procure the specified material or equipment at his own additional expense by means of air freight or other special means of transportation.

.4 Advise the Departmental Representative of any specified equipment, material, or installation of same which appears inadequate or unsuitable or which is in violation of laws, ordinances, rules, or regulations of authorities having jurisdiction. Provide all labour and materials which are obviously necessary or reasonably implied to be necessary to complete the work as if the work was shown on the Drawings and/or described in the Specifications.

.5 Check Drawings of all trades and coordinate the installation of all material and equipment to ensure adequate space and free access and to maintain headroom limitations for all new and indicated future work. Work out jointly, with all Subcontractors on the site, solutions to interference problems. Coordinate all work before fabricating or installing any

material or equipment. It is incumbent on all Subcontractors on the site to ensure that all materials and equipment fit into the allocated spaces and that all equipment can be properly inspected, serviced and replaced if and when required. Advise the Departmental Representative of space problems before fabricating or installing any material or equipment. Demonstrate to the Departmental Representative on completion of his work that all equipment and material installed by him can be properly and safely serviced and replaced. Make no deviations from the intent of the design, or any involving additional cost, without the Departmental Representative's written direction.

.6 Where electrical work and materials are noted as being provided by the Departmental Representative or under other Divisions of these Specifications, the responsibility for integrating, to the extent required, such work and materials into the complete installation, shall remain within Division 26.

.7 Protect equipment and material from the weather, moisture, dust and physical damage.

.8 Cover equipment openings and open ends of conduit, piping and pullboxes as work progresses. Failure to do so will result in the Trade being required to adequately clean or replace materials and equipment at no extra cost to the Departmental Representative.

.9 Protect all existing services encountered. Obtain instructions from the Departmental Representative when existing services require relocation or modification.

.10 Refinish damaged or marred factory finish to factory finish.

.11 The specifications and drawings form an integral part of the Contract Documents. Neither the drawings nor the specifications shall be used alone. Work omitted from the drawings but mentioned or reasonably implied in the specifications, vice versa, shall be considered as properly and sufficiently specified and shall be provided. Misinterpretation of any requirement of either plans or specifications shall not relieve this Contractor of the responsibility of properly completing his trade to the approval of the Departmental Representative.

1.19 EQUIPMENT LIST

.1 Submit a completed Equipment List, showing the make of equipment and material included in the Tender, including the names of the subtrades, 10 days after the award of the Contract.

.2 The equipment list shall be a full list of materials or systems intended for installation.

1.20 PROGRESS CLAIM AND CHANGE ORDER BREAKDOWNS

.1 Ten days after the award of contract, submit detailed progress claim breakdown for each division. Items to be included but shall not be necessarily limited to the following:

.1 Site services
.2 Distribution
.3 Feeders
.4 Cable tray
.5 Branch circuit wiring, conduit and boxes

.6 Wiring devices
.7 Lighting
.8 Mechanical equipment and wiring
.9 Low tension
.10 Testing and commissioning
.11 As-built drawings and maintenance manuals
.12 Mobilization; not to exceed 2% of the contract value

.2 Change order breakdowns shall include but not be necessarily limited to the following:

.1 Labour hours per unit of material or equipment to be added, deleted or altered
.2 Units of material or equipment to be added or deleted.
.3 Per unit cost of material, equipment and labour broken down by category of labour and type of material or equipment
.4 Extensions of the above to arrive at total costs
.5 Miscellaneous and identifiable charges such as re-stocking, overhead, profit, etc

1.21 PROJECT CLOSE-OUT REQUIREMENTS

.1 Refer to Section 01 01 50.

.2 Refer to detailed specifications in each section for detailed requirements. Provide the following list of required substantial completion submissions.

.1 Fire alarm system verification report.
.2 Seismic engineer report and schedules.
.3 Final electrical inspector certificate.
.4 Drafted as-built drawings.
.5 Operating and maintenance manual.
.6 Contractors letter of guarantee.
.7 Complete Demonstration of systems to Departmental Representative.

.3 Record drawings to be submitted to the Departmental Representative and all life safety systems must be operational, verified and tested and demonstrated to Departmental Representative prior to issuance of Schedule C.

1.22 SUBSTANTIAL PERFORMANCE REQUIREMENTS

.1 Before the Departmental Representative is requested to make an inspection for substantial performance of the work:

.1 Commission all systems and prove out all components, interlocks and safety devices.
.2 Submit a letter certifying that all work is complete for the intended use, operational, clean and all required submissions have been completed.
.3 A complete list of incomplete or deficient items shall be provided by the Contractor. If, in the opinion of the Departmental Representative, this list indicates the project is excessively incomplete, a substantial completion inspection will not be performed.

.2 The work will not be considered to be ready for use or substantially complete until the following requirements have been met:

.1 All reported deficiencies have been corrected.

.2 Operating and Maintenance Manuals completed.

.3 "As Built" Record Drawing ready for review.

.4 Systems Commissioning has been completed and has been verified by Departmental Representative.

.5 All demonstrations to the Departmental Representative have been completed.

.6 All documents required have been submitted.

.3 Letters of Assurance will not be issued until the following requirements have been met:

.1 All items listed in 1.22 above have been completed or addressed.

.2 Certificate of penetrations through separations have been sealed and labelled with certified fire stopping material.

.3 Provincial Electrical Inspection - Certificate of inspection.

.4 Seismic Engineers letter of Assurance and final inspection report.

.5 Certificate of Substantial Performance.

.6 Fire alarm system verification report.

1.23 POWER INTERRUPTIONS

.1 Contractor shall work closely with Institutional personnel to arrange all interruptions of any portion of the existing electrical distribution systems.

.2 All interruptions to existing electrical distribution systems and shutdown of existing Panel boards in the contract shall be carried out in coordination with the Institution. Normal working hours of the Institution are considered to be 0730 to 1600 hours, Monday through Friday, except holidays.

.3 Contractor shall submit request for any power shutdown 3 working days prior to such power shutdown. Request shall indicate start time of interruption and duration of interruption. Indicate in request exactly what buildings and/or systems will be affected by the requested power shutdown.

.4 No interruptions to power shall be carried out without the approval of the Departmental Representative.

Part 2 PRODUCTS

2.1 SUSTAINABLE REQUIREMENTS

.1 Materials and products in accordance with Section 01 01 50.

.2 Do verification requirements in accordance with Section 01 01 50.

2.2 MATERIALS AND EQUIPMENT

.1 Provide materials and equipment in accordance with Section 01 01 50 and as follows.

.2 Material and equipment to be CSA certified. Where CSA certified material or equipment is not available, obtain special approval from authority having jurisdiction before delivery to site and submit such approval.

.3 Where equipment or materials are specified by technical description only, they are to be of the best commercial quality available for the intended purpose.

.4 Factory assemble control panels and component assemblies.

2.3 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

.1 Provide all power and electrical system related control wiring, conduit, wire, fittings, disconnect switches, motor starters, for all mechanical equipment unless otherwise specified.

.2 Ground all motors to conduit system with separate grounding conductor in flexible conduit or bonding conductor in the flexible conduit.

.3 Connections shall be made with watertight flexible conduit with watertight connectors.

.4 Control wiring and conduit standards are specified in the Electrical Divisions. Refer to Mechanical Divisions for scope of work and particular details.

2.4 WARNING SIGNS

.1 Provide warning signs, as specified or to meet requirements of Inspection Department and Departmental Representative.

.2 Use decal signs, minimum 175 x 250 mm size.

2.5 WIRING TERMINATIONS

.1 Lugs, terminals, screws used for termination of wiring to be suitable for copper conductors.

2.6 EQUIPMENT IDENTIFICATION

.1 Identify all electrical equipment including but not limited to starters, disconnects, remote ballasts and controls with nameplates and labels as follows:

.2 Nameplates:

.1 Electrical Equipment:

COMPONENT	LABEL TYPE	INFORMATION
Main distribution centre	A	Year installed and name of facility Name of Electrical Engineer and Electrical Contractor
Main Breaker	A	Voltage, phase, amps
Sub-distribution panel	A	Name of panels it is feeding (i.e. Panel A, Panel B)

Panelboards	B	Panel designation (i.e. Panel A, Panel B)
Terminal Cabinet	B	System and Voltage
Disconnect switches	B	Indicate equipment controlled and voltage
Starters/contactors	B	Indicate equipment controlled and voltage
Motor control centre	B	Indicate equipment controlled and voltage
Transformer	B	Transformer designation Circuit and Panel designation
Junction boxes, pull boxes	D	Circuit and panel designation
On/Off switches	C	If it is not obvious, then indicate area being served
Fire Alarm Devices (i.e. pull stations, bell, smoke detector, end-of –line)	C	Zone number and device number in that zone (i.e. Zone 1-#3, Zone 10-#7)
Receptacles	C	Circuit/panel designation
Special receptacles	C	Circuit/panel designation and voltage, phase, amps

.2 Label Type:

	LETTER HEIGHT	**TYPE**	**COLOUR**
Label Type A	9.5 mm	Lamacoid	White lettering/black background
Label Type B	6.0 mm	Lamacoid	White lettering/black background
Label Type C	3.0 mm	Lamacoid	White lettering/black background
Label Type D	3.0 mm	Adhesive label	As specified

.3 Adhesive Labels:

.1 Good quality vinyl, self-laminating label as T & B E-Z Code WSL, Dymo Letratag or Brother P-Touch equivalent printable markers. Embossed Dymo or any labels with edges and corners that are prone to lift will be rejected.

.4 Provide plastic covered typewritten panel directory with circuits and areas served and mounted on inside of door. Directory shall conform to Record Drawings.

2.7 WIRING IDENTIFICATION

.1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour code to CSA C22.1-2018.

.4 Use colour coded wires in communication cables, matched throughout system.

2.8 CONDUIT, CABLE AND PULLBOX IDENTIFICATION

.1 All junction boxes, pull boxes and their covers shall be painted according to the colour coding schedule.

.2 Code with 25 mm plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor and at 15 m intervals.

.3 Colour coding to be as follows unless otherwise specified:

COMPONENT	RACEWAY AND JUNCTION BOXES	RECEPTACLES AND OTHER
Normal 120/208, 240 volt	Gray	White
Normal 347/600 volt	Sand	White
Emergency 120/208, 240 volt	Green with red bands	Red
Emergency 347/600 volt	Sand with red bands	n/a
Fire Alarm	Red	Strobe (red)
Low voltage		
-switching/controls	Black	
-emergency/exit lighting	Black with red bands	
-security	Black with blue bands	Strobe (blue)
-mechanical alarms	Black with yellow bands	Strobe (amber)

2.9 FINISHES

.1 Shop finish metal enclosure surfaces by removal of rust and scale, cleaning, application of rust resistant primer inside and outside and at least two coats of finish enamel.

.2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original finish.

.3 Clean and prime paint exposed hangers, racks, fastenings to prevent rusting. Finish painting shall be provided by Division 09.

2.10 FASTENING TO BUILDING STRUCTURE

.1 General:

.1 Do not use inserts in base material with a compressive strength less than 13.79 MPa (2000 psi).

.2 All inserts supporting conduit racks shall have a factor of safety of 5. All other inserts shall have a factor of safety of 4.

.2 Types:

.1 Cast-in-place type:

.1 Channel type - Burndy, Canadian Strut, Unistrut, Cantruss or Hilti Channel.

.2 Wedge type galvanized steel concrete insert, Grinnell Fig. 281 for up to 200 mm (8") pipe size.

.3 Universal type malleable iron body insert, Grinnell Fig. 282 for up to 200 mm (8") pipe size.

.2 Drilled, mechanical expansion type:

.1 Hilti HSL or UCAN LHL heavy duty anchor for use in concrete with compressive strength not less than 19.6 MPa (2840 psi).

.2 Hilti Kwik-Bolt or UCAN WED stud anchor for concrete. (Do not use in seismic restraint applications).

.3 Hilti HDI or UCAN IPA drop-in anchor for concrete.

.4 Hilti or UCAN Sleeve Anchor (medium and light duty) for concrete and masonry.

.5 Hilti ZBP or UCAN Zamac pin bolt (light duty) for concrete and masonry.

.3 Drilled, adhesive type:

.1 Hilti HVA or UCAN Adhesive Anchor consisting of anchor rod assembly with a capsule containing a two-component adhesive, resin and hardener.

.2 Hilti HY150 consisting of anchor rod with a 2 part adhesive system.

.3 For use in concrete housekeeping bases (in vertical downward position) where the distance to the edge of the concrete base could cause weakness if a mechanical expansion type anchor were used.

.4 Rod assemblies shall extend a minimum of 50 mm (2") into the concrete slab below the housekeeping bases.

.3 Note:

.1 All drilling for inserts shall be performed using the appropriate tool specifically designed for the particular insert. The diameter and depth of each drilled hole shall be to the exact dimensions as specified by the insert manufacturer.

.2 Refer to manufacturer's recommendations for tightening torques to be applied to inserts.

.3 Where specifically called for, drills shall include a dust vacuum system, Hilti SAV Dust Vacuum System.

2.11 EQUIPMENT SUPPORTS

.1 Provide stands and supports for equipment and materials supplied.

.2 Lay out concrete bases and curbs required under Electrical Divisions. Coordinate with Concrete Divisions.

.3 Concrete bases shall be a minimum of 100 mm thick, or as noted and shall project at least 150 mm outside the equipment base, unless otherwise directed. Bases and curbs shall be keyed to the floor and incorporate reinforcing bars and/or steel mesh. Chamfer edges of bases at 45 degrees.

.4 Equipment with bedplates shall have metal wedges placed under the edges of the bedplates to raise them 25mm above the base after levelling. The wedges shall be left permanently in place. Fill the space between the bedplate and the base with non-shrink grout - Embeco or In-Pakt.

.5 Construct equipment supports of structural steel. Securely brace. Employ only welded construction. Bolt mounting plates to the structure.

.6 Support ceiling hung equipment with rod hangers and/or structural steel.

2.12 MISCELLANEOUS METAL

.1 Be responsible for all miscellaneous steel work relative to Electrical Divisions of the Specifications, including but not limited to:

.1 Support of equipment.

.2 Hanging, support, anchoring, guiding and relative work as it applies to wiring raceways and electrical equipment.

.3 Earthquake restraint devices - refer also to “Seismic Restraint” sections

.4 Bridle rings - secure to structure or steel supports.

.2 All steel work shall be primed and undercoat painted ready for finish under the related Division.

2.13 OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data for incorporation into maintenance manual specified in Section 01 01 50 and as follows.

.2 Include in operations and maintenance data:

.1 Details of design elements, construction features, component function and maintenance requirements, to permit effective operation, maintenance, repair, modification, extension and expansion of any portion or feature of installation.

.2 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items, and parts lists. Advertising or sales literature not acceptable.

.3 Wiring and schematic diagrams.

.4 Names and addresses of local suppliers for items included in maintenance manuals.

.3 Include in the manual the following major sections:

.1 Title page (in plastic cover).

.2 Comprehensive description of the operation of the systems, including the function of each item of equipment within the system.

.3 Detailed instructions for the normal maintenance of all systems and equipment installed including procedures and frequency of operational checks and service and trouble shooting instructions.

.4 Local source of supply for each item of equipment.

.5 Wiring and control diagrams.

.6 Spare parts list.

.7 Copies of guarantees and certificates.

.8 Manufacturer's maintenance brochures and shop drawings.

.9 Test and inspection reports.

.4 Submit a draft copy to the Departmental Representative for approval thirty days prior to start up of the systems and equipment.

2.14 PROJECT RECORD DRAWINGS

.1 Refer to Section 01 01 50.

.2 During the construction period, maintain on Site a clean set of drawings and specifications marked up clearly and indelibly in red, indicating "As-Built" conditions where such conditions deviate from the original directions of the Contract Documents and indicating final installation of feeders and branch circuits.

.3 “As-Built” drawing markings shall include but shall not be limited to the following:

.1 All changes in circuiting.

.2 Size and routing of all conduits for all branch circuits including power, lighting and systems. Note that branch circuit wiring is generally not shown on Drawings. Accurately record “As-Built” drawings the size and routing of all installed raceways and cables.

.3 Number and size of conductors (#10 AWG and larger) in raceways and cables.

.4 Location of all junction boxes and pullboxes.

.5 Location of all conduits or duct stubs, installed equipment, devices and fixtures.

.6 All changes to electrical installation resulting from Addenda, Change Orders and Field Instructions.

.7 Exact location of all services left for future work.

.8 Location by accurate horizontal and vertical dimensions of the routes and terminations of all raceways and cables installed underground beyond the building.

Part 3 EXECUTION

3.1 INSTALLATION

.1 Do complete installation in accordance with CSA C22.1 2018 except where specified otherwise.

.2 Do overhead and underground systems in accordance with CSA C22.3 No.1 except where specified otherwise.

.3 Comply with CSA Electrical Bulletins and Local Authorities having jurisdiction.

3.2 NAMEPLATES AND LABELS

.1 Ensure manufacturers nameplates and CSA labels are visible and legible after equipment is installed.

3.3 CONDUIT AND CABLE INSTALLATION

.1 Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete: schedule 40 steel pipe, sized for free passage of conduit and protruding 50 mm.

.2 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.

.3 Install weatherproof service entrance caps where conduit and cables penetrate roofs. Apply sealant after installation.

.4 All cables and conduits shall be concealed in finished areas.

3.4 LOCATION OF OUTLETS

.1 Coordinate outlet locations with Architectural Drawings.

.2 Do not install outlets back-to-back or in the same stud space in wall; allow minimum 400mm 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 unless otherwise indicated.

.5 Locate disconnect devices in mechanical and elevator machine rooms on latch side of doors.

3.5 MOUNTING HEIGHTS

.1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.

.2 If mounting height of equipment is not indicated verify before proceeding with installation. Confirm the height of devices in handicapped facilities before installation.

.3 Refer to detail on architectural drawings.

.4 In the absence of a drawing detail or drawing note, use the following:

Device	Height		Comment
Local switches	1200	48”	
Wall receptacles/data	400	12”	General
Wall receptacles/data	175	7”	Above top of counters or counter splash backs – coordinate with Architectural detail
Wall receptacles/data	1400	56”	In mechanical rooms
Panelboards			Panelboards: as required by Code or as indicated.
Wall mounted telephone	1500	60”	
Fire alarm stations	1200	48”	As required by ULC S524.
Fire alarm bells/audio/visual	2300	90”	ULC S524 requires not less than 1800mm. In any event not closer than 50mm to the ceiling
End of line resistors	1800	72”	
Television outlets			As receptacles –coordinate with equipment location
Wall mounted speakers & clocks	2100	84”	Coordinate with equipment location
Door bell pushbuttons	1200	48”	Coordinate with location
Emergency Lighting (wall mounted)			150mm below ceiling or 2300mm max.

.5 Confirm mounting height with Departmental Representative prior to rough-in.

3.6 DELIVERY AND STORAGE

.1 Store all electrical equipment and devices other than conduits, fittings, boxes, and ducts in a heated and ventilated space, and protect from construction damage. Include in the tender price all costs related to such storage.

.2 Conduits, fittings, boxes, and ducts may be stored outside if properly protected against the weather.

.3 Ship and store floor mounted equipment in upright position.

.4 Ship equipment in adequate containers to assure it arrives undamaged at the site.

.5 Keep equipment doors locked. Protect equipment from damage and dust.

.6 Block moving parts when necessary to prevent damage during movement and shipment of equipment.

.7 Remove from the site, and replace with new, all materials showing evidence of damage or rust.

3.7 CO-ORDINATION OF PROTECTIVE DEVICES

.1 Coordinate and pay for all tests specified herein including further tests as required by authorities having jurisdiction.

.2 All testing shall be performed after each system installation has been completed. Prior to commissioning, all motors, MCCs, transformers and switchgear shall be meggered for insulation integrity and the results recorded prior to the systems being put into operation.

.3 Perform the testing, adjusting, and balancing only when conditions are commensurate with actual operating conditions for the given system.

.4 Advise the Departmental Representative 48 hours in advance of each test. Carry out tests in the presence of Departmental Representative.

.5 Submit detailed printed, dated and signed test reports in duplicate to the Departmental Representative within 7 days after the completion of each test. Include all test reports in the Maintenance Manuals. Each test shall clearly indicated, in a line-by-line format, that the components (not as a group) have been tested, test results, and whether test results are within acceptable limits. Each test report shall be accompanied by a front cover sheet briefly outlining what the test report is for and clearly summarizing all items that have failed the tests. The cover sheet shall indicate names of individuals who conducted the tests and their signatures.

3.8 FIELD QUALITY CONTROL

.1 Load and Balance:

.1 Measure voltage and phase & neutral currents to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.

.2 Conduct and pay for the following tests:

.1 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.

.2 Systems: fire alarm system, communications systems.

.3 Main ground resistance (at all grounding locations).

.3 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

.4 Reports:

.1 Provide written reports in a timely manner upon completion of the testing and load balance. Indicate test hour and date.

3.9 DEMONSTRATION

.1 Demonstrate to and instruct the Departmental Representative on operating and maintenance procedures for all electrical systems using the assistance of specialist sub-trades and manufacturer's representatives for instruction and include all costs in the tender. Systems to be demonstrated shall include, but not be limited to, the following:

.1 Routing and installation of major feeders, duct banks and manholes, grounding and cable trays.

.2 Arrange an acceptable time with the Departmental Representative and submit a program of instruction and demonstration for the Departmental Representative's approval. Assume that the Departmental Representative is not familiar with any of the special equipment and/or systems installed.

.3 Submit to the Departmental Representative, at the time of Substantial Performance inspection, a complete list of systems stating for each system:

.1 Date of instruction.
.2 Duration of instruction.
.3 Name of persons instructed.
.4 Other parties present (manufacturer's representative, etc.).
.5 Signature of the Departmental Representative stating that they properly understood the system installation, operation, and maintenance requirements and identifying any systems or equipment which were not demonstrated to their satisfaction and which must be re-demonstrated.

3.10 CLEANING

.1 Do final cleaning in accordance with Section 01 01 50.

.2 At time of final cleaning, clean lighting reflectors, lenses and other lighting surfaces that have been exposed to construction dust and dirt.

.3 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

.4 Clean and prime paint exposed non-galvanised hangers, racks, fastenings to prevent rusting. Coordinate finish painting with Section 01 01 50.

3.11 WORKMANSHIP

.1 Workmanship shall be in accordance with well established practice and standards accepted and recognized by the Departmental Representative and the Trade.

.2 The Departmental Representative shall have the right to reject any item of work that does not conform to the Contract Documents and accepted standards of performance, quietness of operation, finish and appearance.

.3 Employ only tradesmen holding valid Provincial Trade Qualification Certificates. Tradesmen shall perform only work that their certificate permits. Certificates shall be available for inspection by the Departmental Representative.

3.12 PROTECTION OF WORK

.1 Protect equipment and materials, stored or in place, from the weather, moisture, dust and physical damage.

.2 Mask machined surfaces. Secure covers over equipment openings and open ends of equipment and conduit, as the installation work progresses.

.3 Equipment having operating parts, bearings or machined surfaces, showing signs of rusting, pitting or physical damage will be rejected.

.4 Refinish damaged or marred factory finish.

3.13 PROTECTION ELECTRICAL EQUIPMENT

.1 Protect exposed live equipment during construction for personnel safety.

.2 Shield and mark live parts, e.g. "LIVE 120 VOLTS".

.3 Arrange for installation of temporary doors for rooms containing electrical distribution equipment. Keep these doors locked except when under direct supervision of electrician.

3.14 CONCEALMENT

.1 Conceal wiring and conduit in partitions, walls, crawlspaces and ceiling spaces, unless otherwise noted.

.2 Do not install wiring and conduit on outside walls or on roofs unless specifically directed.

3.15 SERVICE PENETRATIONS IN RATED FIRE SEPARATIONS

.1 Refer to 07 84 00.

.2 All cabling, wiring, conduits, cable trays, etc. passing through rated fire separations shall be smoke and fire stopped to a ULC or cUL tested assembly system, in accordance with CAN4-S115-95, that meets the requirements of the Building code in effect.

.3 The scope includes new services which pass through existing rated separations and also all existing services which pass through a new rated separation or existing separations whose rating has been upgraded.

.4 Fire resistance rating of installed firestopping assembly shall not be less than fire resistance rating of surrounding assembly indicated on Architectural drawings. Where this is not indicated assume a minimum of one hour for walls and two hours for floors.

.5 Install firestopping and smoke seal material and components in accordance with ULC certification and manufacturer's instructions. The Applicator shall be approved, licensed and supervised by the manufacturer in the installation of firestopping and are to follow the requirements of a rated system as detailed above.

.6 Contractors are expected to submit system information detailing firestopping product, backing, penetration, penetrated assembly, fire and temperature rating, and ULC or cUL system number.

.7 Provide fire stopping material and system information in the maintenance manuals and via labels at major penetrations that are likely to be re-penetrated.

.8 Allow openings for 100% capacity of raceway.

.9 Provide split systems where existing cables are involved.

3.16 SERVICE PENETRATIONS IN NON-RATED SEPARATIONS

.1 Provide metal sleeves for all cabling, wiring, conduits, cable trays, etc. passing through non-rated fire separations and non-rated walls and floors shall be tightly fitted and sealed on both sides of the separation with caulking or silicon sealant to prevent the passage of smoke and/or transmission of sound.

3.17 CONDUIT SLEEVES

.1 Provide conduit sleeves for all conduit and wiring passing through rated and non-rated walls and floors. Sleeves shall be concentric with conduit or wiring.

.2 Except as otherwise noted conduit sleeves are not required for holes formed or cored in interior concrete walls or floors.

.3 Conduit sleeves shall extend 50 mm above floors in unfinished areas and wet areas and 6 mm above floors in finished areas.

.4 Conduit sleeves shall extend 25 mm on each side of walls in unfinished areas and 6 mm in finished areas.

.5 Conduit sleeves shall extend 25mm beyond exterior face of building. Caulk with flexible caulking compound.

.6 Sleeve Size: 12 mm clearance all around, between sleeve and conduit or wiring.

.7 Paint exterior surfaces of ferrous sleeves with heavy application of rust inhibiting primer.

.8 Packing of Sleeves:

.1 Where sleeves pass through foundation walls and perimeter walls the space between sleeve and conduit shall be caulked with waterproof fire retardant non-hardening mastic.

.2 Pack future-use sleeves with mineral wool insulation and then seal with ULC approved fire stop sealant for rated fire separations.

3.18 EQUIPMENT INSTALLATION

.1 Provide means of access for servicing equipment.

.2 CSA identification and equipment labels to be clearly visible after installation.

3.19 CUTTING, PATCHING, DIGGING, CANNING, CORING & CONCRETE

.1 Lay out all cutting, patching, digging, canning and coring required to accommodate the electrical services. Coordinate with other Divisions. The performance of actual cutting, patching, digging, canning and coring is specified under other Divisions.

.2 Be responsible for correct location and sizing of all openings required under Electrical Divisions, including piped sleeves.

.3 Openings through structural members of the building shall not be made without the approval of the Departmental Representative.

.4 Openings in Concrete:

.1 Be responsible for the layout of all openings in concrete, where openings are not left ready under previous contract.

.2 All openings shall be core drilled or diamond saw cut.

.3 Refer to structural drawings for permissible locations of openings and permissible opening sizes in concrete floors and walls.

.4 Refer to structural drawings for locations of steel reinforcing.

.5 Be responsible for repairing any damage to steel reinforcing.

.5 Openings in building surfaces other than concrete:

.1 Lay out all openings required.

.6 Poured concrete for duct encasements, pole bases, transformer pads and housekeeping pads shall be provided by other Divisions, coordinated and supervised by the Electrical Divisions.

.7 Precast concrete items such as transformer pad bases and light pole bases to be provided and installed by the Electrical Divisions unless otherwise specified.

.8 Excavation and backfilling will be provided by other Divisions. This division to supervise the work and provide all layouts and parameters.

3.20 PAINTING

.1 Clean exposed bare metal surfaces supplied under the Electrical Divisions removing all dirt, dust, grease and mill scale. Apply at least one coat of corrosion resistant primer paint to all supports and equipment fabricated from ferrous metal.

.2 Paint all hangers and exposed sleeves, in exposed areas, with a rust inhibiting primer, as they are installed.

.3 Repaint all marred factory finished equipment supplied under the Electrical Divisions, to match the original factory finish.

.4 Coordinate with Division 09.

.5 Finish painting of all equipment and materials, supplied under the Electrical Divisions, installed in Electrical Rooms of the building or exposed outside the building, is included under Division 09 of the Specification.

END OF SECTION

Part 1 General

1.1 RELATED WORK

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 RELATED SECTIONS

.1 Section 01 01 50 – General Instructions

.2 Section 26 05 00 - Common Work Results

1.3 REFERENCES

.1 CSA C22.1-2018

.2 CSA C22.2

.3 National Electrical Manufacturers Association (NEMA)

1.4 PRODUCT DATA

.1 Submit product data in accordance with Section 01 01 50.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 01 50.

1.6 TERMS OF REFERENCE

.1 Typically use insulated 98% conductivity copper conductor wiring enclosed in EMT (steel) conduit for the general wiring systems unless otherwise indicated.

.2 Armored (Bx) cables may be permitted only for luminaire drops to a maximum length of 1500mm.

.3 Aluminium conductors not permitted.

.4 Teck cable may only be used where specifically indicated on the drawings or in the specifications. Where permitted, Teck wiring up to 750 volts to be PVC jacketed armoured cable, multi-copper conductor type Teck90 having a PVC jacket with FT-6 flame spread rating.

.5 Provide all control wiring except HVAC controls as specified in Mechanical Divisions. Refer to Equipment Schedule(s) for detailed responsibilities.

.6 Non-metallic sheathed wiring not to be used on this project.

Part 2 Products

2.1 WIRING & CABLES – GENERAL

.1 Conductors: stranded for 12 AWG and larger. Minimum size #12 AWG.

.2 Insulation to be 1000 volt RW90XLPE (X link) for the general building wiring in conduit, unless otherwise specified.

.3 Main feeders to be conduit and insulated copper wiring unless otherwise noted on drawings. Provide ground wiring for all conduits in or below slabs. Increase conduit size as required.

.4 Conductors within cable trays shall have 'plenum' rated (FT6 type) outer jacket to comply with all applicable regulations and bylaws.

.5 Conductors to be colour-coded. Conductors No.10 gauge and smaller shall have colour impregnated into insulation at time of manufacture. Conductors size No.8 gauge and larger may be colour-coded with adhesive colour coding tape, but only black insulated conductors shall be employed in this case, except for neutrals which shall be white wherever possible. Where colour-coding tape is utilized, it shall be applied for a minimum of 50 mm at terminations, junctions and pullboxes and condulet fittings. Conductors shall not be painted.

2.2 TECK CABLE

.1 Conductors:

.1 Grounding conductor: copper

.2 Circuit conductors: copper, size as indicated.

.2 Insulation: Chemically cross-linked thermosetting polyethylene, type RW90, rated 600 V.

.3 Inner jacket: polyvinyl chloride material.

.4 Armour: interlocking aluminum.

.5 Overall covering: polyvinyl chloride material FT-4/6 flame test rated as specified. Provide FT4 or 6 accordingly.

.6 Connectors: Watertight, approved for Teck cable installation.

2.3 LOW VOLTAGE CONTROL CABLES

.1 Type LVT: soft annealed copper conductors, with thermoplastic insulation, outer covering of thermoplastic jacket. Minimum size #18 AWG.

.2 Unless otherwise specified wiring to be multicore individually identified and colour coded with grey sheath enclosed in conduit or (EMT).

2.4 BUILDING WIRE AND CABLE

.1 Unless otherwise directed, building wire and cable shall be copper conductors, sized as indicated.

.2 Except where otherwise directed or required by Code or other applicable regulations, building wire and cable insulation shall be Type RW90, cross-linked polyethylene insulated 600 volts rated for not less then 90°C.

.3 All conductors within cable trays shall have FT6 type outer jacket to comply with all applicable regulations and bylaws.

.4 Use of NMD90 (Loomex) not permitted.

2.5 ARMOURED CABLE

.1 Type: AC 90

.2 Armour: flexible interlocked aluminium

2.6 WIRE AND BOX CONNECTORS AND MISCELLANEOUS MATERIALS

.1 Connectors for wire and cable splices and taps: Unless otherwise directed, use 3M Co. 'Scotchlok,' Thomas & Betts PT Series, Buchanan 'B,' IDI Electric 'Super Nut,' or approved equal, for conductors #8 AWG or smaller; Burndy 'Servit' Type KSU or approved equal for conductors #1/0 AWG and smaller; and Burndy 'OKlip' Type KVSU or approved equal for conductors 750 MCM or smaller.

.2 Clamps, glanding connectors, or box connectors for armoured cable, and flexible conduit as required.

.3 Lugs, terminals, screws used for termination of wiring to be suitable for copper conductors.

.4 Plastic electrical insulation tape: Scotch #88 or approved equal.

Part 3 Execution

3.1 INSTALLATION GENERAL

.1 Unless specifically indicated otherwise, all wiring shall be installed in conduit. Use flexible conduits for final connections to suspend light fixtures and vibrating equipment.

.2 Use no wire smaller than #12 AWG, unless otherwise directed.

.3 Control circuit conductors for motors and mechanical equipment controls shall be not less than #14 AWG except where specifically directed otherwise.

.4 Before pulling wire, ensure conduit is dry and clean. If moisture is present, thoroughly dry out conduits; vacuum if necessary. To facilitate pulling, recognized specially manufactured wire pulling lubricants may be used. Do not use grease. Employ suitable techniques to prevent damage to wire when ambient temperature is below the minimum permitted for each insulation type. Do not pull wires into incomplete conduit runs.

.5 Installation to be free of opens and grounds. Before energization, measure insulation resistance and comply with the Canadian Electrical Code. Submit data sheet with values measured.

.6 The number of splices in any circuit shall be kept to an absolute minimum consistent with available coil length and installation conditions.

.7 Conductors for lighting, receptacle, appliance and equipment branch circuits shall have ampacity not less than the rating of the over-current device protecting the branch circuit and shall be sized for a maximum voltage drop of 2% from panelboard to the last outlet of a circuit. The length of the branch circuit to be used in the determination of the required wire size shall be the combined vertical and horizontal distances from the panelboard to the last device in the circuit. In no case shall the wire sizes as determined above, be less than that indicated in the following table.

120 Volts, 1 Phase

15 Ampere Circuits	20 Ampere Circuits
0-25 m - min. #12 AWG	0-20 m - min. #12 AWG
Over 25 m - min. #10 AWG	0 m-30 m - min. #10 AWG
	Over 30 m - min. #8 AWG

347 Volts, 1 Phase

15 Ampere Circuits	20 Ampere Circuits
0-75 m - min. #12 AWG	0-55 m - min. #12 AWG
Over 75 m - min. #10 AWG	Over 55 m - min. #10 AWG

.8 Make final connections to recessed incandescent or gas-discharge lamp fixtures, and other heat-producing equipment with thermoplastic insulated, lacquered glass-braid-jacketed "equipment wire," except that where higher temperature rating of insulation or larger conductor size than #10 AWG is required, use wire specifically approved for the purpose.

.9 Exercise care in stripping insulation from wire. Do not nick conductors; if nicked replace with new.

3.2 INSTALLATION OF BUILDING WIRES

.1 Install wiring as follows:

.1 In conduit systems in accordance with Section 26 05 34.

3.3 INSTALLATION OF ARMOURED CABLE

.1 Unless specifically directed to the contrary, use armoured cables only for:

.1 Final connections from a junction box above accessible suspended ceilings to recessed light fixtures to a maximum length of 1500mm.

.2 Do not attach cables to the ceiling suspension system or to mechanical ductwork or piping.

3.4 IDENTIFICATION, CODING AND BALANCING

.1 For branch circuit wiring, follow identification system shown on the drawings and as specified in Section 26 05 00 – Common Work.

.2 Connect single phase equipment to minimize imbalance on feeders. Adjust branch circuiting shown as required for optimum balancing. Record all changes on the records drawings.

.3 Colour code all feeders at all terminations, at all points where taps are made, and at all panelboards, switchboards, motor control centres, etc. Use two wraps of 3M #471 plastic film tape 48 mm wide.

.4 Conductors sized No. 10 and smaller are required to be factory coloured, not taped on site.

3.5 TESTING

.1 All power and control wiring shall be tested for insulation resistance value with a 1000 volt megger. Resistance values shall be as recommended by the cable manufacturer.

.2 All wire test results shall be properly tabulated, signed, dated, and submitted to the Departmental Representative.

END OF SECTION

Part 1 General

1.1 RELATED WORK

.1 Section 26 05 00 – Common Work Results.

1.2 REGULATORY REQUIREMENTS

.1 Restraints shall meet the requirements of the latest edition of the National Building Code and amendments.

.2 The Seismic Engineer shall be a registered BC Professional Engineer in good standing and should be able to provide a proof of professional insurance and the related practice credentials if requested by the Departmental Representative.

.3 The Contractor's Seismic Engineer shall submit original signed National Building Code "Letters of Assurance" "Schedules B1, B2, and C-B" to the Departmental Representative.

.4 The above requirements shall not restrict or supplant the requirements of any local bylaws, codes, or other certified agencies which may have jurisdiction over all or part of the installation.

1.3 SCOPE

.1 The total electrical seismic restraint design, field review and inspection will be by a structural engineer who specializes in the restraint of building elements and is registered with the local engineering association. Contractor shall allow for coordination, provision of seismic restraints, as well as all costs for the services of the Seismic Restraint Engineer. This Engineer herein referred to as the Seismic Consultant, will provide normal engineering functions as they pertain to seismic restraint of electrical installations.

.2 It is the responsibility of equipment manufacturers to design their equipment so that the strength and anchorage of internal components of the equipment exceeds the force level used to restrain and anchor the unit itself to the supporting structure.

.3 Manufacturer's shop drawings to be submitted with seismic information on equipment structure, bracing and internal components and as required by Section 01 01 50.

.4 Provide restraint on all equipment and machinery, which is part of the building electrical services and systems, to prevent injury or hazard to persons and equipment in and around the structure. Restrain all such equipment in its normal position in the event of an earthquake.

.5 The Contractor shall be aware of, and comply with, all current seismic restraining requirements and make provision for those that may come into effect during construction of the project. Make proper allowance for such conditions in the tender.

.6 The Seismic Consultant shall provide detailed seismic restraint installation shop drawings to the Contractor. Copies of the shop drawings to be included in the final project manual.

.7 Provide seismic restraints on all equipment, and/or installations or assemblies, which are suspended, pendant, shelf mounted, freestanding and/or bolted to the building structure or support slabs.

.8 The Seismic Consultant shall provide inspections during and after installation. The Contractor shall correct any deficiencies noted without additional cost to the contract.

.9 Include all costs associated with the seismic installation and certification in the base tender.

1.4 SHOP DRAWINGS & SUBMITTALS

.1 Submit shop drawings of all seismic restraint systems including details of attachment to the structure, either tested in an independent testing laboratory or approved by the seismic consultant.

.2 Submit all the proposed types and locations of inserts or connection points to the building structure or support slabs. Follow the directions and recommendations of the Seismic Consultant.

Part 2 Execution

2.1 GENERAL

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

.2 Ensure that seismic restraints do not adversely affect the proper functioning of any vibration isolation mounts or hangers.

2.2 CONDUITS

.1 Provide restraint installation information and details on conduit and equipment as indicated below:

.2 Vertical Conduit:

.1 Attachment - Secure vertical conduit at sufficiently close intervals to keep the conduit in alignment and carry the weight of the conduits and wiring. Stacks shall be supported at their bases and, if over 2 stories in height, at each floor by approved metal floor clamps.

.2 At vertical conduit risers, wherever possible, support the weight of the riser, at a point or points above the center of gravity of the riser. Provide lateral guides at the top and bottom of the riser, and at intermediate points not to exceed 9.2 m o.c.

.3 Riser joints shall be braced or stabilized between floors.

.3 Horizontal Conduits:

.1 Supports - Horizontal conduit shall be supported at sufficiently close intervals to keep it in alignment and prevent sagging.

.2 EMT tubing - tubing shall be supported at approximately 1.2 m intervals for tubing.

.4 Provide transverse bracing at 12.2 m o.c. maximum unless otherwise noted. Provide bracing at all 90^{o} bend assemblies, and pull box locations.

.5 Provide longitudinal bracing at 24.4 m o.c. maximum unless otherwise noted.

.6 Do not brace conduit runs against each other. Use separate support and restraint system.

.7 Support all conduits in accordance with the capability of the pipe to resist seismic load requirements indicated.

.8 Trapeze hangers may be used. Provide flexible conduit connections where conduits pass through building seismic or expansion joints, or where rigidly supported conduits connect to equipment with vibration or seismic isolators.

.9 A conduit system shall not be braced to dissimilar parts of a building or two dissimilar building systems that may respond in a different mode during an earthquake. Examples: wall and a roof; solid concrete wall and a metal deck with lightweight concrete fill.

.10 Provide large enough conduit sleeves through walls or floors to allow for anticipated differential movements with firestopping where required.

.11 It is the responsibility of the contractor to ascertain that an appropriate size restraint device be selected for each individual piece of equipment. Submit details on shop drawings. Review with seismic consultant and submit shop drawings to the Departmental Representative for his reference.

2.3 FLOOR MOUNTED EQUIPMENT

.1 Bolt all equipment, e.g. transformers, switchgear, generators, motor control centres, free standing panelboards, control panels, capacitor banks, etc. to the structure. Design anchors and bolts for seismic force applied horizontally through the center of gravity to a seismic force of 0.5g. For equipment which may be subject to resonances, use a nominal 1.0 g seismic force.

.2 Provide flexible conduit connections between floor mounted equipment to be restrained and its adjacent associated electrical equipment.

2.4 LIGHT FIXTURES

.1 Fluorescent fixtures in suspended ceilings shall be hung independently of the ceiling system. Fixtures shall be secured to concrete or structural deck above by at least two taught cables which are connected to the fixture at diagonal points.

.2 Surface and recessed style fixtures shall be hung independently of the ceiling system. Fixtures shall be secured to concrete or structural deck above by taught cables.

.3 Fixtures which are hung independently of ceiling systems shall have minimum of one seismic cable in addition to the chain or cable used to support the fixture. Seismic restraint cables shall be secured into the concrete or structural deck above.

.4 Cables shall be corrosion resistant and approved for the application.

.5 Fixtures which are rod hung shall have seismic ball alignment fittings at the ceiling and fixture.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.2 CSA C22.1-2018

.3 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)

.4 Transformer grounding shall comply with CSA C22.2 No.41-M87 (R99).

.5 All grounding conductors to be stranded soft annealed copper unless otherwise noted.

1.3 PRODUCT DATA

.1 Submit product data in accordance with Section 01 01 50.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 01 50.

Part 2 Products

2.1 MATERIALS

.1 Grounding equipment to: CSA C22.2 No.41-M87 (R99).

2.2 EQUIPMENT

.1 Clamps for grounding of conductor, size as required.

.2 Copper conductor at least 6m long for each concrete encased electrode, bare, stranded, soft annealed, size as indicated. If not indicated, use 3/0AWG which is the maximum in Table 43 CEC.

.3 Rod electrodes, copper clad steel 20mm dia by 3m long as indicated.

.4 System and circuit, equipment, grounding conductors, bare stranded copper, soft annealed, sized as indicated. Insulation where specified to be green.

.5 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.

.6 Non-corroding accessories necessary for grounding system, type, size material as indicated, including but not necessarily limited to:
- .1 Grounding and bonding bushings.
- .2 Protective type clamps.
- .3 Bolted type conductor connectors.
- .4 Thermit welded type conductor connectors.
- .5 Bonding jumpers, straps.
- .6 Pressure wire connectors.

Part 3 Execution

3.1 INSTALLATION GENERAL

.1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories.

.2 Provide separate, insulated, copper bonding conductor in EVERY conduit used for power, lighting, fire alarm and every low tension system required in the building. Where wire size is not indicates, provide minimum size per applicable CEC tables.

.3 Install connectors in accordance with manufacturer's instructions.

.4 Protect exposed grounding conductors from mechanical injury.

.5 Make buried connections, and connections to conductive water main, electrodes, using copper welding by thermit process or permanent mechanical connectors approved for the use.

.6 Use mechanical connectors for grounding connections to equipment provided with lugs.

.7 Soldered joints not permitted.

.8 Install bonding wire for flexible conduit, connected at both end to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit. Provide a ground conductor in all flexible conduit and secure to system grounding lugs at both the equipment and source.

.9 Install separate ground conductor to each outdoor lighting standard.

.10 Connect building structural steel and metal siding to ground by welding copper to steel.

.11 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

.12 Bond single conductor, metallic armoured cables to cabinet at supply end and provide non-metallic entry plate at load end.

.13 Ground secondary service pedestals in raised computer floors.

.14 Coordinate ground rod installation with local soil conditions to assure proper grounding system.

3.2 **GROUNDING ELECTRODES**

.1 Provide and install an artificial ground consisting typically of a minimum of four 3000mm x 20mm copperweld ground rods, interconnected by bare stranded copper #1 AWG conductors and terminating to the Main Electrical Room ground bus. Conductors shall be connected to the ground rods with compression type fittings and shall be buried 600 mm below grade. Check and measure the installation to ensure an adequate resistance to ground before covering.

.2 Provide ground test well over one of the rods on the ground grid to allow access to the grid for testing.

3.3 **BUILDING SERVICES GROUNDING**

.1 WATER - From the main electrical room ground bus, connect #3 AWG insulated ground conductor in 27mm conduit to water main with approved ground clamp ahead of water meter. Install 1#3/0 ground conductor jumper strapped around water meter and associated unions and valves to ground building side of water system.

.2 METALLIC WASTE WATER PIPING - Each metallic waste water piping system to the building to be grounded by bonding it to the interior metallic water supply system by copper bonding jumper of not less than #3 AWG

.3 GAS PIPE GROUNDING - All interior metallic gas piping which may become energized to be made electrically continuous and to be bonded in accordance with requirements of Canadian Electrical Code.

3.4 **GROUNDING BUS**

.1 Provide ground bus in the main electrical room and main communication room.

.2 Ground items of electrical equipment in electrical room to ground bus with individual bare stranded copper connections size #2 AWG or as indicated. Make sure grounding wires are meeting Canadian Electrical Code (CEC) requirements.

.3 Copper or bronze lugs required for termination of all copper conductors at ground busses.

3.5 **EQUIPMENT GROUNDING AND BONDING**

.1 Install bonding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, frames of motors, starters, UPS, control panels, building steel work, raised floor systems, generators, distribution panels and outdoor lighting.

.2 Provide grounding conductor(s) from all major switchgear to solidly ground the secondary system. This includes equipment located in the main electrical room as well as each sub-electrical room. Grounding conductors to be sized to Canadian Electrical Code and switchgear manufacturer's requirements.

3.6 **MECHANICAL EQUIPMENT BONDING**

.1 Ground wires to be installed in all conduit serving motor feeder circuits and to extend to ground screws on junction and outlet boxes for bonding.

3.7 **FIELD QUALITY CONTROL**

.1 Perform tests in accordance with Section 26 05 00 – Common Work Results.

.2 Perform ground continuity and resistance tests using method appropriate to site conditions.

.3 Measure ground grid resistance with earth test megohmmeter and install additional ground rods and conductors as required until resistance to ground complies with Code requirements and is less than 5Ω. Submit test results to Department Representative.

.4 Carry out all tests required by the Electrical Inspection Authority and provide all required reports and copied to the Departmental Representative. Include all associated costs.

.5 Ensure test results are satisfactory before energizing the electrical system.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

.1 Supply and install all hangers, supports and inserts for the installation shown on the drawings and specified herein, as necessary to fasten electrical equipment securely to the building structure.

1.2 RELATED WORK

.1 Section 26 05 00 – Common Work Results.

.2 Section 26 05 25 - Seismic Restraints:

Part 2 Product

2.1 FRAMING AND SUPPORT SYSTEM

.1 Materials:

.1 Intermediate duty supporting structures shall employ P1000 Unistrut or equal together with the manufactures connecting components and fasteners for a complete system.

.2 Heavy duty supporting structures to be fabricated and welded from steel structural members and prime painted before installation.

.2 Finishes:

.1 Outdoors, wet locations: Hot dipped galvanized.

.2 Indoors, dry locations: Galvanized when available, prime painted if not available.

.3 Nuts, bolts, machine screws: Cadmium plated.

.3 Unistrut:

.1 Section P1000 or as required for load and span, with mounting screws, or approved. P1000 or equal is a minimum standard for supporting conduits 50 mm and larger.

2.2 CONCRETE AND MASONRY ANCHORS

.1 Materials: Hardened steel inserts, zinc plated for corrosion resistance. All anchor bolts must be galvanized.

.2 Components: non-drilling anchors for use in predrilled holes, sized to safely support the applied load with a minimum safety factor of four.

2.3 NON-METALLIC ANCHORS

.1 Material: Plastic anchors for sheet metal screws.

2.4 CONDUIT SUPPORTS

.1 General: Malleable iron two-hole conduit straps where exposed to weather. Stamped steel two-hole straps indoors.

.2 Structural Steel: Bolt on clamp type supports.

.3 Masonry, concrete, stone, etc.: Anchors.

.4 Title: Toggle bolts.

.5 Metal studs, ceiling hangers, etc.: Push-on, snap in type supports

.6 Unistrut: Unistrut conduit clamps.

2.5 CABLE SUPPORTS AND CLAMPS

.1 General: As per conduit supports, except that for single conductor cables, suitable non-ferrous or approved stainless steel or aluminum clamps shall be used.

Part 3 Execution

3.1 GENERAL

.1 Do not cut or drill beams, joists or structural steel unless written permission of the Engineer is obtained.

.2 Distance between conduit or cable supports not to exceed code requirements.

.3 Supports to be suitable for the real loads imposed by equipment.

.4 Supports to be securely fastened, free from vibration and excessive deflection or rotation. Maximum deflections are 4 mm over a 1 meter span and 8 mm over a 2 meter span.

.5 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

.6 Provide conduit rack with 25% spare capacity for multiple runs.

.7 Provide channel support with fittings for vertical runs of conduit and cables.

3.2 INSTALLATION

.1 Secure equipment to solid masonry, tile and plaster surfaces with lead anchors.

.2 Secure equipment to poured concrete with expandable inserts.

.3 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.4 Fasten exposed conduit or cables to building construction or support system using straps.

- .1 One-hole malleable iron or steel straps to secure surface conduits and cables 50 mm and smaller.
- .2 Two-hole steel straps for conduits and cables larger than 50 mm.
- .3 Beam clamps to secure conduit to exposed steel work.

.5 Suspended support systems.

- .1 Support individual cable or conduit runs with 6 mm 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.

.6 Shot driven pins may only be used with written approval of the structural engineer.

.7 Use round or pan head screws for fastening straps, boxes, etc.

.8 Do not support heavy loads from the bottom chord of open web steel joists.

.9 Support outlet boxes, junction boxes, panel tubs, etc., independent of conduits running to them. Support conduits within 600 mm of outlet boxes. Support surface mounted panel tubs with a minimum of four 6 mm fasteners.

.10 For surface mounting of two or more conduits use channels at 1.5 m oc spacing.

.11 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

.12 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.13 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of the Departmental Representative.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

.1 Provide a complete system of splitters boxes and cabinets for the installation of wiring and equipment.

1.2 RELATED SECTIONS

.1 Section 01 01 50 – General Instructions

.2 Section 26 05 00 - Common Work Results

.3 Section 26 05 25 – Seismic Restraints

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data for cabinets in accordance with Section 01 01 50.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 01 50.

Part 2 Products

2.1 SPLITTERS

.1 Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.

.2 Main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.

.3 At least three spare terminals on each set of lugs in splitters less than 400 A.

2.2 JUNCTION BOXES AND PULL BOXES, INDOOR DRY LOCATIONS

.1 Materials:

.1 Code gauge sheet steel, welded construction, phosphatised and/or galvanized.

.2 Components:

.1 For flush mounting, covers to overlap box by 25 mm minimum all around with flush head cover retaining screws.

.2 Use rolled edges for surface boxes.

.3 Size shall be in accordance with Canadian Electrical Code for the given conduit sizes and arrangement and number of conductors and splices in the boxes.

.4 Surface or flush with trim and hinged door, latch and lock and two keys and keyed to match panelboard keys.

.5 Backboards: 19 mm G1S Fir plywood backboard.

.3 Junction boxes mounted in exterior walls shall be complete with box vapour barriers.

2.3 CABINETS

.1 Materials:

.1 Cabinets: Code gauge sheet steel, welded construction, phosphatised and factory paint finish, suitable for field painting.

.2 Locks: to match panelboards.

.3 Backboards: 19 mm G1S fir plywood, one piece per cabinet, covering entire cabinet interior.

.2 Components:

.1 With hinged door and return flange overlapping sides, with handle, lock and catch for surface mounting, size as indicated or to suit.

.2 Surface or flush with trim and hinged door, latch and lock and two keys, size as indicated or to Canadian Electrical Code for the given conduit sizes and arrangement and number of conductors and splices in the boxes. Keyed to match panelboard keys.

Part 3 Execution

3.1 INSTALLATION

.1 Junction Boxes and Pull Boxes:

.1 Supply all pull boxes and junction boxes shown on the drawings or required for the installation.

.2 Boxes installed in party walls to be offset by a minimum of one stud space.

.3 Install in inconspicuous but accessible locations, above removable ceilings or in electrical rooms, utility rooms or storage areas.

.4 Identify with system name and circuit designation as applicable.

.5 Size in accordance with the Canadian Electrical Code, as a minimum.

.2 Cabinets:

.1 Mount cabinets with top not greater than 1980 mm above finished floor, coordinated with masonry, panelboards, fire hose cabinets and similar items. Securely fasten backboards to cabinet interiors.

.2 Install terminal block where indicated.

.3 Identification

.1 Provide equipment identification in accordance with drawings.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 01 50 – General Instructions

.2 Section 26 05 00 - Common Work Results

1.2 REFERENCES

.1 CSA C22.1-2018 - Canadian Electrical Codes, Part 1.

1.3 PRODUCT DATA

.1 Submit product data in accordance with Section 01 01 50.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 01 50.

Part 2 Products

2.1 OUTLET AND CONDUIT BOXES GENERAL

.1 Size boxes in accordance with CSA C22.1-2018.

.2 102 mm square or larger outlet boxes as required for special devices.

.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 Use cast Iron outlet boxes where installed surface in inmate accessible areas.

2.2 OUTLET BOXES FOR METAL CONDUIT

.1 Materials:

.1 Surface or recessed concealed type: Die formed steel, hot dip galvanized, 350 g/m² minimum zinc coating.

.2 Surface mounting exposed: Cast ferrous for threaded conduit, with attached lugs, corrosion resistant two coats finish.

2.3 JUNCTION & PULL BOXES

.1 Electro-galvanized sheet steel type boxes for flush mount in walls with matching extension and plaster rings as required.

.2 Install pull boxes in inconspicuous but accessible locations.

.3 Install pull boxes after cumulative bend total of 270 degrees between boxes.

.4 Install pull boxes so as not to exceed 30m of conduit run between pull boxes.

2.4 CONDUIT BOXES

.1 Cast FS or electro-galvanized sheet steel boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle.

2.5 FITTINGS - GENERAL

.1 Bushing and connectors with nylon insulated throats.

.2 Knock-out fillers to prevent entry of debris.

.3 Conduit outlet bodies for conduit up to 32 mm 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, and armoured cable connections. Reducing washers are not allowed.

.5 Install all outlets flush and surface mounted as required for the installation.

.6 Surface mount above suspended ceilings, or in unfinished areas.

.7 Adjust position of outlets in finished masonry walls to suit course lines. Coordinate cutting of masonry walls to achieve neat openings for all boxes.

.8 Do not distort boxes during installation. If boxes are distorted, replace with new boxes.

.9 Use plaster rings to correct depth. Use 30 mm on concrete block.

.10 Do not use sectional boxes.

.11 Provide boxes sized as required by the Canadian Electrical Code.

.12 Install vapour barrier material to surround and seal all outlet boxes located on exterior walls of building. Maintain wall insulation.

.13 Outlets installed in partition walls to be offset by a minimum of one stud space.

.14 Ceiling outlet boxes shall be provided for every surface mounted fixture or row of fixtures installed on suspended "hard" ceilings.

.15 Primary bushings in termination box for cable connection.

.16 Secondary bushings in termination box for bus duct connection.

.17 For telecom conduit runs:

.1 Achieve the best route with no bend greater than 90 degrees or an aggregate of bends in excess of 180 degrees between pull points or pull boxes.

.2 Contain no continuous section longer than 30.5 meter (100 feet).

.3 Be bonded to ground on one or both ends in accordance with national or local requirements.

.4 Withstand the environment to which they will be exposed.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 01 50 – General Instructions

.2 Section 26 05 00 - Common Work Results

.3 Section 26 05 25 – Seismic Restraints

1.2 REFERENCES

.1 CSA C22.1-2018.

.2 Canadian Standards Association (CSA) CAN/CSA C22.2.

1.3 PRODUCT DATA

.1 Submit product data in accordance with Section 01 01 50.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 01 50.

1.5 SCOPE OF WORK

.1 Drawings do not show all conduits. Those shown are in diagrammatic form only.

.2 Conceal all conduits in finished areas. Conduits may be surface mounted either only where indicated or in-service areas accessible only to authorized personnel.

.3 Note particular requirements for routing of conduits where detailed.

.4 Provide polypropylene pull cord in all “empty” conduits.

.5 Conduits and boxes penetrating rated fire walls, ceilings and floors shall be properly firestopped and sealed for fire and smoke travel.

Part 2 Products

2.1 CONDUITS

.1 Rigid metal conduit: to CSA C22.2 No.45 Galvanized Steel.

.2 Electrical Metallic Tubing (EMT): to CSA C22.2 No.83.

.3 Flexible conduits: to CSA C22.2 No. 56.

.4 Minimum conduit size in the project to be 21mm (3/4') diameter (for power as well as low tension services).

2.2 CONDUIT FASTENINGS

.1 One hole steel straps to secure surface conduits 27 mm and smaller. Use two hole steel straps to conduits larger than 27 mm.

.2 Beam clamps to secure conduits to exposed steel work.

.3 Channel type supports for two or more conduits.

.4 10 mm threaded rods to support suspended channels.

2.3 CONDUIT FITTINGS

.1 Fittings manufactured for use with conduits specified. Coating same as conduit.

.2 Provide factory "ells" where 90 degree bends are required for 35 mm and larger conduits.

.3 EMT couplings and connectors shall be steel. Regular die-cast alloy fittings and couplings are not acceptable. Provide plastic bushings (insulated throat) for all connectors unless there is no chance of burrs. Provide water-tight connectors in damp or wet locations and for surface equipment (e.g. Panelboards, MCC's, etc) in rooms that are fire sprinkler protected.

2.4 EXPANSION FITTINGS FOR RIGID CONDUIT

.1 Weatherproof expansion fittings with internal bonding assembly suitable linear expansion.

.2 Water-tight expansion fittings: with integral bonding jumper, suitable for linear expansion and 19 mm deflection in all directions.

.3 Weatherproof expansion fittings for linear expansion at entry to panel as required.

2.5 RIGID P.V.C. CONDUIT

.1 Conduit: rigid non-metallic conduit of unplasticized polyvinyl chloride as manufactured C.G.E. "Sceptre" Schedule 40.

.2 Fittings: threaded male or female solvent weld connectors and solvent weld couplings, as supplied by conduit manufacturer.

.3 Solvent: as recommended by conduit manufacturer.

2.6 OUTLET AND CONDUIT BOXES IN GENERAL

.1 Size boxes in accordance with CSA C22.1.

.2 102 mm square or larger outlet boxes as required for special devices.

.3 Gang boxes where wiring devices are grouped. Do not use sectional boxes.

.4 Blank cover plates for boxes without wiring devices.

.5 Combination boxes with barriers where outlets for more than one system are grouped.

.6 Bushing and connectors with nylon insulated throats.

.7 Knock-out fillers to prevent entry of foreign materials.

.8 Conduit outlet bodies for conduit up to 35 mm. Use pull boxes for larger conduits.

.9 Double locknuts and insulated bushings on sheet metal boxes.

2.7 SHEET STEEL OUTLET BOXES

.1 Electro-galvanized steel single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. Larger 102 mm square x 54 mm deep outlet boxes (No. 52151 or 52171) to be used when more than one conduit enters one side. Provide extension and plaster rings as required.

.2 For larger boxes use GSB solid type as required.

.3 Boxes for surface mounted switches, receptacles, communications, telephone to be 100mm square No. 52151 or 52171 with Taylor 8300 series covers.

.4 Lighting fixture outlets: 102 mm square outlet boxes (No 52151, 52171 or 72171) or octagonal outlet boxes (No 54151 or 54171).

.5 102 mm square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster and/or tile walls.

2.8 MASONRY BOXES

.1 Electro-galvanized steel masonry single and multi gang type MDB boxes for devices flush mounted in exposed block walls.

2.9 CONCRETE BOXES

.1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.10 SURFACE CONDUIT BOXES

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

Part 3 Execution

3.1 CONDUIT - GENERAL

.1 Generally use electrical metallic tubing (EMT) in the building interior and in above grade slabs except where subject to mechanical injury or where otherwise indicated.

.2 Install all conduit and wiring concealed, unless otherwise shown on the drawings. Do not recess conduit in columns, except as noted, without permission.

.3 Lay out conduit to avoid interference with other work. Maintain a minimum clearance of 150 mm from steam or hot water piping, vents, etc.

.4 At all recessed panels cap 4 - 27 mm empty conduits from panel into ceiling above for future use.

.5 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass. Set out the work and coordinate with other services prior to installation. Maintain access to junction and pull boxes.

.6 Any conduit shown exposed in finished areas is to be free of unnecessary labels and trade marks.

.7 All conduit ends to be reamed to ensure a smooth interior finish that will not damage the insulation of the wiring.

.8 Ensure grounding continuity in all conduit systems.

.9 Use rigid galvanized steel (RGS) threaded conduit where the installation is subject to mechanical injury. In any event, use RGS conduit for surface installations up to 1.5 m (5') above the finished floor.

.10 Field threads on rigid conduit shall be sufficient length to draw conduits ends together.

.11 Unless otherwise noted and where practical, all conduits to be routed through the ceiling space rather than in, or below, slabs or floor structures to facilitate future changes.

.12 Conduits in walls should typically drop (or loop) vertically from above to better facilitate future renovations. Generally conduits from below and horizontal conduits in walls and concrete structures should be avoided unless indicated.

.13 Generally use Rigid PVC conduits in or below ground level slab unless otherwise noted. Transition to RGS conduit in exposed locations: e.g. where conduits emerge from ground level slab.

.14 Conduits are not permitted in terrazo or concrete toppings.

.15 Cap turned up conduits to prevent the entrance of dirt of moisture during construction.

.16 Locate conduits more than 75 mm parallel to steam or hot water lines with a minimum of 25 mm at crossovers.

.17 Bend conduits cold, so that conduit at any point is not flattened more than 1/10th of its original diameter. Conduits bent more than this or kinked to be replaced.

.18 Provide polypropylene pull cord in empty conduits to facilitate pulling wiring in future.

.19 Where conduits become blocked, the use of corrosive agents is prohibited. Remove and replace blocked section.

.20 Damaged conduits to be repaired or replaced.

.21 Dry conduits out thoroughly before installing wiring. Swab out conduit and thoroughly clean internally before wires and cables are pulled.

.22 Conduits shall not pass through structural members except as indicated.

.23 Conduit sizes indicated on drawings are minimum only. Increase sizes as required to suit alternative wiring types or to comply with Code.

.24 Conduits and ducts crossing building expansion joints shall have approved conduit expansion fittings to suit the type of conduit used.

.25 Seal conduits with approved sealant where conduits are run between heated and unheated areas.

.26 Seal openings with approved sealant where conduits, cables, or cable trays pierce fire separations.

.27 Where conduits pass through walls, they shall be grouped and installed through openings. After all conduits shown on the drawings are installed, wall openings shall be closed with material compatible with the wall construction and/or to meet any fire separation integrity.

.28 Where drawings show conduit designations, these conduits shall be identified at each point of termination with Thomas & Betts "Ty-Rap" No. TY532M labels.

.29 Use "Condulet" fittings for power and telephone type conduit terminations in lieu of standard boxes where box support is not provided.

.30 Provide necessary roof jacks or flashing where conduits pass through roof or watertight membranes. Apply approved sealant to maintain membrane integrity.

.31 Use flexible metal conduit for connection to recessed incandescent fixtures without a prewired outlet box and connection to recessed fluorescent fixtures.

.32 Use liquid tight flexible metal conduit for connection to motors, and other vibrating equipment and transformers.

.33 Use explosion proof flexible connection for connection to explosion proof motors.

.34 Install conduit-sealing fittings in hazardous areas, isolation rooms and clean rooms. Fill with compound.

3.2 SURFACE CONDUITS

.1 Surface conduits are acceptable in mechanical and electrical service rooms and in unfinished areas or where indicated.

.2 Run parallel or perpendicular to building lines.

.3 Locate conduits behind infrared or gas fired heaters with minimum 1.5 m clearance.

.4 Conduits to be run in flanged portion of structural steel.

.5 Group conduits wherever possible on suspended and/or surface channels.

.6 Surface conduits will not be accepted in finished areas unless detailed.

3.3 SPARE CONDUITS

.1 Provide spare conduits as indicated.

.2 Provide 4x27 mm spare conduits up to ceiling space and 4x27 mm spare conduits down to ceiling space below from each flush panel. Terminate the conduits in 150x150x100 mm junction boxes in ceiling spaces or in case of an exposed concrete slab, terminate each conduit in a flush concrete box. Provide coverplates for all junction boxes.

3.4 BOXES INSTALLATION

.1 Support boxes independently of connecting conduits.

.2 Ceiling outlet boxes to be provided for each surface mounted fixture or row of fixtures installed in other than T bar ceilings with removable tiles.

.3 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of construction material. Remove upon completion of work.

.4 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.

.5 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers not to be used.

.6 All outlet boxes to be flush mounted in all areas, excluding mechanical rooms, electrical rooms, and above removable ceilings.

.7 Adjust position of outlets in finished masonry walls to suit masonry course lines. Coordinate cutting of masonry walls to achieve neat openings for all boxes. All cutting of masonry work for installation of electrical fittings to be done using rotary cutting equipment.

.8 No sectional or handy boxes to be installed.

.9 Provide vapour barrier wrap or boots behind outlets mounted in exterior walls. Maintain integrity of the vapour barrier and insulation to prevent condensation through boxes.

.10 Coordinate location and mounting heights of outlets above counters, benches, splash-backs and with respect to heating units and plumbing fixtures. Coordinate with architectural details.

.11 Outlets installed back to back in party stud walls to be off-set by one stud space.

.12 Refer to wiring device and communication specification sections and to architectural layouts for mounting heights of outlet boxes.

.13 Back-boxes for all communications systems equipment to be provided in accordance with specific manufacturer's recommendations and as specified in the communications sections of these specifications.

.14 Separate outlets located immediately alongside one another to be mounted at exactly the same height above finished floor. Similarly, outlets mounted on a wall in the same general location at varying heights to be on the same vertical centre-line unless otherwise noted.

.15 Where outlet boxes penetrate through a fire separation, ensure that the boxes are externally tightly fitted with an approved non-combustible material to prevent passage of smoke or flame in the event of a fire.

END OF SECTION

1 GENERAL

1.1 RELATED SECTION

.1 Division 01 - Submittal Procedures

.2 Section 26 05 00 - Common Work Results

.3 Section 26 28 16 – Moulded Case Circuit Breaker

1.2 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Division 01.

.2 Shop drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

.3 Shop drawings to include matching tub and trim details for factory installed low voltage relay cabinets where specified.

1.3 PLANT ASSEMBLY

.1 Install circuit breakers in panelboards before shipment from plant.

.2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.

.3 All panelboards to be of a common manufacturer.

1.4 FINISH

.1 Apply finishes in accordance with Section 26 05 00.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Division 01.

2 PRODUCTS

2.1 PANELBOARDS - GENERAL

.1 Panelboards: product of one manufacturer.

.2 Surface-mounted panelboards in sprinklered areas shall be complete with water shields, approved by the authorities having jurisdiction, to prevent water due to sprinkler operation entering the equipment. Seal all conduits penetrating the panelboard using watertight hubs or "O" rings DSM.

.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 Two keys for each panelboard and key panelboard alike.

.5 Copper bus with neutral bus of same ampere rating as phase busses.

.6 Where panelboards have been specified with Main Circuit Breaker, the main breaker shall not be installed in a position that is normally occupied by a branch circuit breaker. Breaker position shall be in a location that is normally provided in a panel that is suitable for service entrance use.

.7 Finish panelboards grey except in public areas where panel trim and front of panel door shall be provided with a prime coat only. The interior of all panelboards shall be painted white.

2.2 DISTRIBUTION PANELBOARDS

.1 Provide all switch/fuse type and breaker type distribution panelboards for use in the 600 V, 3-phase, 3-wire system and the 208/120 V, 3-phase, 4-wire system. Main sizes, switch and fuse sizes, breaker sizes, and number of branch units shall be as shown on the drawings and panel schedule.

.2 When more than one section is required, the panelboard shall be made up of individual sections bolted together to form a complete panel. All distribution panelboards shall be of the totally enclosed dead front type. The panelboards shall be constructed from formed code gauge galvanized or bonderized steel panels. All front covers shall be hinged with "hold down" bolts.

.3 The panelboards shall be front accessible and shall not exceed the dimensions shown. Panelboards shall be shipped in sections compatible with available access routes.

.4 Main bus bars shall be of tin-plated copper and equipped with pressure type solderless lugs. The copper shall be thoroughly cleaned and pre-plated before the final tin-plating is applied. All bus work shall be suitably supported to withstand maximum short circuit current RMS amperes symmetrical as noted on drawings. The bus bars and mounting frames shall be so arranged that any standard size unit can be readily mounted in place and connected. Adequate wiring and gutter space shall be provided to permit installation and connection of the panelboard feeder conductors and standard conductors for all branch units to the maximum capacity of these units.

.5 Moulded Case Circuit Breakers

.1 Main circuit breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker. Main Circuit breakers that are located in Branch circuit breaker position shall not be used.

2.3 LIGHTING AND POWER PANELBOARDS

.1 Panelboards shall be moulded case circuit breaker type.

.2 Panel type, mounting, system voltage, main bus, main breaker, spare breakers, spaces, breaker ampere rating, number of poles, breaker arrangement and breaker type as well as special panelboard details shall be as noted in the panel schedules on the drawings. Bus bar material shall be copper. Provide all necessary jumpers, connectors, etc., for simple field installation of future circuit breakers. Provide integral main breaker, contactor, double lugs for double neutral conductors, insulated ground buses, and other special features when called for in the panel schedules or as indicated by feeder data.

.3 All panelboards shall be fitted with a branch circuit grounding terminal bus firmly bonded to the inside of the panelboard case and consisting of a length of copper grounding bus with one terminal for each circuit position available in the panel. Branch circuit equipment grounding conductors shall terminate at the ground bus.

.4 Provide, where noted, for certain panelboards, an insulated technical ground bus similar to the above except insulated from the case of the panelboard and complete with one lug capable of accepting the incoming insulated technical ground conductor from the master ground bus.

.5 All panelboards shall be fitted at the bottom or top of the panels as appropriate with a custom fabricated cabinet of the same dimensions, construction and finish as the panelboards and with a separate hinged door with catch and lock all to match the panelboard. Size cabinet to permit incoming cables to be splayed apart such that clamp-on current sensors can be temporarily installed around all phase and neutral conductors for energy metering.

.6 Panelboard enclosures capable of containing not more than 24 single-pole breakers rated 70 A or less shall not be less than 350 mm wide and 103 mm deep. Panelboard enclosures capable of containing more than 24 such breakers shall be not less than 500 mm wide unless specific approval for the use of narrower enclosures is obtained from the Engineer. Panelboard enclosures containing breakers rated above 70 A shall be at least 500 mm wide. All of the above notwithstanding, provide adequate wiring space as required by current CSA Specifications.

.7 Provide panelboards with trim, door, catch and lock. Provide 2 catches per door where necessary to ensure panel doors are flush with trim.

.8 Provide surface-mounted panelboards with "shoe box" trims.

.9 Flush-mounted panelboards shall have doors with concealed hinges. Panel trims shall not have any exposed screws or bolt heads. Panelboard trim shall be completely flat. Installations exhibiting a space between panel cover and the wall will be rejected.

.10 All breakers in all panelboards shall be of the same manufacturer.

.11 Plug-in type circuit breakers shall not be used.

.12 Two- and three-pole circuit breakers shall have a common tripping mechanism and single handle. Handle ties are not acceptable.

.13 Surface-mounted panelboards shall be of sprinkler-proof construction complete with water shields approved by the authorities having jurisdiction to prevent water due to sprinkler operation entering the equipment. All conduits penetrating the panelboard shall be sealed using water-tight hubs or "O" rings DSM.

2.4 PANELBOARD IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00

.2 Nameplate for each panelboard size 5 (2 line) engraved as indicated and include panel designation and voltage/phase.

.3 Complete circuit directory with typewritten card(s) located in slide-in plastic pocket(s) fixed to the back of the related door. Directory card to indicate the panel designation, mains size, voltage/phase and the location and load controlled of each circuit. Include a “letter sized” paper copy of each directory in the project maintenance manual.

.4 Provide a plasticized typewritten information card fixed to the back of each panel door. Information card to indicate the panel designation and location, feeder type and size and locations of any controlling contactors and feeder pullboxes. Include a “letter sized” paper copy of each information card in the project maintenance manual.

3 EXECUTION

3.1 INSTALLATION

.1 Locate panelboards as indicated and mount securely, plumb true and square, to adjoining surfaces.

.2 Mount panelboards to height given in Section 26 05 00 or as indicated.

.3 Connect loads to circuits as indicated.

.4 Connect neutral conductors to common neutral bus with respective neutral identified.

.5 Install 4 x 27 mm empty conduits (or equivalent) from each flush mounted panelboard single tub to accessible ceiling space above. Refer also to Section 26 05 34 – Conduits , Conduit Fastenings and Conduit Fittings.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 01 50 – General Instructions

.2 Section 26 05 00 - Common Work Results

1.2 REFERENCES

.1 CSA C22.1-2018

1.3 PRODUCT DATA

.1 Submit product data in accordance with Section 01 01 50.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 01 50.

Part 2 Products

2.1 SWITCHES

.1 Extra heavy-duty specification grade.

.2 20 A, 120 V, single pole, double pole, three-way, four-way switches as indicated.

.3 Manually-operated general-purpose ac switches as indicated and with following features:

- .1 Terminal holes approved for No.10 AWG wire.
- .2 Silver alloy contacts.
- .3 Urea or melamine molding for parts subject to carbon tracking.
- .4 Suitable for back and side wiring.
- .5 White toggle (red toggle for emergency power circuits).

.4 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rating capacity of motor loads.

.5 Switches of one manufacturer throughout project.

.6 Acceptable products or approved equal:

- .1 Arrow Hart 1900 series
- .2 Bryant 4900 series
- .3 Hubbell HBL.1221 series
- .4 Leviton 1221-2 series
- .5 Pass & Seymour PS20AC1 120V series

2.2 RECEPTACLES – GENERAL

.1 Extra heavy-duty specification grade.

.2 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, with following features:

- .1 White nylon molded housing (red for emergency power circuits, blue for surge protection)
- .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 non- riveted grounding contacts.

.3 Duplex receptacles with a CSA Configuration of 5-15R and 5-20R installed within the Living Unit shall be tamper-resistant. Receptacles dedicated for microwaves, refrigerators, freezers or kitchen counters are excluded.

.4 Receptacles of one manufacturer throughout project.

.5 Acceptable products or approved equal:

- .1 Arrow Hart 6262
- .2 Bryant 5262.
- .3 Hubbell 5262 series
- .4 Leviton 5262 series
- .5 Pass & Seymour 5262 series

2.3 RECEPTACLES – 20A

.1 Extra heavy-duty specification grade.

.2 Duplex receptacles, CSA type 5-20 RA, 125 V, 15/20 A, U ground, with following features:

- .1 White nylon molded housing (red for emergency power circuits)
- .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 non- riveted grounding contacts.

2.4 COVER PLATES

.1 Stainless steel: Type 302 or 304, No. 4 finish, 1mm thick, accurately die cut, protective cover for shipping. For general interior flush mounted wiring devices and surface type FS or FD type boxes.

.2 Steel: sheet steel hot dip galvanized with rolled edges for surface mounted utility boxes.

.3 Wall plates to be flush mounting with "positive bow" feature to ensure that all edges of plate are flush with wall or surface box when installed.

.4 All plates to be bevelled type with smooth rolled outer edge and smooth face. Exposed sharp edges are not acceptable.

.5 Cast metal: die cast profile, ribbed for strength, flash removed, primed with grey enamel finish and complete with four mounting screws to box for special purpose wiring devices.

.6 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for wiring devices as indicated. Double doors for standard duplex receptacles. Coverplates to fasten to box by four screws.

.7 Gaskets: resilient rubber or close cell foam urethane. All gaskets inside inmate cells shall be air tight type to maintain negative air pressure in the cells.

.8 Cover plates for all wiring devices to be from one manufacturer throughout project.

Part 3 Execution

3.1 INSTALLATION GENERAL

.1 Mount wiring devices to height specified in Section 26 05 00 or as indicated.

.2 Upper edge of plates located on separate outlets immediately alongside one another to be at exactly the same height above finished floor.

.3 All plates to be installed parallel or perpendicular to building lines.

3.2 INSTALLATION PARTICULAR

.1 Switches:

.1 Install single throw switches with handle in "UP" position when switch closed.

.2 Install switches in gang type outlet box when more than one switch is required in one location.

.2 Receptacles:

.1 Install all receptacles in the vertical plane unless otherwise noted.

.2 Generally install the 5-15/20R U ground pin down unless otherwise noted.

.3 Install receptacles vertically in gang type outlet box when more than one receptacle is required in one location.

.4 Where split receptacles has one portion switched, mount vertically and switch the upper portion.

.5 Ground fault interrupter duplex receptacles to be used, adjacent sinks or water sources.

.3 Cover plates:

.1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.

.2 Install suitable common cover plates where wiring devices are grouped.

.3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

.4 Use weatherproof cover plates in wet locations and where indicated.

.5 Provide a label on every switch and receptacle cover plate indicating panel and circuit number.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 01 50 – General Instructions

.2 Section 26 05 00 - Common Work Results

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA-C22.2 No. 5-02, Moulded-Case Circuit Breakers, Moulded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, tenth edition, and the second edition of NMX-J-266-ANCE).

1.3 PRODUCT DATA

.1 Submit product data in accordance with Section 01 01 50.

.2 Include time-current characteristic curves for breakers with ampacity of 100A and over or with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage.

Part 2 Products

2.1 BREAKERS - GENERAL

.1 Moulded-case circuit breakers, and ground-fault circuit-interrupters, and accessory high-fault protectors: to CSA C22.2 No. 5.

.2 Breakers shall be of the same manufacturer and have the same interrupting capacity of panel or panelboard into which it is being installed.

.3 Bolt-on moulded-case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40°C ambient.

.4 Plug-in moulded-case circuit breakers shall not be used.

.5 Common-trip breakers: with single handle for multi-pole applications.

.6 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.

.1 Trip settings on breakers with adjustable trips to range from 3-8 times current rating.

.7 Circuit breakers with interchangeable trips as indicated.

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.

Part 3 Execution

3.1 INSTALLATION

.1 Install circuit breakers as indicated.

END OF SECTION

Part 1 General

1.1 RELATED WORK

.1 Provide and locate safety disconnect switches to isolate individual items of equipment in accordance with Canadian Electrical Code CSA 22.1-2018 whether indicated or not on the contract drawings.

1.2 PRODUCT DATA

.1 Submit product data in accordance with Section 26 05 00 Common Work Results.

Part 2 PRODUCTS

2.1 DISCONNECT EQUIPMENT

.1 "Heavy Duty" class, enclosed manual air break switches in non-hazardous locations: to CSA C22.2 No.4.

.2 Fuseholder assemblies to CSA C22.2 No.39.

.3 Fusible and non-fusible disconnect switch shall be rated for NEMA 1 (for indoor use) and NEMA 4X (for outdoor use), size as indicated.

.4 Provision for padlocking in 'off' switch position.

.5 Fuses as indicated. Allow for Class J or L for general circuits, Class RK5 for transformer, motor or other high inrush current circuits.

.6 Fuseholders in each switch suitable without adaptors, for type of fuse as indicated.

.7 Quick-make, quick-break action.

.8 ON-OFF switch position indication on switch enclosure cover.

.9 Weatherproof as required.

2.2 EQUIPMENT IDENTIFICATION

.1 Provide identification lamacoid for main fused switch.

2.3 MAINTENANCE MATERIALS

.1 Provide maintenance materials in accordance with Section 26 05 00

Part 3 EXECUTION

3.1 INSTALLATION

.1 Install disconnect switches complete with fuses where indicated or required.

.2 Provide and locate safety disconnect switches to isolate individual items of equipment in accordance with Canadian Electrical Code CSA 22.1 whether indicated on not on the contract drawings.

END OF SECTION

Part 1 General

1.1 RELATED WORK

.1 Mechanical: Divisions 23 and 25

1.2 REQUIREMENTS

.1 Provide a complete system of wiring to motors and mechanical controls as specified herein and as shown on the drawings.

.2 Unless specifically noted otherwise, wire and leave in operation all electrically operated equipment supplied under contracts related to this project or relocated as part of the scope. Examine the drawings and shop drawings of all Divisions for the extent of electrically operated equipment supplied under other divisions.

.3 Unless specifically noted otherwise, supply all disconnects, relays, starters, etc., necessary for the operation of equipment. Check all starters, relay coils and thermal elements to ensure that they provide the necessary protection for motors.

.4 Do not operate motors and controls until approval is obtained from the trade providing equipment.

.5 Examine drawings and shop drawings of other Divisions to obtain exact location of motors and equipment shown on drawings. Where necessary, obtain conduit locations from other trades' drawings and shop drawings.

.6 Assist in placing in operation all mechanical equipment having electrical connections.

.7 Provide three phase starters with fused 120-volt control transformers and overload relays.

.8 Provide all power wiring for all motors.

.9 Provide power wiring for heating ventilating and air conditioning equipment. Provide terminations in starters and MCCs for control wiring so that starter control circuits may be extended. Where 120-volt power is required for mechanical equipment, i.e. roll type filters, refrigerated aftercoolers, control cabinets, etc. wiring to the equipment terminals is the work of this Division.

.10 Refer to Mechanical Equipment Schedule attached.

.11 The motor control work which shall be provided under Division 26 shall include the following:

- .1 All conduit and control wiring specifically noted on the drawings and outlined in the different parts of the Specification.
- .2 Conduit and control wiring for baseboard heaters, unit heater and force flow heater thermostats.
- .3 All control wiring as specified in the Motor Schedule.
- .4 Control wiring related to air handling shutdown during fire alarm.

Part 2 Products

2.1 3 PHASE MOTOR DISCONNECT SWITCHES

.1 Industrial Type "A", having quick make, quick break visible blade mechanism, cover interlocks and padlocking switch in the closed or open position. Use NEMA 4 enclosures outdoors, and NEMA 1 indoors, switches to be H.P. rated, heavy duty type.

2.2 120 VOLT, 1 PHASE DISCONNECT SWITCHES

.1 Manual disconnect switch HP rated (starter) without overload relay.

2.3 208 VOLT, 1 PHASE MOTOR DISCONNECT SWITCHES

.1 Manual disconnect switch HP rated (starter) without overload relay – two pole.

Part 3 Execution

3.1 INSTALLATION

.1 Provide disconnect switches adjacent to all motors.

.2 Provide all wiring between all force flow and unit heaters and their thermostats. Install wiring between all mechanical components to provide a functional system.

.3 Do control wiring as indicated on the drawings and the motor control schedules.

END OF SECTION

Part 1 General

1.1 RELATED WORK

.1 Section 26 05 00 – Common Work Results

.2 Section 26 98 00 – Testing, Adjusting and Balancing of Electrical Equipment

1.2 COORDINATION

.1 Coordinates starting of electrical equipment and systems with testing, adjusting and balancing, and demonstration and instruction of:

.1 Electrical equipment and systems specified in Division 26.

.2 Mechanical equipment and systems specified in Division 21, 22, 23 & 25.

.3 Other equipment and systems specified in other Divisions.

.2 Where any equipment or system requires testing, adjusting or balancing prior to starting, ensure that such work has been completed prior to starting of electrical equipment and systems.

Part 2 Products (not used)

Part 3 Execution

3.1 STARTING MOTORS

.1 Prior to starting motors:

.1 Perform Megger test on the motors.

.2 Verify phase rotation at motor control centres.

.3 Confirm motor nameplate data with motor starter heater overloads.

3.2 ENERGIZING EQUIPMENT

.1 Complete all testing and provide testing result to Departmental Representative prior to energizing equipment.

.2 Confirm equipment nameplate data with characteristics of power supply.

END OF SECTION

Part 1 General

1.1 INTENT

.1 Except where otherwise specified, arrange testing, adjusting, balancing and related requirements specified herein.

.2 If test results do not conform with applicable requirements, repair, replace, adjust or balance equipment and systems. Repeat testing as necessary until acceptable results are achieved.

.3 Provide all labour, materials, instruments and equipment necessary to perform the tests specified.

.4 All tests shall be witnessed by persons designated by the Departmental Representative, who shall also sign the test documentation.

1.2 RELATED WORK

.1 Section 26 05 00: Common Work Results

.2 Section 26 96 00: Starting of Electrical Equipment and Systems

1.3 MANUFACTURER'S PRODUCTION TEST RECORDS

.1 If requested, submit copies of production test records for production tests required by NEMA and CSA standards for manufactured electrical equipment.

1.4 SITE TESTING REPORTS

.1 Log and tabulate test results on appropriate test report forms. Submit forms to Departmental Representative for approval prior to use.

.2 Submit completed test report forms as specified, immediately after tests are performed.

1.5 REFERENCE DOCUMENTS

.1 Perform tests in accordance with:

.1 The Contract Documents
.2 Requirements of authorities having jurisdiction
.3 Manufacturer's published instructions
.4 Applicable CSA, IEEE, IPCEA, NEMA and ASTM standards

.2 If requirements of any of the foregoing conflict, notify Departmental Representative before proceeding with test and obtain clarification.

1.6 SEQUENCING AND SCHEDULING

.1 Except where otherwise specified, perform all testing, adjusting, balancing and related requirements specified herein prior to Interim Acceptance of the Work.

.2 Perform voltage testing and adjusting after user occupancy or utilization of facility.

Part 2 Products

2.1 TEST EQUIPMENT

.1 Provide all equipment and tools necessary to perform testing, adjusting and balancing specified herein and as otherwise required.

Part 3 Execution

3.1 TESTING OF WIRING AND WIRING DEVICES

.1 All power and control wiring shall be tested for insulation resistance value with a 1000-volt megger. Resistance values shall be as recommended by cable manufacturer. Test results shall be properly tabulated, signed, dated and submitted with maintenance manuals.

.2 Test service grounding conductors for ground resistance.

.3 Test all wiring devices for correct operation.

.4 Test all receptacles for proper polarity and circuitry.

3.2 LOAD BALANCE TESTING

.1 Perform load tests when as many loads as possible, prior to Interim Acceptance of the Work, are operable.

.2 Turn on all possible loads.

.3 Test load balance on all feeders at distribution centres, motor control centre and panelboards.

.4 If load imbalance exceeds 15%, reconnect circuits to balance loads.

3.3 VOLTAGE TESTING AND ADJUSTING

.1 Test voltage at all panelboards.

.2 Test voltage at motor starters.

.3 Adjust transformer tap settings to compensate for under-voltage or over-voltage conditions, if directed to do so by Departmental Representative.

END OF SECTION

PART 1 GENERAL

1.1 Reference Standards

.1 ASTM International
- .1 ASTM A121 - Standard Specification for Metallic-Coated Carbon Steel Barbed Wire; 2013.
- .2 ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- .3 ASTM F1665 - Standard Specification for Poly(Vinyl Chloride)(PVC) and Other Conforming Organic Polymer-Coated Steel Barbed Wire Used with Chain-Link Fence; 2008 (Reapproved 2013).

.2 Underwriters Laboratories of Canada (ULC)
- .1 CAN/ULC S138 - Standard Method of Test for Fire Growth of Insulated Building Panels in a Full-Scale Room Configuration; 2006.

.3 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-138.2-[96] , Steel Framework for Chain Link Fence.
- .2 CAN/CGSB-138.3-[96] , Installation of Chain Link Fence.
- .3 CAN/CGSB-1.181-[99] , Ready-Mixed Organic Zinc-Rich Coating.

.4 Master Painters Institute (MPI)
- .1 Architectural Painting Specification Manual - [current edition].

1.2 Action and Informational Submittals

.1 Provide submittals in accordance with Section 01 01 50 - General Instructions.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 Delivery, Storage and Handling

.1 Deliver, handle, store and protect materials in accordance with Section 01 01 50 - General Instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
- .1 Store materials in accordance with manufacturer's recommendations.
- .2 Store and protect fence and gate materials from damage.
- .3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to Work of this Section and in accordance with Section 01 01 05 General Instructions.

PART 2 PRODUCTS

2.1 Materials

.1 Fittings and hardware: to CAN/CGSB-138.2, galvanized steel
- .1 Include projection with clips or recesses to hold barbed wires.
- .2 Projection of as per drawing.

.2 Organic zinc rich coating: to CAN/CGSB-1.181.

.3 Galvanized steel arms shall be provided where barbed concertina is to be installed.

.4 Barbed tape concertina (B.T.C.) shall be galvanized tape 20 x 0.5 mm clenched around a 2.5 mm diameter spring steel galvanized core wire to form a concertina coil with a nominal exterior coil diameter of 710 mm. The coil, when installed, shall have a minimum diameter of 635 mm. The barbed concertina shall have 20 mm long blade type barbs measured from tip to tip of the blade, and barb clusters shall be spaced approximately 45 mm on centre. The concertina shall be formed by clipping adjacent loops of single helical coils together at a minimum of three (3) points on the circumference. Clips shall be galvanized. The resulting coil, when stretched, shall form a cylindrical pattern. The loop spacing shall not exceed 230 mm.

2.2 Finishes

.1 Galvanizing:
- .1 For barbed wire: to CAN/CGSB-138.2, Class 2.
- .2 For other fittings: to ASTM A123/A123M.

.2 Aluminum coating:
- .1 For barbed wire: to ASTM A121, Class 2 .

PART 3 EXECUTION

3.1 Examination

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

3.2 Temporary Construction Fences

.1 Temporary Construction fence is used primarily as a physical barrier to prevent unauthorized persons access to the site for reasons of safety and to protect the contractor’s assets. Contractor to pay for the rental and maintenance cost of the fence.

.3 Performance criteria:
- .1 Fence type shall be a self-supporting welded mesh sectional fence typically available by rental.

.2 The height of the fence shall be no less than 1800 mm high but may be higher depending on local availability.
.3 The fence must be stable and self supporting.
.4 Welded wire mesh is considered to be non-climbable due to its mesh size which inhibits the insertion of foot to aid climbing.
.5 Include additional vertical pointed projection over the top rail to discourage breach.
.6 Matching vehicle gates are padlocked after work hours.
.7 The temporary construction fence shall be removed from the institution by the contractor after construction is completed.

3.3 Relevant Specifications

.1 Rental construction protection fence comes with welded wire mesh and components conforming to ASTM F2919 Welded Mesh Fence specification. Mesh is galvanized steel no larger than 50X150mm (vertically long rectangle) with vertical wire projecting and exposed at top. Fence must be at least 1800mm high and secured with pins inserted in the ground through the 'T' base support. Sections of fence must be securely clamped together to ensure that each fence run acts as a continuous barrier which will resist lateral forces and separation. Sloped runs must be protected by mesh panels to ensure continuity of barrier from ground up.

3.4 Erection of Fence

.1 Install barbed wire strands and clip securely to lugs of each projection.

.2 The barbed tape concertina coils shall be supported and tied at 230 mm spacing onto each of the barbed wire.

3.5 Installation of Gates

.1 Install gates in locations as directed by Departmental Representative.

.2 Level ground between gate posts and set gate bottom approximately [40] mm above ground surface.

3.6 Touch Up

.1 Clean damaged surfaces with wire brush removing loose and cracked coatings. Apply two coats of organic zinc-rich paint to damaged areas as indicated.
.1 Pre-treat damaged surfaces according to manufacturers' instructions for zinc-rich paint.

3.7 Cleaning

.1 Progress Cleaning:
.1 Clean in accordance with Section 01 01 50 - General Instructions.
.2 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

END OF SECTION

Appendix

Appendix 5.21 FINDINGS AND RECOMMENDATIONS—BUILDING M2C/M2D—[redacted] (831-07-RP)

Building M2C/M2D—[redacted] (subject building) was reportedly constructed in 1965 and has been assigned Real Property ID #1536. The typical structural components and finishes associated with this two-story building consist of exterior brick and cast concrete walls; interior drywall and concrete walls; drywall, concrete and suspended tile ceilings; ceramic, vinyl tile and sheet flooring; and a flat asphalt membrane roof. It should be noted that the building is adjoined to building M2B—visiting & correspondence and may share some mechanical systems.

The results of the assessment for each of the considered hazardous materials within the subject building are provided in the following sub-sections.

It should be noted that the following building locations were not accessed during the project:

- Limited mechanical rooms (pipe chases) between cells were accessed. Those that were accessed are presumed to be representative of those that were not accessed.
- Limited cells were accessed. Accessed cells are presumed to be representative of those not accessed.
- Ceiling space areas other than those in the immediate vicinity of an access hatch
  - Although the ceiling space was visually reviewed from several access hatches, for safety reasons (clearance within the space limited our ability to move about safely), Stantec did not enter the ceiling space to assess conditions throughout.

The results of the assessment for each of the considered hazardous materials within the subject building are provided in the following sub-sections.

Floor plan drawings, which include locations of the samples collected during this assessment and locations of identified hazardous building materials (where practical), are attached to this Appendix.

5.21-1 ASBESTOS

The Previous Reports indicated the presence of the following ACMs, with notes regarding condition or other changes noted during the current assessment:

- Pipe insulation and air duct joint mastic in room 70 were identified as ACMs in the PGL, ACM Survey Report 2004. This room is now room 170 and is part of M2B - visiting & correspondence, and these ACMs have been reported with other information for Building M2B (see Appendix 5.20).
- Various materials in rooms 103, 105, 110 and 111 were identified as ACMs in the PGL, ACM Survey Report 2004. These rooms are part of M12—admission and discharge, and these ACMs have been reported with other information for Building M12 (see Appendix 5.11)..

- Pipe insulation in corridor 234 and 206 (PGL, ACM Survey Report 2004)
  - It should be noted that the PGL report does not include samples of any material fitting this description. This material may have been identified based on lab results from other buildings at Matsqui Institution.
  - This may refer to either cementitious pipe insulation applied to pipe fittings or tar paper jacketing applied around fibreglass pipe insulation. Although neither was observed by Stantec during the current assessment they may be present in wall cavities, pipe chases or other inaccessible areas of the subject building.
- Vinyl asbestos floor tile (9”x9” brown) throughout all cells 207 to 233, corridor 234 and 206 (PGL, ACM Survey Report 2004)
  - This material was not observed during the current assessment. This material is presumed to have been removed.
- Vinyl asbestos floor tile (12”x12” white) in rooms 201, 202, 203, 204 and 205 (PGL, ACM Survey Report 2004)
  - 12”x12” white floor tiles with green specs were observed in these locations, however, three samples collected during the current assessment all indicated no asbestos detected. As such, this material is not considered to be an ACM, and the previously identified ACM floor tiles are presumed to have been removed.
- 12”x12” white vinyl floor tiles in M2D room 203 (RJ Nine Buildings report 2010)
  - 12”x12” white floor tiles with green specs were observed in these locations, however, three samples collected during the current assessment all indicated no asbestos detected. As such, this material is not considered to be an ACM, and the previously identified ACM floor tiles are presumed to have been removed.
- Black/brown mastic in M2D room 203 – associated with vinyl floor tiles (RJ Nine Buildings report 2010)
  - RJ report indicates that the above 12”x12” white floor tile and the associated mastic are confirmed ACMs based on sampling conducted by RJ in 2009, however the laboratory certificate for samples of these materials could not be located in any of the reports provided to Stantec.
  - Sample of floor tile mastic collected by Stantec during the current assessment indicated no asbestos detected.
- Concealed packing material on elbows throughout
  - This material has been identified in various RJ reports for other buildings at Matsqui Institution. As similar elbows of the same vintage were observed to be present in the subject building during the current assessment this material should be presumed to be present and considered ACM until proven otherwise through further sampling/analysis.
  - Stantec cannot obtain confirmatory samples without disassembling pipe elbows
- Bell and spigot housings throughout
  - This material has been identified in various RJ reports for other buildings at Matsqui Institution. As similar fittings of the same vintage were observed to be present in the subject building during the current assessment this material should be presumed to be present and considered ACM until proven otherwise through further sampling/analysis.
  - Stantec cannot obtain confirmatory samples without disassembling bell and spigot fittings

- Grey floor tile sampled in M2C cell #14 room 89 (M2C Maxxam analytical results 2017)
  - Room 89 was not accessed during the current assessment. This ACM is presumed to remain.

In addition to the above, Stantec identified and sampled various additional suspected ACMs and/or collected confirmatory samples of previously identified ACMs. The samples collected were submitted to EMSL for analysis of asbestos content and nature.

A summary of the materials sampled as part of the current assessment, along with the sample locations and analytical results is presented in Table 5.21-1, below. A copy of the certificate of analysis provided by EMSL for the suspected ACM samples submitted as part of this assessment is attached at the end of this Appendix.

Table 5.21-1 Suspected ACM Sample Collection and Analysis Summary Building M2c/M2d—[redacted]

Material/Homogenous Application Description	Sample Number	Sample Location	Result (%/type asbestos)
M2c—J/C Unit—First Floor			
Black window pane caulking on cell windows	M2C-WPC-01A	Room 100, cell	None Detected
	M2C-WPC-01B	Room 79, cell	None Detected
	M2C-WPC-01C	Room 85, cell	None Detected
Black window pane caulking on bubble windows	M2C-WPC-02A	Room 73, control post	None Detected
	M2C-WPC-02B	Room 73, control post	None Detected
	M2C-WPC-02C	Room 73, control post	None Detected
Grey window frame caulking on bubble windows	M2C-WFC-01A	Exterior of room 73, control post	None Detected
	M2C-WFC-01B	Exterior of room 73, control post	None Detected
	M2C-WFC-01C	Exterior of room 73, control post	None Detected
12"x12" white floor tile with green spots	M2C-FT-01	Room 78, cell	None Detected
Tan seam sealant on cell furniture	M2C-SS-01A	Room 100, cell	None Detected
	M2C-SS-01B	Room 77, cell	None Detected
	M2C-SS-01C	Room 82, cell	None Detected
Black roof debris within pipe chase	M2C-RD-01A	Exterior south pipe chase	None Detected
	M2C-RD-01B	Exterior south pipe chase	None Detected
	M2C-RD-01C	Exterior south pipe chase	None Detected
Grey electrical penetration putty	**M2C-PP-01A**	**Exterior east wall**	**6.1% Chrysotile**
	M2C-PP-01B	**Exterior east wall**	**Positive Stop (Not Analyzed)**
	M2C-PP-01C	**Exterior east wall**	**Positive Stop (Not Analyzed)**

Table 5.21-1 Suspected ACM Sample Collection and Analysis Summary Building M2c/M2d—[redacted]

Material/Homogenous Application Description	Sample Number	Sample Location	Result (%/type asbestos)
Grey duct mastic on HVAC ducting	M2C-DM-02A	Exterior south pipe chase	None Detected
	M2C-DM-02B	Exterior south pipe chase	None Detected
	M2C-DM-02C	Exterior south pipe chase	None Detected
M2d—Dissociation—Second Floor			
Insulation paper on fiberglass	M2D-IP-01A	Room 203, control post	None Detected
	M2D-IP-01B	Room 203, control post	None Detected
	M2D-IP-01C	Room 203, control post	None Detected
12"x12" white floor tile with green specs	M2D-FT-01—Floor tile	Room 210, cell	None Detected
Mastic associated with 12"x12" white floor tile with green specs	M2D-FT-01—Mastic	Room 210, cell	None Detected
Black floor tile mastic associated with 12"x12" white floor tile mastic with green specs	M2D-FTM-01	Room 210, cell	None Detected
Black window pane caulking on cell windows	M2D-WPC-01A	Room 230, cell	None Detected
	M2D-WPC-01B	Room 209, cell	None Detected
	M2D-WPC-01C	Room 210, cell	None Detected
Black window pane caulking on bubble windows	M2D-WPC-02A	Room 203, control post	None Detected
	M2D-WPC-02B	Room 203, control post	None Detected
	M2D-WPC-02C	Room 203, control post	None Detected
Tan seam sealant on cell furniture	M2D-SS-01A	Room 230, cell	None Detected
	M2D-SS-01B	Room 209, cell	None Detected
	M2D-SS-01C	Room 210, cell	None Detected
Gold duct mastic applied to HVAC ducting	**M2D-DM-01A**	**Room 201, vestibule, pipe chase**	**6% Chrysotile**
	M2D-DM-01B	**Room 201, vestibule, pipe chase**	**Positive Stop (Not Analyzed)**
	M2D-DM-01C	**Room 201, vestibule, pipe chase**	**Positive Stop (Not Analyzed)**
2'x4' white fissure and pinhole ceiling tiles	M2D-CT-01A	Room 203, control post	None Detected
	M2D-CT-01B	Room 203, control post	None Detected
	M2D-CT-01C	Room 203, control post	None Detected
Drywall joint compound applied to walls and ceilings	M2D-DJC-01A	Room 203, control post	None Detected
	M2D-DJC-01B	Room 203, control post	None Detected

Table 5.21-1 Suspected ACM Sample Collection and Analysis Summary
Building M2c/M2d—[redacted]

Material/Homogenous Application Description	Sample Number	Sample Location	Result (%/type asbestos)
12"x12" white floor tile with green specs	M2D-FT-02A	Room 203, control post, along west wall	None Detected
	M2D-FT-02B	Room 203, control post, along south wall	None Detected
	M2D-FT-02C	Room 205, janitor closet	None Detected
12"x12" beige floor tile with green specs (single tile)	M2D-FT-03	Adjacent to exit door to exercise yard, second floor	None Detected
NOTE: Bold, highlighted text indicates confirmed ACM			

Based on our observations of building construction (estimated vintage of interior finishes and uniformity of building material use) and on our interpretations of the results of suspected ACM samples analyzed through the current assessment along with our review of the information provided in the Previous Reports, the materials presented in Table 5.21-2, below were identified as an ACMs.

Table 5.21-2 Summary of Identified ACMs
Building M2c/M2d—[redacted]

Identified ACM Description and Condition Information		Photo
Grey electrical penetration putty on the exterior east wall.		
Friability	Non-friable	
Condition	Good	
Total Quantity	Less than one square metre	
Content	6.1% Chrysotile	

Table 5.21-2 Summary of Identified ACMs
Building M2c/M2d—[redacted]

Identified ACM Description and Condition Information		Photo
Gold duct mastic applied to HVAC ducting throughout.		
Friability	Non-friable	
Condition	Good	
Total Quantity	Approximately 600 linear metres	
Content	6% Chrysotile	
Concealed packing material inside pipe elbows throughout should be considered ACM until proven otherwise through further sampling/analysis.		 Photo from RJ, M10 Room 202 Report, 2010
Friability	Non-friable	
Condition	Not observed	
Total Quantity	Not observed	
Content	1 to 5% Chrysotile (note that this sample was collected in building M10 at Matsqui Institution, not in the subject building, RJ, M10 Room 202 Report, 2010)	
Concealed material inside bell fittings throughout should be considered ACM until proven otherwise through further sampling/analysis.		
Friability	Non-friable	
Condition	Not observed	
Total Quantity	Not observed	
Content	No sampling information was found within the previous reports	

Table 5.21-2 Summary of Identified ACMs
Building M2c/M2d—[redacted]

Identified ACM Description and Condition Information		Photo
Tar paper jacket on fiberglass insulation (black mastic on pipe elbows/lagging/wrap). **This material was not observed but is potentially present, concealed within the pipe wrap itself, as part of older pipe wrap materials in locations that were not inspected as part of this assessment. (see section 5.21.1.1)**		No photo
Friability	Non-friable	
Condition	Not observed	
Total Quantity	Not observed	
Content	Not observed	
Cementitious insulation may be applied to pipe fittings in wall cavities, pipe chases or other inaccessible areas of the subject building. If discovered, this material should be presumed to be ACM until proven otherwise through further sampling/analysis.		No photo
Friability	Friable	
Condition	Not observed	
Total Quantity	Not observed	
Content	Not observed	
Grey floor tile sampled in M2C cell #14 room 89. Room 89 was not accessed during the current assessment. This material is presumed to remain present.		No photo
Friability	Non-friable	
Condition	Not observed	
Total Quantity	Not observed	
Content	1% Chrysotile (M2C Maxxam analytical results 2017)	

5.21.1.1. Tar Paper Jacket

Tar paper jacketing, also described as black mastic on lagging, elbows or wrap, has been identified as an ACM in several buildings throughout Matsqui Institution including the subject building. It is believed to be associated with pipe insulation jacketing that was used during the original construction of buildings within the institution in the 1960s. The asbestos that has been detected in this material is present in the tar (black mastic) that is applied to the paper jacketing. In many instances the tar is concealed as an inner layer (sandwiched between two layers of paper) of the jacketing and cannot be identified without cutting into the jacketing. In addition, jacketing which looks visually similar from the outside, but which does not include the ACM tar layer is present in many of the same buildings. As such, this material must be identified on a location by location basis as it may be disturbed by future renovation or demolition activities.

5.21.1.2. Potential Asbestos-Containing Vermiculite Insulation

As part of the assessment, Stantec assessed the subject building for areas where vermiculite insulation, a potential ACM, would likely be present. This included making note of attic spaces, floor cavities and masonry block or brick walls, which are typical areas where vermiculite is found. The following observations were made regarding areas where vermiculite is potentially present:

- Some walls of the subject building are comprised of brick and masonry blocks. To assess for the presence of vermiculite insulation the block wall cavity was drilled in two locations and no vermiculite was observed. Brick cavities were not drilled as part of this assessment.
- No other locations that may potentially contain vermiculite (that could not otherwise be assessed) were observed by Stantec

5.21-2 LEAD

Lead is expected to be present in the following within the subject building:

- Lead-acid batteries used in emergency lighting
- Older electrical wiring materials and sheathing
- Solder used on domestic water lines
- Solder used in bell fittings for cast iron pipes and in electrical equipment
- Ceramic tile glaze
- Vent and pipe flashings

With respect to paint, the following paints were considered LCPs through the Previous Reports based on an LCP definition criterion of 600 ppm lead (or greater), with notes regarding condition or other changes noted during the current assessment.

- Green paint on cell #15 angle iron (DST Pre-Reno Segregation Unit 2013)
  - Not observed during the current assessment but presumed to remain present under more recent paint applications
- Green paint on cell door frames (DST Pre-Reno Segregation Unit 2013)
  - Paint remains and was observed to be in good condition
- Grey paint on cell doors (DST Pre-Reno Segregation Unit 2013)
  - Aqua paint observed on cell doors was sampled and found to be non-lead containing.
- Black paint on segregation corridor door frames (DST Pre-Reno Segregation Unit 2013)
  - Aqua paint observed on cell doors was sampled and found to be non-lead containing.
- Grey paint on segregation corridor doors (DST Pre-Reno Segregation Unit 2013)
  - Aqua paint observed on cell doors was sampled and found to be non-lead containing.
- Grey paint on cell door tracks (DST Pre-Reno Segregation Unit 2013)
  - Paint remains and was observed to be in good condition.
- Black paint on cell door tracks (DST Pre-Reno Segregation Unit 2013)
  - Paint remains and was observed to be in good condition.
- Brown coloured paint on metal roof flashing (Stantec Roofing Report 2016)
  - Paint remains and was observed to be in good condition.

In addition to the above, chip samples were obtained from the predominant suspected LCP applications within the subject building. A summary of the sample types, locations and analytical results is presented in Table 5.21-3, below. A copy of the certificate of analysis provided by EMSL for the suspected LCP samples submitted is attached to this Appendix.

Table 5.21-3 Suspected LCP Sample Collection and Analysis Summary
Building M2c/M2d—[redacted]

Sample No.	Sample Colour/Substrate	Sample Location	Lab Result (ppm)
M2c—J/C Unit—First Floor			
M2C-P-01	White on concrete	Room 85, cell, walls	<82
M2C-P-02	Light blue on metal	Room 99, cell, doors	510
M2C-P-03	**Black on metal**	**Room 102, corridor, gates**	**1,300**

**Table 5.21-3 Suspected LCP Sample Collection and Analysis Summary
Building M2c/M2d—[redacted]**

Sample No.	Sample Colour/Substrate	Sample Location	Lab Result (ppm)
M2d—Dissociation Unit—Second Floor			
M2D-P-01	Aqua on metal	Room 234, corridor, doors	<81
M2D-P-02	White on concrete	Room 234, corridor, walls	<120
M2D-P-03	Black on concrete	Room 234, corridor, low trim	<81
M2D-P-04	Green/beige/blue on concrete	Room 230, cell, walls	<83
NOTE: Bold, highlighted text indicates confirmed LCP			

Based on our observations and on our interpretations of suspected LCP sample analytical results, the paints presented in Table 5.21-4, below were identified as LCPs:

**Table 5.21-4 Summary of Identified LCPs
Building M2c/M2d—[redacted]**

Identified LCP Description		Photo
Paint colour	Black	
Substrate	Metal	
Location/approx. extent	Corridor gates	
Lead content	1,300 ppm	
Condition	Good	

Table 5.21-4 Summary of Identified LCPs
Building M2c/M2d—[redacted]

Identified LCP Description		Photo
Paint colour	Green	
Substrate	Metal	
Location/approx. extent	Cell angle iron throughout	
Lead content	0.11 mg/cm^2 (approximately 1,650 ppm[1], DST Pre-Reno Segregation Unit 2013)	
Condition	Good	
Paint colour	Green	
Substrate	Metal	
Location/approx. extent	Cell door frames and some cell walls throughout	
Lead content	1.0 mg/cm^2 (approximately 15,000 ppm[1], DST Pre-Reno Segregation Unit 2013)	
Condition	Good	
Paint colour	Grey	
Substrate	Metal	
Location/approx. extent	Cell door tracks throughout	
Lead content	0.7 mg/cm^2 (approximately 10,500 ppm[1], DST Pre-Reno Segregation Unit 2013)	
Condition	Good	

[1] According to the 2011 publication "*Lead-Containing Paints and Coatings – Preventing Exposure in the Construction industry*, "Recent data collected in B.C. suggest that 0.04 mg/cm2 is equivalent to about 600 µg/g or 0.06% by weight; however, factors such as paint thickness may affect the results". This conversion factor has been utilized by Stantec to convert data from the referenced DST report into ppm for this report.

**Table 5.21-4 Summary of Identified LCPs
Building M2c/M2d—[redacted]**

Identified LCP Description		Photo
Paint colour	Black	
Substrate	Metal	
Location/approx. extent	Cell door tracks throughout	
Lead content	0.8 mg/cm^2 (approximately 12,000 ppm^2, DST Pre-Reno Segregation Unit 2013)	
Condition	Good	
Paint colour	Brown	
Substrate	Metal	
Location/approx. extent	Roof flashing and upper exterior siding	
Lead content	4,100 ppm (Stantec Roofing Report 2016)	
Condition	Good	

5.21-3 POLYCHLORINATED BIPHENYLS

PCBs may be present in the fluorescent light ballasts of the approximately 200 light fixtures observed. As the ballasts were energized, they could not be inspected at the time of the assessment for health and safety reasons.

[2] According to the 2011 publication "*Lead-Containing Paints and Coatings – Preventing Exposure in the Construction industry*, "Recent data collected in B.C. suggest that 0.04 mg/cm2 is equivalent to about 600 µg/g or 0.06% by weight; however, factors such as paint thickness may affect the results". This conversion factor has been utilized by Stantec to convert data from the referenced DST report into ppm for this report.

5.21-4 MERCURY

Mercury vapour is present in the light tubes within the approximately 200 fluorescent light fixtures observed.

5.21-5 MOULD

The observations pertaining to mould and/or moisture that were made during this assessment are summarized in Table 5.21-5, below.

Table 5.21-5 Mould/Moisture Observations Summary—November 5, 2018
Building M2c/M2d—[redacted]

Building Area	Observation	Suspected Source of Moisture	Photo
Second floor control bubble	Moisture-stained ceiling tiles	Pipe leaks, roof leaks or condensation overflow	

5.21-6 OZONE-DEPLETING SUBSTANCES

The following equipment is identified in the Halocarbon Inventory for the subject facility (provided by CSC) as having ODS-containing refrigerant:

- One Mitsubishi Ductless Heat Pump in CU-1 (R-22, 2.50 kg).

5.21-7 SILICA

Silica is expected to be present in the following, which were observed in various locations throughout:

- Cement products such as:
  - Concrete—foundations, floors, walls, blocks
  - Brick/masonry units and associated grout and mortar
  - Stone/ceramic floor tiles and associated grouts and mortars
- Gypsum and associated wall/ceiling finish materials
- Suspended ceiling tiles
- Asphalt and asphalt products containing rock or stone (e.g., roof membrane)

6.21 RECOMMENDATIONS

In general, identified hazardous building materials were observed to be in good condition and do not appear to require specific action to maintain compliance with applicable regulations for continued operations and maintenance. Refer to Section 6.0 of the main body of this report for applicable material-by-material general recommendations.

Additional building-specific recommendations to be considered are provided below.

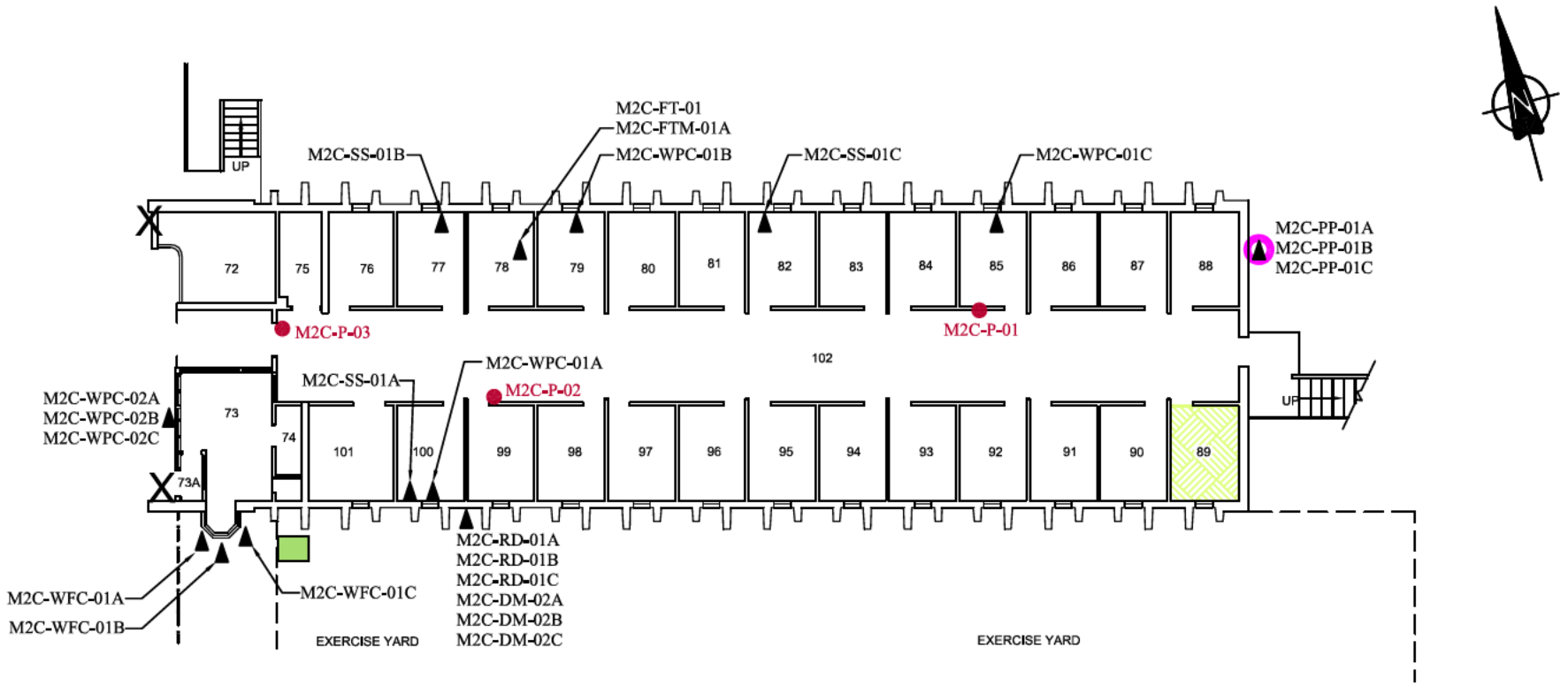
6.21-5 MOULD

Documents published by Health Canada, Ontario Ministry of Health, AIHA, ACGIH and others, provide guidance for interpreting the results of mould investigations. The Health Canada Guide states that:

> "…current knowledge supports the need to prevent damp conditions and mold growth and to remediate any fungal contamination in buildings."

To this end, Stantec recommends the following course of action within the subject building:

- Remove and replace moisture-stained ceiling tiles with new tiles. If staining re-appears on the new tiles, the source of moisture should be identified and corrected.
  - This work can be conducted by regular facility maintenance staff, if conducted prior to the onset of mould growth



FIRST FLOOR [redacted]

BUILDING M2C

LEGEND

- ASBESTOS BULK SAMPLE
- LEAD PAINT SAMPLE
- ACM PENETRATION PUTTY
- INTRUSIVE INVESTIGATION FOR VERMICULITE
- ACM FLOOR PRESUMED TO REMAIN PRESENT
- ODS EQUIPMENT

NOTES:

1. **GOLD MASTIC APPLIED TO HVAC DUCT SEAMS THROUGHOUT IS ASBESTOS-CONTAINING.**
2. **CONCEALED PACKING MATERIAL INSIDE PIPE ELBOWS THROUGHOUT SHOULD BE CONSIDERED ASBESTOS-CONTAINING UNTIL PROVEN OTHERWISE THROUGH FURTHER SAMPLING/ANALYSIS.**
3. **CONCEALED MATERIAL INSIDE BELL FITTINGS THROUGHOUT SHOULD BE CONSIDERED ASBESTOS-CONTAINING UNTIL PROVEN OTHERWISE THROUGH FURTHER SAMPLING/ANALYSIS.**
4. **TAR PAPER JACKET ON FIBERGLASS INSULATION IS ASBESTOS-CONTAINING WHERE PRESENT THROUGHOUT.**
5. **CEMENTITIOUS INSULATION APPLIED TO PIPE FITTING WHERE DISCOVERED THROUGHOUT SHOULD BE PRESUMED TO BE ASBESTOS-CONTAINING UNTIL PROVEN OTHERWISE THROUGH FURTHER SAMPLING/ANALYSIS.**
6. THIS DRAWING ILLUSTRATES SUPPORTING INFORMATION SPECIFIC TO A STANTEC CONSULTING LTD. REPORT AND MUST NOT BE USED FOR OTHER PURPOSES.

FLOOR PLAN SHOWING HAZARDOUS BUILDING MATERIALS AND BULK SAMPLE LOCATIONS

MATSQUI INSTITUTION
33344 KING ROAD, ABBOTSFORD, BC

Client: PUBLIC SERVICES AND PROCUREMENT CANADA

Project No.:	123221180
Scale:	N.T.S.
Date:	19/03/21
Dwn. By:	CD CS/DM SL2019030392
App'd By:	TW

Dwg. No.: 21.1

Stantec

BUILDING M2C		
[redacted] - First Floor		
Rm#	Name	Area m2
72	Kitchenette	11.89
73	Control Post	13.06
73a	Vestibule	1.55
74	Staff Washroom	3.64
75	Laundry	5.93
76-100	Cells	215.65
101	Shower	11.10
102	Corridor	100.08

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FLOOR PLAN SHOWING HAZARDOUS BUILDING MATERIALS AND BULK SAMPLE LOCATIONS

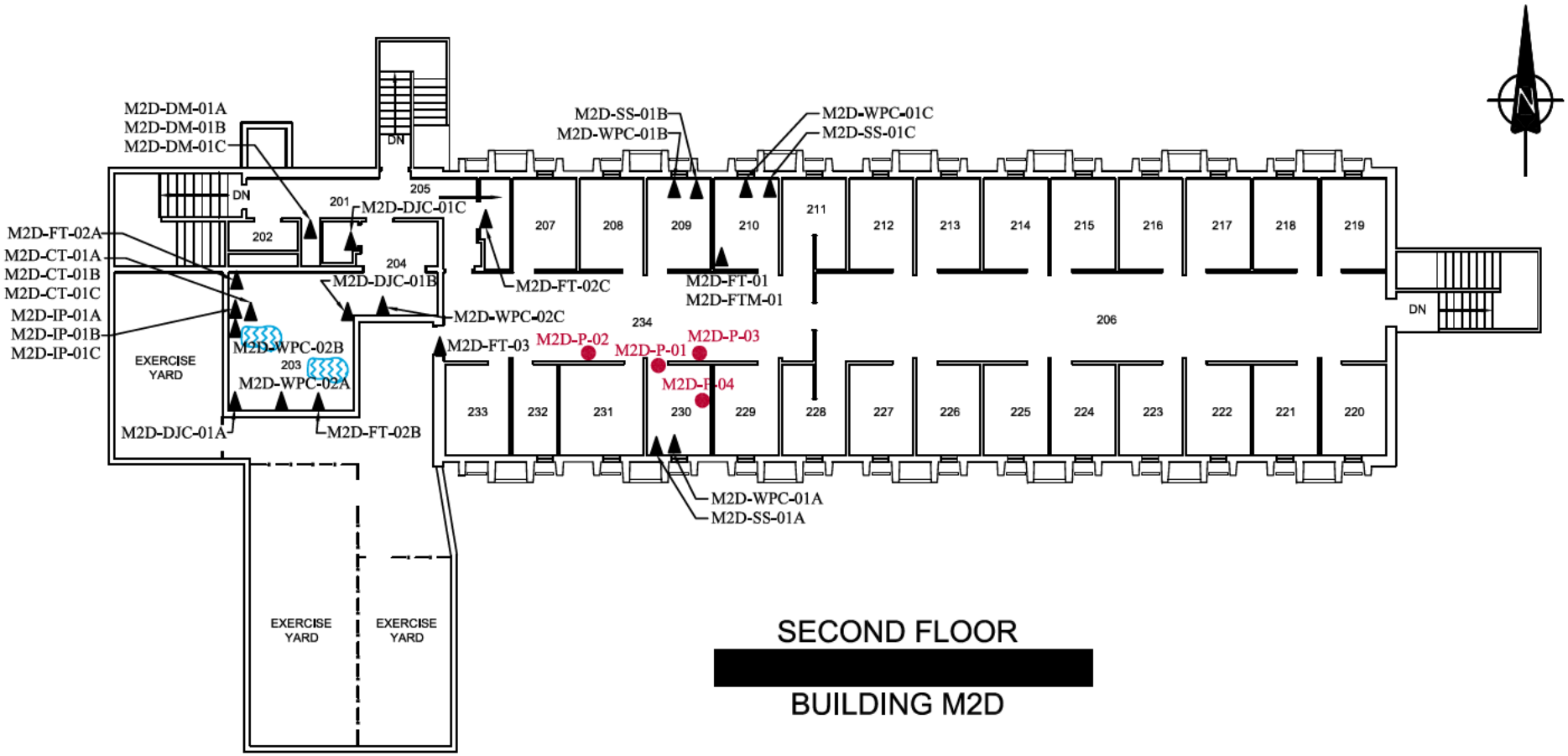
MATSQUI INSTITUTION
33344 KING ROAD, ABBOTSFORD, BC

Client: PUBLIC SERVICES AND PROCUREMENT CANADA

Project No.:	123221180
Scale:	N.T.S.
Date:	19/02/16
Dwn. By:	CD CS SL2019020316
App'd By:	TW

Dwg. No.: 21.2

Stantec



SECOND FLOOR

[redacted]

BUILDING M2D

LEGEND

- ASBESTOS BULK SAMPLE
- LEAD PAINT SAMPLE
- MOISTURE-STAINED CEILING TILES

NOTES:

1. GOLD MASTIC APPLIED TO HVAC DUCT SEAMS THROUGHOUT IS ASBESTOS-CONTAINING.
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3. CONCEALED MATERIAL INSIDE BELL FITTINGS THROUGHOUT SHOULD BE CONSIDERED ASBESTOS-CONTAINING UNTIL PROVEN OTHERWISE THROUGH FURTHER SAMPLING/ANALYSIS.
4. TAR PAPER JACKET ON FIBERGLASS INSULATION IS ASBESTOS-CONTAINING WHERE PRESENT THROUGHOUT.
5. CEMENTITIOUS INSULATION APPLIED TO PIPE FITTING WHERE DISCOVERED THROUGHOUT SHOULD BE PRESUMED TO BE ASBESTOS-CONTAINING UNTIL PROVEN OTHERWISE THROUGH FURTHER SAMPLING/ANALYSIS.
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FLOOR PLAN SHOWING HAZARDOUS BUILDING MATERIALS AND BULK SAMPLE LOCATIONS

MATSQUI INSTITUTION
33344 KING ROAD, ABBOTSFORD, BC

Client: PUBLIC SERVICES AND PROCUREMENT CANADA

Project No.:	123221180
Scale:	N.T.S.
Date:	19/03/21
Dwn. By:	CD SL2019030393 CS/DM
App'd By:	TW

Dwg. No.: 21.3

Stantec

BUILDING M2D		
[redacted] - Second Floor		
Rm#	Name	Area m2
201	Vestibule	18.20
202	Storage	4.08
203	Control Post	29.87
204	Staff Washroom	2.08
205	Janitor Closet	4.05
206	Corridor	96.10
207-10	Cells	34.14
211	B. F. Shower	8.54
212-27	Cells	138.82
228	Shower	8.54
229-30	Cells	17.07
231	B. F. Cell	10.97
232	Laundry Room	6.11
233	Interview Room	8.60
234	Corridor	112.66

NOTE: THIS DRAWING ILLUSTRATES SUPPORTING INFORMATION SPECIFIC TO A STANTEC CONSULTING LTD. REPORT AND MUST NOT BE USED FOR OTHER PURPOSES.

FLOOR PLAN SHOWING HAZARDOUS BUILDING MATERIALS AND BULK SAMPLE LOCATIONS

MATSQUI INSTITUTION
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Client: PUBLIC SERVICES AND PROCUREMENT CANADA

Project No.:	123221180
Scale:	N.T.S.
Date:	19/01/18
Dwn. By:	CD CS SL2019010222
App'd By:	TW

Dwg. No.: 21.4

Stantec

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EMSL Canada Order 691803201
Customer ID: 55JACQ30L
Customer PO: 123221180
Project ID:

Attn: Kim Wiese
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500 - 4730 Kingsway
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Phone: (604) 412-3004
Fax:
Collected:
Received: 11/28/2018
Analyzed: 12/05/2018

Proj: 123221180- M2C-[redacted] - FIRST FLOOR

Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

Client Sample ID: M2C-WPC-01A **Lab Sample ID:** 691803201-0007
Sample Description: Room 100, cell/Black window pane caulking on cell windows

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	12/05/2018	Black	0.0%	100%	None Detected	

Client Sample ID: M2C-WPC-01B **Lab Sample ID:** 691803201-0008
Sample Description: Room 79, cell/Black window pane caulking on cell windows

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	12/05/2018	Black	0.0%	100%	None Detected	

Client Sample ID: M2C-WPC-01C **Lab Sample ID:** 691803201-0009
Sample Description: Room 85, cell/Black window pane caulking on cell windows

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	12/05/2018	Black	0.0%	100%	None Detected	

Client Sample ID: M2C-WPC-02A **Lab Sample ID:** 691803201-0010
Sample Description: Room 73, control post/Black window pane caulking on bubble windows

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	12/05/2018	Black	0.0%	100%	None Detected	

Client Sample ID: M2C-WPC-02B **Lab Sample ID:** 691803201-0011
Sample Description: Room 73, control post/Black window pane caulking on bubble windows

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	12/05/2018	Black	0.0%	100%	None Detected	

Client Sample ID: M2C-WPC-02C **Lab Sample ID:** 691803201-0012
Sample Description: Room 73, control post/Black window pane caulking on bubble windows

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	12/05/2018	Black	0.0%	100%	None Detected	

Client Sample ID: M2C-WFC-01A **Lab Sample ID:** 691803201-0013
Sample Description: Exterior of room 73, control post/Grey window frame caulking on bubble windows

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	12/05/2018	Gray	0.0%	100%	None Detected	

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EMSL Canada Order 691803201
Customer ID: 55JACQ30L
Customer PO: 123221180
Project ID:

Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

Client Sample ID: M2C-WFC-01B ***Lab Sample ID:*** **691803201-0014**

Sample Description: Exterior of room 73, control post/Grey window frame caulking on bubble windows

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	12/05/2018	Gray	0.0%	100%	None Detected	

Client Sample ID M2C-WFC-01C ***Lab Sample ID*** **691803201-0015**

Sample Description: Exterior of room 73, control post/Grey window frame caulking on bubble windows

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	12/05/2018	Gray	0.0%	100%	None Detected	

Client Sample ID: M2C-FT-01 ***Lab Sample ID:*** **691803201-0016**

Sample Description: Room 78, cell/12”x12” white floor tile with green spots

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	12/05/2018	Various	0.0%	100%	None Detected	

Client Sample ID: M2C-SS-01A ***Lab Sample ID:*** **691803201-0021**

Sample Description: Room 100, cell/Tan seam sealant on cell furniture

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	12/05/2018	Tan	0.0%	100%	None Detected	

Client Sample ID: M2C-SS-01B ***Lab Sample ID:*** **691803201-0022**

Sample Description: Room 77, cell/Tan seam sealant on cell furniture

TEST	Analyzed Date	Color	Non Asbestos Fibrous	Non Fibrous	Asbestos	Comment
PLM	12/05/2018	Tan	28.0%	72.0%	None Detected	

Client Sample ID: M2C-SS-01C ***Lab Sample ID:*** **691803201-0023**

Sample Description: Room 82, cell/Tan seam sealant on cell furniture

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	12/05/2018	Tan	32.0%	68.0%	None Detected	

Client Sample ID: M2C-RD-01A ***Lab Sample ID:*** **691803201-0024**

Sample Description: Exterior south pipe chase/Black roof debris within pipe chase

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	12/05/2018	Black	0.0%	100%	None Detected	

Client Sample ID: M2C-RD-01B ***Lab Sample ID:*** **691803201-0025**

Sample Description: Exterior south pipe chase/Black roof debris within pipe chase

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	12/05/2018	Black	0.0%	100%	None Detected	

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EMSL Canada Order 691803201
Customer ID: 55JACQ30L
Customer PO: 123221180
Project ID:

Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

Client Sample ID: M2C-RD-01C **Lab Sample ID:** **691803201-0026**
Sample Description: Exterior south pipe chase/Black roof debris within pipe chase

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	12/05/2018	Black	0.0%	100%	None Detected	

Client Sample ID M2C-PP-01A **Lab Sample ID** **691803201-0027**
Sample Description: Exterior east wall/Grey electrical penetration putty

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	12/05/2018	Gray	0.0%	93.9%	**6.1% Chrysotile**	

Client Sample ID: M2C-PP-01B **Lab Sample ID:** **691803201-0028**
Sample Description: Exterior east wall/Grey electrical penetration putty

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	12/05/2018				Positive Stop (Not Analyzed)	

Client Sample ID: M2C-PP-01C **Lab Sample ID:** **691803201-0029**
Sample Description: Exterior east wall/Grey electrical penetration putty

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	12/05/2018				Positive Stop (Not Analyzed)	

Client Sample ID: M2C-DM-02A **Lab Sample ID:** **691803201-0030**
Sample Description: Exterior south pipe chase/Grey duct mastic on HVAC ducting

TEST	Analyzed Date	Color	Non Asbestos Fibrous	Non Fibrous	Asbestos	Comment
PLM Grav. Reduction	12/05/2018	Gray	0.0%	100%	None Detected	

Client Sample ID: M2C-DM-02B **Lab Sample ID:** **691803201-0031**
Sample Description: Exterior south pipe chase/Grey duct mastic on HVAC ducting

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	12/05/2018	Gray	0.0%	100%	None Detected	

Client Sample ID M2C-DM-02C **Lab Sample ID** **691803201-0032**
Sample Description: Exterior south pipe chase/Grey duct mastic on HVAC ducting

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	12/05/2018	Gray	0.0%	100%	None Detected	

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EMSL Canada Order 691803201
Customer ID: 55JACQ30L
Customer PO: 123221180
Project ID:

Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

Analyst(s):

Stuart Kinquist PLM (2)
PLM Grav. Reduction (18)

Reviewed and approved by:

Nicole Yeo, Laboratory Manager
or Other Approved Signatory

None Detected = <0.1%. EMSL maintains liability limited to cost of analysis. This report relates only to the samples reported above and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. Interpretation and use of test results are the respons bility of the client. Samples received in good condition unless otherwise noted. This report must not be used to claim product endorsement by NVLAP of any agency of the U.S. Government.

Samples analyzed by EMSL Analytical, Inc. Saint Louis, MO NVLAP Lab Code 200742-0

Report amended: 03/22/201909:58:02 Replaces amended report from: 03/01/201917:28:16 Reason Code: Client-Change to Location

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EMSL Canada Order 691803202
Customer ID: 55JACQ30L
Customer PO: 123221180
Project ID:

Attn: Kim Wiese
Stantec Consulting Ltd.
500 - 4730 Kingsway
Burnaby, BC V5H 0C6

Phone: (604) 412-3004
Fax:
Collected:
Received: 11/28/2018
Analyzed: 12/05/2018

Proj: 123221180-M2D-[redacted] - SECOND FLOOR

Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

Client Sample ID: M2D-IP-01A **Lab Sample ID:** 691803202-0001
Sample Description: Room 203, control post/Insulation paper on fiberglass

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	12/04/2018	Brown	90.0%	10.0%	None Detected	

Client Sample ID: M2D-IP-01B **Lab Sample ID:** 691803202-0002
Sample Description: Room 203, control post/Insulation paper on fiberglass

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	12/04/2018	Brown	90.0%	10.0%	None Detected	

Client Sample ID: M2D-IP-01C **Lab Sample ID:** 691803202-0003
Sample Description: Room 203, control post/Insulation paper on fiberglass

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	12/04/2018	Brown	90.0%	10.0%	None Detected	

Client Sample ID: M2D-FT-01-Vinyl Floor Tile **Lab Sample ID:** 691803202-0004
Sample Description: Room 210, cell/12"x12" white floor tile mastic with green specs - Floor Tile

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	12/04/2018	White/Green	0.0%	100%	None Detected	

Client Sample ID: M2D-FT-01-Mastic **Lab Sample ID:** 691803202-0004A
Sample Description: Room 210, cell/12"x12" white floor tile mastic with green specs

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	11/30/2018	Black	0%	100%	None Detected	

Client Sample ID: M2D-FTM-01A **Lab Sample ID:** 691803202-0005
Sample Description: Room 210, cell/Black floor tile mastic associated with 12"x12" white floor tile mastic with green specs

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	12/05/2018	Black	0.0%	100.0%	None Detected	

Client Sample ID: M2D-WPC-01A **Lab Sample ID:** 691803202-0006
Sample Description: Room 230, cell/Black window pane caulking on cell windows

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	12/05/2018	Black	3.0%	97.0%	None Detected	

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Customer PO: 123221180
Project ID:

Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

Client Sample ID: M2D-WPC-01B **Lab Sample ID:** **691803202-0007**
Sample Description: Room 209, cell/Black window pane caulking on cell windows

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	12/05/2018	Black	4.0%	96.0%	None Detected	

Client Sample ID: M2D-WPC-01C **Lab Sample ID:** **691803202-0008**
Sample Description: Room 210, cell/Black window pane caulking on cell windows

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	12/05/2018	Black	3.0%	97.0%	None Detected	

Client Sample ID: M2D-WPC-02A **Lab Sample ID:** **691803202-0009**
Sample Description: Room 203, control post/Black window pane caulking on bubble windows

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	12/05/2018	Black	0.0%	100.0%	None Detected	

Client Sample ID: M2D-WPC-02B **Lab Sample ID:** **691803202-0010**
Sample Description: Room 203, control post/Black window pane caulking on bubble windows

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	12/05/2018	Black	0.0%	100.0%	None Detected	

Client Sample ID: M2D-WPC-02C **Lab Sample ID:** **691803202-0011**
Sample Description: Room 203, control post/Black window pane caulking on bubble windows

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	12/05/2018	Black	0.0%	100.0%	None Detected	

Client Sample ID: M2D-SS-01A **Lab Sample ID:** **691803202-0012**
Sample Description: Room 230, cell/Tan seam sealant on cell furniture

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	12/05/2018	Gray	0.0%	100.0%	None Detected	

Client Sample ID: M2D-SS-01B **Lab Sample ID:** **691803202-0013**
Sample Description: Room 209, cell/Tan seam sealant on cell furniture

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	12/05/2018	Gray	0.0%	100.0%	None Detected	

Client Sample ID: M2D-SS-01C **Lab Sample ID:** **691803202-0014**
Sample Description: Room 210, cell/Tan seam sealant on cell furniture

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM	12/05/2018	White	0.0%	100.0%	None Detected	

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EMSL Canada Order 691803202
Customer ID: 55JACQ30L
Customer PO: 123221180
Project ID:

Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

Client Sample ID: M2D-DM-01A **Lab Sample ID:** **691803202-0015**

Sample Description: Room 201, vestibule, pipe chase/Gold duct mastic applied to HVAC ducting

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	12/05/2018	Gold	0.0%	94.0%	6% Chrysotile	

Client Sample ID: M2D-DM-01B **Lab Sample ID:** **691803202-0016**

Sample Description: Room 201, vestibule, pipe chase/Gold duct mastic applied to HVAC ducting

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	12/05/2018				Positive Stop (Not Analyzed)	

Client Sample ID: M2D-DM-01C **Lab Sample ID:** **691803202-0017**

Sample Description: Room 201, vestibule, pipe chase/Gold duct mastic applied to HVAC ducting

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	12/05/2018				Positive Stop (Not Analyzed)	

Client Sample ID: M2D-CT-01A **Lab Sample ID:** **691803202-0018**

Sample Description: Room 203, control post/2'x4' white fissure and pinhole ceiling tiles

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	12/04/2018	Gray	85.0%	15.0%	None Detected	

Client Sample ID: M2D-CT-01B **Lab Sample ID:** **691803202-0019**

Sample Description: Room 203, control post/2'x4' white fissure and pinhole ceiling tiles

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	12/04/2018	Gray	85.0%	15.0%	None Detected	

Client Sample ID: M2D-CT-01C **Lab Sample ID:** **691803202-0020**

Sample Description: Room 203, control post/2'x4' white fissure and pinhole ceiling tiles

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	12/04/2018	Gray	85.0%	15.0%	None Detected	

Client Sample ID: M2D-DJC-01A **Lab Sample ID:** **691803202-0021**

Sample Description: Room 203, control post/Drywall joint compound applied to walls and ceilings

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	12/04/2018	White	0.0%	100.0%	None Detected	

Client Sample ID: M2D-DJC-01B **Lab Sample ID:** **691803202-0022**

Sample Description: Room 203, control post/Drywall joint compound applied to walls and ceilings

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	12/04/2018	White	0.0%	100.0%	None Detected	

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EMSL Canada Order 691803202
Customer ID: 55JACQ30L
Customer PO: 123221180
Project ID:

Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

Analyst(s):

Ewa Krupinska	PLM (14)
Hilary Belleville	PLM (2) PLM Grav. Reduction (1)
Simon Parent	PLM (4)

Reviewed and approved by:

Nicole Yeo, Laboratory Manager
or Other Approved Signatory

None Detected = <0.1%. EMSL maintains liability limited to cost of analysis. This report relates only to the samples reported above and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. Interpretation and use of test results are the respons bility of the client. Samples received in good condition unless otherwise noted. This report must not be used to claim product endorsement by NVLAP of any agency of the U.S. Government.

Samples analyzed by EMSL Canada Inc. Ottawa, ON

Report amended: 03/22/201909:51:01 Replaces amended report from: 03/22/201909:50:05 Reason Code: Client-Change to Location

EMSL Canada Inc.

4506 Dawson Street Burnaby, BC V5C 4C1
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EMSL Canada Order 691900674
Customer ID: 55JACQ30L
Customer PO: 123221180
Project ID:

Attn: Keith Irwin
Stantec Consulting Ltd.
500 - 4730 Kingsway
Burnaby, BC V5H 0C6

Phone: (604) 412-3004
Fax:
Collected:
Received: 3/13/2019
Analyzed: 3/14/2019

Proj: 123221180

Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

Client Sample ID: M2D-FT-02A ***Lab Sample ID:*** **691900674-0001**

Sample Description: ROOM 203, CONTROL POST, ALONG WEST WALL/12"X12" WHITE FLOOR TILE WITH GREEN SPECS

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	3/14/2019	Gray	0.0%	100%	None Detected	

Client Sample ID: M2D-FT-02B ***Lab Sample ID:*** **691900674-0002**

Sample Description: ROOM 203, CONTROL POST, ALONG SOUTH WALL/12"X12" WHITE FLOOR TILE WITH GREEN SPECS

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	3/14/2019	Gray	0.0%	100%	None Detected	

Client Sample ID: M2D-FT-02C ***Lab Sample ID:*** **691900674-0003**

Sample Description: ROOM 205 (JANITOR CLOSET)/12"X12" WHITE FLOOR TILE WITH GREEN SPECS

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	3/14/2019	Gray	0.0%	100%	None Detected	

Client Sample ID: M2D-FT-03 ***Lab Sample ID:*** **691900674-0004**

Sample Description: ADJACENT TO EXIT DOOR TO EXERCISE YARD (2ND FLOOR)/12"X12" BEIGE FLOOR TILE WITH GREEN SPECS (SINGLE TILE)

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Fibrous	Asbestos	Comment
PLM Grav. Reduction	3/14/2019	Gray	0.0%	100%	None Detected	

Analyst(s):

Nicole Yeo PLM Grav. Reduction (4)

Reviewed and approved by:

Nicole Yeo, Laboratory Manager
or Other Approved Signatory

None Detected = <0.1%. EMSL maintains liability limited to cost of analysis. This report relates only to the samples reported above and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. Interpretation and use of test results are the respons bility of the client. Samples received in good condition unless otherwise noted. This report must not be used to claim product endorsement by NVLAP of any agency of the U.S. Government.

Samples analyzed by EMSL Canada Inc. Burnaby, BC

Report amended: 03/29/201916:09:01 Replaces initial report from: 03/14/201910:15:52 Reason Code: Client-Change to Appearance

EMSL Canada Inc.
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EMSL Canada Or	551814226
CustomerID:	55JACQ30L
CustomerPO:	123221180
ProjectID:	

Attn: **Kim Wiese**
Stantec Consulting Ltd.
500 - 4730 Kingsway
Burnaby, BC V5H 0C6

Phone: (604) 412-3004
Fax:
Received: 11/28/18 10:43 AM
Collected:

Project: **123221180**

Test Report: Lead in Paint Chips by Flame AAS (SW 846 3050B/7000B)*

Client SampleDescription	Collected	Analyzed	Weight	RDL	Lead Concentration
M2C-P-01		11/30/2018	0.2425 g	82 ppm	<82 ppm
551814226-0020	Site: M2C - [redacted] - FIRST FLOOR - WHITE ON CONCRETE - ROOM 85, CELL, WALLS				
M2C-P-02		11/30/2018	0.2443 g	82 ppm	510 ppm
551814226-0021	Site: M2C - [redacted] - FIRST FLOOR - LIGHT BLUE ON METAL- ROOM 99, CELL, DOORS				
M2C-P-03		11/30/2018	0.2401 g	83 ppm	1300 ppm
551814226-0022	Site: M2C - [redacted] - FIRST FLOOR - BLACK ON METAL - ROOM 102, CORRIDOR, GATES				

Rowena Fanto, Lead Supervisor
or other approved signatory

*Analysis following Lead in Paint by EMSL SOP/Determination of Environmental Lead by FLAA. Reporting limit is 0.010 % wt based on the minimum sample weight per our SOP. Unless noted, results in this report are not blank corrected. This report relates only to the samples reported above and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities. Samples received in good condition unless otherwise noted. "<" (less than) result signifies that the analyte was not detected at or above the reporting limit. Measurement of uncertainty is available upon request. The QC data associated with the sample results included in this report meet the recovery and precision requirements unless specifically indicated otherwise. Definitions of modifications are available upon request.

Samples analyzed by EMSL Canada Inc. Mississauga, ON A2LA Accredited Environmental Testing Cert #2845.08

Initial report from 12/05/2018 10:28:13

EMSL Canada Inc.
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EMSL Canada Or	551814226
CustomerID:	55JACQ30L
CustomerPO:	123221180
ProjectID:	

Attn: **Kim Wiese**
Stantec Consulting Ltd.
500 - 4730 Kingsway
Burnaby, BC V5H 0C6

Phone: (604) 412-3004
Fax:
Received: 11/28/18 10:43 AM
Collected:

Project: **123221180**

Test Report: Lead in Paint Chips by Flame AAS (SW 846 3050B/7000B)*

Client SampleDescription	*Collected*	*Analyzed*	*Weight*	*RDL*	*Lead Concentration*
M2D-P-01		11/30/2018	0.2454 g	81 ppm	<81 ppm
551814226-0023	Site: M2D - [redacted] - SECOND FLOOR - AQUA ON METAL- ROOM 234, CORRIDOR , DOORS				
M2D-P-02		11/30/2018	0.1632 g	120 ppm	<120 ppm
551814226-0024	Site: M2D - [redacted] - SECOND FLOOR - WHITE ON CONCRETE - ROOM 234, CORRIDOR, WALLS Insufficient sample to reach reporting limit.				
M2D-P-03		11/30/2018	0.2457 g	81 ppm	<81 ppm
551814226-0025	Site: M2D - [redacted] - SECOND FLOOR - BLACK ON CONCRETE - ROOM 234, CELL, LOW TRIM				
M2D-P-04		11/30/2018	0.2408 g	83 ppm	<83 ppm
551814226-0026	Site: M2D - [redacted] - SECOND FLOOR - GREEN/BEIGE/BLUE ON CONCRETE - ROOM 230, CELL, WALLS				

Rowena Fanto, Lead Supervisor
or other approved signatory

*Analysis following Lead in Paint by EMSL SOP/Determination of Environmental Lead by FLAA. Reporting limit is 0.010 % wt based on the minimum sample weight per our SOP. Unless noted, results in this report are not blank corrected. This report relates only to the samples reported above and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities. Samples received in good condition unless otherwise noted. "<" (less than) result signifies that the analyte was not detected at or above the reporting limit. Measurement of uncertainty is available upon request. The QC data associated with the sample results included in this report meet the recovery and precision requirements unless specifically indicated otherwise. Definitions of modifications are available upon request.

Samples analyzed by EMSL Canada Inc. Mississauga, ON A2LA Accredited Cert #2845 08; AIHA-LAP, LLC - ELLAP #196142

Report Amended: 04/09/2019 13:42:15 Replaces Report Amended: 04/08/2019 09:00:27. Reason Code: Client-Change to Location

Stantec

PRE-RENOVATION HAZARDOUS BUILDING MATERIALS ASSESSMENT—SITE REVIEW REPORT

Client:	Integral Group	Report #:	001
Stantec Site Rep.:	Amanda Bell	Stantec Project #:	123221653
		Site Review Date:	August 13, 2020
Location:	CSC Matsqui Institution—Building M2C/M2D 33344 King Road, Abbotsford, BC	Issued Date:	August 28, 2020

Reference: **Design of Under-Slab Supply Venting at Matsqui Institution Building M2C/M2D (Living Unit 5)**

Stantec Consulting Ltd. (Stantec) was retained by Integral Group on behalf of Public Services and Procurement Canada (PSPC) for to complete a pre-renovation hazardous building materials assessment in support of the planned under-slab supply venting renovation project (the Project) planned for building M2C/M2D (subject building) located at CSC Matsqui Institution at 33344 King Road, Abbotsford, British Columbia (BC).

The assessment intended to supplement the information in the following reports (Previous Reports):

- Stantec March 2019 report on Project No. 123221180 “Hazardous Building Materials Assessments—39 Buildings/Structures at CSC Matsqui Institution, 33344 King Road, Abbotsford, BC” prepared for Public Services and Procurement Canada (Stantec Report 2019)
- RJ & Associates Environmental Consulting Inc. Report entitled *Localized Investigation Report for Hazardous Containing Materials Located within Room #202, Chapel Building #M10, Matsqui Institution, 33344 King Road, Abbotsford, BC* dated April 28, 2010, prepared for Public Works and Government Services Canada (RJ, M10 Room 202 Report 2010)
- RJ & Associates Environmental Consulting Inc. Report entitled *Localized Investigation Report for Hazardous Containing Materials Located in mechanical Room #4, & Roof top Admission/Discharge building M12—Matsqui Institution, 33344 King Road, Abbotsford, BC* dated April 28, 2010, prepared for Public Works and Government Services Canada (RJ Admission/Discharge Report 2010)
- Pottinger Gaherty Environmental Consultants Ltd. Report No. 125-54.01 entitled *Asbestos Containing Material Survey Report, Matsqui Maximum Security Institution, Abbotsford, British Columbia* dated March 2004, prepared for Public Works and Government Services Canada (PGL, ACM Survey Report 2004)
- DST Consulting Engineers Report No. BE-VC-016546 entitled *Final Pre-Renovation, Hazardous Building Materials Assessment—Matsqui Institution Segregation Unit—33344 King Road, Abbotsford, BC* dated May 1, 2013, prepared for Public Works and Government Services Canada (DST Pre-Reno Segregation Unit 2013)

The purpose of the assessment was to document hazardous building materials that may require special management practices during the Project, in accordance with the requirements of the Canada Labour Code, Part II Canada Occupational Health and Safety Regulations (COHSR) and the current version of British Columbia’s Occupational Health & Safety Regulation (BC Reg. 296/97).

STANDARDS, SCOPE AND METHODOLOGY

Site work was carried out in accordance with the requirements of COHSR, BC Reg. 296/97 and Stantec's Safe Work Practices (SWPs).

The Previous Reports were reviewed to provide an understanding of the identities and locations of previously identified hazardous building materials, prior to completing a site assessment. A site assessment was completed to document whether previously identified hazardous building materials would be impacted by the Project, and to conduct supplemental assessment of materials and/or areas to be impacted by the Project that were not considered during the development of the Previous Reports, which was preliminary in nature.

Mechanical systems, structures and finishes associated with the subject building were visually examined to determine the presence of the following hazardous building materials (both previously identified and newly suspected), specifically pertaining to those building materials that may be impacted by the Project:

- Asbestos-containing materials (ACMs)
- Lead, including lead-containing paints (LCPs)
- Other hazardous building materials including electrical equipment containing polychlorinated biphenyls (PCBs); building materials impacted by mould; electrical items containing mercury; equipment that may contain ozone-depleting substances (ODSs); and materials presumed to contain silica

Applicable standards for each of the hazardous building materials considered during this assessment are summarized below, along with the scope and methodology completed pertaining to those materials, during this assessment.

- Asbestos
  - According to the current version of BC Reg. 296/97, ACM means any material containing at least 0.5% asbestos, or vermiculite insulation with any asbestos.
  - Where observed, samples were collected from each "homogenous application" of additional suspected ACMs (materials suspected to contain asbestos that are uniform in material type, colour, texture application and estimated installation date) that may be impacted by renovation work, and submitted to EMSL Canada Inc. (EMSL) in Vancouver, BC for analysis of asbestos content using polarized light microscopy (PLM) with dispersion staining, in accordance with the United States Environmental Protection Agency (EPA) 600/R-93/116 analytical method "Asbestos (bulk) by PLM." EMSL's analytical laboratory is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP).
  - The number of samples collected for each homogenous application of a suspected ACM was based on the recommendations provided in the 2017 WorkSafeBC publication "Safe Work Practices for Handling Asbestos", along with the assessor's experience and understanding of the consistency of the observed building material applications.
    - When asbestos is detected in concentrations greater than half of one percent in one of the samples within a set that was collected to represent a "homogenous application" of a particular material (or detected in any concentration, in a set of samples collected for applications of vermiculite), the entire sample set,
      and the entire application of that material is then considered to be an ACM.
- Lead
  - Work involving LCPs and lead-containing coatings in British Columbia is to be conducted in accordance with applicable regulations, guidelines and standards including, but not limited to the current versions of the following, at a minimum:
    - The WorkSafeBC 2017 publication entitled Safe Work Practices for Handling Lead (BC Lead Guide)

  - BC Reg. 296/97
- With respect to potential lead exposures associated with disturbance to surfaces coated with lead-containing products, the 2011 WorkSafeBC manual titled Lead-Containing Paint and Coatings: Preventing Exposure in the Construction Industry, indicates the following:
  - The improper removal of lead paint containing 600 mg/kg (equivalent to “parts per million” or “ppm”) lead results in airborne lead concentrations that exceed half of the exposure limit.
    - This potential for exposure exceeding half of the occupational exposure limit would be the trigger for implementation of an exposure control plan.
  - Lead concentrations as low as 90 mg/kg may present a risk to pregnant women and children.
    - Any risk assessment should include for the presence of high risk individuals within the workplace.
- In addition to the above, the BC Lead Guide indicates the following:
  - Unlike for asbestos-containing material, WorkSafeBC does not numerically define what would be considered a lead-containing paint or coating. All suspected paints or coatings should be tested for lead because, depending on the nature of the work, even a small amount could pose a risk to workers. In order to determine which controls and personal protective equipment would be required for a particular job, a qualified person must consider this information as part of the risk assessment.
- Further, using an arc welder or oxyacetylene torch on steel that is coated with lead-containing paint can create hazardous lead fumes and is prohibited by section 12.115 of BC Reg. 296/97. In addition, the following information is provided in the Lead Guideline:
  - Welding or torch cutting of paints or coatings on metal can create very high concentrations of airborne lead fumes. Torch cutting structural steel, coated with paint containing as little as 130 mg/kg (equivalent to ppm) lead, can release airborne levels of lead as high as 0.8 mg/m^3 (16 times the exposure limit).
  - Given this information and that the analytical detection limit for lead paint analysis is 90 ppm (not significantly different than 130 ppm, which, per above, may release airborne lead levels 16 times the exposure limit), any paint coating on a metal surface to be welded, burned or torch-cut must be removed prior to that action being undertaken, unless a project-specific or tasks-specific risk assessment and safe work practices are developed by a qualified person.
- Ultimately, the Contractor is responsible to review the work tasks required and the ways in which materials (including those coated with paints that may contain lead in varying concentrations) will be impacted, as well as the individuals that will be present in the immediate vicinity of the work (i.e., potential for high-risk individuals) in order to determine the appropriate personal protective equipment (PPE—including respirators and protective clothing), containment and/or decontamination measures and work procedures that should be followed to protect workers from lead exposure.
- Samples of suspected LCPs were collected from major paint applications. The sampling of paint applications involved the collection of paint chip samples of paint layers to the substrate, where possible. Samples collected were submitted to EMSL in Mississauga, ON for analysis of total lead content using EPA Method SW 846 3050B*/7000B. EMSL’s analytical laboratory is also accredited by the AIHA Environmental Lead Laboratory Approval Program (ELLAP).

- Other hazardous building materials
  - Various other hazardous building materials may be present that would have special handling and/or disposal considerations if they were to be impacted by the Project.
  - Assessment for the presence of other hazardous building materials was completed through visual means, as follows, specifically pertaining to building materials expected to be impacted during the Project:
    - Visual review for the presence of PCBs in electrical equipment was completed. Equipment that is generally suspected of containing PCBs includes lamp ballasts, transformers, hydraulic systems, compressors, switchgear and capacitors. No sampling of dielectric fluids was undertaken as part of this assessment.
    - Presence of suspect visible mould was assessed through visual observations. Material observed with dark-coloured staining and/or a textured and discoloured appearance is described as “suspected mould”. Mould identified visually is defined as “suspected mould” unless it is confirmed as mould by laboratory analysis.
    - Assessment for equipment likely to contain ODSs was completed. Information on the type of equipment, manufacturer and type and quantity of refrigerants was recorded, where available.
    - Assessment for electrical equipment that is likely to contain mercury was completed visually. Information on the type of equipment (i.e., light tubes, gauges, switches, batteries, thermometers, etc.), and quantities was recorded, where such information was available.
    - Assessment for the presence of silica was conducted. The presence of silica in building materials such as concrete, masonry, stone, terrazzo, refractory brick, ceramic tile, ceiling tile etc. was noted.

ASSESSMENT FINDINGS

Observations made, and results of samples collected on August 13, 2020 are summarized in the table below.

Area	Observation	Photographs	Samples Collected	Analytical Results
Room 201, vestibule pipe chase (potentially present in other concealed locations throughout the Project area)	Previously identified ACM—gold duct mastic applied to HVAC ducting Expected to be impacted by the Project		N/A	6% Chrysotile (Stantec Report, 2019)
Throughout the Project area	Previously identified ACM—concealed packing material potentially present inside pipe elbows This material was not observed in the Project area but is potentially present in concealed locations within the project area. Pipe elbows are likely to be impacted by the Project.	 (Photo from RJ, M10 Room 202 Report, 2010)	N/A	1–5% Chrysotile (RJ, M10 Room 202 Report, 2010)

Area	Observation	Photographs	Samples Collected	Analytical Results
Potentially present in concealed locations throughout the Project area	Previously identified ACM—tar paper jacket on fiberglass insulation (black mastic on pipe elbows/lagging/wrap) This material was not observed in the Project area but is potentially present, concealed within the pipe wrap itself, as part of older pipe wrap materials in concealed locations within the project area. Pipe wrap/jacketing likely to be impacted by the Project	No photo	N/A	10–30% Chrysotile (RJ Admission/Discharge Report 2010)
Potentially present in concealed locations throughout the Project area	Previously identified ACM—cementitious insulation applied to pipe fittings This material was not observed in the Project area but potentially present in wall cavities, pipe chases or other inaccessible areas of the project area. Pipe fittings are likely to be impacted by the Project.	No photo	No record of samples collected	PGL, ACM Survey Report 2004

Design of Under-Slab Supply Venting at Matsqui Institution Building M2C/M2D (Living Unit 5)

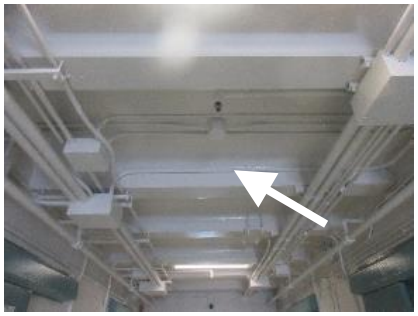
Area	Observation	Photographs	Samples Collected	Analytical Results
Various locations throughout	The following previously identified ACMs are not expected to be impacted by the Project: • Concealed material inside bell fittings • Exterior east wall grey electrical penetration putty • Grey floor tile in M2C cell #14 room 89	 	N/A	N/A
Pipe chases throughout the Project area	Additional suspected ACM—texture coat applied to concrete perimeter walls in pipe chases Likely to be impacted by the Project		TC-01A TC-01B TC-01C TC-01D TC-01E	No asbestos detected

Area	Observation	Photographs	Samples Collected	Analytical Results
Various locations thorughout Project area	Destructive testing was conducted by Stantec in two locations to assess wall cavities for the presence of vermiculite, a potential ACM. No vermiculite insulation was observed within the subject building through observations or destructive testing.	No photo	N/A	N/A
Some cell walls and door frames within the Project area	Previously identified LCP—green on metal cell door frames and some concrete cell walls Cell walls expected to be impacted by the Project		N/A	1.0 mg/cm^2—approximately 15,000 ppm[1] (DST Pre-Reno Segregation Unit 2013)

[2] According to the 2011 publication "*Lead-Containing Paints and Coatings—Preventing Exposure in the Construction industry*, "Recent data collected in BC suggest that 0.04 mg/cm^2 is equivalent to about 600 µg/g or 0.06% by weight; however, factors such as paint thickness may affect the results". This conversion factor has been utilized by Stantec to convert data from the referenced DST report into ppm for this report.

Area	Observation	Photographs	Samples Collected	Analytical Results
Various locations throughout	The following previously identified LCPs are not expected to be impacted by the Project: • Black on metal corridor gates • Green on metal cell angle iron throughout • Grey on metal cell door tracks throughout • Black on metal cell door tracks throughout • Brown on metal roof flashing and upper exterior siding	No photo	N/A	N/A
Main level (M2C) walls throughout the Project area	Additional suspected LCP—white on masonry block walls Likely to be impacted by the Project		P-01	<80 ppm
Main level (M2C) ceilings throughout the Project area	Additional suspected LCP—white on concrete ceilings Likely to be impacted by the Project		P-02	<120 ppm

Design of Under-Slab Supply Venting at Matsqui Institution Building M2C/M2D (Living Unit 5)

Area	Observation	Photographs	Samples Collected	Analytical Results
Second level (M2D) walls throughout the Project area	Additional suspected LCP—white on concrete walls Likely to be impacted by the Project		P-03	<80 ppm
Second level (M2D) ceiling throughout the Project area	Additional suspected LCP—white on concrete ceilings Likely to be impacted by the Project		P-04	<80 ppm
Pipe chases throughout the Project area	Additional suspected LCP—grey on textured concrete on perimeter walls in pipe chases Likely to be impacted by the Project		P-05	190 ppm

Area	Observation	Photographs	Samples Collected	Analytical Results
Throughout the Project area	Lead is expected to be present in older electrical wiring materials and sheathing, solder used in electrical equipment and ceramic tile glaze. Likely to be impacted by the Project		No	N/A
Throughout the subject building	Lead is expected to be present in lead acid batteries used in emergency lighting, solder used on domestic water lines, solder used in bell fittings for cast iron pipes and vent and pipe flashings observed. Not expected to be impacted by the Project	No photo	No	N/A
Throughout the Project area	PCBs may be present in the fluorescent light ballasts. Mercury vapour is present in the light tubes within the fluorescent light fixtures observed. Fluorescent lights are expected to be impacted by the Project.		No	N/A

Area	Observation	Photographs	Samples Collected	Analytical Results
Second level conrtrol bubble	Two moisture-stained ceiling tiles Likely to be impacted by the Project		No	N/A
Throughout	ODS-containing equipment (e.g., air conditioning equipment) is not expected to be impacted by the Project	N/A	No	N/A

Area	Observation	Photographs	Samples Collected	Analytical Results
Throughout the Project area	Silica is expected to be present in the following which is expected to be impacted by the Project: • Cement products such as: – Concrete—foundations, floors, walls, blocks – Brick/masonry units and associated grout and mortar – Stone/ceramic tiles and associated grouts and mortars • Gypsum and associated wall/ceiling finish materials • Suspended ceiling tiles • Asphalt and asphalt products containing rock or stone (e.g., roof membrane)	  	No	N/A

The certificates of analysis for the samples submitted as part of this assessment, as provided by EMSL, are attached to this document, for reference.

CONCLUSIONS AND RECOMMENDATIONS

In summary, and to supplement the information in the Previous Reports, the following actual or potential hazardous building materials are likely to be impacted (i.e., require handling, alteration, disturbance, removal and/or disposal) by the Project:

- Asbestos
  - ACMs confirmed as present within the Project area, and expected to be impacted by work of the Project:
    - Gold duct mastic applied to seams of HVAC ducting in room 201, vestibule, pipe chase (potentially present in other concealed locations throughout)
  - ACMs not observed in the Project area, but potentially present in concealed locations and may be impacted by work of the Project:
    - Concealed packing material potentially present inside pipe elbows in concealed areas of the Project area
    - Tar paper jacket on fiberglass insulation (black mastic on pipe elbows/lagging/wrap) potentially present in concealed areas of the Project area
    - Cementitious insulation applied to pipe fittings in wall cavities, pipe chases or other inaccessible areas of the Project area
- Lead
  - Green coloured paint on metal cell door frames and some concrete cell walls throughout
  - Lead is expected to be present in older electrical wiring materials and sheathing, solder used in electrical equipment and ceramic tile glaze
- PCBs
  - PCBs which may be present in the fluorescent light ballasts
- Mercury
  - Mercury vapour which is present in the light tubes within the fluorescent light fixtures
- Mould
  - Two moisture stained ceiling tiles within the second level control bubble
- Silica
  - Silica is expected to be present in concrete foundation, floors, walls, blocks, brick/masonry units and associated grout and mortar, stone/ceramic tiles and associated grouts and mortars, gypsum and associated wall/ceiling finish materials, suspended ceiling tiles, and asphalt and asphalt products containing rock or stone (e.g., roof membrane).

Based on the visual assessment and results of laboratory analyses and review of previous documentations, Stantec recommends the following with regards to meeting the requirements of COHSR and BC Reg. 296/97 as they pertain to the Project:

- Asbestos
  - ACMs that will be impacted during the renovations and/or demolition activities should be removed by appropriately trained personnel (e.g., asbestos abatement contractor personnel), in accordance with the requirements of the COHSR, BC Reg. 296/97 and the Asbestos Guide, and prior to the initiation of project work that will disturb them.

  - If previously identified ACMs, or materials meeting the description of previously identified ACMs as outlined herein (e.g., concealed packing material inside pipe elbows, tar paper jacket on fiberglass insulation, cementitious pipe insulation) are discovered in concealed locations and require impacts to complete work of the Project, these materials should be presumed to contain asbestos (unless appropriate assessment and testing proves otherwise), and removed by appropriately trained personnel (e.g., asbestos abatement contractor personnel), in accordance with the requirements of the COHSR, BC Reg. 296/97 and the Asbestos Guide.
  - If encountered during the Project, any suspected ACMs not accessible during this assessment or the Previous Reports should be considered as asbestos-containing and handled as such, unless proven otherwise, through analytical testing.
- Lead
  - When lead-containing items, including LCPs or are to be disturbed and/or removed, ensure compliance with the following:
    - Exposure protection requirements of COHSR and the BC Reg. 296/97, including the provisions of the BC Lead Guide
    - Transportation and disposal requirements of the British Columbia Hazardous Waste Regulation (BC Reg. 63/88)
    - Transportation requirements of the Federal Transportation of Dangerous Goods Regulation
  - Corrective action or remedial work on applications containing any concentration of lead should be undertaken in a manner so as to avoid generating fine particulate matter or dust (i.e., avoid sanding). Airborne lead dust or fumes should not exceed the COHSR and BC Reg. 296/97 8-hour Occupational Exposure Limit (OEL) of 0.05 milligram per cubic metre (mg/m3) during the removal of products containing any concentration of lead. The use of personal protective equipment is recommended to reduce the potential for over-exposure to lead dust.
  - Actual methods to maintain exposures within applicable limits are to be determined by the contractor through their own risk assessment, which will take into account the lead content of the applications, along with their planned disturbance methods (and associated dust control), tools, PPE and the overall duration of the work.
  - Any paint coating on a metal surface to be welded, burned or torch-cut must be removed prior to that action being undertaken, unless a project-specific or tasks-specific risk assessment and safe work practices are developed by a qualified person. Development of such risk assessments and work practices will involve consideration of information including, but not limited to, the following:
    - Composition of the material to be disturbed
    - Lead content of the paint coating
    - Methods and tools to be used, including exhaust ventilation
    - Duration of the work/work shift
    - Training of the personnel conducting the task
    - Respiratory protection program in effect
- PCBs
  - When decommissioned, verify the PCB content of fluorescent lamp ballasts as per the Environment Canada 1991 publication “Identification of Lamp Ballasts Containing PCBs, Report EPS2/CC/2”, or equivalent reference.
  - Separate PCB-containing ballasts for appropriate disposal
  - PCB-containing items identified for removal and disposal should be handled, transported, stored and disposed of in accordance with the following:
    - The transportation and disposal requirements of BC Reg. 63/88
    - The transportation requirements of the Federal Transportation of Dangerous Goods Regulation
    - The Federal PCB Regulations (SOR/2008-273)
  - Should a material suspected to contain PCBs become uncovered during the Project (i.e., dielectric fluids, hydraulic fluids), all work in the areas that may disturb the material should be stopped. Samples of the suspect material should be submitted for laboratory analysis to determine if PCBs are present.

- Mercury
  - Complete removal of mercury-containing equipment is required prior to renovation or demolition activities that may disturb the equipment. When mercury-containing items are removed (fluorescent light tubes), ensure all mercury waste is handled, stored and disposed of in accordance with the requirements the following:
    - The transportation and disposal requirements of BC Reg. 63/88
    - The transportation requirements of the Federal Transportation of Dangerous Goods Regulation
  - Precautions should be taken if workers may potentially be exposed to mercury or mercury vapours to ensure that workers exposure levels do not exceed the occupational exposure limit of 0.025 mg/m^3 as per the COHSR and BC Reg. 296/97. This can be achieved by providing respiratory and skin protection applicable to the hazard and task to be completed.
- Mould
  - Remove and replace moisture-stained ceiling tiles with new tiles. If staining re-appears on the new tiles, the source of moisture should be identified and corrected.
    - This work can be conducted by regular facility maintenance staff, if conducted prior to the onset of mould growth.
- Silica
  - When silica-containing materials are to be disturbed during the Project, ensure dust control measures are employed such that airborne silica dust concentrations do not exceed the exposure limit as stipulated by BC Reg. 296/97 (cristobalite and quartz—each 0.025 mg/m^3). This would include, but not be limited to, the following:
    - Providing workers with respiratory protection
    - Wetting the surface of the materials, use of water or dust suppressing agents to prevent dust emissions
    - Providing workers with facilities to properly wash prior to exiting the work area
- Other hazardous building materials
  - As other hazardous building materials that are expected to be impacted by the Project were not identified, no recommendations have been developed.

SITE REVIEW LIMITATIONS

In preparation of this report, Stantec used professional judgment based on experience. The work was conducted in accordance with generally accepted professional standards. Stantec relied on information gathered during the site investigation and laboratory analytical reports.

This report reflects the observations made within accessible and accessed portions of the subject building, and the results of analyses performed on the specific material sampled during the assessment. Analytical results reflect the sampled material at the specific sample locations. Destructive investigation for concealed wall, ceiling or flooring layers was not conducted.

This assessment was conducted pertaining only to those building materials expected to be impacted by the Project as described by Integral Group. This assessment does not constitute a comprehensive hazardous building materials assessment for the subject building.

This report has been prepared for the exclusive use of Integral Group for the purpose of assessing general conditions pertaining to the work planned within the subject building as described by Integral Group. Any use that a third party makes of this report, or reliance on, or decisions to be made on it, are the responsibility of such third parties. Stantec accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

CLOSING

If any conditions become apparent that differ significantly from our understanding of conditions as presented in this document, we request that we be notified immediately to reassess the information provided herein.

We trust that the document meets your current requirements. Should you have any questions or concerns regarding the above, please do not hesitate to contact the undersigned.

Regards,

Stantec Consulting Ltd.

Field report prepared by:

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Attachments: Attachment A: Laboratory Certificate of Analysis—Bulk Samples for Asbestos Analysis (EMSL)—2 pages
Attachment B: Laboratory Certificate of Analysis—Paint Chip Samples for Lead Analysis (EMSL)—1 page

ATTACHMENT A

Laboratory Certificate of Analysis—Bulk Samples for Asbestos Analysis (EMSL)

EMSL Canada Inc.

4506 Dawson Street Burnaby, BC V5C 4C1
Phone/Fax: (604) 757-3158 / (604) 757-4731
http://www.EMSL.com / vancouverlab@EMSL.com

EMSL Canada Order 692001903
Customer ID: 55JACQ30L
Customer PO: 123221653
Project ID:

Attn: Amanda Bell
Stantec Consulting Ltd.
500 - 4730 Kingsway
Burnaby, BC V5H 0C6

Phone: (604) 412-3004
Fax:
Collected: 8/13/2020
Received: 8/13/2020
Analyzed: 8/18/2020

Proj: 123221653 / M2C (LIVING UNIT 5)

Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

Client Sample ID: TC-01A ***Lab Sample ID:*** **692001903-0001**

Sample Description: PIPE CHASE BETWEEN CELLS 18 AND 19/TEXTURE COAT - CMEENTITIOUS APPLIED TO PERIMETER WALLS WITHIN PIPE CHASES THROUGHOUT

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	8/18/2020	Gray	0.0%	100.0%	None Detected	

Client Sample ID: TC-01B ***Lab Sample ID:*** **692001903-0002**

Sample Description: PIPE CHASE BETWEEN CELLS 20 AND 21/TEXTURE COAT - CMEENTITIOUS APPLIED TO PERIMETER WALLS WITHIN PIPE CHASES THROUGHOUT

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	8/18/2020	Gray	0.0%	100.0%	None Detected	

Client Sample ID: TC-01C ***Lab Sample ID:*** **692001903-0003**

Sample Description: PIPE CHASE BETWEEN CELLS 8 AND 9/TEXTURE COAT - CMEENTITIOUS APPLIED TO PERIMETER WALLS WITHIN PIPE CHASES THROUGHOUT

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	8/18/2020	Gray	0.0%	100.0%	None Detected	

Client Sample ID: TC-01D ***Lab Sample ID:*** **692001903-0004**

Sample Description: PIPE CHASE BETWEEN CELLS 3 AND 4/TEXTURE COAT - CMEENTITIOUS APPLIED TO PERIMETER WALLS WITHIN PIPE CHASES THROUGHOUT

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	8/18/2020	Gray	0.0%	100.0%	None Detected	

Client Sample ID: TC-01E ***Lab Sample ID:*** **692001903-0005**

Sample Description: PIPE CHASE BETWEEN CELLS 1 AND 2/TEXTURE COAT - CMEENTITIOUS APPLIED TO PERIMETER WALLS WITHIN PIPE CHASES THROUGHOUT

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	8/18/2020	Gray	0.0%	100.0%	None Detected	

EMSL Canada Inc.

4506 Dawson Street Burnaby, BC V5C 4C1
Phone/Fax: (604) 757-3158 / (604) 757-4731
http://www.EMSL.com / vancouverlab@EMSL.com

EMSL Canada Order 692001903
Customer ID: 55JACQ30L
Customer PO: 123221653
Project ID:

Test Report: Asbestos Analysis in Bulk Material for Occupational Health and Safety British Columbia Regulation 188/2011 via EPA 600/R-93/116 Method

Analyst(s):

Margaret Lee PLM (5)

Reviewed and approved by:

Nicole Yeo, Laboratory Manager
or Other Approved Signatory

None Detected = <0.1%. EMSL maintains liability limited to cost of analysis. This report relates only to the samples reported above and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. Interpretation and use of test results are the responsibility of the client. Samples received in good condition unless otherwise noted. This report must not be used to claim product endorsement by NVLAP of any agency or the U.S. Government

Samples analyzed by EMSL Canada Inc. Burnaby, BC

Initial report from: 08/20/202011:14:39

ATTACHMENT B

Laboratory Certificate of Analysis—Paint Chip Samples for Lead Analysis (EMSL)

EMSL Canada Inc.
2333 18th Avenue NE, Unit 48, Calgary, AB T2E 8T6
Phone/Fax: (403) 879-1149 / (403) 879-1152
http://www.EMSL.com CalgaryLab@EMSL.com

EMSL Canada Or	652005791
CustomerID:	55JACQ30N
CustomerPO:	123221653
ProjectID:	

Attn: **Amanda Bell**
Stantec Consulting, Ltd.
4370 Dominion Street
5th Floor
Burnaby, BC V5G 4L7

Phone: (604) 436-3014
Fax: (604) 436-3752
Received: 8/14/2020 08:30 AM
Collected:

Project: **123221653**

Test Report: Lead in Paint Chips by Flame AAS (SW 846 3050B/7000B)*

Client Sample Description	*Lab ID*	*Collected*	*Analyzed*	*Weight*	*Lead Concentration*
P-01	*652005791-0001*		8/18/2020	0.2574 g	<80 ppm
	Site: MAIN LEVEL, CELL 14				
P-02	*652005791-0002*		8/18/2020	0.1729 g	<120 ppm
	Site: MAIN LEVEL HALLWAY, BETWEEN CELL 4 & 17 Insufficient sample to reach reporting limit.				
P-03	*652005791-0003*		8/18/2020	0.2520 g	<80 ppm
	Site: SECOND LEVEL, CELL 14				
P-04	*652005791-0004*		8/18/2020	0.2517 g	<80 ppm
	Site: SECOND LEVEL HALLWAY, BETWEEN CELL 6 & 18				
P-05	*652005791-0005*		8/18/2020	0.2512 g	190 ppm
	Site: MAIN LEVEL PIPE CHASE, BETWEEN LAUNDRY AND CELL 13, PERIMETER WALL				

jgsalvador

Jefferson Salvador, Laboratory Manager
or other approved signatory

Initial report from 08/20/2020 16:51:26