



FORT ST. JAMES ARENA UPGRADE

Specifications

Issued for:

Request For Proposals (RFP)

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Project: Fort St. James Arena Upgrade
Address: 300 Stuart Drive E., Fort St. James, BC V0J 1P0

Authority Having Jurisdiction: District of Fort St. James

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Part 1 AGREEMENT DECLARATION

- .1 CCDC 2 - 2020 Edition, Stipulated Price Contract as may be amended, forms the basis of Agreement between the Owner and Contractor.

- .2 This Agreement is bound to the CCDC 2 Definitions and CCDC 2 General Conditions.

END OF SECTION

Part 1 Definitions

1.1 DEFINITIONS DECLARATION

- .1 CCDC 2 - 2020 Edition, Stipulated Price Contract as may be amended, forms the basis of Definitions between the Owner and Contractor.
- .2 These Definitions are bound to the CCDC 2 Definitions and CCDC 2 General Conditions.

1.2 SUPPLEMENTARY WORDS AND TERMS TO CCDC 2-2020

- .1 The following words and terms are additional to the CCDC 2 Definitions.
 - .1 **Addendum:** A document that amends the RFP Documents during the RFP Period and becomes part of the Contract Documents when a Contract is executed (Plural: Addenda).
 - .2 **Agreement:** The signed and sealed legal instrument binding parties in a Contract, describing in strict terms their mutual arrangement, roles and responsibilities, commencement, and completion responsibilities.
 - .3 **Alternative Price:** The amount stipulated by a Proponent for an Alternative and stated as an addition, a deduction, or no change to the Proposed Price.
 - .4 **Construction Documents:** The Drawings and Project Manual (Specifications). When combined with a Contract and Contract conditions, these documents form the Contract Documents.
 - .5 **Contingency Allowance:** An additional monetary amount added to a Project cost estimate and designated to cover unpredictable or unforeseen items of Work. The amount is usually based on some percentage of the estimated cost and expended and adjusted by Change Order. It is not intended to cover additions to the scope of Work.
 - .6 **General Conditions:** That part of the Contract Documents which sets forth many of the rights, responsibilities and relationships of the parties involved in a Contract.
 - .7 **Proposal:** A contractor's response to the RFP, stating its proposed price to complete the Work of the Contract
 - .8 **Proponent:** A contractor submitting a Proposal in response to the RFP.
 - .9 **Provide:** To Supply and Install complete and ready for intended use.
 - .10 **Request for Proposals (RFP):** Document soliciting proposals from prospective Proponents and providing instructions that convey an Owner's expectations and criteria associated with submitting a Proposal.
 - .11 **RFP Documents:** A set of documents consisting of the Request for Proposals, Proposal Response Form, Submission Declaration Form, Contract Documents, and other information issued for the benefit of Proponents to prepare and submit their Proposals.
 - .12 **RFP Form:** The form used to collect detailed information about a Proposal.
 - .13 **Section:** A portion of a Project Specification covering one or more segments of the total Work or requirements. Sections are included in a Project manual as required to meet Project requirements.

- .14 **Standard:** A document establishing physical characteristics and criteria for performance or quality of materials, products, or methods based on standardized testing methodology and procedures, written by a recognized technical, industry, or governmental agency or organization.
- .15 **Separate Price:** A separate price for work to be added to the base price if selected by the Owner. This price type is not a part of the proposed price.
- .16 **Stipulated Price:** An amount set forth in a Stipulated Price Contract as the total payment for the performance of the Work. Sometimes referred to as a stipulated sum or a lump sum stipulated price.
- .17 **Unit Price:** The amount payable for a single unit of Work as stated in a Schedule of Prices.
- .18 **Install:** To remove from site storage, move or transport to intended location, install in position, connect to utilities, repair site caused damage, and make ready for use.
- .19 **Supply:** To acquire or purchase, ship or transport to the site, unload, remove packaging to permit inspection for damage, re-package, replace damaged items, and safely store on-site.

END OF SECTION

Part 1 General Conditions

1.1 GENERAL CONDITIONS DECLARATION

- .1 CCDC 2 -2020 - The General Conditions of the Stipulated Price Contract - is the General Conditions between the Owner and Contractor.

END OF SECTION

Part 1 General

1.1 SCOPE OF WORK

- .1 Work of the Contract generally comprises renovations to the existing Fort St. James Arena foyer, including all labor, materials, construction work, site preparation, and equipment required for architectural, structural, mechanical, and electrical work necessary for selective demolition, modifications, and new construction, as indicated in the Contract Documents.
- .2 Division of the Work among Subcontractors, suppliers or vendors is solely the Contractor's responsibility. Neither Owner nor Consultant assumes any responsibility to act as an arbiter to establish subcontract terms between sectors or disciplines of work.

1.2 SCHEDULE AND COST

- .1 Develop scheduled timeframe (dates) during which certain components will be undertaken.
- .2 Allow for all overhead and management costs related to the Project for duration of Construction period.

1.3 THE SITE

- .1 Construction hoarding will be required.
- .2 Before commencing the Work, coordinate and obtain Owner's agreement on Contractor's traffic movement and mobilization/storage areas for the various components.

1.4 CONTRACTOR'S USE OF PREMISES

- .1 Limit use of site and premises to allow ongoing occupancy by the Owner and the public.
- .2 Building Exits During Construction: Maintain existing exit routes except as noted on Drawings.
- .3 Construction Operations: Limit to areas noted on Drawings; however, greyed-out areas on Drawings are for reference only and do not constitute an absolute boundary to renovation extents.

1.5 OWNER'S OCCUPANCY

- .1 The Arena ice rink area and dressing rooms will need to remain operational during construction. Prioritize welfare of facility staff, the public, visitors, and preservation of facility operations at all times. Be prepared to stop work upon Owner's request.
- .2 Cooperate with Owner in scheduling operations to minimize conflict and to facilitate Owner usage.
- .3 Maintain fire and life safety systems to occupied areas and public access to exits during all stages of the work.

1.6 MATERIAL RECYCLING AND WASTE REDUCTION

- .1 Material recycling is mandated through Regional District requirements, hazardous waste is controlled by provincial government, and transportation of same on some roads is controlled by federal government.
- .2 Employ material recycling and waste reduction measures to result in majority of waste materials being recycled.

END OF SECTION

Part 1 General

1.1 ACCESS AND EGRESS

- .1 Design, construct and maintain temporary "access to" and "egress from" work areas and other lease areas, including stairs, pavement, ramps or ladders and scaffolding, independent of finished surfaces and in accordance with applicable laws and regulations.

1.2 USE OF SITE AND FACILITIES

- .1 Execute work with least possible interference or disturbance to normal use of premises.
- .2 Maintain existing services to building and provide for personnel and vehicle access.
- .3 Provide sanitary facilities for use by Contractor's personnel. Keep facilities clean.
- .4 Closures: Protect work temporarily until works are completed.

1.3 EXISTING SERVICES

- .1 Notify Consultant and utility companies of intended interruption of services and obtain required permissions.
- .2 Where Work involves breaking into or connecting to existing services, give Consultant at least 48 hours of notice for necessary interruption of mechanical or electrical service throughout course of work. Keep duration of interruptions to a minimum. Carry out interruptions after normal facility working hours, preferably on weekends.
- .3 Provide for personnel and vehicular traffic.

1.4 SPECIAL REQUIREMENTS

- .1 Conform to District's noise bylaw for working hours when carrying out noise-generating Work.
- .2 Submit schedule in accordance with Section 01 32 18 - Construction Progress Schedules - Bar (GANTT) Chart.
- .3 Ensure Contractor's personnel employed on site become familiar with and obey safety, fire, traffic and security regulations and requirements.
- .4 Keep within limits of work and avenues of ingress and egress.
- .5 Ingress and egress of Contractor vehicles at site is limited to construction site.
- .6 Deliver materials Monday to Friday 07:00 to 17:00 hours unless otherwise approved by Owner.

1.5 SUBSTANCE USE AND WORKER CONDUCT

- .1 Smoking, vaping, consumption of alcohol, and use of controlled drugs and illegal substances are PROHIBITED at the Place of the Work.
 - .1 Consultant and Owner reserve the right to require removal from project any workers who do not comply with this requirement.
- .2 Employ only orderly, skilled, and competent persons to do the Work.
 - .1 Should Owner or Consultant inform Contractor in writing that a person or persons engaged in the Work are, in Owner's or Consultant's opinion, incompetent or disorderly, such person or persons will be discharged from the Work and will not again be employed on the Work.

- .3 Contractor's, Subcontractors' and Suppliers' representatives and employees are required to conduct themselves in a respectful and safe manner at all times.
 - .1 Owner and Consultant reserve the right to order removal from the Project any person whose conduct or behaviour, in the Owner's or Consultant's opinion:
 - .1 Jeopardizes the safety or security of the Project; persons on or offsite, or the Owner's operations.
 - .2 Is detrimental to the Project.
 - .3 Could be considered as harassment in the workplace.
 - .2 Immediately upon receipt of such order, arrange for appointment of a replacement representative or employee acceptable to the Owner.
 - .1 Transition of new personnel onto the Project shall be at Contractor's sole expense.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Administrative and procedural requirements for cash allowances.

1.2 RELATED SECTIONS

- .1 Section 01 29 00 - Payment Procedures.

1.3 CASH ALLOWANCES – GENERAL

- .1 Cash allowances, unless otherwise specified, cover net cost to Contractor of services, products, construction machinery and equipment, freight, handling, unloading, storage, installation, commissioning and other authorized expenses incurred in performing Work.
- .2 Where costs under a cash allowance exceed amount of allowance, Contractor will be compensated for excess incurred and substantiated, plus allowance for overhead and profit on such excess portion, as set out in Contract Documents.
- .3 Include progress payments on accounts of work authorized under cash allowances in monthly application for payment.
- .4 Prepare schedule jointly with Consultant and Owner to show when items under cash allowances must be authorized by Consultant for ordering purposes so progress of Work will not be delayed.

1.4 CASH ALLOWANCES FOR SUPPLY ONLY OF PRODUCTS

- .1 Amount of each cash allowance includes:
 - .1 Cost of Products as invoiced by the Supplier, including delivery and applicable taxes, but excluding Value Added Taxes.
- .2 Amount of each cash allowance does not include for the following items, which costs are included in the Contract Price and not in the cash allowance. No additional costs will be considered for the following:
 - .1 Unloading, handling and storage on site.
 - .2 Installation and all other related costs.
 - .3 Overheads and profits related to the cash allowance.

1.5 CASH ALLOWANCES FOR SUPPLY AND INSTALLATION OF PRODUCTS

- .1 Amount of each cash allowance includes:
 - .1 Costs to provide specified Products, including supply, unloading, handling, site storage, installation, and related costs, excluding Value Added Taxes.
 - .2 Subcontractor's and sub-Subcontractor's overheads and profits related to the cash allowance.
- .2 Amount of each cash allowance does not include Contractor's overhead, profit, and other related costs, which are included in the Contract Price and not in the cash allowance.

1.6 EXPENDITURE OF CASH ALLOWANCES

- .1 Owner, through Consultant:

- .1 Will provide Contractor with documentation required to price a cash allowance item.
 - .2 May request Contractor to identify potential Suppliers or Subcontractors, as applicable, and to obtain at least three competitive prices for each cash allowance item.
 - .3 May request the Contractor to disclose originals of bids, quotations, and other price-related information received from potential Suppliers or Subcontractors.
 - .4 Will determine by whom and for what amount each cash allowance item will be performed.
- .2 Submit complete breakdown of costs to Owner for approval, including Subcontractor and Supplier quotes.
 - .3 Obtain Owner's written approval in form of a Change Order before entering into subcontract, amending existing subcontract, or performing own forces work included in cash allowance.
- .1 Upon issuance of Change Order, Contractor's responsibilities for cash allowance item shall be the same as for other work of the Contract.

END OF SECTION

Part 1 General

1.1 SCHEDULE OF VALUES

- .1 Invoices shall clearly indicate the progress billing of all three disciplines, with further sub-division as follows:
 - .1 General Contractor
 - .1 Structural Steel
 - .2 Concrete
 - .3 Piles
 - .4 Earthworks
 - .5 Sitework
 - .6 Interior Partitions
 - .7 Finishes, Doors and Hardware
 - .8 Flooring Systems
 - .9 Ceiling Systems
 - .10 Glazing Systems
 - .11 Fire-stopping
 - .2 Mechanical Contractor
 - .1 Cooling Equipment – Supply
 - .2 Cooling Equipment – Installation
 - .3 Ventilation Equipment – Supply
 - .4 Ductwork
 - .5 Hydronic Piping including Condensate Pipe
 - .6 Insulation
 - .7 Plumbing Systems
 - .8 Controls
 - .9 Sprinkler Systems
 - .3 Electrical Contractor
 - .1 UPS Equipment – Supply
 - .2 Generator – Supply
 - .3 DC Plant Equipment – Supply
 - .4 Automatic Transfer System - Supply
 - .5 UPS Systems Installation
 - .6 DC Plant Systems Installation
 - .7 Normal Power Systems – Supply and Install
 - .8 Emergency Power Systems – Supply and Install
 - .9 UPS Output Power Systems – Supply and Install
 - .10 Grounding
 - .11 Lighting
 - .12 Fibre Guide Systems
 - .13 Communication Tray Systems
 - .14 Outdoor Power Systems

1.2 PROGRESS PAYMENT

- .1 Submit Application for Payment roughly on the 15 of each month (from the 13th to the 17th.
- .2 Consultant will issue to Owner, no later than 10 days after receipt of an application for payment, certificate for payment in amount applied for or in such other amount as Consultant determines to be due. If Consultant amends application, Consultant will give notification in writing giving reasons for amendment.

1.3 SUBSTANTIAL PERFORMANCE OF WORK

- .1 Prepare and submit to Consultant written application to the Owner for Substantial Performance of the Work, Statutory Declaration and comprehensive list of items to be completed or corrected and apply for a review by Consultant to establish Substantial Performance of Work. Failure to include items on list does not alter responsibility to complete Contract.
- .2 No later than 10 days after receipt of list and application, Consultant will review Work to verify validity of application is substantially performed.
- .3 Date of Substantial Performance of the Work will be stated in the Certificate of Completion of the Work.
- .4 Immediately following issuance of the Certificate of Completion, in consultation with Consultant, establish reasonable date for finishing Work.

1.4 PAYMENT OF HOLDBACK UPON SUBSTANTIAL PERFORMANCE OF WORK

- .1 After issuance of certificate of completion of Work:
 - .1 Submit application for payment of holdback amount.
 - .2 Submit sworn statement that accounts for labour, subcontracts, products, construction machinery and equipment, and other indebtedness which may have been incurred in Substantial Performance of Work and for which Owner might in be held responsible have been paid in full, except for amounts properly retained as holdback or as identified amount in dispute.
- .2 After receipt of application for payment and sworn statement, Consultant will issue certificate for payment of holdback amount.
- .3 Where holdback amount has not been placed in a separate holdback account, Owner shall, 10 days prior to expiry of holdback period stipulated in lien legislation applicable to Place of Work, place holdback amount in bank account in joint names of Owner and Contractor.
- .4 Amount authorized by certificate for payment of holdback amount is due and payable on day following expiration of holdback period stipulated in lien legislation applicable to Place of Work. Where lien legislation does not exist or apply, holdback amount is due and payable in accordance with other legislation, industry practice, or provisions which may be agreed to between parties. Owner may retain out of holdback amount sums required by law to satisfy liens against Work or, if permitted by lien legislation applicable to Place of Work, other third-party monetary claims against Contractor which are enforceable against Owner.

1.5 PROGRESSIVE RELEASE OF HOLDBACK

- .1 Where legislation permits, if Consultant has certified that Work of subcontractor or supplier has been performed prior to Substantial Performance of Work, Owner shall pay holdback amount retained for such subcontract Work, or products supplied by such supplier, on day following expiration of holdback period for such Work stipulated in lien legislation applicable to Place of Work.
- .2 In addition to provisions of preceding paragraph, and certificate wording, ensure that such subcontract Work or products is protected pending issuance of final certificate for payment and be responsible for correction of defects or Work not performed, regardless of whether or not such was apparent when such certificates were issued.

1.6 FINAL PAYMENT

- .1 Submit application for final payment when Work is completed.
- .2 Consultant will, no later than 10 days after receipt of application for final payment, review Work to verify validity of application. Consultant will give notification that application is valid or give reasons why it is not valid, no later than 7 days after reviewing Work.
- .3 Consultant will issue final certificate for payment when application for final payment is found valid.

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE

- .1 Contractor's responsibilities include:
 - .1 Preparing meeting agendas.
 - .2 Providing physical space and making arrangements for meetings.
 - .3 Preside at meetings.
 - .4 Recording meeting minutes, including significant proceedings and decisions. Identify actions by parties.
 - .5 Reproducing and distributing copies of minutes within 3 Working Days after each meeting and transmitting to meeting participants, affected parties not in attendance, Consultant, and Owner.
- .2 Ensure representative of Contractor, Subcontractors and suppliers attending meetings are qualified and authorized to act on behalf of party each represents.

1.2 PRECONSTRUCTION MEETING

- .1 Within 10 days after award of Contract, request a meeting of Contract parties to discuss and resolve administrative procedures and responsibilities.
- .2 Provide attendance by senior representatives of Consultant, Contractor, major Subcontractors, field inspectors, and supervisors.
- .3 Establish time and location of meeting and notify parties concerned minimum 5 days before meeting.
- .4 Agenda to include:
 - .1 Appointment of official representative of participants in the Work.
 - .2 Schedule of Work: in accordance with Section 01 32 18 - Construction Progress Schedules - Bar (GANTT) Chart.
 - .3 Schedule of submission of shop drawings and samples. Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.
 - .4 Requirements for temporary facilities, site sign, offices, storage sheds, utilities, fences in accordance with Section 01 52 00 - Construction Facilities.
 - .5 Site security.
 - .6 Proposed changes, change orders, procedures, approvals required, time extensions, overtime, administrative requirements.
 - .7 Owner provided equipment.
 - .8 Record drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .9 Maintenance manuals in accordance with Section 01 78 00 - Closeout Submittals.
 - .10 Take-over procedures, acceptance, warranties in accordance with Section 01 78 00 - Closeout Submittals.
 - .11 Monthly progress claims, administrative procedures, photographs, hold backs.
 - .12 Appointment of inspection and testing agencies or firms.
 - .13 Insurances, transcript of policies.

1.3 PROGRESS MEETINGS

- .1 During course of Work schedule bi-weekly progress meetings, with Contractor, major Subcontractors involved in Work and Consultant in attendance.
 - .1 Notify parties minimum 5 days prior to meetings.
- .2 Reporting: Provide biweekly progress updates to Consultant at least 2 Working Days before each progress meeting. Include:
 - .1 Shop Drawing Tracking List
 - .2 RFI Tracking List
 - .3 Site Instruction / Proposed Change Notice Tracking Sheet
 - .4 Schedule Update
 - .5 Pictures of milestone work completed during period (see scheduling item above)
- .3 Agenda to include the following:
 - .1 Review, approval of minutes of previous meeting.
 - .2 Review of Work progress since previous meeting.
 - .3 Field observations, problems, conflicts.
 - .4 Problems which impede construction schedule.
 - .5 Review of off-site fabrication delivery schedules.
 - .6 Corrective measures and procedures to ensure schedule compliance
 - .7 Revision to construction schedule.
 - .8 Progress schedule, during succeeding work period.
 - .9 Review submittal schedules: expedite as required.
 - .10 Maintenance of quality standards.
 - .11 Review proposed changes for affect on construction schedule and on completion date.
 - .12 Other business.
- .4 Meeting Minutes; Record minutes of meetings; circulate to attending parties and affected parties not in attendance, along with progress reporting, within 3 days after meeting.

END OF SECTION

Part 1 General

1.1 DEFINITIONS

- .1 Activity: element of Work performed during course of Project. Activity normally has expected duration, expected cost, and expected resource requirements. Activities can be subdivided into tasks.
- .2 Bar Chart (GANTT Chart): graphic display of schedule-related information. In typical bar chart, activities or other Project elements are listed down left side of chart, dates are shown across top, and activity durations are shown as date-placed horizontal bars. Generally, Bar Chart should be derived from commercially available computerized project management system.
- .3 Baseline: original approved plan (for project, work package, or activity), plus or minus approved scope changes.
- .4 Construction Work Week: Monday to Friday, inclusive, will provide 5-day work week and define schedule calendar Working Days as part of Bar (GANTT) Chart submission.
- .5 Construction Work outside of routine hours. Work that takes place outside of regular work periods of Monday to Friday 07:00 to 17:00 hours.
- .6 Duration: number of work periods (not including holidays or other nonworking periods) required to complete activity or other project element. Usually expressed as workdays or workweeks.
- .7 Master Plan: summary-level schedule that identifies major activities and key milestones.
- .8 Milestone: significant event in project, usually completion of major deliverable.
- .9 Project Schedule: planned dates for performing activities and the planned dates for meeting milestones. Dynamic, detailed record of tasks or activities that must be accomplished to satisfy Project objectives. Monitoring and control process involves using Project Schedule in executing and controlling activities and is used as basis for decision making throughout project life cycle.

1.2 REQUIREMENTS

- .1 Ensure Master Plan and Detail Schedules are practical and remain within specified Contract duration.
- .2 Plan to complete Work in accordance with prescribed milestones and time frame specified in Section 01 11 00 – Summary of Work.
- .3 Limit activity durations to maximum of approximately 10 Working Days, to allow for progress reporting.
- .4 It is understood that Award of Contract or time of beginning, rate of progress, Substantial Performance Certificate and Total Performance Certificate as defined times of completion are of essence of this Contract.

1.3 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit to Consultant within 14 Working Days of Award of Contract Bar (GANTT) Chart as Master Plan for planning, monitoring and reporting of project progress.
- .3 Submit Project Schedule to Consultant within 5 Working Days of receipt of acceptance of Master Plan.

1.4 MASTER PLAN

- .1 Structure schedule to allow orderly planning, organizing and execution of Work as Bar Chart (GANTT).
- .2 Consultants will review and return revised schedules within 10 Working Days.
- .3 Revise impractical schedule and resubmit within 5 Working Days.
- .4 Accepted revised schedule will become Master Plan and be used as baseline for updates.

1.5 PROJECT SCHEDULE

- .1 Develop detailed Project Schedule derived from Master Plan.
- .2 Ensure detailed Project Schedule includes as minimum milestone and activity types as follows:
 - .1 Award
 - .2 Shop Drawings, Samples
 - .3 Permits
 - .4 Mobilization
 - .5 Rack installation date
 - .6 Ceiling Installation date
 - .7 Interior wall completion (95%)
 - .8 Outdoor work start date.
 - .9 Generator Pad completion date.
 - .10 Structural steel support framing installation date.
 - .11 Outdoor fibre conduit completion date.
 - .12 Generator installation date (de-energized)
 - .13 UPS installation date (de-energized)
 - .14 Automatic Transfer Switch installation date (de-energized)
 - .15 Electrical Boards arrive on site.
 - .16 Electrical boards wired and ready for energization.
 - .17 Energization of UPS.
 - .18 Energization of Mechanical Equipment.
 - .19 Mechanical rooftop equipment arrival.
 - .20 Indoor mechanical equipment arrival (≥ 5 tons only).
 - .21 Testing and Commissioning
- .3 The schedule shall also predict the monthly predicted spend rate, including all sub-trades.

1.6 PROGRESS UPDATES

- .1 Provide biweekly Project schedule updates with progress reporting specified in Section 01 31 19 – Project Meetings.

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE

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

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Shop Drawings includes drawings, diagrams, illustrations, schedules, performance charts, brochures and other data provided by Contractor to illustrate details of a portion of the Work.
- .2 Where required in Specifications, submit Shop Drawings bearing stamp and signature of qualified professional registered or licensed to practise in British Columbia, Canada.
- .3 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
- .4 Allow 7 days for Consultant's review of each submission.

- .5 Adjustments made on Shop Drawings by Consultant are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Consultant and obtain Consultant's direction before proceeding with Work.
- .6 Make changes in Shop Drawings as Consultant may require, consistent with Contract Documents. When resubmitting, notify Consultant in writing of revisions other than those requested.
- .7 Accompany submissions with transmittal letter, in duplicate, providing information as follows:
 - .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Identification and quantity of each Shop Drawing, Product data and sample.
 - .5 Other pertinent data.
- .8 Include in submissions:
 - .1 Date and revision dates.
 - .2 Project title and number.
 - .3 Name and address of:
 - .1 Subcontractor.
 - .2 Supplier.
 - .3 Manufacturer.
 - .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
 - .5 Details of appropriate portions of Work as applicable:
 - .1 Fabrication.
 - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
 - .3 Setting or erection details.
 - .4 Capacities.
 - .5 Performance characteristics.
 - .6 Standards.
 - .7 Operating weight.
 - .8 Wiring diagrams.
 - .9 Single line and schematic diagrams.
 - .10 Relationship to adjacent work.
- .9 After Consultant's review, distribute copies.
- .10 Submit electronic copies of Shop Drawings for each requirement requested in Specifications sections and as Consultant may reasonably request.
- .11 Submit electronic copies of Product data sheets or brochures for requirements requested in Specifications sections and as requested by Consultant where Shop Drawings will not be prepared due to standardized manufacture of Product.

- .12 Submit electronic copies of test reports for requirements requested in Specifications sections and as requested by Consultant.
 - .1 Report signed by authorized official of testing laboratory that material, Product or system identical to material, Product or system to be provided has been tested in accord with specified requirements.
 - .2 Testing must have been within 3 years of date of Project's Contract award date.
- .13 Submit electronic copies of certificates for requirements requested in Specifications sections and as requested by Consultant.
 - .1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of Product, system or material attesting that Product, system or material meets specification requirements.
 - .2 Certificates must be dated after award of project contract complete with project name.
- .14 Submit electronic copies of manufacturer's instructions for requirements requested in Specifications sections and as requested by Consultant.
 - .1 Pre-printed material describing installation of Product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.
- .15 Submit electronic copies of Manufacturer's Field Reports for requirements requested in Specifications sections and as requested by Consultant.
 - .1 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
- .16 Submit three hard copies and one electronic copy of Operation and Maintenance Data as specified in Specifications sections and as requested by Consultant.
- .17 Delete information not applicable to Project, and supplement standard information as required to provide details applicable to Project.
- .18 If upon review by Consultant, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If Shop Drawings are rejected, noted copy will be returned and resubmission of corrected Shop Drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.
- .19 Consultant's review of Shop Drawings is for sole purpose of ascertaining conformance with general concept.
 - .1 This review does not mean Consultant approves detail design inherent in Shop Drawings, responsibility for which remains with the Contractor; such review does not relieve Contractor of its responsibility for errors and omissions in Shop Drawings or of its responsibility for meeting requirements of Contract Documents.
 - .2 Confirm and correlate field dimensions at the Place of the Work for information pertaining to fabrication processes, construction techniques and for coordination of Work of sub-trades.

END OF SECTION

Part 1 General

1.1 INTENT

- .1 Delegated Design Submittals required by this section are 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, assigned to a design entity other than the Consultant including. Delegated Design includes but is not limited to:
 - .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 This section provides standard forms for submittal of Letter of Commitment and Letter of Compliance required complying with requirements of Building Code and design delegated to a professional engineer within technical Specifications sections.
- .3 Delegated Design Submittals are not required for components of Work requiring engineering for temporary Work (i.e.: crane hoisting, engineered lifts, falsework, shoring, concrete formwork) that would normally form a part of Contractor's scope of Work.
- .4 Requirements of this section:
 - .1 Generally conform with recommended Responsibilities for Engineering Services for Building Projects published by Engineers and Geoscientists of British Columbia (EGBC), with regards to duties of specialty professionals appointed during construction period.
 - .2 Do not diminish Consultant's responsibilities 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 07 84 00 - Firestopping
- .2 Refer to Structural Drawings for items requiring delegated design submittals
- .3 Divisions 23 and 26: Coordinate with disciplines for items requiring delegated design submittals.

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 required services or certifications, 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 Fall arrest system for rooftop anchors.
 - .3 Exterior cladding and façade systems.

- .4 Elements requiring specialized fabrication equipment or proprietary fabrication process not usually available at job site (e.g., open-web steel joists, noise and vibration isolation devices, elevators).
- .5 Elements requiring civil engineering, not normally a part of scope of services performed by Consultant's architectural; structural; mechanical; electrical; or geotechnical disciplines.

Part 2 Products

2.1 LETTER OF COMMITMENT

- .1 Before starting Work requiring design and seal of professional engineer, submit signed and sealed Model Schedule S-B – Assurance of Professional Field Review and Compliance by Supporting Engineer, addressed to Consultant, in EGBC-recommended format.

2.2 LETTER OF COMPLIANCE

- .1 On completion of Work requiring design and seal of a professional engineer, submit signed and sealed Model Schedule S-C: Assurance of Professional Field Review and Compliance by Supporting Registered Professional, addressed to Consultant, in EGBC-recommended format.

Part 3 Execution

3.1 IMPLEMENTATION

- .1 Include summary of Work described in technical Specification section as a part of required Model Schedule S-B
- .2 Prepare required submittals and submit to Consultant within sufficient time to allow for Consultant's detailed review and acceptance.

END OF SECTION

Part 1 General

1.1 INSPECTION

- .1 Allow Consultant access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.
- .2 Give timely notice requesting inspection if Work is designated for special tests, inspections, or approvals by Consultant's instructions, or required law of Place of Work.
- .3 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and reinstall covering construction to as-new condition at no additional cost to Owner.
- .4 Consultant will order part of Work to be examined if Work is suspected to be not in accordance with Contract Documents. If, upon examination such work is found not in accordance with Contract Documents, correct such Work and pay cost of examination and correction.

1.2 INDEPENDENT INSPECTION AGENCIES

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

1.3 ACCESS TO WORK

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

1.4 PROCEDURES

- .1 Notify appropriate agency and Consultant in advance of requirement for tests, in order that attendance arrangements can be made.
- .2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in orderly sequence to not cause delays in Work.

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

1.5 REJECTED WORK

- .1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by Consultant as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.
- .2 Make good other Contractor's work damaged by such removals or replacements promptly.
- .3 If in opinion of Consultant it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, Owner will deduct from Contract Price difference in value between Work performed and that called for by Contract Documents, amount of which will be determined by Consultant.

1.6 REPORTS

- .1 Submit electronic copy of inspection and test reports to Consultant.
- .2 Provide copies to Subcontractor of work being inspected or tested and manufacturer or fabricator of material being inspected or tested.

1.7 TESTS AND MIX DESIGNS

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

END OF SECTION

Part 1 General

1.1 INSTALLATION AND REMOVAL

- .1 Provide temporary utilities and controls as required to execute work expeditiously.
- .2 Remove from site such work after use.

1.2 WATER SUPPLY

- .1 The Owner's water supply may be used by the Contractor.

1.3 TEMPORARY HEATING AND VENTILATION

- .1 Provide temporary heating as required during construction period, including attendance, use maintenance and fuel.
- .2 Provide temporary heat and ventilation in enclosed areas as required to:
 - .1 Facilitate progress of Work.
 - .2 Protect Work and products against dampness and cold.
 - .3 Prevent moisture condensation on surfaces.
 - .4 Provide ambient temperatures and humidity levels for storage, installation and curing of materials.
 - .5 Provide adequate ventilation to meet health regulations for safe working environment.
- .3 Ventilating:
 - .1 Prevent accumulations of dust, fumes, mists, vapours and gases in areas occupied during construction.
 - .2 Provide local exhaust ventilation to prevent harmful intrusion of hazardous substances into atmosphere of occupied areas.
 - .3 Dispose of exhaust materials in manner that will not result in harmful exposure to persons.
 - .4 Ventilate storage spaces containing hazardous or volatile materials.
 - .5 Ventilate temporary sanitary facilities.
 - .6 Continue operation of ventilation and exhaust system for time after cessation of work process to assure removal of harmful contaminants.
- .4 Maintain strict supervision of operation of temporary heating and ventilating equipment to:
 - .1 Comply with applicable codes and standards.
 - .2 Enforce safe practices.
 - .3 Prevent abuse of services.
 - .4 Prevent damage to finishes.
 - .5 Vent direct-fired combustion units to outside.
- .5 Be responsible for damage to Work due to failure in providing adequate heat and protection during construction.

1.4 TEMPORARY POWER AND LIGHT

- .1 Contractor may use facility power for construction purposes and is responsible for costs associated with making connections.
 - .1 Coordinate connection to facility power supply with Owner.
- .2 Provide temporary lighting as required to do the Work and to provide full and clear visibility for full width of haul roads and work areas during night work operations.

1.5 TEMPORARY COMMUNICATION FACILITIES

- .1 Provide a cell phone for use at construction site.

1.6 FIRE PROTECTION

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

END OF SECTION

Part 1 General

1.1 INSTALLATION AND REMOVAL

- .1 Provide construction facilities as required to execute the Work expeditiously.
- .2 Remove from site such work after use.

1.2 HOARDING

- .1 See Section 01 56 00 – Temporary Barriers and Enclosures

1.3 SCAFFOLDING AND STAIRS

- .1 Scaffolding: To CAN/CSA-S269.2 for deconstruction and making-good.
- .2 Provide and maintain engineered scaffolding systems, ramps, ladders, swing staging, platforms, and temporary stairs (scaffold stairs).
- .3 Maintain and protect existing entrances and exits for ongoing use.

1.4 HOISTING

- .1 Provide, operate, and maintain hoist cranes as required for moving of workers, materials, and equipment. Make financial arrangements with subcontractors for their use of hoists.
- .2 Hoist cranes to be operated by qualified operator.

1.5 SITE STORAGE/LOADING

- .1 Confine work and operations to areas of work and other areas allowed by Contract Documents. Do not unreasonably encumber premises with Products and equipment.
- .2 Do not load or permit to load any part of Work with weight or force that will endanger Work.

1.6 CONSTRUCTION PARKING

- .1 Parking is available at the Place of the Work. Coordinate areas for Contractor parking with the Owner.

1.7 EQUIPMENT, TOOLS, AND MATERIALS STORAGE

- .1 Provide and maintain, in clean and orderly condition, lockable weatherproof sheds for storage of tools, equipment and materials.
- .2 Locate materials not requiring storage in weatherproof sheds onsite in manner that minimizes interference with work activities.

1.8 SANITARY FACILITIES

- .1 Provide sanitary facilities for work force in accordance with applicable laws and regulations and requirements of authorities having jurisdiction.
- .2 Post notices and take precautions as required by local health authorities. Keep area and premises in sanitary condition.
- .3 Provide temporary portable toilet for duration of construction contract.
 - .1 Regular emptying/cleaning of this is required on a monthly or weekly basis, depending on frequency of use.

1.9 SECURITY

- .1 Provide security for site. Contractor is responsible for any damage or missing items until Substantial Performance.

1.10 OFFICES

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

1.11 PROTECTION AND MAINTENANCE OF TRAFFIC

- .1 Provide access and temporary relocated roads as necessary to maintain traffic and access to Place of the Work.
- .2 Maintain and protect traffic on affected roads during construction period except as otherwise specifically directed by Consultant.
- .3 Provide traffic control measures for protection and diversion of traffic. Provide watch persons and flag-persons, barricades, lights around and in front of equipment and work, and adequate warning, danger, and direction signs.
- .4 Protect travelling public from damage to person and property.
- .5 Contractor's traffic on roads selected for hauling material to and from site to interfere as little as possible with public traffic.
- .6 Verify adequacy of existing roads and comply with allowable load limit on these roads. Repair damage to roads caused by construction operations, at no additional cost to Owner.
- .7 Dust control: Adequate to ensure safe operation at all times. Maintain wetted surfaces during deconstruction.
- .8 Provide snow removal during construction period.

1.12 CONSTRUCTION SIGNAGE

- .1 No other signs or advertisements, other than warning signs, are permitted on site.
- .2 Signs and notices for safety and instruction in both official languages Graphic symbols to CAN/CSA-Z321.

- .3 Maintain approved signs and notices in good condition for Project duration. Dispose of off site on completion of Project or earlier, upon Consultant's direction.

1.13 CLEAN UP

- .1 Remove construction debris, waste materials, and packaging material from work site daily.
- .2 Promptly clean off dirt, mud, and debris tracked onto paved areas.

END OF SECTION

Part 1 General

1.1 REFERENCES

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

1.2 INSTALLATION AND REMOVAL

- .1 Provide temporary controls as required to execute the Work expeditiously.
- .2 Remove from site such work after use.

1.3 HOARDING

- .1 Provide, erect, and remove when complete temporary enclosures as required. Locations are to be as required for all work and not limited to as shown on Drawings. Maintain continuous access to working areas of facility as required by Owner.

1.4 GUARDRAILS AND BARRICADES

- .1 Provide secure, rigid guardrails and barricades around deep excavations, open shafts, open edges of floors, and roofs.
- .2 Provide as required by governing authorities.

1.5 WEATHER ENCLOSURES

- .1 Provide weathertight closures at unfinished openings at all new and existing buildings as demolition progresses.

1.6 ACCESS TO SITE

- .1 Provide and maintain access roads, sidewalk crossings, ramps and construction runways as may be required for access to Work.

1.7 FIRE ROUTES

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

1.8 PROTECTION OF EXISTING BUILDING(S)

- .1 Provide protection to existing building(s) and equipment during performance of Work.
- .2 Provide necessary screens, covers, and hoardings.
- .3 Confirm with Owner and Managing Consultant locations and installation schedule two weeks prior to installation.
- .4 Be responsible for damage incurred due to lack of or improper protection.

Part 2 Products

.1 Not Used

Part 3 Execution

.1 Not Used

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 If there is question as to whether Products or systems comply with applicable standards, Consultant reserves right to have such Products or systems tested to prove or disprove compliance.
 - .1 Costs for such testing will be born by Owner in event of conformance with Contract Documents or by Contractor in event of non-conformance.

1.2 QUALITY

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

1.3 AVAILABILITY

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

1.4 STORAGE, HANDLING AND PROTECTION

- .1 Handle and store Products in accordance with manufacturer's instructions and in manner that prevents damage, adulteration, deterioration and soiling.
- .2 Store packaged and 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 susceptible to weather damage in weatherproof enclosures.
- .4 Store cementitious Products clear of earth and concrete floors, and away from walls.
- .5 Keep sand to be used for grout or mortar materials clean and dry. Store on wooden platforms, and cover with waterproof tarpaulins.
- .6 Store sheet materials and lumber off ground on flat, solid supports, sloped 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 to Consultant's satisfaction at own expense.
- .9 Touch up damaged factory finished surfaces to Consultant's satisfaction. Use touch-up materials matching original finish. Do not paint over name plates.

1.5 TRANSPORTATION

- .1 Pay transportation and handling costs for Products and materials required in performance of Work.

1.6 MANUFACTURER'S INSTRUCTIONS

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

1.7 QUALITY OF WORK

- .1 Ensure Quality of Work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify Consultant if required Work is such as to make it impractical to produce required results.
- .2 Do not employ anyone unskilled in their required duties. Consultant 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 Consultant, whose decision is final.

1.8 COORDINATION

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

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

1.9 REMEDIAL WORK

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

1.10 LOCATION OF FIXTURES

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

1.11 EXISTING UTILITIES

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

END OF SECTION

Part 1 General

1.1 SUBMITTALS

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

1.2 MATERIALS

- .1 Materials: In accordance with Contract Documents.
- .2 Change in Materials: Submit substitution request.

1.3 PREPARATION

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

1.4 EXECUTION

- .1 Execute cutting, fitting, and patching 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 Remove samples of installed Work for testing.
- .6 Provide openings in non-structural elements of Work for penetrations of mechanical and electrical Work.
- .7 Execute Work by methods to avoid damage to other Work, and which will provide proper surfaces to receive patching and finishing.
- .8 Cut rigid materials using masonry saw or core drill. Pneumatic or impact tools not allowed on masonry work without prior approval.
- .9 Restore work with new products in accordance with requirements of Contract Documents.
- .10 Fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- .11 Refinish surfaces to match adjacent finishes: Refinish continuous surfaces to nearest intersection. Refinish assemblies by refinishing entire unit.
- .12 Conceal pipes, ducts and wiring in floor, wall and ceiling construction of finished areas, except where indicated otherwise.

END OF SECTION

Part 1 General

1.1 PROJECT CLEANLINESS

- .1 Maintain Work in tidy condition, free from accumulation of waste products and debris, including that caused by Owner or other Contractors.
- .2 Remove waste materials from site daily at regularly scheduled times or dispose of as directed by Consultant. Do not burn waste materials on site.
- .3 Clear snow and ice from site.
- .4 Arrange with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .5 Provide on-site containers for collection of waste materials and debris.
- .6 Store volatile waste in covered metal containers; remove from premises at end of each working day.
- .7 Provide adequate ventilation during use of volatile and noxious substances. Use of building ventilation systems is not permitted for this purpose.
- .8 Use only cleaning materials recommended by manufacturer of surface to be cleaned and as recommended by cleaning material manufacturer.

1.2 FINAL CLEANING

- .1 When Work is Substantially Performed, remove surplus Products, tools, construction equipment, and materials not required for performance of remaining Work.
- .2 Prior to final review, remove remainder of surplus Products, tools, construction equipment, and materials.
- .3 Remove waste Products and debris, including that caused by Owner or other Contractors.
- .4 Sweep and rake gravel areas.
- .5 Remove snow and ice from access paths leading up to building entrances.

END OF SECTION

Part 1 General

1.1 WASTE MANAGEMENT AND GOALS

- .1 Before start of Work, conduct meeting with Consultant to review and discuss Waste Management Plan and Goals.
- .2 Waste Management Goal is to divert all materials considered recyclable from landfill sites.
- .3 Accomplish maximum control of solid construction waste.
- .4 Preserve environment and prevent pollution and environment damage.

1.2 DEFINITIONS

- .1 Class III: non-hazardous waste - construction renovation waste.
- .2 Inert Fill: inert waste - exclusively asphalt and concrete.
- .3 Recycled: ability of product or material to be recovered at end of its life cycle and reused.

1.3 WASTE DISPOSAL

- .1 Do not bury or burn rubbish and waste materials.
- .2 Do not dispose of waste, volatile materials, mineral spirits, oil, and paint thinner into waterways or into storm or sanitary sewers.
- .3 Keep records of construction waste, including:
 - .1 Number and size of bins.
 - .2 Waste type of each bin.
 - .3 Reused or recycled waste destination.
- .4 Remove demolition and deconstruction materials as demolition and deconstruction Work progresses.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 APPLICATION

- .1 Handle waste materials not reused, salvaged, or recycled in accordance with applicable laws and requirements of authority having jurisdiction.

3.2 CLEANING

- .1 Source separate materials to be reused/recycled into specified sort areas.

END OF SECTION

Part 1 General

1.1 INSPECTION AND DECLARATION

- .1 Contractor's Inspection: Inspect the Work with applicable Subcontractors. Identify deficiencies and defects, and repair as required to conform to Contract Documents.
 - .1 Notify Consultant in writing of satisfactory completion of Contractor's Inspection and that corrections have been made.
 - .2 Request Consultant's Inspection.
- .2 Consultant's Inspection: Inspect the Work jointly with Consultant to identify obvious defects and deficiencies. Correct Work accordingly.
- .3 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 and adjusted and are fully operational.
 - .4 Certificates required by regulatory authorities have been submitted.
 - .5 Systems' operations have been demonstrated to Owner's personnel.
 - .6 Work is complete and ready for final inspection.
- .4 Final Inspection: when items noted above are completed, request Consultant's final inspection of Work. If Work is deemed incomplete by Consultant, complete outstanding items and request reinspection.
- .5 Substantial Performance: when Consultant considers deficiencies and defects have been corrected and it appears requirements of Contract have been substantially performed, make written application Substantial Performance of the Work.

Part 2 Products

2.1 NOT USED.

Part 3 Execution

3.1 NOT USED.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Prepare Operations and Maintenance (O&M) Manual, including instructions and data, using personnel experienced in operation and maintenance of described Products and systems.
 - .1 Submit draft O&M Manual to Consultant for review at least 2 weeks before Substantial Performance.
 - .2 Substantial Performance will not be issued until draft is submitted.
 - .3 Draft will be returned after final inspection, with Consultant's comments.
 - .4 Revise content of documents as required prior to final submittal.
- .2 Parts, Tools, and Materials Submittals: Provide spare parts, maintenance materials, and special tools that are new, undamaged or defective, and of same quality and manufacture as Products provided in Work.
 - .1 Pay costs of transportation and handling.
 - .2 Furnish evidence, if requested, for type, source and quality of Products provided.
 - .3 Defective Products will be rejected, regardless of previous inspections. Replace at own expense.

1.2 FORMAT

- .1 Cover: identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.
- .2 Arrange content by systems, under Section numbers and sequence of Table of Contents.
- .3 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
- .4 Text: manufacturer's printed data, or typewritten data.
- .5 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- .6 Provide electronic pdf copy upon completion (scan documents to suit). Document to be searchable. Photocopies of shop drawings will not be accepted.

1.3 CONTENTS - EACH VOLUME

- .1 Table of Contents: provide Project title;
 - .1 Date of submission; names.
 - .2 Addresses and telephone numbers of Contractor with name of responsible parties.
 - .3 Schedule of Products and systems, indexed to content of volume.

- .2 For each Product or system:
 - .1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
- .3 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.
- .4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- .5 Typewritten Text: as required to supplement Product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00 - Quality Control.

1.4 AS-BUILTS AND SAMPLES

- .1 Maintain at site, for Consultant's reference, one record copy of:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Change Orders and other modifications to Contract.
 - .5 Reviewed Shop Drawings, Product data, and samples.
 - .6 Field test records.
 - .7 Inspection certificates.
 - .8 Manufacturer's certificates.
- .2 Store record documents and samples in field office apart from documents used for construction. Provide files, racks, and secure storage.
- .3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual. Label each document "PROJECT RECORD" in neat, large, printed letters.
- .4 Maintain record documents in clean, dry and legible condition. Do not use record documents for construction purposes.
- .5 Keep record documents and samples available for inspection by Consultant.

1.5 RECORDING ACTUAL SITE CONDITIONS

- .1 Record information on set of black line opaque drawings, and in copy of Project Manual provided by Consultant.
- .2 Record information by marking up with felt-tip marking pens, maintaining separate colours for each major system.
- .3 Record information concurrently with construction progress. Do not conceal Work until required information is recorded.
- .4 Drawings and Shop Drawings: Mark each item to record actual construction, including:
 - .1 Measured depths of elements of foundation in relation to finish first floor datum.

- .2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
- .3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
- .4 Field changes of dimension and detail.
- .5 Changes made by change orders.
- .6 Details not on original Contract Drawings.
- .7 References to related shop drawings and modifications.
- .5 Specifications: mark each item to record actual construction, including:
 - .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
 - .2 Changes made by Addenda and change orders.
- .6 Other Documents: Maintain manufacturer's certifications, inspection certifications, field test records, required by individual Specifications sections.
- .7 At the end of Project, provide Owner with original hard copy sets of as-built drawings and specifications for each discipline.
- .8 Owner will arrange to have the Contractor-provided as-built drawings (red-lines) incorporated into CAD.

1.6 EQUIPMENT AND SYSTEMS

- .1 Each Item of Equipment and Each System: include description of unit or system and component parts. Indicate function, normal operation characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.
- .2 Panel Board Circuit Directories: Provide electrical service characteristics, controls, and communications.
- .3 Post laminated copies of AC and DC single-line drawings in electrical rooms.
- .4 Post laminated copies for mechanical schematic and sequence of controls in mechanical room.
- .5 Provide grounding audits and diagrams.
- .6 Provide systems demonstrations.
- .7 Include installed colour-coded wiring diagrams.
- .8 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- .9 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- .10 Provide servicing and lubrication schedule, and list of lubricants required.

- .11 Include manufacturer's printed operation and maintenance instructions.
- .12 Include sequence of operation by controls manufacturer.
- .13 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- .14 Provide installed control diagrams by controls manufacturer.
- .15 Provide Contractor's co-ordination drawings, with installed colour coded piping diagrams.
- .16 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- .17 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- .18 Additional requirements: as specified in individual Specifications sections.

1.7 MATERIALS AND FINISHES

- .1 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .2 Moisture-Protection and Weather-Exposed Products: Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .3 Additional Requirements: as specified in individual Specifications sections.

1.8 SPARE PARTS

- .1 Provide spare parts in quantities as specified in Specifications sections.
- .2 Provide items of same manufacture and quality as items incorporated into the Work.
- .3 Deliver to location as directed; place and store.
- .4 Receive and catalogue items. Submit inventory listing to Consultant. Include approved listings in Maintenance Manual.
- .5 Obtain receipt for delivered Products; submit prior to final payment.

1.9 MAINTENANCE MATERIALS

- .1 Provide maintenance materials and extra materials in quantities specified in Specifications sections.
- .2 Provide items of same manufacture and quality as items incorporated into the Work.
- .3 Deliver to location as directed; place and store.
- .4 Receive and catalogue items. Submit inventory listing to Consultant. Include approved listings in Maintenance Manual.

- .5 Obtain receipt for delivered Products and submit prior to final payment.

1.10 SPECIAL TOOLS

- .1 Provide special tools in quantities specified in Specifications sections.
- .2 Equip with tags identifying tool's associated function and equipment.
- .3 Deliver to location as directed; place and store.

1.11 STORAGE, HANDLING AND PROTECTION

- .1 Store spare parts, maintenance materials, and special tools in manner to prevent damage and deterioration.
- .2 Store Products and materials susceptible to damage from weather in weatherproof enclosures.
- .3 Remove and replace damaged Products at own expense and to Consultant's satisfaction.

1.12 WARRANTIES AND BONDS

- .1 Submit warranty information made available during construction phase to Consultant for approval prior to each monthly application for payment.
- .2 Develop Warranty Management Plan and submit to Consultant for review at least 20 Working Days before planned pre-warranty conference.
 - .1 Include required actions and documents to ensure Owner receives warranties to which it is entitled.
 - .2 Provide Plan in narrative form, with sufficient detail to make it suitable for use by future maintenance and repair personnel.
- .3 Assemble approved information in binder and submit upon acceptance of work. Organize binder as follows:
 - .1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.
 - .2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
 - .3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten days after completion of applicable item of work.
 - .4 Verify that documents are in proper form, contain full information, and are notarized.
 - .5 Retain warranties and bonds until time specified for submittal.
- .4 Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial Performance is determined.
- .5 Conduct joint 11-month warranty inspection, measured from time of acceptance, by Consultant.

- .6 Include information contained in Warranty Management Plan as follows:
 - .1 Roles and responsibilities of personnel associated with warranty process, including points of contact and telephone numbers within the organizations of Contractors, subcontractors, manufacturers or suppliers involved.
 - .2 Provide list for each warranted equipment, item, feature of construction or system indicating:
 - .1 Name of item.
 - .2 Model and serial numbers.
 - .3 Location where installed.
 - .4 Name and phone numbers of manufacturers or suppliers.
 - .5 Names, addresses and telephone numbers of sources of spare parts.
 - .6 Warranties and terms of warranty: include one-year overall warranty of construction. Indicate items that have extended warranties and show separate warranty expiration dates.
 - .7 Cross-reference to warranty certificates as applicable.
 - .8 Starting point and duration of warranty period.
 - .9 Summary of maintenance procedures required to continue warranty in force.
 - .10 Cross-Reference to specific pertinent Operation and Maintenance manuals.
 - .11 Organization, names and phone numbers of persons to call for warranty service.
 - .12 Typical response time and repair time expected for various warranted equipment.
 - .3 Post copies of instructions near selected pieces of equipment where operation is critical for warranty and safety reasons.
- .7 Respond in a timely manner to oral or written notification of required construction warranty repair work.
- .8 Written verification will follow oral instructions. Failure to respond will be cause for Owner to proceed with action against Contractor.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .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, millwork and other materials to meet existing construction as indicated.
 - .3 Repair procedures for selective demolition operations.
 - .4 To make minor modifications to allow the work to be completed.
 - .1 Removal of disconnected mechanical and electrical is defined on architectural, mechanical, and electrical documents and forms part of the scope.
 - .2 Retain all existing fire extinguishers.
 - .3 Alteration project procedures.
 - .4 Removal of designated building equipment and fixtures.
 - .5 Removal of designated construction.
 - .6 Disposal of materials.
 - .7 Storage of designated materials.
 - .8 Identification of utilities.

1.2 RELATED REQUIREMENTS

- .1 Division 20 – Mechanical
- .2 Division 26 – Electrical

1.3 REFERENCES

- .1 The versions of the standards referenced in this section are those listed in the BC Building Code, current edition at the time of the application for Building Permit; or if they are not referenced in the specified code, they are the latest version of the standard in effect at the time of the application for Building Permit.
- .2 American National Standards Institute (ANSI)
 - .1 ANSI A10.8, Safety Requirements for Scaffolding.
- .3 Canadian Standards Association (CSA)
 - .1 CSA S350, Code of Practice for Safety in Demolition of Structures.
- .4 National Fire Protection Association (NFPA)
 - .1 NFPA 241, Standard for Safeguarding Construction, Alteration, and Demolition Operations.
- .5 Provincial Legislation
 - .1 Legislation specific to Authority Having Jurisdiction for work governed by this Section

- .6 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 Owner.
 - .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.

1.4 ALTERATION PROJECT PROCEDURES

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

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Demolition Meeting: Conduct a pre-demolition meeting at Project site in accordance with requirements listed in Section 01 31 19 – 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 work adheres to aesthetic criteria established by Drawings and dimensions indicated, with all elements in plane as drawn, maintaining their relationships with other building elements.
 - .2 Coordination for shutoff, capping, and continuation of utility services.
 - .3 Accurately record actual locations of capped utilities and subsurface obstructions.

1.6 ACTION SUBMITTALS / INFORMATIONAL SUBMITTALS

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

- .2 Qualification Data: For firms and persons specified below to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses and other information specified.
- .3 Prior to beginning of Work on site submit detailed Waste Reduction Workplan in accordance with Sections 01 74 21 - Waste Management and Disposal and indicate:
 - .1 Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity.
 - .2 Schedule of selective demolition.
 - .3 Number and location of dumpsters.
 - .4 Anticipated frequency of tipping.
 - .5 Name and address of haulers and waste facilities.
- .4 Proposed Dust-Control and Noise-Control Measures.
- .5 Inventory: Prior to removal of building elements, submit list of items that is intended to be removed and salvaged during selective demolition for review and approval of Consultant and Owner.
- .6 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.

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 Perform work in accordance with governing environmental notification requirements, applicable regulations, and requirements of Authority Having Jurisdiction.
 - .2 Comply with requirements of BC Workers Compensation Act and Occupational Health and Safety Regulation.
 - .3 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:

1.8 REGULATORY REQUIREMENTS

- .1 Conform to applicable code for demolition work, dust control, products requiring electrical disconnection and re-connection.
- .2 Obtain required permits from authorities.
- .3 Do not close or obstruct egress width to any building or site exit.
- .4 Do not disable or disrupt building fire or life safety systems without 3 days prior written notice to Owner.
- .5 Conform to procedures applicable when hazardous or contaminated materials are discovered.

1.9 SEQUENCING

- .1 Sequence activities in the order determined by the Contractor.

1.10 SCHEDULING

- .1 Schedule Work to coincide with new construction.
- .2 Describe demolition removal procedures and schedule.

1.11 PROJECT CONDITIONS

- .1 Conduct demolition to minimize interference with adjacent and occupied building areas.
- .2 Cease operations immediately if structure appears to be in danger and notify Consultant.
- .3 Do not resume operations until directed.
- .4 Visit and examine the site and note all characteristics and irregularities affecting the work of this Section.
- .5 Should material resembling spray or trowel-applied asbestos or other designated substance listed as hazardous as defined in the Hazardous Product Act be encountered, take preventative measures, and notify Consultant and Owner immediately.

1.12 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - 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.

Part 2 Products

2.1 TEMPORARY SUPPORT STRUCTURES

- .1 Design temporary support structures required for demolition work and underpinning and other foundation supports 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 of the building.

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.

- .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 Hoarding and Dust Screens: Refer to Section 01 56 00 –Temporary Barriers and Enclosures for stud framing and gypsum board sheathing materials.

2.5 EXISTING MATERIALS

- .1 Items to be retained for re-use in new construction include, but are not limited to the following:
 - .1 Confirm with Consultant any materials that appear to be in re-usable condition prior to disposal.
 - .2 Confirm with Consultant any materials scheduled for re-use that are not in re-usable condition prior to installation.

Part 3 Execution

3.1 EXAMINATION

- .1 Inspect building with Consultant 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 Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- .4 Notify the Consultant 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 Consultant.
 - .2 Consultant will issue additional instructions or revise drawings as required to correct conflict.
- .5 Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 PREPARATION

- .1 Provide, erect, and maintain temporary barriers at locations indicated.
- .2 Erect and maintain weatherproof closures for exterior openings.
- .3 Erect and maintain temporary partitions to prevent spread of dust, odours, and noise to permit continued Owner occupancy.
- .4 Protect existing materials, furnishings, and equipment which are not to be demolished.
- .5 Prevent movement of structure; provide bracing and shoring.
- .6 Notify affected utility companies before starting work and comply with their requirements.
- .7 Mark location and termination of utilities.
- .8 Provide appropriate temporary signage including signage for exit or building egress.

- .9 Identify and mark all equipment and materials identified to be retained by Owner 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.
- .10 Post warning signs on electrical lines and equipment that must remain energized to serve other areas during period of demolition.
- .11 Confirm that all electrical and telephone service lines entering building are not disconnected.
- .12 Do not disrupt active or energized utilities crossing the demolition site.
- .13 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.
- .14 Mark all materials required to be re-used, store in a safe place until ready for re-installation.
- .15 Adjust all junction boxes, receptacles and switch boxes flush with new wall construction where additional layers to existing construction are indicated.
- .16 Protection of In-Place Conditions
 - .1 Take precautions to guard against damage to adjacent work. Be liable for any damage or injury caused.
 - .2 Cease operations and notify Consultant if safety or any adjacent work appears to be endangered. Do not resume operations until reviewed with Consultant.
 - .3 Protect building systems, services and equipment.
 - .4 Provide temporary dust screens, covers, railings, supports and other protection as required.
 - .5 Provide and maintain fire prevention equipment and alarms accessible during demolition.
- .17 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 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.

3.4 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 Selling or burning of materials on the site 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 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.
- .7 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.
- .8 Demolish ceiling finishes as indicated on drawings.
- .9 Remove all wall coverings scheduled for demolition. Patch and repair wall surfaces with skim coat of gypsum board joint compound leaving wall surfaces smooth and even ready for new wall finishes.
- .10 Patch and repair all walls, floor and ceilings damaged during demolition with material matching adjacent walls, prepare ready for new finishes.
- .11 Patch and repair all mechanical equipment and electrical fixtures damaged or exposed during demolition to match adjacent finished surfaces.

3.5 CORING, DRILLING AND SAW-CUTTING CONCRETE

- .1 Complete an ultrasound inspection of affected concrete area before coring. Employ the services of an experienced inspector. Confirm with Owner before coring or drilling, location of reinforcing steel and raceways that may be present.
- .2 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.
- .3 Do not core structural beams or cut conduits or reinforcing steel without written permission from Landlord.

3.6 CLEANUP

- .1 Remove temporary Work.
- .2 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.
- .3 Maintain access to exits clean and free of obstruction during removal of debris.
- .4 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 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. Refer to Section 02 81 16.
 - .2 Mechanical or electrical equipment, except as required to make minor modifications to allow the work to be completed.
- .3 Drawings contain details that suggest directions for solving some of the major demolition and removal requirements for this project; Contractor is required to develop these details further by submitting a demolition plan prepared by a professional engineer employed by the Contractor.

1.2 RELATED SECTIONS

- .1 Section 02 81 16 – Hazardous Materials
- .2 Section 09 21 16 – Gypsum Board Assemblies
- .3 Section 09 91 00 – Painting
- .4 Division 20 – Mechanical: Specific requirements for demolishing, cutting, patching, or relocating mechanical items.
- .5 Division 26 – Electrical: Specific requirements for demolishing, cutting, patching, or relocating electrical items.

1.3 REFERENCES

- .1 American National Standards Institute (ANSI)
 - .1 ANSI A10.8-2011, Safety Requirements for Scaffolding.
- .2 Canadian Federal Legislation
 - .1 Motor Vehicle Safety Act (MVSA), 2023
 - .2 Hazardous Materials Information Review Act, 2020
- .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 Owner.
- .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.

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Demolition Meeting: Conduct a pre-demolition meeting at Project site 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 Coordination with Owner's continuing occupancy of portions of existing building.
 - .3 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 Owner's property, demolished materials shall become Contractor's property and shall be removed from Project site.

1.6 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 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.
- .3 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.

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.
 - .3 Conform to the British Columbia Occupational Health and Safety Regulations.
 - .4 Conform to Workers' Compensation Board Regulations.
 - .5 Conform to local municipal bylaws and regulations governing this type of work.
- .2 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 waste materials for recycling in accordance with Section 01 74 21 - Construction Waste Management and Disposal
- .2 Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, demolished materials shall become Contractor's property and shall be removed from Project site. Maximize salvage, and recycling of such materials as much as is practicable, 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 Owner will occupy portions of building immediately adjacent to selective demolition area:
 - .1 Conduct selective demolition so that Owner's operations will not be disrupted.
 - .2 Provide not less than 72 hours notice to Owner of activities that will affect Owner's 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 Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
- .6 Maintain fire-protection facilities in service during selective demolition operations

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 Consultant 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. Refer to Section 03 35 00 for floor preparation.
- .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:
 - .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 reuse in new construction are as indicated on Drawings.

Part 3 Execution

3.1 EXAMINATION

- .1 Inspect building 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 Consultant 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 Consultant.
 - .2 Consultant 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 Owner 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 Consultant if safety or any adjacent work appears to be endangered. Do not resume operations until reviewed with Consultant.
- .3 Prevent debris from blocking drainage inlets and systems and ground draining; protect materials 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 Provide and maintain shoring, bracing, or structural support to preserve stability and prevent movement, settlement, or collapse of construction to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished:
 - .1 Strengthen or add new supports when required during progress of selective demolition.

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 Complete an x-ray or ultrasound inspection of affected concrete area before coring. Employ the services of an experienced inspector. Confirm with Owner before coring or drilling, location of reinforcing steel and raceways that may be present.
- .2 Confirm coring and drilling times with Owner.
- .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 structural beams or cut reinforcing steel without written permission from Owner & Consultant.

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 Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - .1 Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 - .2 Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
 - .3 Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 - .4 Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
 - .5 Maintain adequate ventilation when using cutting torches.
 - .6 Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 - .7 Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 - .8 Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 - .9 Return elements of construction and surfaces that are to remain to condition existing before selective demolition operations began.
- .7 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.
- .8 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 and in accordance with Section 03 35 00.
- .4 Floor substrate shall be smooth, free from ridges and depressions, and adhesive remnants that could telegraph through resilient flooring materials and carpets.
- .9 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.
- .10 Fill all openings in gypsum board walls with gypsum board and framing to match existing, skim coat to make wall smooth and even.
- .11 Demolish ceiling finishes as indicated on Drawings.
- .12 Patch and repair all walls, floor and ceilings damaged during demolition with material matching adjacent walls, prepare ready for new finishes.
- .13 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 01 73 30 – 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 an 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 Consultant 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 SECTION INCLUDES

- .1 Removal, clean up, transport, and disposal of asbestos-containing materials and other hazardous materials identified in way of the work in accordance with applicable regulatory requirements.

1.2 SCOPE OF WORK

- .1 Scope of work covers the complete removal, cleanup, transport and disposal at a licensed landfill of all asbestos, lead and PCB containing materials and equipment in way of the work as defined in the project Architectural, Mechanical and Electrical Specifications and Drawings.
- .2 HazMat removal for this project will be conducted under Moderate and High-Risk work conditions as defined by the Work Safe B.C. for Asbestos, Lead, Silica and PCBs.
- .3 Conditions of Work:
 - .1 All work at the site must conform to CSA Z317.13-17 Standards and WorkSafeBC Occupational Health and Safety Regulations and Guidelines.
 - .2 Viewing Windows must be installed within each enclosure to provide unrestricted access for use by the Fire Department, Night Watchman, Supervisors and Consultants. The viewing window will be a minimum of two feet by two feet in size.
 - .3 The waste bins will be in the loading dock or other approved location.

1.3 STANDARDS

- .1 Comply with requirements of the following:
 - .1 BC Workers Compensation Act and Occupational Health and Safety Regulation.
 - .2 WorkSafeBC
 - .3 WHMIS Core Manual and Safety Data Sheets (SDS) for regulated Products.
 - .4 CSA Z-190 standard for respirator fit testing.
 - .5 Current WCB publication regarding work with asbestos.
 - .6 BC Building Code, most current edition.
 - .7 Applicable electrical codes.
 - .8 WorkSafeBC Notice of Project.
 - .9 CSA S350, Code of Practice for Safety in Demolition of Structures

1.4 PERMITS

- .1 Ensure that through the requirements for renovations or demolition, all electrical disconnection, capping or isolation of the appropriate services and utilities is complete should these services be affected by the removal.

1.5 WASTE HANDLING AND DISPOSAL

- .1 Disposal of all hazardous wastes will be conducted in accordance with the B.C. Ministry of Environment and local regulations pertaining to hazardous waste.

- .2 The contractor will have a Transportation or Dangerous Goods certified person prepare a waste manifest form prior to the disposal of any asbestos-containing waste materials from the site.
- .3 All waste bins used for material transportation will be lockable. The contractor will ensure that the waste bin is always locked when there is no employee watching the bin. Hazardous wastes will be moved only after 07:00 p.m. or as agreed to by the owner.
- .4 The waste level in the bins is not to go above one foot from the top of the bin before transport.

Part 2 Products

2.1 NOT USED.

Part 3 Execution

3.1 PROCEDURES AND REQUIREMENTS

- .1 The Hazardous Materials (hazmat) Contractor will be a subcontractor to the Prime Contractor for the purposes of this Specification unless otherwise determined in contract documents.
- .2 Asbestos removal for this project will be conducted under moderate risk work conditions as defined by the Work Safe B.C. publication "Safe Work Practices for Handling Asbestos".
- .3 Submit, upon Contract award, a copy of exposure control plans and site-specific written work procedures, including methods of hazardous materials removal and procedures to work on and around hazardous materials specifically as they relate to this Project.

3.2 ASBESTOS ABATEMENT – GENERAL

- .1 The work specified herein shall be the removal of known hazardous materials by competent persons trained, knowledgeable and qualified in the handling, transport and disposal of the hazardous materials using moderate and high-risk work procedures. Any worker deemed by the Industrial Hygiene Consultant to be inadequately trained to perform these duties will be removed from the project.
- .2 Construct and use scaffolds and platforms for access and to support asbestos workers and to remove the asbestos-containing materials shall in accordance with Occupational Health & Safety regulations.
- .3 All necessary documentation shall be the responsibility of the HazMat and Prime Contractors.
- .4 The health and safety of all contract employees in the areas affected during hazmat removal shall be the responsibility of the HazMat Contractor and the Prime Contractor and should the HazMat Contractor require the assistance of any other trade during the hazmat work, he will provide all necessary equipment, labour and training required to affect the work.
- .5 The HazMat Contractor will assume total responsibility for the erection, maintenance, signs and integrity of all enclosures and barriers related to the hazmat work.
- .6 The HazMat Contractor will provide all necessary labour, materials, insurance, permits and equipment necessary to carry out the work in accordance with all applicable regulations and this documentation.

- .7 The HazMat Contractor will provide all necessary labour to secure the required utilities for all asbestos work.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Labour, Products, materials, services and equipment necessary for:
 - .1 Finishing slabs-on-grade.
 - .2 Concrete topping, coating, patching and levelling compounds.
 - .3 Surface treatment with concrete hardener, sealer, and slip resistant coatings for interior concrete floor surfaces.
 - .4 Floor finishing and tolerances.
 - .5 Finishing of Formed Surfaces.
 - .6 Finishing of concrete patchwork including trenching.

1.2 RELATED SECTIONS

- .1 Section 03 11 00 – Concrete Forming – See structural drawings
- .2 Section 03 30 00 - Cast-in-Place Concrete – See structural drawings
- .3 Section 07 92 00 - Joint Sealants.
- .4 Section 09 91 00 - Painting.
- .5 Section 09 65 10 – Resilient Sheet Flooring.

1.3 REFERENCES

- .1 The versions of the standards referenced in this section are those listed in the BC Building Code, current edition at the time of the application for Building Permit; or if they are not referenced in the specified code, they are the latest version of the standard in effect at the time of the application for Building Permit.
- .2 CAN/CSA A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete.
- .3 CAN/CGSB-25.20, Surface Sealers for Floors.
- .4 ACI 302.1R, Guide for Concrete Floor and Slab Construction.
- .5 ASTM E1155M, Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers.

1.4 SUBMITTALS

- .1 Section 01 33 00: Submittal procedures.
- .2 Product Data: Provide data on concrete hardener, sealer, and slip resistant finish compatibilities, and limitations.

1.5 MAINTENANCE DATA

- .1 Section 01 33 00: Submittal procedures.
- .2 Maintenance Data: Provide data on maintenance renewal of applied coatings.

1.6 QUALITY ASSURANCE

- .1 Perform Work in accordance with CAN/CSA A23.1/A23.2.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver materials in manufacturer's packaging including application instructions.

1.8 COORDINATION

- .1 Coordinate floor finishing with concrete floor placement and concrete floor curing.
- .2 Coordinate exposed architectural concrete finishing with concrete formwork and concrete placement.

Part 2 Products

2.1 BONDING AGENTS

- .1 Portland cement/ epoxy-based bonding agent: Formulated for bonding new concrete to cured concrete.
- .2 Acceptable materials:
 - .1 Ardex Bonding and Anti-corrosion agent
 - .2 Grace Daraweld C
 - .3 Target Polymer Bonding Agent
 - .4 Sternson Surfacrete Concentrate Bond Agent
 - .5 Steels Multipurpose Acrylic
 - .6 Or approved substitution.

2.2 LEVELING COMPOUND

- .1 Self-drying, cement-based, polymer modified, trowel-grade underlayment.
- .2 Acceptable materials:
 - .1 Mapei Plani/Patch
 - .2 Ardex Feather Finish, Ardex Fortifinish high strength, Ardex SD-P trowelable and rampable.
 - .3 Starpatch Super Fine Skim Coat Mortar
 - .4 Or approved substitution.

2.3 EPOXY FLOOR COATING

- .1 Epoxy Floor Coating: 2-part, water-based epoxy coating
 - .1 Colour: Concrete grey
 - .2 Sheen: Satin.
 - .3 Basis-of-Design Product: Armorseal 8100 by Sherwin Williams.
 - .1 Substitutions: May be considered; submit substitution request.
- .2 Primer: As recommended by floor coating manufacturer for substrate and service conditions.

2.4 FLOOR HARDENER

- .1 Non-metallic hardener (plain): premixed, dry shake surface hardener.
 - .1 Acceptable material: Sternson Diamag 7; Target Non-Metallic; CPD Floor Hardener Pre-Mix (Standard); Master Builders Mastercron; Sonneborn Harcol Redi-Mix.

- .2 Non-metallic hardener (coloured): premixed, dry shake surface hardener, colour selected by Consultant.
 - .1 Acceptable material: Sternson Colorplete; Master Builders Colorcron; Sonneborn Harcol Redi-Mix.

2.5 MIXING

- .1 Site mix materials in accordance with manufacturer's written instructions.

2.6 SUBSTITUTIONS

- .1 Specified manufacturer's products stated herein establish minimum acceptable standards for work of this Section.
- .2 Other manufacturers offering products meeting or exceeding specified products and requirements may be considered.

Part 3 Execution

3.1 EXAMINATION

- .1 Section 01 71 00: Verify site conditions.
- .2 Verify that floor surfaces are acceptable to receive the work of this section.

3.2 PREPARATION

- .1 Prior to finishing concrete floors, confirm with the manufacturers of all finished flooring to be used on the project, the specific floor finish, (rough or smooth) required for the application of the finished flooring.
- .2 Prior to application of levelling compounds and curing compounds, confirm compatibility of products with finished flooring manufacturers.
- .3 Examine surfaces to receive curing compounds, patching and levelling compounds and report any defects which may affect the performance of the work of this section.
- .4 Beginning of installation means acceptance of existing conditions.
- .5 Prepare and clean substrates in accordance with manufacturer's directions for application of curing compounds, patching and levelling compounds.
- .6 Concrete surfaces shall have been cured for time periods stipulated by manufacturers for installation of their products.
- .7 Preparation for Floor Coating Application: Prepare in accordance with SSPC-SP13/NACE 6; completely remove existing paint finishes down to bare concrete.

3.3 FLOOR SLAB FINISHING

- .1 Finish concrete floor surfaces in accordance with CSA-23.1, Section 22 - Treatment of Unformed Surfaces, for Class 'A' floor finish.
- .2 Steel Trowel Finish: In accordance with CSA-23.1, Section 22 and as follows:
 - .1 Thoroughly float surface until compacted. Continue floating until sufficient mortar rises to surface and fills all voids.
 - .2 When floor surface has hardened sufficiently and no fines are brought to the surface, trowel floor with steel trowel to smooth surface free from pinholes and imperfections.

- .3 Ensure trowel lines are removed and provide a smooth finish.
- .4 Schedule:
 - .1 Exposed concrete floors as indicated and scheduled.
 - .2 Concrete floors to receive resilient flooring.
- .3 Float Finish: In accordance with CSA-23.1, Section 22, clause 22.3.2 - Floating
- .4 Floors: Provide uniform slope to drain without variation that would result in standing water. Slope at 2% unless indicated otherwise.
- .5 Areas With Floor Drains, maintain design floor elevation at walls; slope surfaces uniformly to drains at 2% nominal or as otherwise indicated.
- .6 Tool all control joints and construction joints. Coordinate tooling with concrete finishing. Re-tool joints at completion of finishing as required to give full size joint and provide sound substrate suitable for sealant application.

3.4 FLOOR TOLERANCES

- .1 Concrete tolerance for horizontal surfaces in accordance with CSA-A23.1/A23.2. Use F-number method to verify flatness within 48 hours after slab installation.
- .2 Finish concrete to achieve the following tolerances:
 - .1 Under Resilient Finishes: F_F 36 and F_L 22.
- .3 Correct the slab surface if the actual F_F or F_L number for the floor installation measures less than required.
- .4 Correct defects in the defined traffic floor by grinding or removal and replacement of the defective work. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process.

3.5 CORRECTION OF FLOOR TOLERANCES

- .1 Where floor tolerances are not within the specified limits, grind or fill the floor to bring the surface to within the requirements.
- .2 Where grinding is required, grind floors as soon as possible, preferably within three days but not until the concrete is sufficiently strong to prevent dislodging coarse aggregate particles.
- .3 Where filling is required, the concrete surface shall be prepared by mechanical roughening or hydro milling to remove all surface film and laitance.
- .4 Apply levelling compound as specified in accordance with manufacturer's printed instructions.

3.6 APPLICATION: CURING COMPOUND

- .1 Apply curing and sealing compound in accordance with the manufacturer's instructions to all areas not scheduled to receive further floor finish. Apply at the rate of not less than 10 m²/litre for smooth steel troweled surfaces and 5 to 7.5 m²/litre for float or broom finished surfaces.
- .2 Do not apply concrete curing compound to floors designated to receive resilient flooring, liquid applied finishes or ceramic tile.

3.7 BONDING AGENT

- .1 Apply bonding agent to all concrete when new concrete will be applied against it under the following conditions:
 - .1 Patching
 - .2 At construction joints.

3.8 FINISHING OF FORMED SURFACES

- .1 Classification: For formed surfaces shall be as follows:
 - .1 Class 1 – Architectural Concrete Finish: Exposed concrete surfaces exposed exterior and interior concrete surfaces at grade and above grade where indicated, such as the underside of stair soffits.
 - .1 For Class 1 Architectural Concrete Finish surfaces, finishing shall conform to CAN/CSA A23.1, Section 24, Finishing of Formed Surfaces, clause 24.3.6, Smooth-Form Finish and additional requirements in accordance with procedures under Section 27 – Architectural Concrete, with patching to be performed in accordance with Clause 24.2. Patching.
 - .2 Finishing including HDO, of Class 1 Architectural Concrete Finish surfaces to be performed in accordance with Section 03 33 00 – Architectural Concrete.
 - .2 Class 2 – Smooth-Form Finish: Exposed interior concrete surfaces below grade level, except where indicated as Class 1 – Architectural Concrete, such as Ambulance bay concrete, exposed concrete columns at pharmacy loading bay and service rooms.
 - .1 For Class 2 Smooth-Form Finish concrete surface finishing shall conform to CAN/CSA-A23.1, Section 24 Finishing of Formed Surfaces, clause 24.3.6, Smooth-Form Finish, with patching to be done in accordance with Clause 24.2. Patching.
 - .3 Class 3 – Rough Form Finish: All concealed concrete surfaces and all exposed concrete surfaces of elevator shafts, pits and trenches.
 - .1 For Class 3 Rough-Form concrete surface finishing shall conform to CAN/CSA-A23.1, Section 24 Finishing, Clause 24.3.5, Rough Form Finish, with patching to be done in accordance with Clause 24.2. Patching.

3.9 DEFECTIVE CONCRETE

- .1 Repair honeycombing, rock pockets, chips, spalls and stains in exposed concrete surfaces. Remove fins and other protrusions in concrete surfaces by chipping, not grinding.
- .2 Patch honeycombing, rock pockets, chips and spalls to match surrounding sound concrete surfaces, textures and colour.
- .3 Remove stains from concrete surfaces.

3.10 EPOXY FLOOR COATING APPLICATION

- .1 Prime and apply floor coating in accordance with manufacturer's written application instructions.
- .2 Protect freshly coated areas and let floor coating cure fully in accordance with manufacturer's recommendations before allowing traffic.

3.11 PROTECTION

- .1 At all times during the work protect architectural members as required with polyethylene sheets or the like from staining or becoming coated with leakage, due to continuing concreting operations. Protect concrete from staining due to rusting of reinforcing steel.

3.12 CLEANING

- .1 Section 01 74 11: Cleaning installed work.
- .2 As work proceeds and on completion deposit all recyclable packing materials and containers in appropriate recycling containers.
- .3 Rubbish and debris resulting from work of this section shall be collected regularly, and removed from the project site and disposed of in accordance with Section 01 74 11 – Cleaning.
- .4 Repair, remove and clean all drips or smears resulting from the work of this section on exposed, finished surfaces or surfaces to be subsequently finished.
- .5 Clean adjacent soiled surfaces.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 03 30 00 - Cast-in-Place Concrete
- .2 Section 04 04 05 - Mortar and Masonry Grout
- .3 Section 04 04 15 - Masonry Anchorage and Reinforcement
- .4 Section 04 04 25 – Masonry Units
- .5 Section 04 26 19 - Reinforced Unit Masonry

1.2 REFERENCE

- .1 The versions of the standards referenced in this section are those listed in the BC Building Code, current edition at the time of the application for Building Permit; or if they are not referenced in the specified code, they are the latest version of the standard in effect at the time of the application for Building Permit
- .2 Canadian Standards Association (CSA International)
 - .1 CSA A165 Series - Standards on Concrete Masonry Units.
 - .2 CSA A371 - Masonry Construction for Buildings.
 - .3 CSA-S304.1 - Masonry Design for Buildings
 - .4 CSA A179- Mortar and Grout for Unit Masonry.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-installation meetings: comply with Section 01 31 19 - Project Meetings. Conduct pre-installation meeting one week prior to commencing work of this Section and on-site installations to:
 - .1 Verify project requirements.
 - .2 Verify substrate conditions.
 - .3 Co-ordinate products, installation methods and techniques.
 - .4 Sequence work of related sections.
 - .5 Co-ordinate with other building subtrades.
 - .6 Review manufacturer's installation instructions.
 - .7 Review masonry cutting operations, methods and tools and determine worker safety and protection from dust during cutting operations.
 - .8 Review warranty requirements.
- .2 Comply with manufacturer's written recommendations for sequencing construction operations.

1.4 ACTION SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, limitations and colours.
 - .2 Provide two copies of Workplace Hazardous Materials Information System (WHMIS) - Material Safety Data Sheets (MSDS) in accordance with Section 01 35 29.06 - Health and Safety Requirements and 01 35 43 - Environmental Procedures.

1.5 INFORMATION SUBMITTALS

- .1 Certificates: provide manufacturer's product certificates certifying materials comply with specified requirements.
- .2 Test and Evaluation Reports:
 - .1 Test reports to certify compliance of masonry units and mortar ingredients with specified performance characteristics and physical properties.
 - .2 Provide data for masonry units, in addition to requirements set out in referenced CSA and ASTM Standards, indicating initial rates of absorption.
- .3 Installer Instructions: provide manufacturer's installation instructions, including storage, handling, safety and cleaning.
- .4 Manufacturer's Reports: provide written reports prepared by manufacturer's on-site personnel to include:
 - .1 Verification of compliance of work with Contract.
 - .2 Site visit reports providing detailed review of installation of work, and installed work.

1.6 CLOSEOUT SUBMITTALS

- .1 Provide manufacturer's instructions for care, cleaning and maintenance of prefaced masonry units for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- .1 Provide manufacturer's instructions in accordance with Section 01 78 00 - Closeout Submittals covering maintenance requirements and parts catalogue, with cuts and identifying numbers.

1.8 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installer: experienced in performing work of this section who has specialized in installation of work similar to that required for this project.
 - .2 Masons: company or person specializing in masonry installations with 5 years documented experience with masonry work similar to this project.

1.9 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 - Product Requirements.
- .2 Deliver materials to job site in dry condition.
- .3 Storage and Protection.
 - .1 Keep materials dry until use.
 - .2 Store under waterproof cover on pallets or plank platforms held off ground by means of plank or timber skids.

1.10 SITE CONDITIONS

- .1 Ambient Conditions: assemble and erect components when temperatures are above 4 degrees C.
- .2 Weather Requirements: to CSA-A371 to IMIAC - Recommended Practices and Guide Specifications for Hot and Cold Weather Masonry Construction.

- .3 Cold weather requirements:
 - .1 To CSA-A371 with following requirements.
 - .1 Maintain temperature of mortar between 5 degrees C and 50 degrees C until batch is used or becomes stable.
 - .2 Maintain ambient temperature of masonry work and its constituent materials between 5 degrees C and 50 degrees C and protect site from windchill.
 - .3 Maintain temperature of masonry above 0 degrees C for minimum of 14 days, after mortar is installed.
 - .4 Preheat unheated wall sections in enclosure for minimum 72 hours above 10 degrees C, before applying mortar.
 - .2 Hot weather requirements:
 - .1 Protect freshly laid masonry from drying too rapidly, by means of waterproof, non-staining coverings.
 - .2 Keep masonry dry using waterproof, non-staining coverings that extend over walls and down sides sufficient to protect walls from wind driven rain, until masonry work is completed and protected by flashings or other permanent construction.
 - .3 Spray mortar surface at intervals and keep moist for maximum of three days after installation.

Part 2 Products

2.1 MANUFACTURERS

- .1 Ensure manufacturer has minimum 5 years experience in manufacturing components similar to or exceeding requirements of project.

2.2 MATERIALS

- .1 Masonry materials are specified elsewhere in related Sections:

Part 3 Execution

3.1 INSTALLERS

- .1 Experienced and qualified masons to carry out erection, assembly and installation of masonry work.

3.2 MANUFACTURER'S INSTRUCTIONS

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

3.3 PREPARATION

- .1 Surface Preparation: prepare surface in accordance with manufacturer's written recommendations and co-ordinate with Section 01 70 00 - Examination and Preparation.
- .2 Establish and protect lines, levels, and coursing.
- .3 Protect adjacent materials from damage and disfiguration.

3.4 INSTALLATION

- .1 Do masonry work in accordance with CSA-A371 except where specified otherwise.
- .2 Build masonry plumb, level, and true to line, with vertical joints in alignment, respecting construction tolerances permitted by CSA-A371.
- .3 Layout coursing and bond to achieve correct coursing heights, and continuity of bond above and below openings, with minimum of cutting.

3.5 CONSTRUCTION

- .1 Exposed masonry.
 - .1 Remove chipped, cracked, and otherwise damaged units, in accordance with CSA A165, Clause 82.1, in exposed masonry and replace with undamaged units.
- .2 Jointing.
 - .1 Allow joints to set just enough to remove excess water, then tool with round jointer to provide smooth, joints true to line, compressed, uniformly concave joints.
 - .2 Strike flush joints concealed in walls and joints in walls to receive plaster, tile, insulation, or other applied material except paint or similar thin finish coating.
- .3 Cutting.
 - .1 Cut out for electrical switches, outlet boxes, and other recessed or built-in objects.
 - .2 Make cuts straight, clean, and free from uneven edges.
- .4 Building-in.
 - .1 Build in items required to be built into masonry.
 - .2 Prevent displacement of built-in items during construction. Check plumb, location and alignment frequently, as work progresses.
 - .3 Brace door jambs to maintain plumb. Fill spaces between jambs and masonry with mortar.
- .5 Support of loads.
 - .1 Use 20 MPa concrete to Section 03 30 00 - Cast-in-Place Concrete, where concrete fill is used in lieu of solid units.
 - .2 Use grout to CSA A179 where grout is used in lieu of solid units.
 - .3 Install building paper below voids to be filled with concrete; keep paper 25 mm back from faces of units.
- .6 Provision for movement.

- .1 Leave 3 mm space below shelf angles.
- .2 Leave 6 mm space between top of non-load bearing walls and partitions and structural elements. Do not use wedges.
- .3 Built masonry to tie in with stabilizers, with provision for vertical movement.
- .7 Control joints.
 - .1 Construct continuous control joints as indicated.

3.6 SITE TOLERANCES

- .1 Tolerances in notes to CSA-A371 apply.

3.7 FIELD QUALITY CONTROL

- .1 Site Tests, Inspection:
 - .1 Perform field inspection and testing in accordance with Section 01 45 00 - Quality Control.
 - .2 Notify inspection agency minimum of 24 hours in advance of requirement for tests.
- .2 Manufacturer's Services:
 - .1 Have manufacturer of products supplied under this Section review work involved in handling, installation/application, and protection of its products, and submit written reports in acceptable format to verify compliance of work with Contract.
 - .2 Manufacturer's field services: provide manufacturer's field services, consisting of product use recommendations and periodic site visits for inspection of product installation, in accordance with manufacturer's instructions.
 - .3 Schedule site visits to review work as installation is about to begin.
 - .4 Schedule site visits to review work at stages listed:
 - .1 After delivery and storage of products, and when preparatory work on which work of this Section depends is complete, but before installation begins.
 - .2 Twice during progress of work at 25% and 60% complete.
 - .3 Upon completion of work, after cleaning is carried out.
 - .5 Obtain reports within three days of review and submit immediately.

3.8 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
- .2 Progress Cleaning: in accordance with related masonry sections.
- .3 Final Cleaning:
 - .1 Perform cleaning after installation to remove construction and accumulated environmental dirt.

- .2 Upon completion of installation and verification of performance of installation, remove surplus materials, rubbish, tools and equipment barriers.
- .3 Divert unused or damaged masonry units from landfill as specified in Section 01 74 00.

3.9 PROTECTION

- .1 Protect masonry and other work from marking and other damage. Protect completed work from mortar droppings. Use non-staining coverings.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Mortar and grout for masonry.
- .2 Mortar for minor repairs.

1.2 RELATED SECTIONS

- .1 Section 01 74 21 – Construction Waste Management and Disposal.
- .2 Section 04 26 19 - Reinforced Unit Masonry.
- .3 Section 08 11 13 - Standard Hollow Metal Doors and Frames: Grouted steel door frames.

1.3 REFERENCES

- .1 ASTM C207-18 - Hydrated Lime for Masonry Purposes.
- .2 ASTM C494/C494M-19 - Chemical Admixtures for Concrete.
- .3 ASTM C1329-16a - Mortar Cement.
- .4 ASTM C1489-15 - Lime Putty for Structural Purposes.
- .5 CSA A179-14 (R2019) - Mortar and Grout for Unit Masonry.
- .6 CSA A371-14 (R2019) - Masonry Construction for Buildings.
- .7 CAN/CSA A3000-18 - Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
- .8 CSA S304.1-14 (R2019) - Design of Masonry Structures.

1.4 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Include design mix, indicate whether the Proportion or Property specification of CSA A179 is to be used, required environmental conditions, and admixture limitations.

1.5 DELIVERY, STORAGE, AND PROTECTION

- .1 Maintain packaged materials clean, dry, and protected against dampness, freezing, and foreign matter.

1.6 ENVIRONMENTAL REQUIREMENTS

- .1 Cold and Hot Weather Requirements: CSA A371 - Masonry Construction for Buildings.

1.7 QUALITY ASSURANCE

- .1 Use installers who are in good standing with the Canadian Masonry Contractors Association.

Part 2 Products

2.1 MATERIALS

- .1 Cementitious Material: CSA A179.
- .2 Masonry Cement: CSA A3002, Type S.
- .3 Mortar Aggregate: CSA A179, fine aggregate.
- .4 Grout aggregate: CSA A179, fine aggregate.

- .5 Water: Clean and potable.
- .6 Bonding Agent: Latex type.
- .7 Premix Mortar: CSA A179, Type S.

2.2 MORTAR MIXES

- .1 Mortar for Interior Above Grade:
 - .1 Non-Loadbearing Partitions: CSA A179, Type N using the Property specification.

2.3 MORTAR MIXING

- .1 Mix mortar ingredients in accordance with CSA A179 in quantities needed for immediate use.
- .2 Do not use antifreeze liquids, calcium chloride, frost inhibitors based on calcium chloride, salts or other substances used for lowering the freezing point or accelerating setting time.
- .3 If moisture is lost by evaporation, retemper with water in quantities and at intervals sufficient to restore workability.
- .4 Use mortar within period specified by mortar manufacturer.

2.4 GROUT MIXES

- .1 Bond Beams: 21 MPa strength at 28 days; 200-250 mm slump; mixed in accordance with CSA A179 Fine grout.
- .2 Engineered Masonry: 21 MPa strength at 28 days; 200-250 mm slump; mixed in accordance with CSA A179, Fine grout.

2.5 GROUT MIXING

- .1 Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with CSA A179 Fine grout.
- .2 Do not use antifreeze liquids, calcium chloride, frost inhibitors based on calcium chloride, salts or other substances used for lowering the freezing point or accelerating setting time.

Part 3 Execution

3.1 EXAMINATION

- .1 Request inspection of spaces to be grouted.

3.2 PREPARATION

- .1 Apply bonding agent to existing concrete surfaces.
- .2 Plug clean-out holes with block masonry units. Brace masonry for wet grout pressure.

3.3 INSTALLATION

- .1 Install mortar and grout in accordance with CSA A179.
- .2 Repair any existing masonry that is disturbed due to new work.

3.4 FIELD QUALITY CONTROL

- .1 Test mortar mix in accordance with CSA A179.
- .2 Test grout mix in accordance with CSA A179 for compressive strength and slump.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Continuous wire reinforcement and reinforcing rods.
- .2 Masonry anchors and ties.

1.2 RELATED SECTIONS

- .1 Section 01 74 21 - Construction Waste Management and Disposal
- .2 Section 04 26 19 - Reinforced Unit Masonry.

1.3 REFERENCES

- .1 ASTM A1008/A1008M-15 - Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
- .2 CAN/CSA-A23.1/A23.2-19 - Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete.
- .3 CAN/CSA-G40.18-M92 (R2002) - Billet-Steel Bars for Concrete Reinforcement.
- .4 CAN/CSA G40.20-04/G40.21-13 (R2018) - General Requirements for Rolled or Welded Structural Steel/Structural Quality Steel.
- .5 CSA-A370-14 (R2018) - Connectors for Masonry.
- .6 CSA-A371-14 (R2019) - Masonry Construction for Buildings.
- .7 CSA G30.3-M1983 (R1998) - Cold-Drawn Steel Wire for Concrete Reinforcement.
- .8 CSA-S304.1-14 (R2019) - Masonry Design for Buildings.

1.4 DESIGN CRITERIA

- .1 Comply with requirements of CSA A370-04, ACI/ASCE/TMS/518 and U.B.C. for non-conventional masonry connectors.
- .2 Deflection: maximum 2.0 mm (0.079"), including free play, when acted upon by a lateral load of 0.45 kN (100 lbs.), in all possible positions of adjustment.
- .3 Positive restraint at position of maximum adjustment.
- .4 Free Play of multi-component ties: Not more than 1.2 mm (0.047") when assembled in all possible configurations.

1.5 WARRANTY

- .1 Refer to Section 01 11 00: Warranty. Warranty Period for all supplied materials, equipment and installation is two (2) years from the date of Service Commencement.

Part 2 Products

2.1 MATERIALS

- .1 Steel Wire: CSA G30.3.
- .2 Steel Sheet and Strip: ASTM A1008/A1008M, Grade 40.
- .3 Steel Bars, Plates, Angles: CAN/CSA-G40.21, Type W.
- .4 Steel Bolts: ASTM A307, Type A.

2.2 MASONRY CONNECTORS

- .1 Single Wythe Joint Reinforcement: CSA A370, continuous Ladder type; cold drawn steel wire, 3.65 mm side rods with 3.65 mm cross ties.
- .2 Bar Anchors: CSA A370, 38x50 mm size x 4.76 mm thick,
- .3 Bar Reinforcing Steel: Grade 400R, deformed billet bars.
- .4 Hardware and Bolts: Galvanized.
- .5 Steel support angles and brackets: Refer to structural detail drawings and specifications.

2.3 MASONRY CONNECTORS FOR REPAIRS

- .1 Screw in type to suit application.

2.4 FABRICATION

- .1 Fabricate connectors to CSA-A370.
- .2 Fabricate bar reinforcing to CSA A23.1-04/A23.2-04.

Part 3 Execution

3.1 SCHEDULES

- .1 Joint Reinforcement: Refer to structural drawings.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Concrete Block Masonry Units:
- .1 Concrete block units.

1.2 RELATED SECTIONS

- .1 Section 01 74 21 - Construction Waste Management and Disposal
- .2 Section 04 05 13 - Mortar And Masonry Grout.
- .3 Section 04 05 19 - Masonry Anchorage and Reinforcement.
- .4 Section 04 26 19 - Reinforced Unit Masonry.

1.3 REFERENCES

- .1 CSA A165 Series-14 (R2019) - Standards on Concrete Masonry Units.
- .2 CSA A371-14 (R2019) - Masonry Construction for Buildings.
- .3 CSA-S304.1-14 (R2019) - Masonry Design for Buildings.
- .4 CAN4-S106-15 (R2020) - Fire Tests of Window and Glass Block Assemblies.

Part 2 Products

2.1 CONCRETE BLOCK MASONRY UNITS

- .1 Concrete Block Masonry Units (CMU): CSA A165 Series (CSA A165.1), Type H/7.5/C/M.
- .2 Fire Resistant Concrete Block Masonry Units: CSA A165 Series (A165.1), Classification H/15/B/M.
 - .1 Fire resistance rating: as noted on drawings
 - .3 Size and Shape: Nominal modular size of 190 x 190 x 390 mm. Provide special units for 90 degree corners, bond beams, lintels and bullnose corners.
 - .4 All interior exposed corners shall be bull nosed units unless detailed otherwise. This includes any returns to door frames etc.

2.2 FABRICATION

- .1 Manufacture masonry units to CSA A371 and CSA S304.1.

Part 3 Execution

3.1 INSTALLATION

- .1 Install masonry units as specified in masonry Section 04 26 19 and as per structural drawings.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Concrete masonry units.
- .2 Reinforcement, anchorage, and accessories.

1.2 RELATED SECTIONS

- .1 Section 01 74 21 - Construction Waste Management and Disposal
- .2 Section 04 04 05 - Mortar and Masonry Grout: Mortar and grout.
- .3 Section 04 04 15 - Masonry Anchorage and Reinforcement: Connectors and reinforcing.
- .4 Section 05 50 00 - Metal Fabrications: lateral support angles and fabricated steel items.
- .5 Section 07 84 00 - Firestopping: Firestopping at penetrations of masonry work.
- .6 Section 07 92 00 - Joint Sealants: Rod and sealant at control and expansion joints.

1.3 REFERENCES

- .1 ASTM A653/A653M-20 - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .2 CSA A371-14 (R2019) - Masonry Construction for Buildings.
- .3 CSA S304.1-14 (R2019) - Design of Masonry Structures.
- .4 ULC (Underwriters Laboratories of Canada) - List of Equipment and Materials for:
 - .1 Building Materials.
 - .2 Fire Resistance.
 - .3 Firestop Systems and Components.

1.4 QUALITY ASSURANCE

- .1 Perform Work in accordance with CSA A371 - Masonry Construction for Buildings and CSA S304.1 - Design of Masonry Structures.

1.5 REGULATORY REQUIREMENTS

- .1 Conform to BC Building Code for ULC Assembly No. U906 requirements for fire rated masonry construction.

1.6 DELIVERY, STORAGE, AND PROTECTION

- .1 Package and protect masonry units to arrive undamaged at the job site.
- .2 Store masonry under waterproof cover on pallets or plank platforms held off ground.

1.7 ENVIRONMENTAL REQUIREMENTS

- .1 Cold and Hot Weather Requirements: CSA A371 - Masonry Construction for Buildings.

Part 2 Products

2.1 CONCRETE BLOCK MASONRY UNITS

- .1 Concrete Block Units (CMU): Specified in Section 04 04 25.

2.2 REINFORCEMENT AND ANCHORAGE

- .1 Joint Reinforcement: As Specified in Section 04 04 15.

- .2 Bar Reinforcing Steel: As Specified in Section 04 04 15.
- .3 Bar Anchors: As Specified in Section 04 04 15.
- .4 Steel Angles: Specified in Section 05 50 00.

2.3 MORTAR AND GROUT

- .1 Mortar and Grout: Type as specified in Section 04 04 05.

2.4 ACCESSORIES

- .1 Preformed Control Joints: Neoprene material. Provide with corner and tee accessories, heat fused joints.
- .2 Compressible Joint Filler: ASTM 1330, closed cell polyethylene, urethane or neoprene foam rod; oversized 30 to 50 percent larger than joint width; self-expanding; maximum lengths.
- .3 Preformed Impregnated Foam Sealants: Precompressed, high-density urethane foam impregnated with non-drying, water repellent agent, factory-produced in precompressed sizes to fit joint widths indicated.
- .4 Nailing Strips: Softwood, preservative treated for moisture resistance, dovetail shape, sized to masonry joints.
- .5 Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

2.5 REINFORCEMENT AND ANCHORAGE

- .1 Joint Reinforcement: As Specified in Section 04 04 15.
- .2 Bar Reinforcing Steel: As Specified in Section 04 04 15.
- .3 Bar Anchors: As Specified in Section 04 04 15.
- .4 Steel Angles: Specified in Section 05 50 00.

2.6 MORTAR AND GROUT

- .1 Mortar and Grout: Type as specified in Section 04 04 05.

2.7 ACCESSORIES

- .1 Preformed Control Joints: Neoprene material. Provide with corner and tee accessories, cement fused joints.
- .2 Compressible Joint Filler: ASTM 1330, closed cell polyethylene, urethane or neoprene foam rod; oversized 30 to 50 percent larger than joint width; self-expanding, maximum lengths.
- .3 Preformed Impregnated Foam Sealants: Precompressed, high-density urethane foam impregnated with non-drying, water repellent agent, factory-produced in precompressed sizes to fit joint widths indicated.
- .4 Nailing Strips: Softwood, preservative treated for moisture resistance, dovetail shape, sized to masonry joints.
- .5 Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify that field conditions are acceptable and are ready to receive work.
- .2 Verify items provided by other sections of work are properly sized and located.
- .3 Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.2 PREPARATION

- .1 Direct and coordinate placement of metal anchors supplied to other Sections.
- .2 Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.
- .3 Verify that items built-in under other sections are properly located and sized.

3.3 COURSING

- .1 Build masonry plumb, level, and true to line, with vertical joints in alignment.
- .2 Establish lines, levels, and coursing indicated. Protect from displacement.
- .3 Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- .4 Concrete Masonry Units:
 - .1 Bond: Running.
 - .2 Coursing: One unit and one mortar joint to equal 200 mm.
 - .3 Mortar Joints: Concave.

3.4 PLACING AND BONDING

- .1 Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
- .2 Lay hollow masonry units with face shell bedding on head and bed joints.
- .3 Buttering corners of joints or excessive furrowing of mortar joints are not permitted.
- .4 Remove excess mortar as work progresses.
- .5 Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- .6 Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
- .7 Cut mortar joints flush where wall tile or resilient base is scheduled,.

3.5 PROVISION FOR MOVEMENT

- .1 Leave 25 mm space between top of non-loadbearing wall and structural elements. Do not use wedges.

3.6 REINFORCEMENT AND ANCHORAGE

- .1 Install masonry connectors and reinforcement in accordance with CSA A370, CSA A371 and CSA S304.1 and as indicated on the structural drawings.
- .2 Place joint reinforcement spaced at 600 mm vertically.
- .3 Lap joint reinforcement ends minimum 150 mm.
- .4 Reinforce and grout masonry units and bond beams in accordance with CSA A371.
- .5 Install vertical reinforcing steel with a minimum clearance of 13 mm from the masonry and not less than one bar diameter between bars.
- .6 Secure reinforcing steel in place. Inspect steel connections before grouting.
- .7 Provide cleanout openings at bottom of cores containing reinforcement.
- .8 Fill cells containing reinforcement and anchor bolts solidly with grout.

3.7 LINTELS

- .1 Install reinforced unit masonry lintels over openings where steel or precast concrete lintels are not scheduled, in accordance with CSA A371 and CSA S304.1 and as detailed.

LINTEL SCHEDULE FOR NON-LOAD BEARING WALLS AND OPENINGS IN LOAD BEARING WALLS - 200 mm (unless noted otherwise on Structural Drawings)

Unit Size	SPAN				
	0-1200	1200-1800	1800-2400	2400-3600	3900
100	L90x90x8	100x90x10	125x90x10	----	
150	L90x90x8 Lin. Block 1-15M bot.	125x90x10 Lin. Block 1-20M bot.	L125x90x10 Lin. Block 1-20M bar fill 1 block course over lintel	----	
200	2-10M bot. 200 high	2-10M bot. 200 high	2-15M bot. 200 high	2-20M T&B 400 high	2-20M T&G 400 high
300 (250 sim)	2-15M bot. 200 high	2-15M bot. 200 high	2-20M bot. 200 high	2-20M T&G 400 high	2-20M T&G 400 high

NOTE: for openings of 3900 clear span, fill core of block over lintel block with grout.

- .1 All grout 15 MPa at 28 days.
- .2 200 minimum bearing each end.

For larger openings in load bearing walls see structural detail. Refer to Structural Drawings for lintel information other than specified above and provide as applicable.

3.8 LATERAL SUPPORT AND ANCHORAGE

- .1 Install lateral support and anchorage as indicated.
- .2 Space supports and anchors embedded in concrete in accordance with CSA A370, CSA A371 and CSA S304.1.

3.9 SUPPORT OF LOADS

- .1 Grout bond beams and pilasters as indicated on the drawings.
- .2 Use grout to CSA A179 where grout is used in lieu of solid units.
- .3 Use 25 MPa strength concrete where concrete is used in lieu of solid units.
- .4 Install building paper below voids to be filled with grout; keep paper 25 mm back from face of units.

3.10 ENGINEERED MASONRY

- .1 Lay masonry units with core cells vertically aligned and cavities between wythes clear of mortar and unobstructed.
- .2 Reinforce masonry unit cores and cavities with reinforcement bars and grout in accordance with CSA A179, CSA A371 and CSA S304.1.

3.11 CONTROL JOINTS

- .1 Provide continuous control joints and install sealant as per Section 07 92 00.
- .2 Do not continue horizontal joint reinforcement through control and expansion joints.
- .3 Break vertical mortar bond with sheet building paper fitted to one side of the hollow contour end of the block unit. Fill the resultant elliptical core with grout fill. Rake joint at exposed unit faces for placement of backer rod and sealant.

- .4 Size control joint in accordance with Section 07 92 00 for sealant performance.

3.12 BUILT-IN WORK

- .1 As work progresses, install built-in metal door and glazed frames, and other items to be built-in the work and furnished by other sections.
- .2 Install built-in items plumb and level.
- .3 Bed anchors of metal door frames in adjacent mortar joints. Fill frame voids solid with grout. Fill adjacent masonry cores with grout minimum 300 mm from framed openings.
- .4 Do not build in organic materials subject to deterioration.

3.13 TOLERANCES

- .1 Tolerances for unit masonry as recommended in CSA A371.

3.14 CUTTING AND FITTING

- .1 Cut neatly for electrical switches, outlet boxes and other recessed or built-in objects. Coordinate with other sections of work to provide correct size, shape, and location.
- .2 Make cuts straight, clean and free of uneven edges.
- .3 Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.15 CLEANING

- .1 Remove excess mortar and mortar smears as work progresses.
- .2 Replace defective mortar. Match adjacent work.
- .3 Clean soiled surfaces with cleaning solution.
- .4 Use non-metallic tools in cleaning operations.

3.16 PROTECTION OF FINISHED WORK

- .1 Without damaging completed work, provide protective boards at exposed external corners which may be damaged by construction activities.

3.17 SCHEDULES

- .1 Interior Fire Rated Walls: Single wythe engineered concrete masonry units, 200 mm nominal thickness, to fire assembly rating indicated.
- .2 Unrated Walls: Single wythe engineered concrete masonry units, 200 mm nominal thickness.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Furnishing of all labour, materials, services and equipment necessary for the design, supply and installation of shop fabricated miscellaneous metal items.

1.2 RELATED SECTIONS

- .1 Section 03 30 00 - Cast-in-place Concrete – See Structural Drawings.
- .2 Section 04 26 19 - Reinforced Unit Masonry – See Structural Drawings.
- .3 Section 05 12 00 - Structural Steel Framing – See Structural Drawings.
- .4 Section 06 41 11 - Architectural Cabinetwork.
- .5 Section 09 91 00 - Painting.

1.3 REFERENCES

- .1 The versions of the standards referenced in this section are those listed in the BC Building Code, current edition at the time of the application for Building Permit; or if they are not referenced in the specified code, they are the latest version of the standard in effect at the time of the application for Building Permit.
- .2 ASTM A53/A53M - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
- .3 ASTM A153/A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- .4 ASTM A307 - Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- .5 ASTM A500 - Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- .6 ASTM A501 - Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
- .7 CAN/CGSB-1.181 - Ready-Mixed, Organic Zinc-Rich Coating.
- .8 CAN/CSA-G40.20-04/G40.21 - General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .9 CAN/CSA-G164 - Hot Dip Galvanizing of Irregularly Shaped Articles.
- .10 CSA W48 - Filler Metals and Allied Materials for Metal Arc Welding
- .11 CSA W59 - Welded Steel Construction (Metal Arc Welding).
- .12 SSPC (The Society for Protective Coatings) (formerly SSPC - Steel Structures Painting Council) - Steel Structures Painting Manual.

1.4 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
- .3 Indicate welded connections using standard welding symbols. Indicate net weld lengths.

1.5 QUALITY ASSURANCE

- .1 Prepare Shop Drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the Province of British Columbia.
- .2 Welded Steel Construction: CSA W59.
- .3 Structural Design and Inspection:
 - .1 Provide and pay for the services of professional engineer registered in the Province of British Columbia who specializes in the restraint of building elements to:
 - .1 design the components of the work of this Section requiring structural performance,
 - .2 be responsible for determining sizes, joint spacing to allow for thermal and seismic movement and loading of components in accordance with all applicable codes and regulations,
 - .3 be responsible for production and review of shop drawings,
 - .4 inspect the work of this Section during fabrication and erection,
 - .5 stamp and sign each shop drawing,
 - .6 provide site administration and inspection of this part of the Work.

Part 2 Products

2.1 MATERIALS - STEEL

- .1 Steel Sections and Plates: CAN/CSA-G40.20/G40.21.
- .2 Steel Pipe: ASTM A53/A53M, Grade A Schedule 40, standard weight, black finish.
- .3 Steel Tubing: ASTM A500, Grade B, black finish.
- .4 Bolts, Nuts, and Washers: ASTM A307, galvanized to CSA G164 for galvanized components.
- .5 Welding Materials: Type required for materials being welded.
- .6 Welding Filler Material: CSA W48.
- .7 Shop and Touch-Up Primer: SPCC 15 Type I red oxide.
- .8 Touch-Up Primer for Galvanized Surfaces: CAN/CGSB-1.181 zinc rich.

2.2 MATERIALS - ALUMINUM

- .1 Extruded Aluminum: ASTM B221/B221M alloy, 6063, Temper T5.
- .2 Sheet Aluminum: ASTM B209/B209M, Alloy 6063, Temper T5.
- .3 Aluminum-Alloy Drawn Seamless Tubes: ASTM B210, Alloy 6063, Temper T6.
- .4 Aluminum-Alloy Bars: ASTM B211, Alloy 6063, Temper T6.
- .5 Bolts, Nuts, and Washers: Stainless steel.
- .6 Welding Materials: Type required for materials being welded.

2.3 FABRICATION

- .1 Fit and shop assemble items in largest practical sections, for delivery to site.
- .2 Fabricate items with joints tightly fitted and secured.
- .3 Continuously seal joined members by continuous welds.

- .4 Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- .5 Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- .6 Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.4 FABRICATION TOLERANCES

- .1 Squareness: 3 mm maximum difference in diagonal measurements.
- .2 Maximum Offset Between Faces: 1.5 mm.
- .3 Maximum Misalignment of Adjacent Members: 1.5 mm.
- .4 Maximum Bow: 3 mm in 1.2 m.
- .5 Maximum Deviation from Plane: 1.5 mm in 1.2 m.

2.5 FINISHES - STEEL

- .1 Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- .2 Exterior Exposed Steel: prepare to SSPC-SP-6, Commercial Blast.
- .3 Interior Exposed Steel: prepare to SSPC-SP-3, Power Tool Cleaning.
- .4 For exterior items that are Hot Dip Galvanized prepared to SSPC-SP3, Power Tool Cleaning. Prime paint to be compatible.
- .5 Do not prime surfaces in direct contact with concrete or where field welding is required.
- .6 Preparation as per MPI 5.3L and the American galvanizers association for galvanized materials requiring painting.
- .7 Prime paint items with one coat.

2.6 FINISHES - ALUMINUM

- .1 Finish coatings to conform to AAMA 2603 for interior and AAMA 2605 for exterior.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify existing conditions before starting work.
- .2 Verify that field conditions are acceptable and are ready to receive work.
- .3 Verify dimensions, tolerances, and method of attachment with other work.

3.2 SITE PREPARATION

- .1 Clean and strip primed steel items to bare metal where site welding is required.
- .2 Supply steel items required to be cast into concrete or embedded in masonry with setting templates to appropriate sections.
- .3 Touch up with Zinc Paint for field welded hot dip galvanized items.

3.3 INSTALLATION

- .1 Install items plumb and level, accurately fitted, free from distortion or defects.

- .2 Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- .3 Field weld components indicated on shop drawings.
- .4 Perform field welding to CSA requirements.
- .5 Obtain approval prior to site cutting or making adjustments not scheduled.
- .6 After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.
- .7 Install corner guards on walls and erect with materials and components straight, tight and in alignment. Mechanically fasten corner guards to substrate at 300 mm on centre.

3.4 ERECTION TOLERANCES

- .1 Maximum Variation from Plumb: 3 mm per story, non-cumulative.
- .2 Maximum Offset from True Alignment: 3 mm.
- .3 Maximum Out-of-Position: 3 mm.

3.5 COATINGS/DISSIMILAR METALS

- .1 Aluminum surfaces to be placed in contact with masonry or concrete shall, before shipment from the fabricating plant, be given a heavy coat of an alkali resistant bituminous paint. The paint shall be applied without the addition of any thinner in strict accordance with the paint manufacturer's instructions.
- .2 Where aluminum work is fastened to steel supporting members or other dissimilar metal parts, the aluminum shall be kept from direct contact with such parts by a heavy shop coat of alkali resistant bituminous paint. The paint shall be applied without the addition of any thinner, in strict accordance with the paint manufacturer's instructions. Such paint shall be allowed to dry before assembly of parts.

3.6 SCHEDULE OF ITEMS

- .1 The following list of items is provided as a guide only. Examine all drawings and provide fabricated metal components complete with anchorages and fitments necessary for installation.
 - .1 Brackets required for Millwork items if indicated otherwise prefabbed under Section 06 41 11.
 - .2 Steel angle lintels.
 - .3 Miscellaneous steel angle supports.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 07 52 00 – Modified Bitumen Membrane Roofing (Patch Work)
- .2 Section 07 62 00 - Sheet Metal Flashing and Trim

1.2 REFERENCE STANDARDS

- .1 ASTM
 - .1 ASTM D5456-17e1, Standard Specification for Evaluation of Structural Composite Lumber Products
- .2 American Wood-Preservers' Association (AWPA)
 - .1 AWPA M2-16, Standard Inspection of Treated Wood Products
 - .2 AWPA M4-15, Standard for the Care of Preservative-Treated Wood Products
- .3 Canadian Standards Association (CSA)
 - .1 CSA B111-1974 (R2003), Wire Nails, Spikes and Staples
 - .2 CAN/CSA-G164-18, Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .3 CSA O80 Series-15, Wood Preservation
 - .4 CSA O112 Series-19 (R2014), CSA Standards for Wood Adhesives
 - .5 CSA O121-17, Douglas Fir Plywood
 - .6 CAN/CSA-O122-16, Structural Glued-Laminated Timber
 - .7 CSA O141-05 (R2014), Softwood Lumber
 - .8 CAN/CSA-O437 Series-93 (R2011), Standards on OSB and Waferboard
 - .9 CSA O151-17, Canadian Softwood Plywood
 - .10 CSA O153-13, Popular Plywood
- .4 National Lumber Grades Authority (NLGA)
 - .1 Special Products Standard for Fingerjoined Structural Lumber SPS
 - .2 Standard Grading Rules for Canadian Lumber
- .5 National Research Council Canada (NRC)
 - .1 National Building Code of Canada (NBC), 2015

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide shop drawings of miscellaneous metal fittings and components to Section 01 33 00 - Submittal Procedures.

1.4 QUALITY ASSURANCE

- .1 Identify lumber by official grade mark continuing symbol of grading agency, mill number or name, grade of lumber, species or species grouping or combination designation, rules under which grade and conditions of seasoning at time of manufacture.
- .2 Plywood, particleboard, OSB and wood based composite panels to CSA and ANSI standards.
- .3 For products treated with preservative by pressure impregnation, submit following information certified by authorized signing officer of treatment plant:

- .1 Information listed in AWPA.M2 and revisions specified in CSA O80 Series, Supplementary Requirement to AWPA Standard M2 applicable to specified treatment.
- .2 Moisture content after drying following treatment with water-borne preservative.
- .3 Acceptable types of paint, stain, and clear finishes that may be used over treated materials to be finished after treatment.

1.5 ENVIRONMENTAL PROTECTION

- .1 Collect and remove from site all waste pieces and sawdust from pressure treated wood materials. Dispose of to Section 01 74 21 - Construction Waste Management and Disposal

Part 2 Products

2.1 FRAMING AND STRUCTURAL MEMBERS

- .1 Lumber: unless specified otherwise, softwood, S4S, moisture content 19% (S-dry) or less to following standards:
 - .1 CAN/CSA-O141 - Softwood Lumber.
 - .2 NLGA Standard Grading Rules for Canadian Lumber.
- .2 Glued end-jointed (finger-jointed) lumber is not acceptable.
- .3 Structural Composite Lumber (SCL): to ASTM D5456.
- .4 Framing and board lumber: to National Building Code (NBC), except as follows:
 - .1 Framing and board lumber: S-P-F species, NLGA No.2 grade or better.
- .5 Furring, blocking, nailing strips, grounds, rough bucks, curbs, fascia backing and sleepers:
 - .1 Board sizes: SPF species, "Standard" or better grade.
 - .2 Dimension sizes: SPF species, "Standard" light framing or better grade.
- .6 Do not use products containing added urea formaldehyde in the Facility.

2.2 PANEL MATERIALS

- .1 Douglas fir plywood (DFP): to CSA O121, standard construction.
- .2 Canadian softwood plywood (CSP): to CSA O151, standard construction.
- .3 Poplar plywood (PP): to CSA O153, standard construction.
- .4 Mat-formed structural panelboards (OSB wafer): to CAN/CSA-O437.
- .5 Plywood to be 16 mm thick and have a FSR (flame-spread rating) of not more than 150.
- .6 Fire Rated Plywood Panels to CSA O325, FSC Certified, Class A fire retardant produced under Performance Standard PS-1, certified by the American Plywood Association.
- .7 The use of wood products, such as particle board, or laminating adhesives made with formaldehyde-based resins and binders is not acceptable.

2.3 MISCELLANEOUS LUMBER

- .1 Provide lumber for support or attachment of other construction, including furring, blocking, nailing strips, ground, rough bucks, cants, curbs, fascia, backing sleepers, and similar members.

- .2 Fabricate miscellaneous lumber from dimension lumber of sizes indicated, and into shapes shown on drawings.
- .3 Moisture Content: 19% maximum for lumber items not specified to receive wood preservative treatment.
- .4 Grade: for dimension lumber sizes provide No. 2 or Standard grade lumber per NLGA. For board-sized lumber, provide sheathing grade, S2S.

2.4 ACCESSORIES

- .1 Sealants: to Section 07 92 00 - Joint Sealing.
- .2 General purpose adhesive: to CSA O112 Series.
- .3 Nails, spikes, and staples: to CSA B111 and NBC requirements.
- .4 Bolts: 12 mm diameter unless indicated otherwise, complete with nuts and washers. Hot dipped galvanized.
- .5 Proprietary fasteners: toggle bolts, expansion shields and lag bolts, screws and lead plugs, recommended for purpose by manufacturer.
- .6 Explosive actuated fastening devices: recommended for purpose by manufacturer.
- .7 Protective membrane material to be SIGA Wetguard 200 SA , a self-adhered, vapor semi-impermeable, waterproofing membrane, composed of non-woven with anti-slip functional layer, with full-coverage pressure-sensitive glue layer applied to the reverse.

2.5 FASTENER FINISHES

- .1 Galvanizing: to CSA G164, use galvanized finished fasteners for exterior work and pressure-preservative treated lumber.

2.6 PRESSURE PRESERVATIVE TREATED WOOD

- .1 Sustainable requirements: only wood materials located outside of building air barrier assembly may be pressure preservative treated.
- .2 Provide lumber and plywood materials pressure preservative treated for following:
 - .1 Roof curbs, fascia backing, sleepers.
 - .2 Furring, blocking on exterior of building.
 - .3 Rough bucks at all exterior openings.
 - .4 Other materials indicated on Drawings.
- .3 Preservative: to CSA O80 Series, water-borne, alkaline copper quaternary (ACQ).
- .4 Treat material to CSA O80 Series using ACQ preservative to obtain minimum net retention for exposures as follows:
 - .1 UC3.2 - material above grade.
 - .2 UC4.1 - material below grade or in contact with ground.
- .5 Identify each piece of treated material with a tag or ink mark bearing Canadian Wood Preservers' Bureau quality mark.
- .6 Following water-borne preservative treatment, dry material to maximum moisture content of 19% (S-dry)% or less.
- .7 Field treatment: comply with AWWA M4 and revisions specified in CSA O80 Series, Supplementary Requirements to AWWA M2. Apply surface applied wood preservative to heartwood exposed from trimming, cutting, or boring.

- .8 Remove chemical deposits on treated wood to receive applied finish.

Part 3 Execution

3.1 INSTALLATION

- .1 Comply with requirements of BCBC, supplemented by following paragraphs.
- .2 Refer to Structural Drawings for additional requirements.
- .3 Install members true to line, levels, and elevations. Space uniformly.
- .4 Construct continuous members from pieces of longest practical length.
- .5 Install spanning members with "crown-edge" up.
- .6 Select exposed framing for appearance. Install lumber and panel materials so that grade-marks and other defacing marks are concealed or are removed by sanding where materials are left exposed. Sanding is acceptable only in locations where defacement will not be evident after finishing.
- .7 Install blocking at locations indicated to support washroom accessories.
- .8 Install furring and blocking as required to space-out and support casework, cabinets, wall and ceiling finishes, facings, fascia, soffit, siding, electrical equipment mounting boards, and other work as required.
- .9 Install rough bucks, nailers and linings to rough openings as required to provide backing for frames and other work.
- .10 Use dust collectors and high quality respirator masks when cutting or sanding wood panels.

3.2 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 Use nailing disks for soft sheathing as recommended by sheathing manufacturer.
- .4 Use fastenings of following types, except where specific type is indicated or specified:
 - .1 To hollow masonry, plaster, and panel surfaces use toggle bolt.
 - .2 To solid masonry and concrete use expansion shield with lag screw, lead plug with wood screw.
 - .3 To structural steel use bolts through drilled holes, welded stud-bolts, power driven self-drilling screws, welded stud-bolts, or explosive actuated stud-bolts.
- .5 Furring and blocking:
 - .1 Install furring and blocking as required to space-out and support casework, cabinets, surface applied fixtures and equipment, wall and ceiling finishes, facings, fascia, soffit, siding, and other work as indicated.
 - .2 Align and plumb faces of furring and blocking to tolerance of 1:600.
- .6 Nailing strips, grounds and rough bucks:
 - .1 Install rough bucks, nailers, and linings to rough openings as required to provide backing for frames and other work.
 - .2 Except where indicated otherwise, use material at least 38 mm thick.

- .3 For concrete block or cast-in-place concrete backing secure lumber with 10 mm diameter galvanized bolts located within 300 mm from ends of members and uniformly spaced at maximum 1200 mm on centre between. Countersink bolts where necessary to provide clearance for other work.
- .7 Fascia Backing, Curbs, Nailers:
 - .1 Install fascia backing, nailers, curbs, and other wood supports as required and secure using galvanized fasteners.
 - .2 Secure roof curbs, nailers with 10 mm diameter galvanized bolts where indicated, galvanized nails elsewhere. Space bolts within 300 mm from ends of members and uniformly spaces at maximum 1 200 mm on centre between. Countersink bolts where necessary to provide clearance for other work.
 - .3 On roof deck provide strips of roofing vapour barrier sheet under curbs, nailers, and sleepers installed directly onto roof deck. Extend vapour barrier sheet minimum 300 mm onto roof deck both sides of curbs or sleeper to allow for overlap and sealing to roofing vapour barrier. Apply as continuous strips, with 200 mm overlap at joints, and seal joints with mastic. Use same material used for roofing vapour barrier. Coordinate with roofing Subcontractor.
- .8 Electrical equipment backboards: Install 19 mm fire rated fir plywood boards. On all walls in telephone and data rooms receiving wiring and equipment; minimum 1220 mm x 2440 mm panels on periphery walls over 300 mm wide, mounted 300 mm off of finished floor.

3.3 HANDLING AND USE OF TREATED TIMBER

- .1 Handle and use treated material in a manner which will avoid damage or field fabrication, causing alteration in original treatment.
- .2 Treat in field, cuts and damages to surface of treated material with an appropriate, clear preservative as described in CSA O80. Ensure that damaged areas such as abrasions nail and spike holes, are thoroughly saturated with field treatment solutions in accordance with CSA O80.

3.4 WORKMANSHIP

- .1 Construct all work to details, using adequate fastening methods to ensure solid durable finished work suitable for purpose intended.
- .2 Do all nailing and fastening neatly, evenly, and thoroughly.
- .3 Install all members true to line, levels, and elevations. Set plumb and space uniformly.
- .4 Use timbers of longest possible length to minimize joints.

3.5 SCHEDULES

- .1 Exterior sheathing: plywood, DFP or CSP sheathing grade or PP standard sheathing grade, square edge, thickness indicated.
- .2 Electrical equipment backboards: fire rated fir plywood, G1S grade, square edge, 19 mm thick.
- .3 Blocking for millwork, as indicated on drawings.
- .4 Blocking in walls flush to studs.
- .5 Blocking surface mounted.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Concealed blocking for support of toilet and bath accessories, wall cabinets, equipment and other wall mounted apparatus.
- .2 Electrical panel back boards.
- .3 Roof curbs for mechanical equipment and other equipment as per RCABC design guidelines.

1.2 RELATED SECTIONS

- .1 Section 06 10 00 – Rough Carpentry
- .2 Section 06 41 11 – Architectural Cabinetwork
- .3 Section 07 52 00 –Modified Bitumen Membrane Roofing (Patch Work)
- .4 Section 09 21 16 – Non-Structural Metal Stud Framing.
- .5 Section 09 91 00 - Painting: fire resistant paint to plywood in Electrical Rooms.

1.3 REFERENCES

- .1 The versions of the standards referenced in this section are those listed in the BC Building Code, current edition at the time of the application for Building Permit; or if they are not referenced in the specified code, they are the latest version of the standard in effect at the time of the application for Building Permit.
- .2 CSA B111 - Wire Nails, Spikes and Staples.
- .3 CSA O141 - Softwood Lumber.
- .4 CSA O151 - Canadian Softwood Plywood.
- .5 CSA O80 Series-97 - CSA Standards for Wood Preservation.
- .6 National Lumber Grades Authority (NLGA) - Standard Grading Rules for Canadian Lumber.

1.4 WARRANTY

- .1 Warranty Period for all supplied materials, equipment and installation is two (2) years from the date of service commencement.
- .2 Warranty: Include coverage to correct defective work and for failure to meet specified requirements.

Part 2 Products

2.1 MATERIALS

- .1 Lumber: NLGA (Standard Grading Rules for Canadian Lumber).
 - .1 CSA O141, softwood SPF species, grade 2, FSC Certified.
 - .2 19 percent maximum moisture content, pressure preservative treat.
- .2 Plywood: CSA O151 (CSP), Grade un-sanded, Urea Formaldehyde free and is FSC Certified.

2.2 ACCESSORIES

- .1 Fasteners and Anchors:
 - .1 Fasteners: Hot dipped galvanized steel for high humidity and treated wood locations, unfinished steel elsewhere.
 - .2 Anchors: Toggle bolt type for anchorage to hollow masonry. Expansion shield and lag bolt type for anchorage to solid masonry or concrete. Bolt or ballistic fastener for anchorages to steel.

Part 3 Execution

3.1 FRAMING

- .1 Set members level and plumb, in correct position.
- .2 Place horizontal members, crown side up.

3.2 SHEATHING

- .1 Secure sheathing to framing members with ends over firm bearing and staggered.

3.3 SCHEDULE

- .1 Install solid wood backing for support of all millwork cabinets.
- .2 Install wood curbs and blocking to equipment curbs.
- .3 Install concealed 19mm plywood backing for all wall mounted accessories.

END OF SECTION

Part 1

General

1.1 INTENT

- .1 The work of this section includes the supply, fabrication, and delivery to the job site finishing, and installation of site manufactured finish carpentry indicated on the drawings and as specified.
- .2 Finish carpentry work shall include all clear, kiln dried, dressed, or resawn material exposed to view in a finished building interior and exterior, including running and standing trim, wall bases, door frames, paneling, trim and other trim related products.

1.2 RELATED SECTIONS

- .1 Section 01 74 00 – Cleaning & Waste Processing
- .2 Section 06 10 00 - Rough Carpentry
- .2 Section 06 41 00 - Architectural Cabinetwork
- .3 Section 08 11 13 – Standard Metal Doors and Frames
- .4 Section 08 14 16 - Flush Wood Doors
- .5 Section 08 71 00 - Door Hardware
- .6 Section 08 80 50 - Glass and Glazing
- .7 Section 09 91 00 - Painting

1.3 LEED REQUIREMENTS

- .1 Meet requirements and provide submittals in accordance with Section 01 35 21 LEED Requirements and Procedures.

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Section 01 31 00: Project management and coordination procedures.
- .2 Coordination:
 - .1 Coordinate with other work having a direct bearing on work of this section.
 - .2 Coordinate the work with plumbing and electrical rough-in, installation of associated and adjacent components and equipment.

1.5 SUBMITTALS

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Provide data on fire retardant treatment materials and application instructions.
- .3 Shop Drawings:
 - .1 Indicate site dimensions, materials, component profiles, fastening methods, jointing details, and accessories to a minimum scale of 1:10.
 - .2 Provide instructions for attachment hardware, finish hardware, and specialties.
- .4 If requested by Consultant submit following samples:
 - .1 Three samples of finish plywood, 300 x 300 mm in size illustrating wood grain and specified finish.
 - .2 Three samples of wood trim 300 mm long.

1.6 QUALITY ASSURANCE

- .1 Section 01 40 00: Quality Control.
- .2 Perform work in accordance with AWS Manual Custom quality.
- .3 Work of this Section shall be manufactured and/or installed to specified AWS Manual requirements.
- .4 Work that does not meet AWS Manual Quality Standards, as specified, shall be replaced, reworked, and/or refinished by the Finish Carpentry subcontractor, with no additional cost to the project.

1.7 REGULATORY REQUIREMENTS

- .1 Conform to the current BC Building Code for fire retardant requirements.

1.8 DELIVERY, STORAGE, AND PROTECTION

- .1 The Architectural Woodwork Manufacturer and the Contractor shall be jointly responsible to make certain that architectural woodwork is not delivered until the building and storage areas are sufficiently dry so that the architectural woodwork will not be damaged by excessive changes in moisture content.
- .2 Architectural woodwork delivery, storage and handling shall be in accordance with Section 2 Care and Storage of the NAAWS.
- .3 Delivered materials which are damaged in any way or do not comply with these specifications will be rejected by the Consultant and shall be removed from the job site and replaced with acceptable materials.
- .4 Protect work from moisture damage.

Part 2 Products

2.1 LUMBER MATERIALS

- .1 Softwood lumber: AWS Lumber Grade 1, plain sawn, S4S, moisture content 4 - 9% (S-dry) or less in accordance with following standards: CAN/CSA-O141, NLGA, AWS.
- .2 Hardwood Lumber: AWS Lumber Grade 1, select American Black Walnut, quarter sawn, moisture content 4 - 9 % or less in accordance with following standards; NHLA, AWS Manual.
- .3 Glued end-jointed (finger-jointed) lumber is not acceptable.

2.2 SHEET MATERIALS

- .1 Canadian softwood plywood (CSP) to CSA-O121, standard construction.
 - .1 Urea-formaldehyde free.
- .2 Medium Density Fibreboard (MDF): ANSI A208.2 Industrial grade, 54lb/ft³ density, moisture resistant; composed of recycled and/or recovered wood particles reduced to fibres, wheat straw fibre or agrifibre, made with high waterproof resin binders; of grade to suit application; sanded faces, no added formaldehyde. Minimum 94% total recycled content, at least 10% of which shall be post-consumer recycled content.
- .3 Particleboard: industrial grade, 47lb/ft³ density, manufactured from recycled and/or recovered wood, no added urea-formaldehyde.
 - .1 Acceptable Product:
 - .1 Flakeboard Vesta FR, no-added urea-formaldehyde.
 - .2 Medex SDF.
 - .3 Or approved substitution.

- .4 Hardboard: CAN/CGSB 11.3; pressed wood fibre with resin binder, tempered grade, 6 mm thick, smooth one side, no added formaldehyde.

2.3 ADHESIVE

- .1 Adhesive: ANSI/WDMA I.S.-1 Series, Type recommended by AWS Manual to suit application.
- .2 Total Volatile Organic Carbon (TVOC) emissive content: 20 gr/litre.

2.4 FASTENERS

- .1 Fasteners: Of size and type to suit application; chromed steel finish in concealed locations and stainless-steel finish in exposed locations.
- .2 Concealed Joint Fasteners: Threaded steel.

2.5 ACCESSORIES

- .1 Lumber for Shimming, Blocking: Softwood lumber of SPF species.
- .2 Edge Trim: Solid PVC 3 mm, hot melt type.
- .3 Glass: 4 mm tempered, specified in Section 08 80 50.
- .4 Primer: Latex type, low VOC emitting.
- .5 Wood Filler: Oil base, tinted to match surface finish colour.

2.6 SITE FINISHING

- .1 Seal surfaces in contact with cementitious materials.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify existing conditions before starting work.
- .2 Verify that field measurements are as indicated on reviewed shop drawings.
- .3 Verify adequacy of backing and support framing.
- .4 Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.
- .5 Examine doors and frames and verify proper preparation for hardware.

3.2 INSTALLATION

- .1 Install work in accordance with AWI/AWMAC Custom Quality Standard, except where indicated otherwise..
- .2 Set and secure materials and components in place, plumb and level.
- .3 Carefully scribe work abutting other components, abutting walls, and surfaces, fit properly into recesses and to accommodate piping, columns, fixtures, outlets, or other projecting, intersecting or penetrating objects, with maximum gaps of 1 mm. Do not use additional overlay trim to conceal larger gaps.
- .4 Form joints to conceal shrinkage.

3.3 CONSTRUCTION

- .1 Fastening:
 - .1 Position items of finished carpentry work accurately, level, plumb, true and fasten or anchor securely.

- .2 Design and select fasteners to suit size and nature of components being joined. Use proprietary devices as recommended by manufacturer.
- .3 Set finishing nails to receive filler.
- .4 Where screws are used to secure members:
 - .1 Concealed installation: countersink screw in round cleanly cut hole and plug with wood plug to match material being secured.
 - .2 Exposed installation, where specified: use flat headed screws with finishing washers.
- .5 Replace items of finish carpentry with damage to wood surfaces including hammer and other bruises.
- .6 Use fasteners compatible with material through which they pass.
- .7 Use heavy-duty fasteners for securing wall hung items.
- .2 Shelving.
 - .1 Install shelving on shelf brackets.

3.4 PREPARATION FOR SITE FINISHING

- .1 Set exposed fasteners. Apply wood filler in exposed fastener indentations. Sand work smooth.
- .2 Before installation, prime paint surfaces of items or assemblies to be in contact with cementitious materials.

3.5 ERECTION TOLERANCES

- .1 Maximum Variation from True Position: 1.5 mm.
- .2 Maximum Offset from True Alignment with Abutting Materials: 0.7 mm.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Furnish all labour, material, services and equipment necessary for the supply, fabrication, finishing, delivery and installation of all Casework, wood panels, wood frames, wood trim and plastic laminate-faced components as indicated on the drawings, as scheduled and as specified herein.
- .2 Work shall include, but not necessarily be limited to the following:
 - .1 Casework including countertops, backsplashes, box cabinets, wall cabinets and shelving and shelving.
 - .2 All plastic laminate work on wood substrates.
 - .3 All solid surface work on wood substrates.
 - .4 Supply and installation of all cabinet hardware.
 - .5 All accessories required for binding millwork together and securing in place.
 - .6 Supply and installation of fabricated steel casework support brackets as detailed in drawings.
 - .7 All sealants required between joints between counters and backsplashes and between casework and walls.
 - .8 Cutting and drilling to accommodate fixtures, services and all other work of other contractors that is required to be part of or pass-through finished casework assembly.
 - .9 Supervision of later work to be installed by other contracting forces within the work produced by this Section.

1.2 RELATED SECTIONS

- .1 Section 06 10 13 – Wood Blocking and Curbs.
- .2 Section 05 50 00 - Metal Fabrications: brackets and supports for millwork.
- .3 Section 06 61 16 – Solid Surfacing Fabrication.
- .4 Section 06 66 60 - Plastic Laminate Finishing.
- .5 Section 08 80 50 – Glazing.
- .6 Section 09 21 16 – Non-Structural Metal Stud Framing: Non-Structural Metal Stud Framing: including Sheet Metal Backing 1.2 mm thick galvanized steel plate.
- .7 Section 09 65 10 - Resilient Sheet Flooring: Rubber Base.

1.3 REFERENCES

- .1 The versions of the standards referenced in this section are those listed in the BC Building Code, current edition at the time of the application for Building Permit; or if they are not referenced in the specified code, they are the latest version of the standard in effect at the time of the application for Building Permit.
- .2 ANSI A208.2 - Medium Density Fibreboard (MDF) for Interior Applications.
- .3 ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
- .4 AWMAC (Architectural Woodwork Manufacturers Association of Canada) – North American Architectural Woodwork Standards, latest edition.
- .5 BHMA A156.9: Cabinet Hardware.

- .6 CAN/CGSB-11.3 - Hardboard.
- .7 CSA O80 Series - CSA Standards for Wood Preservation.
- .8 CHPVA (Canadian Hardwood Plywood and Veneer Association) - Official Grading Rules for Canadian Hardwood Plywood.
- .9 NEMA (National Electrical Manufacturers Association) LD3 - High-Pressure Decorative Laminates.
- .10 NHLA (National Hardwood Lumber Association).
- .11 NLGA (National Lumber Grades Authority) - Standard Grading Rules for Canadian Lumber, 2005.

1.4 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Shop Drawings:
 - .1 Notations prior to commencement of work under this section.
 - .2 Drawing Scale: Minimum metric scale of 1:10
 - .3 Hardware location and schedule of finishes.
 - .4 Indicate component sections for oversized units
- .3 Product Data: Provide data for hardware accessories.
- .4 Samples:
 - .1 Submit two (2), 300 x 300 mm size samples, illustrating cabinet finish. One to the consultant and one to the field office.
 - .2 Submit two (2), 300 x 300 mm size samples, illustrating countertop finish and edge. One to the consultant and one to the field office.

1.5 QUALITY ASSURANCE

- .1 Section 01 45 00: Quality Control.
- .2 Products of This Section: Manufactured to ISO 9000 certification requirements.
- .3 Perform work in accordance with AWMAC Custom quality.
- .4 Fabricator Qualifications: Company specializing in fabricating Products specified in this section with minimum five (5) years experience.
- .5 Installer Qualifications: Company specializing in performing the work of this section with minimum five (5) years documented experience.
- .6 Manufacture and install architectural woodwork to AWMAC's architectural woodwork standards in effect at time of RFP closing. Architectural woodwork shall be subject to an inspection at the manufacturing facility and/or site by an appointed AWMAC Certified Inspector. Inspection costs shall be included in the Proposal price for this project.
- .7 Finish all exposed wood products on the interior of the Facility, including all wood surfaces and edges.
- .8 Provide seismic anchorage on all cabinets and shelving over 1200 mm high or where units are likely to be a hazard from overturning.

1.6 WARRANTY

- .1 Warranty: Correct defective Work within a two (2) year period after Service Commencement.

- .2 Warranty to include replacing and refinishing due to delamination of laminates, defects or faulty workmanship.

1.7 PRE-INSTALLATION MEETING

- .1 Convene two (2) weeks before starting work of this section if requested by the consultant.

1.8 DELIVERY, STORAGE, AND PROTECTION

- .1 Transport, handle, and store Products in accordance with AWMAC guidelines.
- .2 Promptly inspect shipments to ensure that Products comply with requirements, quantities are correct, and Products are undamaged.
- .3 Provide equipment and personnel to handle Products by methods to prevent soiling, disfigurement, or damage.
- .4 Protect units from moisture damage as specified in AWMAC Section 2.
- .5 Protect surfaces with recyclable wrapping.

1.9 ENVIRONMENTAL REQUIREMENTS

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

Part 2 Products

2.1 LUMBER MATERIALS

- .1 Hardwood Lumber: AWMAC Custom Grade; maple species, plain sawn, maximum moisture content of 10 percent; with vertical grain, of quality suitable for transparent finish.
- .2 Softwood Lumber: AWMAC Custom Grade; SPF species, plain sawn, maximum moisture content of 10 percent.

2.2 SHEET MATERIALS

- .1 Hardwood Plywood: CHPVA A; MDF core; maple face species, plain sliced; of quality suitable for transparent finish and formaldehyde-free.
- .2 Softwood Plywood: conforming to requirements of CSA 0151 and graded in accordance with AWMAC; core material of veneer lumber and formaldehyde-free of thicknesses indicated on drawings.
- .3 Douglas Fir Plywood: conforming to requirements of CSA 0121 graded in accordance with AWMAC; core material and formaldehyde-free of thicknesses indicated on drawings.
- .4 Plywood for countertops: marine grade.
- .5 Medium Density Fibreboard (MDF): ANSI A208.2 moisture resistant; composed of wood particles reduced to fibres, FSC Certified, made with high waterproof resin binders; of grade to suit application; sanded faces, no added formaldehyde. Minimum 94% total recycled content, at least 10% of which shall be post-consumer recycled content.
- .6 Hardboard: CAN/CGSB 11.3; pressed wood fibre with resin binder, tempered grade, 6 mm thick, smooth one side, no added formaldehyde.
- .7 Fibreboard: Fibreboard shall made from wheat straw fibre and formaldehyde-free, moisture resistant polyurethane resin.

2.3 MANUFACTURERS - HIGH PRESSURE LAMINATE

- .1 Refer to Section 06 66 60.

- .2 Other manufacturers offering products meeting or exceeding specified products, colours, patterns, and requirements may be considered. Proposed substitutions are to closely match scheduled colours and patterns and be reviewed and approved by the Consultant or they may be rejected.

2.4 LAMINATE MATERIALS

- .1 High Pressure Laminate: NEMA LD3, high pressure laminate, refer to Interior Finishes List.
- .2 Fibre Reinforced Laminate: NEMA 3.13; UL-723; ASTM E 84, class A, fibre reinforced laminate.
- .3 Laminate Backing Sheet: NEMA LD3, BKL, same thickness and colour as face laminate.

2.5 ACCESSORIES

- .1 Adhesive: ANSI/WDMA I.S.-1 Series, Type I. Total Volatile Organic Carbon (TVOC) emissive content: 20 gr/litre. Provide adhesives that are non-toxic, low VOC, and use non-solvent glue complying with AWMAC Quality Standards Manual, Canadian Eco-Logo program.
- .2 Edge Trim:
 - .1 Edging at Millwork Components: Solid 3mm PVC heat applied matching colour as exposed finish.
 - .2 Backsplash Edging: Plastic laminate when installed against a wall.
- .3 Glass: minimum 6mm tempered, as specified in Section 08 80 50.
- .4 Fasteners: Size and type to suit application.
- .5 Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; bright zinc finish in exposed locations.
- .6 Concealed Joint Fasteners: Threaded steel.
- .7 Tape: Aluminum foil, insulating and heat dissipating tape.
- .8 Primer: Latex type, low VOC emitting.
- .9 Fabricated steel casework support brackets
- .10 Adhesive for Countertop Edging: Titebond GREENchoice Heavy Duty Construction Adhesive.

2.6 HARDWARE ITEMS

- .1 Hardware list specified herein must be read in conjunction with information as provided on the drawings and shall not be construed as the total number of items to be supplied, but to be used as a guide only. Examine the plans and furnish items, which normally fall under the scope of this work and provide necessary hardware to suit operation and purpose of the millwork fitments. Products and Manufacturers noted are approved standard. Alternates and/or equals to be submitted.
- .2 Cabinet Hardware: To ANSI/BHMA A156.9 – 2003
- .3 All hardware to conform to Section 10 of Architectural Woodwork Manufacturers of Canada, Edition 4 September 1, 2021.
 - .1 Cabinet Hinges: All hinges to be of metal construction meeting or exceeding the ANSI/BHMA Grade 1 “performance” and “permanent set” test requirements 110° opening all metal hinge with “softclose” feature.
 - .1 Blum

- .2 Grass
- .3 Mepla.
- .2 Drawer Glides: Drawer glides are the nominal length of 550 mm, full extension concealed all metal ball bearing glide with “softclose” feature, Load Capacity: 75 lbs (34 kg) at general purpose drawers, 100 lbs (45.4 kg) at file drawers, 150 lbs (68 kg) at lateral file drawers wider than 610 mm and less than 762 mm, 200 lbs (91 kg) at lateral file drawers wider than 762 mm.
 - .1 Accuride
 - .2 Blum
 - .3 Grass.
- .3 Cabinet Pulls:
 - .1 Regular: Standard stainless “D” pull – Richelieu 33205170.
- .4 Piano Hinges:
 - .1 Continuous hinge (piano hinge): stainless steel, full height or length, size to suit application.
- .5 Countertop Grommets:
 - .1 70mm dia. – Black – Richelieu – 12702V.
 - .2 Grommets to be provided for all above counter workstations. Exact locations to be confirmed during construction.
- .6 Adjustable Shelf Hardware:
 - .1 5 mm Dia. Pins with seismic feature – Richelieu MP5849N30 White.
- .7 Cabinet Locks:
 - .1 5 pin, removable core, master keyed, provide 2 keys per lock, finish to match door pulls – Schlage CL 100 or CL 200 Series
- .8 Counter top support brackets Richelieu, Extra-Heavy-Duty Countertop Bracket, EH1824P/EH1818P, sized to suite counter, white primer or approved alternate. Prefinished powder coat finish, 3 mm thick steel, sizes; as selected from manufacturer's standard range to suit application, colour; as selected by Consultant. Use fabricated casework brackets where required.
- .4 Display Case
 - .1 Display Case Doors and Shelves:
 - .1 Clear tempered glazing, refer to Section 08 80 50.
 - .2 Display Case Door Thickness: 8 mm.
 - .3 Shelf Thickness: 10 mm.
 - .4 Shelf Bracket for Concealed Standard Richelieu No. 742182G
 - .5 Concealed T standards 704082G
 - .2 Display Case Door Hardware:
 - .1 Door tracks and locking see Section 08 80 50.

2.7 MANUFACTURED UNITS – DECORATIVE LAMINATE CASEWORK

- .1 Base cabinets and upper units as indicated on drawings.
 - .1 Fabricate caseworks to AWMAC Custom Quality grade, flush overlay style, supplemented as follows.
 - .2 Furring, blocking, nailing strips, grounds and rough bucks and sleepers.
 - .1 Board sizes: "Standard" or better grade.
 - .2 Dimension sizes: "Standard" light framing or better grade.
 - .3 Framing softwood lumber, SPF, AWMAC custom grade or better.
 - .4 Case bodies (ends, divisions, and bottoms): plywood, 19 mm thick. Laminated with HPDL VGS grade, self-edge.
 - .5 Toe kicks: plywood, 19 mm thick. Where finished with floor materials leave unfinished. Where exposed finish with HDPL VGS grade.
 - .6 Backs: plywood, 6 mm thick. Laminated with HPDL VGS grade.
 - .7 Shelving: plywood, 19 mm thick. Laminated with HPDL HGS grade. Band front edge with 3 mm PVC, and self-edge or thin PVC edging for other three edges of loose shelves.
 - .8 Provide valances as indicated where under upper cabinet lighting is provided.
 - .2 Drawers:
 - .1 Sides and Backs: Plywood, 12 mm thick. Laminated with HPDL, VGS grade.
 - .2 Bottoms: Hardboard, tempered, 6mm thick. Melamine finish.
 - .3 Fronts: Plywood, 19 mm thick. Laminated with HPDL VGS grade. Edges banded with 3 mm PVC. No added urea formaldehyde.
 - .3 Cabinet Doors:
 - .1 Plywood, 19 mm thick. Laminated with HPDL VGS grade. Edges banded with 3 mm PVC. No added urea formaldehyde.

2.8 PLASTIC LAMINATE COUNTERTOPS

- .1 Comply with AWMAC Quality Standards, custom grade requirements for counter construction supplemented as follows:
 - .2 High Pressure Laminate: NEMA LD3, high pressure laminate, Grade HGS; Refer to Interior Finishes List for pattern and colour.
 - .1 Edge Treatment: Extruded T PVC refer to 2.6 Accessories.
 - .2 Core Material: Marine grade plywood required at countertops, high humidity areas and all food service areas.

2.9 SOLID SURFACE COUNTERTOPS

- .1 Solid Polymer Surfacing: refer to Interior Finishes List, and Section 06 61 16.
 - .1 Edge Treatment: Straight square edge profile.
 - .2 Backsplash and side splash: Applied.

2.10 FABRICATION

- .1 Fabricate to AWMAC - Custom Grade.

- .2 Shop prepare and identify components for matching during site assembly.
- .3 Shop assemble casework for delivery to site in units easily handled and to permit passage through building openings.
- .4 When necessary to cut and fit on site, provide materials with ample allowance for site cutting and scribing.
- .5 Cabinet style: Flush overlay.
- .6 Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 600 mm from sink cut-outs.
- .7 Refer to drawings for wood grain directions where applicable.
- .8 Shop apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
- .9 Fabricate metal countertop surfaces pressure glued to plywood core backing with welded joints.
- .10 Mechanically fasten countertops with steel brackets at 400 mm on centre.
- .11 Provide cut-outs for plumbing fixtures, inserts, fixtures and fittings. Verify locations of cut-outs from on-site dimensions. Seal cut edges.
- .12 All bottoms of sink cabinet boxes and areas that may come into contact with water will have a marine-grade plywood substrate. Do not use fibreboard or particle board.
- .13 Use marine-grade plywood substrate for countertops. Do not use fibreboard or particle board. Where appropriate, provide support brackets (knee bracing) to support countertops throughout the Facility. Do not support countertops with legs extending to the floor.
- .14 For Millwork cabinets, seal all wood surfaces and edges. All door, drawer and other exposed Millwork edges will have applied a minimum 3 mm PVC edge strip, heat applied. All PVC edging to match tone of adjacent Millwork. There will be no edge conditions where plastic laminate abuts plastic laminate.
- .15 All composite wood products and laminating adhesives used in the Millwork will not contain added urea-formaldehyde resins.
- .16 Provide a Millwork base equal to the height of the flash cove flooring for flash cove flooring to return up at all floor-mounted lower cabinet locations.
- .17 Shop glaze glass materials using the Interior Dry method specified in Section 08 80 50.
- .18 Edge Trim:
 - .1 Secure T edging with specified heavy duty construction adhesive at plastic laminate finished countertops.
 - .2 Secure solid PVC edging using heat-applied method at other millwork components.
 - .3 Secure laminate self-edging using contact adhesive to backsplashes against walls.
- .19 Core for all other panel products other than mentioned above will consist of hardwood plywood.

2.11 TRIM FABRICATION

- .1 Make custom miters and intersections with welded corners.

Part 3

Execution

3.1

EXAMINATION

- .1 Verify existing conditions before starting work.
- .2 Verify adequacy of backing and support framing.
- .3 Verify location and sizes of utility rough-in associated with work of this section.

3.2

INSTALLATION

- .1 Install Work in accordance with AWMAC Custom Grade.
- .2 Set and secure casework in place; rigid, plumb, and level.
- .3 Use fixture attachments in concealed locations for wall mounted components.
- .4 Use concealed joint fasteners to align and secure adjoining cabinet units.
- .5 Carefully scribe casework abutting other components, with maximum gaps of 1 mm. Do not use additional overlay trim for this purpose.
- .6 Secure cabinet to floor using appropriate angles and anchorages.
- .7 Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.
- .8 Apply plastic laminate finishes where indicated.
 - .1 Reinforce all vertical corners of millwork.
 - .2 Apply laminate backing sheet on reverse side of plastic laminate finished surfaces.
- .9 All doors and drawers will be lockable unless indicated otherwise.

3.3

TRIM INSTALLATION

- .1 Install Millwork trims and accessories in accordance with manufacturer's product data.

3.4

ADJUSTING

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

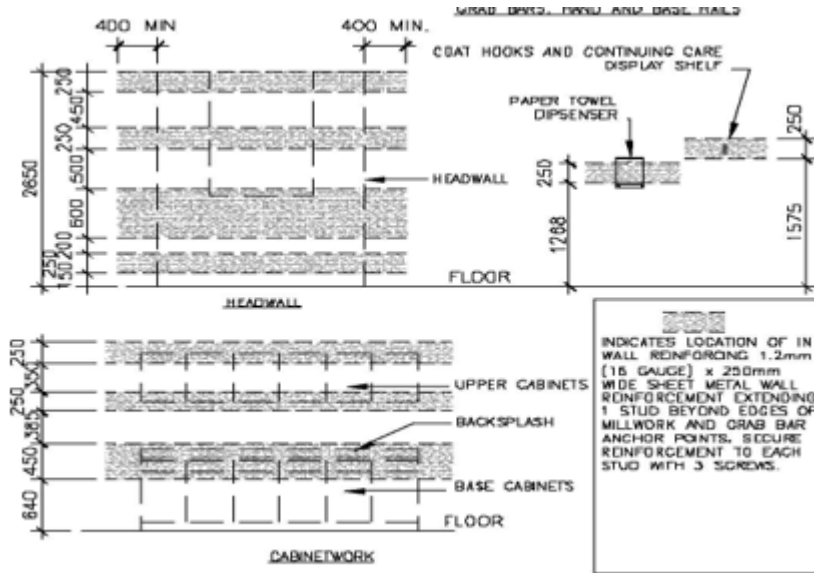
3.5

CLEANING

- .1 Clean casework, counters, shelves, hardware, fittings, and fixtures.

3.6

The dimensions shown below is a guide only. Follow mounting heights shown on room elevations and schedules.



END OF SECTION

Part 1 General

1.1 SUMMARY OF WORK

- .1 Supply and install solid surface counters and backsplashes as shown on drawings.

1.2 RELATED WORK

- .1 Section 06 41 11 – Architectural Cabinetwork.
- .2 Section 22 40 00 – Plumbing Fixtures and Trim – sinks.

1.3 REFERENCES

- .1 The versions of the standards referenced in this section are those listed in the B C Building Code, current edition at the time of the application for Building Permit; if they are not referenced in the specified code, they are the latest version of the standard in effect at the time of the application for Building Permit.
- .2 ASTM E 228 – Standard Test Method for Linear Thermal Expansion of Solid Materials With a Vitreous Silica Dilatometer.
- .3 ASTM D 790 – Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
- .4 ASTM D 2583 – Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.
- .5 ASTM G 21 – Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- .6 ASTM G 22 – Standard Practice for Determining Resistance of Plastics to Bacteria.
- .7 NEMA LD 3 – High Pressure Decorative Laminates.
- .8 ISSFA-2 – International Solid Surface Fabricators Association – Classification and Standards for Solid Surfacing Material

1.4 SUBMITTALS

- .1 Shop drawings: Refer to Section 01 33 00 – Submittal Procedures. Indicate dimensions, component sizes, fabrication details, attachment provisions and coordination requirements with adjacent work.
- .2 Samples: Submit minimum 50 mm x 50 mm samples. Indicate full range of color and pattern variation. Approved samples will be retained as standards for work. Provide one sample to consultant and one sample to field office.
- .3 Product data: Indicate product description, fabrication information and compliance with specified performance requirements.
- .4 Maintenance data: Submit manufacturer's care and maintenance data, including repair and cleaning instructions. Include in project close-out documents.

1.5 QUALITY ASSURANCE

- .1 Allowable tolerances:
 - .1 Variation in component size: ± 3 mm.
 - .2 Location of openings: ± 3 mm from indicated location.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Store components indoors prior to installation.
- .2 Handle materials to prevent damage to finished surfaces. Provide protective coverings to prevent physical damage or staining following installation for duration of project.

Part 2 Products

2.1 MATERIALS

- .1 Solid surfacing (SD#): Homogenous non-porous sheet material composed of reacted monomers, acrylic resins, fire-retardant fill materials, and coloring agents. Free from conspicuous internal strengthening fibers.
- .2 Nominal sheet thickness: 13 mm.
- .3 Edge treatment: double eased with 38 mm profile, straight square profile.

2.2 SHAPED COMPONENTS

- .1 Dimensions herein are interior dimensions unless indicated otherwise.

2.3 MANUFACTURERS

- .1 Acceptable products: Corian DuPont, Group 2. Colours to be determined.
- .2 Other manufacturers offering products meeting or exceeding specified products and requirements may be considered.

2.4 ACCESSORIES

- .1 Joint adhesive: Manufacturer's standard two-part adhesive kit to create inconspicuous, non-porous joints, with a chemical bond.
- .2 Silicone Sealant: Mildew resistant, recommended by manufacturer.

2.5 FABRICATION

- .1 Fabricator/installer shall be approved by solid polymer manufacturer.
- .2 Fabricate components in shop to greatest extent practical to sizes and shapes indicated, in accordance with approved shop drawings and solid polymer manufacturer requirements.
- .3 Form joints between components using manufacturer's standard joint adhesive for hard seam. Joints shall be inconspicuous in appearance and without voids. Attach 102 mm wide reinforcing strip of solid polymer material under each joint.
- .4 Provide holes and cut-outs for penetrations as indicated.
- .5 Rout and finish component edges to a smooth, uniform finish. Rout all cut-outs, then sand all edges smooth. Defective or inaccurate work will be rejected.
- .6 Finish: All surfaces shall have uniform finish of satin or gloss.
- .7 No sharp corners or exposed edges. Exposed top and bottom edges will be radiused minimum 7 mm. Outside corners will be radiused minimum 25 mm

- .8 Thermoforming: Comply with forming data from manufacturer.
 - .1 Construct matching molds of plywood to form component shape.
 - .2 Form pieces to shape prior to seaming and joining.
 - .3 Cut pieces larger than finished dimensions. Sand edges. Remove all nicks and scratches.
 - .4 Heat entire component uniformly prior to forming.
 - .5 Prevent blistering, whitening and cracking of solid polymer material during forming.

Part 3 Execution

3.1 INSTALLATION

- .1 Install components plumb and level, in accordance with approved shop drawings and product installation details.
- .2 Form field joints using manufacturer's recommended adhesive, with joints inconspicuous in finished work. Keep components and hands clean when making joints.
- .3 Provide backsplashes and endsplashes as indicated on the drawings. Adhere to countertops and other components using manufacturer's standard color-matched silicone sealant.
- .4 Keep components and hands clean during installation. Remove adhesives, sealants and other stains. Components shall be clean on Date of Substantial Completion.
- .5 Coordinate plumbing installation with plumbing contractor. Make plumbing connections to sinks in accordance with Division 22 - Plumbing.
- .6 Protect surfaces from damage until Date of Substantial Completion

3.2 INSTALLATION OF VANITIES

- .1 Install plumb, level, true and straight. Shim as necessary using concealed shims.
- .2 Attach top securely to base unit or support brackets in accordance with manufacturer's printed instructions.
- .3 Seal between wall and component with silicone sealant.
- .4 Attach backsplashes and end splashes to countertops using silicone sealant.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
 - .1 Remove traces of primer, caulking, epoxy and filler materials and clean doors and frames.
- .3 Waste Management: separate waste materials in accordance with Section 01 74 21 - Construction Waste Management and Disposal

3.4 PROTECTION

- .1 Cover finished surfaces with heavy kraft paper or put in cartons during shipment.
- .2 Protect installed surfaces in accordance with manufacturer's written recommendations.
 - .1 Remove protection only immediately before final inspection.
- .3 Protect installed products and components from damage during construction.

- .4 Repair damage to adjacent materials caused by laminate, adhesive, and core materials installation.
- .5 Protect surfaces from damage until date of Substantial Performance of the Work. Repair or replace damaged components that cannot be repaired to Design Consultant's satisfaction.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Plastic laminate finishing for architectural millwork.
- .2 High pressure laminate panels.

1.2 RELATED SECTIONS

- .1 Section 06 41 11 - Architectural Woodwork.

1.3 QUALITY ASSURANCE

- .1 Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .2 Fabricator Qualification: Engage a fabricator experienced in successfully fabricating components similar to those indicated in these documents, as well as production capacity to meet the schedule requirements of this Contract.
- .3 Installer Qualifications: Engage an experienced installer who has successfully completed work similar in material, design, and extent of that indicated in these documents.
- .4 Mockups: Construct mockups to demonstrate quality of execution. Construct mockup of each type of laminate application as directed by the Consultant. Approved mockups may remain as part of the final installation.
- .5 Pre-installation Conference: Attend pre-installation conference to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements. Include fabricator and installer.

1.4 REFERENCES

- .1 Canadian General Standards Board (CGSB): CAN/CGSB-71.20-M88, Adhesive, Contact, Brushable.
- .2 Canadian Standards Association (CSA International): CSA O112-M1977(R2001), Standards for Wood Adhesives.
- .3 Environmental Choice Program (ECP): CCD-044-95, Adhesives.
- .4 National Electrical Manufacturers Association (NEMA): NEMA LD3-2000, High Pressure Decorative Laminates.

1.5 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheet in accordance with Section 01 33 00 – Submittal Procedures.
 - .2 Submit WHMIS MSDS - Material Safety Data Sheets. Indicate VOC's for adhesives, solvents and cleaners.
- .2 Samples:
 - .1 Submit samples in accordance with Section 01 33 00 – Submittal Procedures.
 - .2 Submit duplicate samples of joints, edging, cutouts and square edge profiles.
- .3 Manufacturer's Instructions:

- .1 Submit manufacturer's installation instructions.
- .4 Closeout Submittals:
 - .1 Provide maintenance data for laminate work for incorporation into manual.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Storage and Protection:
 - .1 Deliver, handle, store and protect materials of this section in accordance with Section 01 61 00 – Product Requirements.
 - .2 Maintain relative humidity between 25% and 60% at 22° C during storage and installation.

Part 2 Products

2.1 LAMINATE MATERIALS

- .1 Laminated plastic for flatwork: to NEMA LD 3.
 - .1 Manufacturers: Wilsonart, Arborite, Formica, Nevamar, Pionite, or equal.
 - .2 Type: General purpose.
 - .3 Grade: HGS for horizontal surfaces, VGS for vertical surfaces, square edge at tops.
 - .4 Size: 1.27 mm (0.05") thick for horizontal surfaces and 1.0 mm (0.039") thick for vertical surfaces, square edge at tops.
 - .5 Colour: As selected by Consultant.
 - .6 Pattern: As selected by Consultant.
 - .7 Texture Finish: As selected by Consultant.
 - .8 Use maximum length sheets of 3050mm (10'-0") as required to cover vertical surfaces without horizontal seams.
- .2 Laminated plastic for backing sheet: to NEMA LD 3.
 - .1 Type: Backer.
 - .2 Grade: BKH for horizontal surfaces, and BKV for vertical surfaces.
 - .3 Size: not less than 1.2 mm thick for horizontal surfaces and not less than 1.0 mm thick for vertical surfaces.
 - .4 Colour: Same colour as face laminate.
- .3 Laminated plastic for liner: to NEMA LD 3.
 - .1 Type: Cabinet Liner.
 - .2 Grade: CLS.
 - .3 Size: 1.0 mm (0.039") thick
 - .4 Colour: As selected by Consultant.
- .4 Laminate: High pressure laminate (HPL) panels.
 - .1 Manufacturer: ABET Laminate
 - .2 Product: Stratifato HPL
 - .3 Compliance:
 - EN 438: 2005 - Part 4

- .4 Density: To meet ISO 1183
 - .5 Colour: As selected by consultant
 - .6 Thickness: 12mm
 - .7 Note: Refer to drawing for locations at Washrooms. Symbols Male and Female
- .5 Sealants: One component mildew resistant sealant conforming to ASTM 920-00; colour to match laminate.
- .1 Sustainability Requirements: Adhesives and sealants must meet the VOC requirements of the South Coast Air Quality Management District (SCAQMD) Rule #1168.
- .6 Draw bolts and splines: as recommended by fabricator.

2.2 FABRICATION

- .1 Comply with NEMA LD 3, Annex A.
- .2 Obtain governing dimensions before fabricating items which are to accommodate or abut appliances, equipment and other materials.
- .3 Ensure adjacent parts of continuous laminate work match in colour and pattern.
- .4 Veneer laminated plastic to core material in accordance with adhesive manufacturer's instructions. Ensure core and laminate profiles coincide to provide continuous support and bond over entire surface. Use continuous lengths up to 3000 mm. Keep joints 600 mm from sink cutouts.
- .5 Use straight self-edging laminate strip for flatwork to cover exposed edge of core material. Chamfer exposed edges uniformly at approximately 20 degrees. Do not miter laminate edges.
- .6 Apply laminate backing sheet to reverse side of core of plastic laminate work.
- .7 Plastic laminate will be provided on both sides of doors and drawer fronts.
- .8 Apply laminated plastic liner sheet to interior of cabinetry to the back side of all exposed surfaces receiving plastic laminate finish.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install work plumb, true and square, neatly scribed to adjoining surfaces.
- .2 Make allowances around perimeter where fixed objects pass through or project into laminated plastic work to permit normal movement without restriction.
- .3 Use draw bolts and splines in countertop joints. Maximum spacing 450 mm on centre, 75 mm from edge. Make flush hairline joints.
- .4 Provide cutouts for inserts, grilles, appliances, outlet boxes and other penetrations. Round internal corners, chamfer edges and seal exposed core.

- .5 At junction of laminated plastic counter back splash and adjacent wall finish, apply small bead of sealant.

3.3 PROTECTION

- .1 Cover finished laminated plastic veneered surfaces with heavy kraft paper or put in cartons during shipment. Protect installed laminated surfaces by approved means. Do not remove until immediately before final inspection.

3.4 CLEANING

- .1 Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .2 Perform care and cleaning with NEMA LD 3, Annex B.
- .3 Remove traces of primer, caulking, epoxy and filler materials; clean doors and frames.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 07 92 00 – Joint Sealants.
- .2 Section 09 21 16 – Gypsum Board Assemblies

1.2 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM D2832-92(R1999), Standard Guide for Determining Volatile and Nonvolatile Content of Paint and Related Coatings.
 - .2 ASTM D5116-97, Standard Guide For Small-Scale Environmental Chamber Determinations of Organic Emissions From Indoor Materials/Products.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-71.20-M88, Adhesive, Contact, Brushable.
 - .2 CAN/ULC-S102, -2003, Surface Burning Characteristics of Building Materials and Assemblies.
- .3 Canadian Standards Association (CSA International)
 - .1 CSA O112-M1977(R2001, Standards for Wood Adhesives.
 - .2 CSA O112.5-1.1-Series-M-1977(R2001), Urea Resin Adhesives for Wood (Room- and High-Temperature Curing).
 - .3 CSA O112.7-1.1-Series M-1977(R2001), Resorcinol and Phenol-Resorcinol Resin Adhesives for Wood (Room- and Intermediate-Temperature Curing).
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .5 Environmental Choice Program (EPC)
 - .1 CCD-044-95, Adhesives.
 - .2 CCD-045-95, Sealants and Caulking Compounds.

1.3 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheet in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Submit two copies of WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01330 - Submittal Procedures. Indicate VOC's for adhesives, solvents and cleaners.
 - .3 Submit manufacturer's product test results to demonstrate flame spread < 150 and Smoke development < 300 to CAN/ULC S102.
- .2 Samples:
 - .1 Submit 3 (100mm x 100mm) samples of product for colour and finish verification.

- .2 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Submit duplicate samples of joints, edging, and cutouts.
- .3 Manufacturer's Instructions:
 - .1 Submit manufacturer's installation instructions.
- .4 Closeout Submittals:
 - .1 Provide maintenance data for laminate work for incorporation into manual for Closeout Submittals.

1.4 QUALITY ASSURANCE

- .1 Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.
- .2 Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .3 Pre-installation Meetings: Conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Storage and Protection:
 - .1 Deliver, handle, store and protect materials of this section in accordance with Section 01 60 00 - Product Requirements.
 - .2 Maintain relative humidity between 25 and 60% at 22 degrees C during storage and installation.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Divert cut-offs from landfill by disposal into on-site wood recycling bin, as directed by the Construction Manager.
- .2 Divert reusable materials for reuse at nearest used building materials facility or similar type facility.
- .3 Divert unused caulking, sealants, surface coatings and adhesive materials from landfill through disposal in accordance with Section 01 74 19 - Construction Waste Management & Disposal.

Part 2 Products

2.1 MATERIALS

- .1 Fiberglass Reinforced Plastic panels.
 - .1 Standard of Acceptance, Panolam FRP, Embossed Wall Panel, as manufactured by Panolam Industries.
 - .2 Color: Grey.
 - .3 Surface: Textured.
 - .4 Composition: random chopped fibreglass roving reinforcement; modified polyester copolymer and inorganic fillers and pigments.

- .2 Physical Characteristics:
 - .1 Tensile strength: 45MPa when tested to ASTM D790.
 - .2 Tensile modulus: 5516 MPa when tested to ASTM D790.
 - .3 Flexural Strength: 93 MPa when tested to ASTM D638.
 - .4 Flexural Modulus: 5171 MPa when tested to ASTM D638.
 - .5 IZOD Impact Strength: 0.27 when tested to ASTM D256.
 - .6 Barcol Hardness: 25-35 when tested to ASTM D583.
 - .7 Coefficient of linear thermal Expansion; 41um/m.°C, when tested to ASTM D696.
 - .8 Water Absorbtion: <0.75% in 24 hr. @ 25°C.
 - .9 Mold, bacterial growth and mildew resistant, to meet USDA requirements for use in commercial kitchens.
 - .10 Flame spread < 150 and Smoke development < 300 to CAN/ULC S102.
- .3 Finish Panel Quality:
 - .1 Panel shall have a ware side with an embossed finish.
 - .2 Dimensional tolerances shall be no greater than:
 - .1 +/- 3.2mm in width.
 - .2 +/- 3.2mm in panel lengths up to 3700mm.
 - .3 less than 3.2mm out of square.
 - .3 Test for acceptable VOC emissions in accordance with ASTM D2369 and ASTM D2832.
- .4 Adhesives:
 - .1 Low VOC adhesives in accordance with manufacturer's recommendations.
- .5 Accessories:
 - .1 Provide manufacturer's standard trims for closures, inside and outside corners, and intersections with dissimilar materials. Also require a closure J strip to wrap the edge of the backup cement board at exposed edges including the bottom.
- .6 Sealants: To Section 07 92 00.
 - .1 Test for acceptable VOC emissions in accordance with ASTM D2369 and ASTM D2832.

2.2 FABRICATION

- .1 Protective eye-ware and breathing apparatus must be worn in accordance with WHMIS requirements and manufacturer's written instructions.
- .2 Cut panels using only carbide tipped tools.
- .3 Obtain governing dimensions before fabricating items which are to accommodate or abut appliances, equipment and other materials.
- .4 Ensure adjacent parts of continuous panels match in colour and pattern.
- .5 Laminated panels to substrate in accordance with adhesive manufacturer's instructions. Ensure substrate and laminate profiles coincide to provide continuous support and bond over entire surface. Use continuous lengths up to 1800 mm.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install work plumb, true and square, neatly scribed to adjoining surfaces.
- .2 Make allowances around perimeter where fixed objects pass through or project into FRP work to permit normal movement without restriction.
- .3 Provide cutouts for inserts, grilles, appliances, outlet boxes and other penetrations.
- .4 Site apply FRP panels as indicated. Adhere FRP panels over entire surface of cement board backup panels. Make panel intersections with hairline joints. Use full sized laminate sheets. Make joints only where approved. Install purpose made joint covers between panels and corner conditions.

3.3 PROTECTION

- .1 Protect installed FRP panel surfaces by approved means. Do not remove until immediately before final inspection.

3.4 CLEANING

- .1 Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .2 Perform care and cleaning to manufacturer's written instructions.

3.5 SCHEDULE

- .1 Install FRP panels adjacent to the mop sink as indicated.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Blanket insulation for filling shim spaces and crevices in interior and exterior walls.
- .2 Acoustic insulation for interior partitions, door frames and ceilings.

1.2 RELATED SECTIONS

- .1 Section 07 84 00 - Firestopping.
- .2 Section 09 21 16 - Gypsum Board Assemblies

1.3 REFERENCES

- .1 The versions of the standards referenced in this section are those listed in the BC Building Code, current edition at the time of the application for Building Permit; or if they are not referenced in the specified code, they are the latest version of the standard in effect at the time of the application for Building Permit.
- .2 ASTM C665 - Mineral-Fibre Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
- .3 ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
- .4 CAN/ULC-S102 - Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .5 CAN/ULC-S702 - Thermal Insulation, Mineral Fibre, for Buildings.

1.4 SYSTEM DESCRIPTION

- .1 Materials of This Section: Provide continuity of thermal barrier at building enclosure elements. in conjunction with thermal insulating materials in other Sections.
- .2 Materials of This Section: Provide thermal protection to air seal materials at building enclosure elements.
- .3 Materials of This Section: Provide acoustical batts to gypsum partitions as scheduled.

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Section 01 30 00 - Coordination:
 - .1 Coordinate with other work having a direct bearing on work of this section.

Part 2 Products

2.1 MANUFACTURERS

- .1 Acceptable Materials/Products:
 - .1 Fire Batt: Roxul RockBoard Insulation. (High Density Mineral Wool).
 - .2 Thermal Batt: Certainteed Fibre Glass Building Insulation, Owens Corning Thermal Batt Insulation, Johns Manville unfaced batt insulation.
 - .3 Acoustic Batt: Owens Corning Sound Attenuation Batt, unfaced glass fibre acoustic insulation, Johns Manville Sound Control Batt.

- .2 Other manufacturers offering products meeting or exceeding specified requirements may be considered.

2.2 INSULATION

- .1 Batt and blanket mineral fibre: to ASTM C553.
 - .1 Type: 1.
 - .2 Thickness: as indicated on drawings and to match stud thickness.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify existing conditions before starting work.
- .2 Verify that substrate, adjacent materials, and insulation are dry and ready to receive insulation.

3.2 INSTALLATION

- .1 Install in exterior walls spaces without gaps or voids. Do not compress insulation.
- .2 Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- .3 Prior to installation ensure stud tracks are cleaned.
- .4 Insulate doors frames.
- .5 Fit insulation tight in spaces and tight to exterior side of mechanical and electrical services within the plane of insulation. Split batts around services within the wall.
- .6 Retain insulation in place with wire mesh or fasteners secured to framing members. Tape seal tears or cuts in vapour retarder
- .7 Do not mix and match products used within the same system.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Foamed-in-place insulation in exterior framed walls, at exterior wall crevices requiring a thermal seal, with fire protection thermal barrier cover and as detailed.
- .2 Foamed-in-place insulation at junctions of dissimilar wall and roof materials to achieve a thermal and air seal, with fire protection thermal barrier cover and as detailed.
- .3 Thermal barrier products for exposed foamed-in-place insulation to be supplied and installed under this Section.
- .4 Foamed-in-place insulation around window and door frames.

1.2 RELATED SECTIONS

- .1 Section 08 41 13 - Aluminum Framed Storefronts
- .2 Section 08 51 00 - Aluminum Windows

1.3 REFERENCE STANDARDS

- .1 The versions of the standards referenced in this section are those listed in the BC Building Code, current edition at the time of the application for Building Permit; or if they are not referenced in the specified code, they are the latest version of the standard in effect at the time of the application for Building Permit.
- .2 ASTM D1621, Compressive Properties of Rigid Cellular Plastics
- .3 ASTM D1622, Test Method for Apparent Density of Rigid Cellular Plastics.
- .4 ASTM D2482, Test Method for Surface Strength of Paper (Wax Pick Method).
- .5 ASTM E96/E96M, Test Methods for Water Vapour Transmission of Materials.
- .6 ASTM E84-15a - Standard Test Method for Surface Burning Characteristics of Building Materials.
- .7 CAN/ULC-S102- Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .8 CAN/ULC-S705.1 - Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density - Material - Specification (Includes Amendments 1 and 2, 2005).
- .9 CAN/ULC-S705.2 - Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density - Application.
- .10 CUFCA (The Canadian Urethane Foam Contractors Association).

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Section 01 30 00:
 - .1 Coordinate with other work having a direct bearing on work of this section.

- .2 Coordinate work to ensure timely placement of insulation within construction spaces.
- .3 Complete the following stages prior to application of insulating foam:
 - .1 Installation of wood blocking required
 - .2 Installation of electrical or mechanical penetrations
 - .3 Installation of Aluminum Storefronts and windows

1.5 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Provide product description, insulation properties, preparation requirements, and overcoat properties.
- .3 Sprayed polyurethane foam (SPF) installer certificate: Submit name of SPF installer with copy of certification card verifying that the SPF installer is licensed by the source manufacturer.
- .4 Manufacturer's Certificate: Certify that Products meet or exceed specified requirements as evidenced by a current CCMC Evaluation Report certifying the polyurethane foam product for use as an air barrier component is in accordance with the BC Building Code
- .5 Product Data: Provide product description, insulation properties, preparation requirements and overcoat properties.
- .6 Installation Data: Submit manufacturer's special installation requirements, perimeter conditions requiring special attention.
- .7 Testing Reports: Submit as performed by manufacturer's approved testing agency and as required by CAN/ULC S705.2.
- .8 Daily Reports: As required by CAN/ULC S705.2.
- .9 Adhesion tests at transition membranes as per manufacturer's application guidelines for air barrier system

1.6 QUALITY ASSURANCE

- .1 Installer Qualifications: Applicators licensed and certified by the SPF Quality Assurance Program used by CUFCA.
- .2 Personnel licensed or approved by insulation manufacturer's quality and training Program
- .3 A copy of the manufacturer's technical manual for the application of sprayed on polyurethane foam must be kept on site.
- .4 Tests on the spray polyurethane must be conducted daily in accordance with CAN/ULC-S705.2 Ensure results comply. Record test results.

1.7 REGULATORY REQUIREMENTS

- .1 Conform to applicable code for flame and smoke, concealment, and overcoat requirements.

1.8 WASTE MANAGEMENT AND DISPOSAL

- .1 Comply with Section 01 74 21 – Construction Waste Management and Disposal.

1.9 ENVIRONMENTAL REQUIREMENTS

- .1 Apply insulating material only if the surface and ambient air temperatures are within manufacturer's prescribed limits.

Part 2 Products

2.1 MANUFACTURERS

- .1 Basis of Design: BASF Walltite Eco v.2.
- .2 Other acceptable materials:
 - .1 Polar Foam; PF 7300.
 - .2 CertainTeed; CertaSpray Closed Cell Foam.
 - .3 Dow Chemical; Froth-Pak Insulation.
- .3 For perimeter of window and door frames:
 - .1 TREMCO, ExoAir Flex Foam
 - .2 Dupont, Enefoam
 - .3 Sika, Sika Boom

2.2 MATERIALS

- .1 Insulation: CAN/ULC-S705.1, two component polyurethane type.
 - .1 Thermal Conductivity: ASTM C518; 26.38W/m.K
 - .2 Water Vapour Permeance: ASTM E96; 894 ng/Pa.s.m².
 - .3 Water Vapour Absorption: ASTM D2482; 3.2 percent by volume at 24 hours/25 degrees C/100 percent RH.
 - .4 Compressive Strength: ASTM D1621; 12.4 kPa.
 - .5 Density: ASTM D1622; 8.26 kg/m³.
 - .6 Flame Spread and Smoke Developed Rating: ASTM E84 430/260.
- .2 Sustainable Requirements:
 - .1 Zero ozone depleting blowing agents.
 - .2 Minimum Recycled Content: EcoLogo certified; 5% by weight.
 - .3 Eco-efficiency, life cycle analysis approved by an independent third party.
 - .4 Maximum VOC limit 100 g/l.
- .3 Insulation: ASTM D2842, single component low expansion polyurethane type for insulation around window and door frames.

2.3 ACCESSORIES

- .1 Primer: As required by insulation manufacturer.
- .2 Overcoat: Cementitious type, spray applied.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify work within construction spaces or crevices is complete prior to insulation application.
- .2 Verify that surfaces are clean, dry, and free of matter that may inhibit insulation or overcoat adhesion.

3.2 PREPARATION

- .1 Ensure the work area is adequately ventilated.
- .2 Ensure continuous and proper ventilation of the work area, through a fresh air intake and the extraction of foul air, during the application process and for 24 hours thereafter.
- .3 When necessary, install temporary partitions to prevent any over spray outside of the work area from the sprayed-on insulation material.
- .4 Ensure all structures are protected, in accordance with manufacturer's recommendations.
- .5 Protect all adjacent surfaces and equipment against any damage that may be caused by dispersion and over spray of insulation material beyond prescribed limits.
- .6 Surfaces must be clean and dry, as required by CAN/ULC-S705.2. The substrate must be free of all frost, dust, oil, grease, oxidization, or any other element that may affect adhesion of the system i.e. high moisture content.
- .7 All transition membranes must be installed prior to application of the polyurethane foam. Install membranes accordance with the manufacturer's recommendations. Adhesion of the material to the substrate must be sufficient to resist the stress applied by the polyurethane foam during the curing time.
- .8 Apply primer in accordance with manufacturer's written instructions.

3.3 INSTALLATION - INSULATION

- .1 All excessively wide joints should be covered or filled before applying the polyurethane foam.
- .2 Install transition membranes according to manufacturer's recommendations.
- .3 Spray foam insulation in accordance with CAN/ULC-S705.2 with a tolerance of +6 / -0 mm in relation to the specified thickness.
- .4 Avoid the formation of sub-layer air pockets when applying.
- .5 Avoid spraying the foam on any surfaces other than those indicated. Use a drop sheet or masking tape to protect other surfaces.
- .6 Once the foam has hardened, remove all over spray from non-prescribed surfaces.
- .7 Ensure the subsequent coverage of the applied insulating foam will be completed within manufacturer's prescribed limits.
- .8 Spray the polyurethane foam in overlapping layers, to obtain a smooth, uniform surface.
- .9 Do not spray polyurethane foam any closer than 75 mm (3") from chimneys, heating vents, steam pipes, recessed lighting fixtures, and other heat sources. Do not spray the interior of any exit openings or electrical junction boxes.

- .10 In temperatures below 10 degrees C use transition membranes specifically formulated for low temperature application and primer. Adhesion tests must be conducted. If no proper adhesion, then secure the membranes mechanically.

3.4 APPLICATION - PERIMETER OF FRAMES

- .1 Prior to application, slightly moisten surfaces to which foamed-in-place insulation is being applied, to accelerate curing.
- .2 Temporarily brace door and window frames as may be required to prevent possible bowing of frames due to over expansion of the foamed-in-place insulation. Take all precautions required to ensure that windows are not bowed out, putting undue stress on glazing and to restrict operation of operable windows and doors.
- .3 Where foam-in-place insulation is used to maintain continuity of thermal barrier and is installed in conjunction with air/vapour barrier membrane around frames including metal and aluminium frames or protrusions, ensure that the foam-in-place insulation is installed on the exterior side of the air/vapour barrier membrane.
- .4 Upon completion of foam-in-place insulation work, clean adjacent surfaces of over spray and dusting to the satisfaction of the Consultant.

3.5 APPLICATION - THERMAL BARRIER

- .1 Where foamed in place insulation is left exposed, apply overcoat thermal barrier according to manufacturer's instructions.

3.6 CLEANING

- .1 Section 01 74 11: Progressive Cleaning.
 - .1 Leave Work area clean at end of each day.
 - .2 When cleaning equipment, it should be performed in areas designated for this purpose, and the contents of the empty containers neutralized according to the procedure established by the CAN/ULC-S705.2.
- .2 Section 01 74 11: Final Cleaning.
- .3 Remove surplus materials, rubbish, tools, and equipment on completion.
- .4 Section 01 74 21: Waste Management.
 - .1 Separate waste materials for recycling.

3.7 PROTECTION OF FINISHED WORK

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

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Preformed metal siding system for walls, soffits, with related flashings and accessory components.

1.2 RELATED SECTIONS

- .1 Section 07 62 00 - Sheet Metal Flashing and Trim.

1.3 REFERENCES

- .1 The versions of the standards referenced in this section are those listed in the BC Building Code, current edition at the time of the application for Building Permit; or if they are not referenced in the specified code, they are the latest version of the standard in effect at the time of the application for Building Permit.
- .2 ASTM A167 - Stainless and Heat-Resisting Chromium Nickel Steel Plate, Sheet, and Strip.
- .3 ASTM A606 - Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance.
- .4 ASTM A653/A653 - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .5 ASTM A755/A755M-03 - Steel Sheet, Metallic Coated by the Hot-Dip Process and Pre-painted by the Coil-Coating Process For Exterior Exposed Building Products.
- .6 ASTM A792/A792M - Steel Sheet, 55% Aluminum-Zinc Alloy Coated by the Hot-Dip Process.
- .7 ASTM B209M - Aluminum and Aluminum-Alloy Sheet and Plate Metric.

1.4 SYSTEM DESCRIPTION

- .1 Assembly of components includes preformed and prefinished metal siding and soffit system of horizontal profile; site assembled.

1.5 DESIGN REQUIREMENTS

- .1 Work of this Section shall be designed by an Professional Engineer licensed to design structures and registered in the Province of British Columbia.
 - .1 Provide calculations for loadings and stresses under the Professional Engineer's seal registered in the Province of British Columbia.
 - .2 Letters of Assurance:
 - .1 The Engineer sealing the shop drawings shall submit to the Consultant, as required by the BC Building Code, the following:
 - .1 Schedule B.
 - .2 Schedule C-B Assurance of Professional Field Review and Compliance.
 - .3 The Engineer sealing the shop drawings shall provide field reviews of the installation and shall provide sufficient reviews in order to provide letters of professional assurance. Written inspection reports shall be submitted to the

Consultant promptly as field reviews occur.

- .2 Design exterior metal siding systems to support wind load prevalent for the location of the building, with a deflection not exceeding 1/180 of a 1220 mm span; calculate design pressure from National Building Code using 1-50 year return. Metal thicknesses shall be no less than that indicated herein.
- .3 Unless otherwise shown on the structural drawings, design system to withstand seismic loads in accordance with BC Building Code.
- .4 Allow for movement in cladding caused by deflection in structure.
- .5 System shall be designed to allow unobstructed movement of air between the exterior and interior sides of metal cladding in accordance with Canadian Building Digest #40.
- .6 System shall provide clear internal paths of drainage in order to drain any trapped moisture to the exterior, discharging moisture in a manner avoiding staining of architectural finishes, collecting in puddles, formation of icicles and dripping on pedestrians.
- .7 Assembly shall be weatherproof and prevent infiltration of water into the system.
- .8 Panel assembly shall be fastened to the building structure in a manner which transmits all loads to the main structure without exceeding the capacity of any fastener.
- .9 Panel assembly shall be non-combustible.
- .10 Preformed Metal Siding system shall be supported and braced to the building structure in accordance with the BCBC Clause 4.1.8.17 using an Importance Factor IE = 1.5.

1.6 PERFORMANCE REQUIREMENTS

- .1 Verify Wall systems shall be resistant to damage from dimensional changes caused by temperature, settlement and seismic forces that may be presented by construction components or climatic conditions that exist at the site.
- .2 Components: Design and size components to withstand dead and live loads caused by positive and negative wind pressure acting normal to plane of wall.
- .3 Maximum Allowable Deflection of Panel: 1/90 of span.
- .4 Movement: Accommodate movement within system without damage to components or deterioration of seals, movement within system; movement between system and perimeter components when subject to seasonal temperature cycling; dynamic loading and release of loads; deflection of structural support framing.
- .5 Drainage: Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.
- .6 Products: Provide continuity of thermal barrier at building enclosure elements in conjunction with thermal insulating materials.
- .7 Air Seal: Provide continuity of air barrier seal at building enclosure elements in conjunction with air seal materials specified in Section 07 27 00.

1.7 ADMINISTRATIVE REQUIREMENTS

- .1 Section 01 30 00 - Coordination:
 - .1 Coordinate with other work having a direct bearing on work of this section.
 - .2 Coordinate the Work for installation of air barrier seals.
 - .3 Coordinate the Work with installation of windows, louvres, and components or materials.

1.8 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Shop Drawings: Indicate dimensions, layout, joints, construction details, methods of anchorage.
- .3 Samples: Submit two samples of siding, 200 x 200 mm in size illustrating finish colour, sheen, and texture.

1.9 SUBMITTALS FOR INFORMATION

- .1 Section 01 33 00: Submission procedures.
- .2 Installation Data: Manufacturer's special installation requirements.

1.10 QUALITY ASSURANCE

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience.
- .2 Installer Qualifications: Company specializing in performing the work of this section with minimum three (3) years documented experience.

1.11 DELIVERY, STORAGE, AND PROTECTION

- .1 Protect panels from accelerated weathering by removing or venting sheet plastic shipping wrap.
- .2 Store prefinished material off ground protected from weather, to prevent twisting, bending, or abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- .3 Prevent contact with materials which may cause discolouration or staining.

1.12 WARRANTY

- .1 Warranty Period for all supplied materials, equipment and installation is two (2) years from the date of service commencement.
- .2 Warranty: Include coverage to correct defective work and for failure to meet specified requirements.

Part 2 Products

2.1 MANUFACTURERS

- .1 Manufacturers - Acceptable Materials/Products:
 - .1 Metal wall cladding: Westform Metals, 22mm corrugated panels, 24 gauge, colour to be determined.
 - .2 Soffit panels: Westform Metals, model WF-HF-12 aluminum panels, 24 gauge, colour to be determined.
- .2 Other manufacturers offering products meeting or exceeding specified products and requirements may be considered.

2.2 EXTERIOR SHEET MATERIALS

- .1 Pre-coated Galvanized Steel: ASTM A653/A653M, Coating Designation Z275; with factory applied PVDF topcoat system. Colour selected by the Design Consultant.

2.3 ACCESSORIES

- .1 Subgirts: Rolled, Z-shaped, thermally broken Z-275 galvanized steel girts to suit design loads and application.
- .2 Hat Sections, Strapping and Other Sub framing: Minimum 1.22 mm galvanized steel.
- .3 Trims as recommended by supplier.
- .4 Provide all additional structural supports not shown on Drawings as required.
- .5 Gaskets: Manufacturer's standard type suitable for use with system, permanently resilient; ultraviolet and ozone resistant; colour as selected.
- .6 Sealants: Manufacturer's standard type suitable for use with installation of system; non-staining, non-skinning, non-shrinking and non-sagging; ultra-violet and ozone resistant; colour as selected.
- .7 Fasteners: Manufacturer's standard type to suit application; with soft neoprene washers, steel, hot dip galvanized; fastener cap same colour as exterior panel. Exposed fasteners same finish as panel system.
- .8 Field Touch-up Paint: As recommended by panel manufacturer.
- .9 Bituminous Paint: Asphalt base.

2.4 COMPONENTS

- .1 Exterior Sheet: Minimum 0.8 mm thick pre-coated steel stock profile as indicated; 915 mm wide panel; lapped edges, filled with sealant.
- .2 Soffit Panels: 0.8 mm thick pre-coated steel, perforated and non-perforated profile in 300 mm nominal wide panels.
- .3 Internal and External Corners: Same material, thickness, and finish as exterior sheets; profile to suit system; shop cut and factory mitred to required angles. Mitred internal corners to be back braced with pre-coated sheet stock to maintain continuity of profile.
- .4 Expansion Joints: Same material, thickness and finish as exterior sheets type, of profile to suit system.
- .5 Trim, Closure Pieces, Caps, Flashings, Facias, and Infills: Same material, thickness and finish as exterior sheets; brake formed to required profiles.
- .6 Anchors: Galvanized steel.

2.5 FABRICATION

- .1 Form sections true to shape, accurate in size, square, and free from distortion or defects.
- .2 Form pieces in longest practicable lengths.
- .3 Panel Profile: refer to panel specs.
- .4 Fabricate corners in one continuous piece with minimum 100mm returns.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify existing conditions before starting work.
- .2 Verify that building framing members are ready to receive panel system.

- .3 Take site measurements to ensure that work is fabricated to fit structure; surrounding construction; around obstructions and projections in place, or as shown on Drawings; and to suit location of services.
- .4 Notify Contractor in writing of any discrepancies or defects which would affect the proper installation of the work of this Section.
- .5 Verify that backup construction is aligned for proper installation of siding before commencing erection.

3.2 INSTALLATION

- .1 Install metal siding system on walls and soffits to manufacturer instructions.
- .2 Protect surfaces in contact with cementitious materials and dissimilar metals with bituminous paint. Allow to dry prior to installation.
- .3 Fasten siding to structural supports; aligned, level, and plumb.
- .4 Locate joints over supports. Lap panel ends minimum 50mm.
- .5 Provide expansion joints where indicated.
- .6 Use concealed fasteners unless otherwise approved by Consultant.
- .7 Seal and place gaskets to prevent weather penetration. Maintain neat appearance.

3.3 REPAIR

- .1 After erection touch up galvanized finishes removed or damaged during erection.
- .2 Remove damaged, dented, defaced, defectively finished, oil canned panels due to installation or tool marked components and replace with new as directed by the Contractor.
- .3 Refinish shop applied finishes in field only with approval of Contractor.

3.4 ERECTION TOLERANCES

- .1 Maximum Offset from True Alignment Between Adjacent Members Butting or In Line: 1.6 mm.
- .2 Maximum Variation from Plane or Location Indicated on Drawings: 6 mm.

3.5 CLEANING

- .1 Section 01 74 11: Cleaning installed work.
- .2 Clean off drill shavings from subgirts and channels at the end of each work day and prior to application of metal cladding.
- .3 Protect all adjacent surfaces from damage due to work under this section.
- .4 As work proceeds and on completion deposit all recyclable packing materials and containers in appropriate recycling containers.
- .5 Remove site cuttings from finish surfaces.
- .6 Clean and wash prefinished surfaces with mild soap and water; rinse with clean water.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures
- .2 Section 01 45 00 - Quality Control
- .3 Section 01 74 21 – Construction Waste Management and Disposal
- .4 Section 06 10 00 - Rough Carpentry
- .5 Section 07 62 00 - Sheet Metal Flashing and Trim

1.2 REFERENCES

- .1 ASTM International Inc.
 - .1 ASTM C1177/C1177M-06, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
- .2 Canadian Standards Association (CSA International)
 - .1 CSA A123.21-04, Standard Test Method for the Dynamic Wind Uplift Resistance of Mechanically Attached Membrane-Roofing Systems
- .3 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .4 Underwriters Laboratories' of Canada (ULC)CAN/ULC-S701-05, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.
 - .1 CAN/ULC-S704-03, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.
- .5 Roofing Contractors Association of British Columbia (RCABC) – Roofing Specifications Manual.
- .6 Canadian General Standards Board
 - .1 CGSB 37-GP-56M, Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing.

1.3 SYSTEM DESCRIPTION

- .1 The existing roof consists of insulation, SBS membrane over a plywood deck.
- .2 This project consists of new mechanical hoods and pipe penetrations thru the existing roof. Roofing contractor to remove top components and provide new membrane seals and flashing around the new penetrations.
- .3 Any infills at abandon openings shall be infilled to match the existing components.

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Coordinate with other work having a direct bearing on work of this section.
 - .2 Coordinate the work with the installation of associated metal flashings, as the work of this section proceeds.
- .2 Pre-installation Meetings:
 - .1 Convene one (1) week before starting work of this section.

- .2 Review preparation and installation procedures and coordinating and scheduling required with related work.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide the most recent technical roofing components data sheets describing materials' physical properties and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Provide WHMIS MSDS sheets and indicate VOC content for:
 - .1 Primers.
 - .2 Asphalt.
 - .3 Sealers.
- .3 Provide shop drawings:
 - .1 Indicate base and cap sheet details, curb details and tapered insulation details.
 - .2 Provide layout for tapered insulation.
- .4 Samples: Submit samples 300 x 300 mm of vapour barrier, insulation, overlay and roofing membrane (base and cap sheet).
- .5 Manufacturer's Certificate: certify that products meet or exceed specified requirements.
- .6 Test and Evaluation Reports: submit laboratory test reports certifying compliance of bitumens and roofing felts and membrane with specification requirements.
- .7 Manufacturer's Installation Instructions: indicate special precautions required for seaming the membrane.
- .8 Manufacturer's field report: in accordance with Section 01 45 00 - Quality Control.
- .9 Reports: indicate procedures followed, ambient temperatures and wind velocity during application.

1.6 QUALITY ASSURANCE

- .1 Perform work in accordance with RCABC – Roofing Practices Manual.
- .2 Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 10 years' experience.
- .3 Installer qualifications: company or person specializing in application of modified bituminous roofing systems with 5 years documented experience approved by manufacturer and an active member in good standing with the RCABC.

1.7 REGULATORY REQUIREMENTS

- .1 Conform to applicable code for roof assembly fire hazard requirements.

1.8 FIRE PROTECTION

- .1 Maintain fire watch for 1 hour after each day's roofing operations cease.

1.9 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver products in manufacturer's original containers, dry, undamaged, seals and labels intact.
- .2 Storage and Handling Requirements:
 - .1 Safety: comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of asphalt, sealing compounds, primers and caulking materials.
 - .2 Provide and maintain dry, off-ground weatherproof storage.
 - .3 Store rolls of felt and membrane in upright position. Store membrane rolls with salvage 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 Store insulation protected from daylight and weather and deleterious materials.
- .3 Stand roll materials on end.

1.10 ENVIRONMENTAL REQUIREMENTS

- .1 Ambient Conditions
 - .1 Do not install roofing when temperature remains below -18 degrees C for torch application.
 - .2 Minimum temperature for solvent-based adhesive is -5 degrees C.
- .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.

1.11 WARRANTY

- .1 The Contractor shall provide a standard TEN YEAR MATERIALS WARRANTY issued by the manufacturer of the roofing membrane.
- .2 Warranty: Include damage to existing building resulting from failure to prevent penetration of water.

Part 2 Products

2.1 SHEATHING

- .1 Refer to Section 06 10 00 – Rough Carpentry.

2.2 INSULATION

- .1 Board Insulation to match existing type and thickness.

2.3 FLAME BARRIER TAPE

- .1 Glass fleece reinforced SBS modified bitumen roll sheet, self-adhesive underside protected by silicone release sheet and thermo fusible plastic film on top side.

2.4 MEMBRANE

- .1 Base sheet: to CGSB 37-GP-56M, containing minimum 12% SBS elastomeric polymer, non-woven polyester reinforcement.
 - .1 Styrene-Butadiene-Styrene (SBS) elastomeric polymer prefabricated sheet.
 - .2 Base sheet membrane properties:
 - .1 Weight: 180g/m², minimum 2.5mm in thickness.
 - .2 Application: fully adhered, heat welded.
 - .3 Top and bottom surface: thermo fusible plastic film.
 - .3 Standard of acceptance: IKO Industries Ltd, Soprema Waterproofing Inc., Siplast Icopal.
 - .4 Other acceptable manufacturers offering functionally and aesthetically equivalent, to be approved prior to award of contract.
- .2 Base Flashing Sheet: to CGSB 37-GP-56M containing minimum 15% SBS elastomeric polymer, non-woven polyester reinforcement.
 - .1 Weight: 180g/m², minimum 2.5mm in thickness.
 - .2 Self-adhesive stripe underside protected with silicone release sheet, thermo fusible plastic top surface.
 - .3 Standard of acceptance: IKO Industries Ltd, Soprema Waterproofing Inc., Siplast Icopal
 - .4 Other acceptable manufacturers offering functionally and aesthetically equivalent, to be approved prior to award of contract.
- .3 Cap and flashing sheet: to CGSB 37-GP-56M containing minimum 12% SBS elastomeric polymer, non-woven polyester reinforcement.
 - .1 Styrene-Butadiene-Styrene (SBS) elastomeric polymer prefabricated sheet.
 - .2 Cap sheet membrane properties:
 - .1 Weight: 250g/m², minimum 4.0mm in thickness.
 - .2 Application: fully adhered, heat welded.
 - .3 Top Surface: brown granular finish, to match existing.
 - .4 Bottom surface: thermo fusible plastic film.
 - .3 Standard of acceptance: IKO Industries Ltd, Soprema Waterproofing Inc., Siplast Icopal.
 - .4 Other acceptable manufacturers offering functionally and aesthetically equivalent, to be approved prior to award of contract.
- .4 Walkway membranes: Sopralene Flam 250 GR – Dark Grey in Colour.

2.5 MISC ROOF COMPONENTS

- .1 Plastic cement / mastic: to CAN/CGSB-37.5
- .2 Sheet Metal Flashing around new penetrations.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify that surfaces and site conditions are ready to receive work.
- .2 Verify deck is supported and secured.

- .3 Verify deck is clean and smooth, free of depressions, waves, or projections, properly sloped to drains.
- .4 Verify deck surfaces are dry and free of snow or ice.
- .5 Verify roof openings, curbs, pipes, conduit, sleeves, ducts, and vents through roof are solidly set.

3.2 MEMBRANE APPLICATION

- .1 Apply membrane and primer to manufacturer written instructions.
- .2 Apply membrane; lap and seal edges and ends permanently waterproof.
- .3 Apply membrane smooth, free from air pockets, wrinkles, or tears. Ensure full bond of membrane to substrate.
- .4 Seal membrane around roof protrusions and penetrations.
- .5 Install additional layer of torch applied material for a protective layer leading to all roof top mechanical units. Such walkways shall be parallel to the outside building lines

3.3 FLASHINGS AND ACCESSORIES

- .1 Apply flexible sheet base flashings to seal membrane to vertical elements.
- .2 Seal flashings and flanges of items penetrating or protruding through the membrane.

3.4 FIELD QUALITY CONTROL

- .1 Correct identified defects or irregularities.

3.5 CLEANING

- .1 Section 01 74 11: Cleaning.
- .2 In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and comply with their documented instructions.
- .3 Repair or replace defaced or disfigured finishes caused by work of this section.

3.6 PROTECTION OF FINISHED WORK

- .1 Protect building surfaces against damage from roofing work.
- .2 Where traffic must continue over finished roof membrane, protect surfaces.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Parapet, cap, sill, lintel, and counter flashings.
- .2 Counterflashings over base flashings.
- .3 Counterflashings at roof mounted equipment and vent stacks.

1.2 RELATED SECTIONS

- .1 Section 07 52 00 - Modified Bitumen Membrane Roofing (PatchWork)
- .2 Section 07 46 16 - Preformed Metal Siding
- .3 Section 07 92 00 - Joint Sealants.
- .4 Division 22 – Sanitary/Storm Drainage System: Flashing sleeves and collars for mechanical items protruding through roofing membrane.
- .5 Division 27 - For the rooftop communications pathway systems passing through roofing membrane.
- .6 Roof curbs for mechanical equipment.

1.3 REFERENCES

- .1 The versions of the standards referenced in this section are those listed in the BC Building Code, current edition at the time of the application for Building Permit; or if they are not referenced in the specified code, they are the latest version of the standard in effect at the time of the application for Building Permit.
- .2 ASTM A653/A653M - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) or 55% Aluminum-zinc alloy coated (Galvalum) by the Hot-Dip Process.
- .3 ASTM B209M - Aluminum and Aluminum-Alloy Sheet and Plate Metric.
- .4 ASTM D4586 - Asphalt Roof Cement, Asbestos-Free.
- .5 ASTM D226 - Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
- .6 CSA HA Series-Mi 980 Standards for Aluminum and Aluminum Alloys; and
- .7 CSA A231.1-06/A231.2 - Precast Concrete Paving Slabs/Precast Concrete Pavers.
- .8 Roofing Contractors Association of British Columbia - Roofing Specifications Manual.
- .9 SMACNA (Sheet Metal and Air Conditioning Contractors' National Association) - Architectural Sheet Metal Manual.

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Coordinate with other work having a direct bearing on work of this section.
- .2 Coordinate with the work of Section 07 52 00 for installing flashings.

1.5 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.
- .3 Samples:

- .1 Submit two (2) samples, 75 x 75 mm in size illustrating metal finish colour. One to the consultant and one to the site field office.
- .4 Mock-ups
 - .1 Provide a mockup on site of typical conditions as requested to show the typical installations including joints and corner conditions.

1.6 QUALITY ASSURANCE

- .1 Perform work in accordance with SMACNA standard details and requirements.
- .2 Installer Qualifications: Company specializing in performing the work of this section with minimum three (3) years experience.

1.7 DELIVERY, STORAGE, AND PROTECTION

- .1 Stack preformed and prefinished material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- .2 Prevent contact with materials which may cause discolouration or staining.

1.8 WARRANTY

- .1 Warranty Period for all supplied materials, equipment and installation is two (2) years from the date of service commencement.
- .2 Warranty: Include coverage to correct defective work and for failure to meet specified requirements

Part 2 Products

2.1 SHEET METAL MATERIALS

- .1 Pre-Coated Galvanized Steel: ASTM A653/A653M, G90 zinc coating; 0.61mm core steel, shop pre-coated with modified silicone PVDF coating of colour to be selected.
- .2 Heavy Gauge Pre-Coated Galvanized Steel: ASTM A653/A653M, G90 zinc coating; 1.5 mm core steel, shop pre-coated with modified silicone PVDF coating of colour to be selected.
- .3 Performed perforated metal closures to be colour matched.

2.2 ACCESSORIES

- .1 Fasteners: Galvanized steel or Stainless Steel Same material and finish as flashing metal, with soft neoprene washers.
- .2 Underlayment: ASTM D226, No. 15 asphalt saturated roofing felt.
- .3 Slip Sheet: Rosin sized building paper.
- .4 Protective Backing Paint: Zinc chromate alkyd.
- .5 Sealant: Polyurethane type, specified in Section 07 92 00.
- .6 Bedding Compound: Rubber-asphalt Butyl type,
- .7 Plastic Cement: ASTM D4586.
- .8 Reglets: Surface mounted, galvanized steel.

2.3 DESIGN CRITERIA

- .1 Base Steel Thicknesses of Sheet Steel:
 - .1 Base metal thicknesses of sheet steel specified herein are based on the Manufacturers Standard Gauge (MSG) system. The minimum thickness shall be the design thickness (nominal base steel thickness) minus the maximum allowable under-tolerance as specified by CSA-S136. Thicknesses (gauge) specified are for uncoated steel.
 - .2 Design thicknesses are in accordance with CSSBI Sheet Steel Facts No. 10, Table 1 - MSG Sheet Steel Gauge Numbers and Thicknesses
- .2 Design sheet metal flashings and trim to provide for thermal movement of component materials caused by ambient temperature range of -35°C to 75°C without causing buckling, failure of joint seals, undue stress on fasteners or other detrimental effects.
- .3 Design sheet metal flashings and trim to accommodate movement between materials and building structure, caused by structural movements, without permanent distortion, damage to components, racking of joints, opening of seams, buckling and oil canning.

2.4 FABRICATION

- .1 Fabricate metal flashings and other sheet metal work in accordance with applicable CRCA 'FL' series specifications and as indicated. S Lock or standing seam.
- .2 Form pieces in 2 400 mm maximum lengths. Make allowance for expansion at joints.
- .3 Hem exposed edges on underside 12 mm. Miter and seal corners with sealant.
- .4 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.
- .5 Apply isolation coating to metal surfaces to be embedded in concrete or mortar.
- .6 Apply isolation coating to metal surfaces to be in contact with pressure-preservative treated wood or use separation sheet.

2.5 METAL FLASHINGS

- .1 Form flashings, copings and fascias to profiles indicated of 0.8 mm thick prefinished steel.

2.6 REGLETS AND CAP FLASHINGS

- .1 Form recessed reglets of 0.8 mm thick sheet metal in accordance with RCABC Roofing Practices Manual details. Provide slotted fixing holes and steel/plastic washer fasteners.

2.7 FINISHES

- .1 Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 0.4 mm.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify existing conditions before starting work.
- .2 Verify roof openings, curbs, pipes, sleeves, ducts, or vents through roof are solidly set, reglets in place, and nailing strips located.

- .3 Verify roofing termination and base flashings are in place, sealed, and secure.

3.2 PREPARATION

- .1 Install starter and edge strips, and cleats before starting installation.
- .2 Install surface mounted reglets true to lines and levels. Seal top of reglets with sealant.

3.3 INSTALLATION

- .1 Conform to drawing details and as in the SMACNA manual.
- .2 Insert flashings into reglets to form tight fit. Secure in place with lead wedges. Pack remaining spaces with lead wool. Seal flashings into reglets with sealant.
- .3 Apply plastic cement compound between metal flashings and felt flashings.
- .4 Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles. Flash joints using S-lock forming tight fit over hook strips.
- .5 Seal metal joints watertight.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
 - .1 Remove insulation material spilled during installation and leave work area ready for application of wall board.
- .3 Waste Management: separate waste materials for in accordance with Section 01 74 21 - Construction Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Fire-stopping and fire-safing materials and accessories, free of asbestos.
- .2 Only tested firestop systems shall be used in specific locations as follows:
 - .1 Penetrations for the passage of duct, cable, cable tray, conduit, piping, electrical busways and raceways through fire-rated vertical barriers (walls and partitions), horizontal barriers (floor/ceiling assemblies), and vertical service shaft walls and partitions.
 - .2 Openings between structurally separate sections of wall or floors.
 - .3 Gaps between the top of walls and ceilings or roof assemblies.
 - .4 Expansion joints in walls and floors.
 - .5 Openings and penetrations in fire-rated partitions or walls containing fire doors.
 - .6 Openings around structural members which penetrate floors or walls.
 - .7 Alternative Solutions containing the manufacturer's firestop custom detail shall be used when no listed firestop system is available for an application in specific locations including, but not limited to the following:

1.2 RELATED SECTIONS

- .1 Section 04 04 00 - Common Work Results for Masonry
- .2 Section 09 21 16 - Gypsum Board Assemblies
- .3 Section 23 33 00 – Air Duct Accessories
- .4 Section 26 05 21 – Wiring and Cables

1.3 REFERENCES

- .1 The versions of the standards referenced in this section are those listed in the BC Building Code, current edition at the time of the application for Building Permit; or if they are not referenced in the specified code, they are the latest version of the standard in effect at the time of the application for Building Permit.
- .2 ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
- .3 ASTM E119 - Method for Fire Tests of Building Construction and Materials.
- .4 ASTM E814 - Test Method of Fire Tests of Through-Penetration Fire Stops.
- .5 ASTM E1966 - Test Method for Fire-Resistive Joint Systems
- .6 CAN/ULC S101 - Fire Endurance Tests of Building Construction and Materials.
- .7 CAN/ULC S102 - Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .8 CAN/ULC S115 - Fire Tests of Firestop Systems.
- .9 British Columbia Building Code.
- .10 NFPA - Life Safety Code.
- .11 Canadian Electrical Code.

1.4 DEFINITIONS

- .1 Firestopping (Firesafing): Material or combination of materials used to retain integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke and hot gases through penetrations in, or construction joints between, fire-rated wall and floor assemblies.
- .2 Listed Firestop System: A specific construction consisting of materials, any penetrating items and their means of support, that has met the requirements of an F, FT, FH and/or FTH rating when tested in accordance with CAN/ULC-S115 - Standard Method of Fire Tests of Firestop Systems.

1.5 SYSTEM DESCRIPTION

- .1 Listed Firestop System to achieve a fire rating as noted on Drawings.
- .2 Surface Burning: CAN/ULC S102 with a flame spread/smoke developed rating of 5/40.
- .3 Firestop all interruptions to fire rated assemblies, materials, and components.

1.6 SUBMITTALS

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Manufacturer's specifications and technical data for each material including the composition and limitations, documentation of listed firestop systems to be used and manufacturer's installation instructions.
- .3 Alternative Solutions: Manufacturer's firestop custom details for each custom application including both project name and subcontractor's name who will install the firestop solution as described in the detail drawing. This alternative solution must be reviewed by a professional Engineer registered in British Columbia who shall take responsibility for the design under seal.
- .4 Submit material safety data sheets provided with product delivered to job-site.
- .5 VOC Content Limitations: For firestop system products, submit documentation in accordance with Article 1.12.
- .6 Shop Drawings: Provide shop drawings for products cast in concrete.

1.7 INSTALLER QUALIFICATIONS

- .1 Engage an experienced Installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having the necessary experience, staff, and training to install manufacture's products per specified requirements.

1.8 QUALITY ASSURANCE

- .1 A manufacturer's direct representative (not distributor or agent) to be on-site during initial installation of firestop systems to train appropriate contractor personnel in proper selection and installation procedures. This will be done per manufacturer's written recommendations published in their literature and drawing details. Single Source Responsibility: Obtain firestop systems for each type of penetration and construction situation from a single primary firestop systems manufacturer.
- .2 Installation be qualified journeyman or apprentices registered in the RedSeal trade of Heat and Frost.
- .3 Engage BCICA for Quality Assurance Certificate Program to obtain Quality Assurance Certificate.

- .4 Listed Firestop System installation must meet requirements of CAN/ULC-S115 tested assemblies that provide an F rating or FT rating as shown in 2.3.15 below.
- .5 Proposed firestop materials and methods shall conform to applicable governing codes having local jurisdiction.
- .6 Listed Firestop Systems do not re-establish the structural integrity of load bearing partitions/assemblies, or support live loads and traffic. Installer shall consult the structural engineer prior to penetrating any load bearing assembly.
- .7 Alternative Solutions described in 1.6 - Submittals, Paragraph .3 shall be submitted to local authorities having jurisdiction for their review and approval prior to installation. Firestop custom details must follow current requirements set forth by the International Firestop Council.

1.9 REGULATORY REQUIREMENTS

- .1 Conform to ULC for fire resistance ratings and surface burning characteristics.

1.10 COORDINATION MEETING

- .1 All subtrades penetrating rated fire separations or providing joints between rated fire separations (regardless if firestopping or not) shall meet with firestop manufacturer prior to firestop installation to coordinate construction practices to best meet the requirements of the proposed listed firestop systems.

1.11 PROJECT CONDITIONS

- .1 Do not use materials that contain flammable solvents.
- .2 Scheduling:
 - .1 Schedule installation of other firestopping materials after completion of penetrating item installation but prior to covering or concealing of openings.
 - .2 Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.
 - .3 Weather conditions: Do not proceed with installation of firestop materials when temperatures exceed the manufacturer's recommended limitations for installation printed on product label and product data sheet.
 - .4 During installation, provide masking and drop cloths to prevent firestopping materials from contaminating any adjacent surfaces.

Part 2 Products

2.1 FIRESTOPPING, GENERAL

- .1 Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by the firestopping manufacturer based on testing and field experience.
- .2 Firestopping sealants/coatings shall be silicone based and not re-emulsify when opposed to standing or wetting.
- .3 Provide components for each firestopping system that are needed to install fill material. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.

2.2 MANUFACTURERS

- .1 Acceptable Products/Materials: Subject to compliance with through penetration firestop systems and joint systems tested in accordance with CAN/ULC-S115, provide products of the following manufacturers as identified below:
 - .1 Hilti (Canada) Corporation, Mississauga, Ontario, 1-800-363-4458
www.ca.hilti.com, or approved alternate.
 - .2 Acceptable Materials/Products are listed in article 2.3 - Materials are based on products manufactured by Hilti (Canada) Corporation. Alternate manufacturers and products may be accepted.
 - .3 Other manufacturers offering products meeting or exceeding specified products and requirements may be considered.
 - .1 3M is an approved manufacturer.
 - .2 Pyro-Flex Fire Barrier System by MM Systems is an approved manufacturer.

2.3 MATERIALS

- .1 Fire stopping and smoke seal systems: in accordance with CAN-ULC-S115.
 - .1 Fire stop system rating: 1 hour.
- .2 Service penetration assemblies: systems tested to CAN-ULC-S115.
- .3 Service penetration fire stop components: certified by test laboratory to CAN-ULC-S115.
- .4 Fire-resistance rating of installed fire stopping assembly in accordance with NBC.
- .5 Fire stopping and smoke seals at openings intended for ease of re-entry such as cables: elastomeric seal.
- .6 Fire stopping and smoke seals at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control: elastomeric seal.
- .7 Primers: to manufacturer's recommendation for specific material, substrate, and end use.
- .8 Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.
- .9 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.
- .10 Sealants for vertical joints: non-sagging.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify existing conditions before starting work.
- .2 Verify openings are ready to receive the work of this section.

3.2 PREPARATION

- .1 Verification of Conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.
 - .1 Verify penetrations are properly sized and in suitable condition for application of materials.

- .2 Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, rust, laitance, release agents, water repellents, and any other substances that may affect proper adhesion.
- .3 Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.
- .4 Comply with manufacturer's recommendations for temperature and humidity conditions before, during and after installation of firestopping.
- .5 Do not proceed until unsatisfactory conditions have been corrected.

3.3 COORDINATION

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

3.4 INSTALLATION

- .1 Install firestop materials in accordance with Directory affiliated with listed firestop system.
- .2 Comply with manufacturer's instructions for installation of through-penetration and construction joint materials.
- .3 Consult with Mechanical Consultant, Contractor, and damper manufacturer prior to installation of any firestop solutions that might hamper the performance of fire dampers as it pertains to ductwork.
- .4 Protect materials from damage on surfaces subjected to traffic.

3.5 FIELD QUALITY CONTROL

- .1 Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas.
- .2 Keep areas of work accessible until inspection by applicable code authorities.
- .3 Perform under this section patching and repairing of firestopping caused by cutting or penetrating of existing firestop systems already installed by other trades.
- .4 Install a warning card that is clearly visible adjacent to all large and medium openings that may be re-penetrated. This card should contain the following information:
 - .1 Warning that the opening has being fire stop protected
 - .2 Indicate the fire stop system used
 - .3 F rating or FT rating
 - .4 Fire stop product(s) used
 - .5 Person to contact and phone number in case of modification or new penetration of fire stop system.
- .5 Manufacturer's Field Service: During initial installation, firestop manufacture shall be present to assure proper installation of products.

3.6 CLEANING

- .1 Section 01 74 11: Cleaning installed work.
- .2 Remove equipment, materials and debris, leaving area in undamaged, clean condition.
- .3 Clean all surfaces adjacent to sealed holes and joints to be free of excess firestop materials and soiling as work progresses.

3.7 PROTECTION OF FINISHED WORK

- .1 Protect adjacent surfaces from damage by material installation.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Preparing substrate surfaces.
- .2 Sealant and joint backing.

1.2 RELATED SECTIONS

- .1 Section 04 26 19 - Reinforced Unit Masonry
- .2 Section 07 52 00 - Modified Bitumen Membrane Roofing (Patch Work)
- .3 Section 07 62 00 - Sheet Metal Flashing and Trim
- .4 Section 08 11 13 - Standard Metal Doors and Frames
- .5 Section 08 41 13 - Aluminum Framed Storefronts
- .6 Section 08 51 00 – Aluminum Windows
- .7 Section 08 80 50 - Glass and Glazing
- .8 Section 09 21 16 - Gypsum Board Assemblies

1.3 REFERENCES

- .1 The versions of the standards referenced in this section are those listed in the BC Building Code, current edition at the time of the application for Building Permit; or if they are not referenced in the specified code, they are the latest version of the standard in effect at the time of the application for Building Permit.
- .2 ASTM C834-17 - Latex Sealants.
- .3 ASTM C919-22 - Use of Sealants in Acoustical Applications.
- .4 ASTM C920-18 - Elastomeric Joint Sealants.
- .5 ASTM C1184-18e1 - Structural Silicone Sealants.
- .6 ASTM C1193-16 - Guide for Use of Joint Sealants.
- .7 ASTM C1311-22 - Solvent Release Sealants.
- .8 ASTM C1330-18 - Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants.
- .9 ASTM C1401-14 - Standard Guide for Structural Sealant Glazing.
- .10 ASTM C1481-12 - Standard Guide for Use of Joint Sealants with Exterior Insulation and Finish Systems (EIFS).
- .11 ASTM E330/E330M-14(2021) - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.

1.4 PERFORMANCE REQUIREMENTS

- .1 Sealant Design: Design structural sealant to withstand specified loads without breakage, loss, failure of seals, product deterioration, and other defects.
- .2 Design installed sealant to withstand:

- .1 Dead loads and live loads caused by positive and negative wind loads acting normal to plane of wall as calculated in accordance with BC Building Code. as measured in accordance with ASTM E330.
- .2 Movement from ambient temperature range of 49 degrees C.
- .3 Movement and deflection of structural support framing.
- .4 Water and air penetration.
- .5 Minimum 25% joint movement.

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Section 01 30 00 - Coordination:
 - .1 Coordinate with other work having a direct bearing on work of this section.
 - .2 Coordinate the work with all sections referencing this section.

1.6 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Provide data indicating sealant chemical characteristics, performance criteria, substrate preparation, limitations and colour availability.
- .3 Samples: Submit two samples illustrating sealant colours for selection.

1.7 QUALITY ASSURANCE

- .1 Perform sealant application work in accordance with ASTM C1193 and ASTM C1481.
- .2 Perform structural sealant application work in accordance with ASTM C1401.
- .3 Perform acoustical sealant application work in accordance with ASTM C919.
- .4 Applicator Qualifications: Company specializing in performing the work of this section with minimum 3 years experience.

1.8 MOCK-UP

- .1 Section 01 43 00: Requirements for mock-up.
- .2 Provide mock-up to include sealant joints in conjunction with window, storefront and door frames including frame to flooring materials.
- .3 Construct mock-up with specified sealant types and with other components noted.
- .4 Locate where directed.
- .5 Approved mock-up may remain as part of the Work.

1.9 ENVIRONMENTAL REQUIREMENTS

- .1 Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

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 off-gas to exterior, are contained behind air barriers, or are applied several months before occupancy to maximize off-gas time.
- .3 Where sealants are qualified with primers use only these primers.
- .4 Accessories:
 - .1 Primer: Non-staining type, recommended by sealant manufacturer to suit application.
 - .2 Joint Backing: Polyethylene, Urethane, Neoprene or Vinyl Foam.
 - .1 Extruded closed cell foam backer rod.
 - .2 Size: oversize 30 to 50 %.
 - .3 Tensile strength: 20 to 30psi.
 - .4 Acceptable material: Tremco Sof-Rod or approved equal to ASTM D1056; round, closed cell, polyethylene foam rod; oversized 30 to 50 percent larger than joint width.
 - .3 Bond Breaker: Pressure sensitive tape which will not bond to sealant recommended by sealant manufacturer to suit application.

2.2 SEALANT MATERIAL DESIGNATIONS

- .1 Butyl Sealant (Type A): ASTM C1311, single component, solvent release, non-skinning, non-sagging, black colour.
- .2 Acoustic Sealant (Type B): ASTM C920, Acoustic grade, single component, non-skinning, non-hardening; Grey colour.
- .3 Polyurethane Sealant (Type C): ASTM C920, Grade NS, single component, chemical curing, non-staining, non-bleeding, non-sagging self-leveling type; colour as selected.
- .4 Polyurethane Sealant (Type D): ASTM C920, multi-component, non-sagging type; colour as selected.
- .5 Silicone Sealant (Type E): ASTM C920, single component, mildew resistant, water impervious; colour white. Equal to Dowsil 795
- .6 Security Sealants (Type F): – Interior and Exterior applications:
 - .1 One component, non-sag, moisture cured polyurethane adhesive/sealant, specially designed for use in interior and exterior security areas.
 - .2 Acceptable Product: MasterSeal CR 195, or approved equivalent.
- .7 Structural silicone glazing sealant (Type S) ASTM C920 Grade NS Class 50, use NT, G and A.
- .8 Saw-cut sealant: Multi-component, self-levelling, conforming to ASTM D2240.
- .9 Paintable Sealants: acrylic emulsion, interior.

2.3 JOINT CLEANER

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

2.4 ACCESSORIES

- .1 Primer: Non-staining type, recommended by sealant manufacturer to suit application.

- .2 Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
- .3 Joint Backing: ASTM C1330; round, closed cell polyethylene foam rod; oversized 30 to 50 percent larger than joint width.
- .4 Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.
- .5 Masking tape: Non-staining, non-absorbent type compatible with sealant and adjacent surfaces.

2.5 SELECTION OF SEALANT TYPES

- .1 Where no specified type of sealant is shown or specified choose one of the sealants specified in this Section.
- .2 Make sealant selections consistent with manufacturer's recommendations.
- .3 Use acrylic sealant Type only on the interior and only in situations where little or no movement can occur.
- .4 Use mould & mildew resistant silicone sealant for non-moving joints in washrooms and kitchens. Do not use on floors.
- .5 Use silicone general construction sealant Type E or polyurethane sealant Type C and D for all joints, interior and exterior, where no other specific sealant type specified. Do not use on horizontal traffic joints or where immersed in water.
- .6 Use structural glazing silicone Type S for sealing structural glass, interior and exterior.
- .7 Use acoustical sealant Type B and air seal sealant Type A only where they will be fully concealed and only where no constant or consistent air pressure difference will exist across the joint.
- .8 Use multi-component sealant for exterior vertical joints where large movement is anticipated. Not for continuous water immersion.
- .9 Use two component polysulphide fuel resistant sealant Type C in pavement around diesel generators, and wherever fuel oils may be present.
- .10 Use multi-component sealant type for saw-cuts in slabs on grade interior and exterior.
- .11 Use multi-component sealant primed penetration element surfaces other than concrete, for mechanical and electrical service penetrations in concrete foundation walls and cored holes in tunnel. Ensure compatible material at tunnel penetrations.
- .12 Use two-component flexible epoxy sealant for joint sealant where floor finished concrete with hardener" and Ashford Sealer" are specified in Room Finish Schedule.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify existing conditions before starting work.
- .2 Verify that substrate surfaces are clean, dry, and free of frost and ready to receive work.
- .3 Verify that joint backing and release tapes are compatible with sealant and EIFS materials.

3.2 PREPARATION

- .1 Remove loose materials and foreign matter which might impair adhesion of sealant.
- .2 Clean and prime joints in accordance with sealant manufacturer's written instructions.
- .3 Perform preparation in accordance with ASTM C1193 for solvent release and latex base sealants, ASTM C1481 for EIFS systems.
- .4 Protect elements surrounding the work of this section from damage or disfiguration.

3.3 INSTALLATION

- .1 Perform installation in accordance with ASTM C1193 for solvent release and latex base sealants, ASTM C919 for acoustical sealants.
- .2 Measure joint dimensions and size materials to achieve required 2:1 width/depth ratios.
- .3 Install joint backing to achieve a neck dimension no greater than 1/3 of the joint width.
- .4 Install bond breaker where joint backing is not used.
- .5 Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- .6 Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- .7 Tool joints concave.

3.4 CLEANING

- .1 Section 01 74 11: Cleaning installed work.
- .2 Clean adjacent soiled surfaces.

3.5 PROTECTION OF FINISHED WORK

- .1 Remove masking tape and excess sealant.
- .2 Protect sealants until cured.

3.6 SCHEDULE

- .1 This is not a complete list of locations, refer to details on drawings and other related specification sections noted under Article 1.2 above.

Seals to the building envelope systems and around openings in the building envelope systems as required to prevent water ingress;
Seals around and over cavities in or behind surface elements to allow effective infection prevention and control;
Sealant around door frames will include joints at bottom of door frames (between floor finish and frames);
Sealed joints between dissimilar or similar materials to allow a smooth or even transitions;
Sealed expansion or controls joints in the building envelope systems or structural systems to allow movement.
For the exterior, use sealants to completely and continuously fill joints between dissimilar and/or similar materials.
For the interior, use sealants (at frames such as those at doors and windows to completely fill joints between dissimilar materials using one component, acrylic emulsion, paintable type.
Seal all door frames to floor;

Use silicone caulking that is mildew-resistant and impervious to water for caulking washroom plumbing fixtures.

Use sealants with self-levelling properties for expansion and control joints in concrete floors using two-component epoxy urethane sealants.
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Use non-sag sealants for exterior vertical expansion and control joints in masonry or wall cladding.
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Use sealants that allow for minimum 25% movement in joint width.
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END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Non-rated and fire rated steel frames and doors.
- .2 Insulated steel doors. (into Arena from Hall)
- .3 Interior steel doors.
- .4 Interior glazed light frames.
- .5 Glass and glazing.

1.2 RELATED SECTIONS

- .1 Section 08 71 00 - Door Hardware.
- .2 Section 08 80 50 - Glass and Glazing.
- .3 Section 08 88 13 - Fire-Resistive Glazing
- .4 Section 09 91 00 – Painting.

1.3 REFERENCES

- .1 The versions of the standards referenced in this section are those listed in the BC Building Code, current edition at the time of the application for Building Permit; or if they are not referenced in the specified code, they are the latest version of the standard in effect at the time of the application for Building Permit.
- .2 ASTM A653/A653M - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .3 AAMA/WDMA/CSA 101/I.S.2/A440, North American Fenestration Standard/Specification for Windows, Doors, and Unit Skylights.
- .4 AAMA/WDMA/CSA/101/I.S.2/A440S1, Canadian Supplement to Standard/Specification for Windows, Doors, and Unit Skylights.
- .5 ASTM A653/A653M - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .6 ASTM C578 - Rigid, Cellular Polystyrene Thermal Insulation.
- .7 ASTM C665 - Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
- .8 ASTM C1289 - Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
- .9 ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- .10 ASTM E413 - Classification for Rating Sound Insulation
- .11 CAN4-S104 - Fire Tests of Door Assemblies.
- .12 CAN4-S105 - Fire Door Frames Meeting the Performance Required by CAN4-S104.
- .13 CAN/ULC-S701 - Thermal Insulation, Polystyrene, Boards and Pipe Covering.
- .14 CAN/ULC-S702 - Thermal Insulation, Mineral Fibre, for Buildings.
- .15 CAN/ULC-S704 - Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.
- .16 CGSB 41-GP-19Ma - Rigid Vinyl Extrusions for Windows and Doors.

- .17 CSA G40.20-04/G40.21 - General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .18 CSA W59 - Welded Steel Construction (Metal Arc Welding).
- .19 Canadian Steel Door Manufacturers Association (CSDMA), Recommended Dimensional Standards for Commercial Steel Doors and Frames,
- .20 Canadian Steel Door Manufacturers Association (CSDMA), Selection and Usage Guide for Steel Doors and Frames,
- .21 DHI - Door Hardware Institute: The Installation of Commercial Steel Doors and Steel Frames, Insulated Steel Doors in Wood Frames and Builder's Hardware.
- .22 NFPA 80- Standard for Fire Doors and Fire Windows.
- .23 NFPA 252 - Standard Methods of Fire Tests of Door Assemblies.

1.4 SUBMITTALS FOR REVIEW

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

1.5 QUALITY ASSURANCE

- .1 Materials and manufacture of metal doors will comply with the requirements of the Canadian Steel Door and Frame Manufacturer's Association (CSDFMA)
- .2 Exterior doors to conform to AAMA/WDMA/CSA 101/I.S.2/A440-08 - NAFS - North American Fenestration Standard / Specification for Windows, Doors, and Skylights and AAMA/WDMA/CSA/101/I.S.2/A440S1, Canadian Supplement to Standard/ Specification for Windows, Doors, and Unit Skylights.

1.6 REGULATORY REQUIREMENTS

- .1 Fire Rated Door and Frame Construction: Labelled and listed to CAN/ULC S104M, Fire Tests of Door Assemblies.
- .2 Fire Rated Door Construction: Rate of rise of 250 C degrees across door thickness.
- .3 Installed Door and Frame Assembly: Conform to NFPA 80 for fire rated class as scheduled.

1.7 DELIVERY, STORAGE, AND PROTECTION

- .1 Section 01 61 00: Deliver, store, protect and handle products to site.
- .2 Remove doors and frames from wrappings or coverings upon receipt on site and inspect for damage.
- .3 Store in vertical position, spaced with blocking to permit air circulation between components.
- .4 Store materials on planks or dunnage, out of water and covered to protect from damage.

- .5 Clean and touch up scratches or disfigurement caused by shipping or handling with zinc-rich primer.

1.8 COORDINATION

- .1 Coordinate the work with frame opening construction, door, and hardware installation.
- .2 Sequence installation to ensure wire connections are achieved in an orderly and expeditious manner.

Part 2 Products

2.1 MATERIALS

- .1 Sheet Steel - Standard Doors: Hot dipped galvanized steel to ASTM A653/A653M, commercial grade (CS), Type B, minimum base steel thickness in accordance with CSDMA.
 - .1 Interior Doors and Frames: Coating designation ZF75 (A25).
 - .2 Exterior Doors: Coating designation ZF180 (A60).
- .2 Minimum base steel thickness (gauge) in accordance with CSDFMA Table 1, except as follows:
 - .1 Door face sheets: 1.2 mm (18 gauge). Over 914mm wide: 1.6mm (16 gauge)
 - .2 Frames: 1.6 mm (16 gauge).
 - .3 Astragals: 1.9 mm (14 gauge).
 - .4 Floor anchors: 1.6 mm (16 gauge).
 - .5 Jamb anchors:
 - .1 "T" strap type: 1.6 mm (16 gauge).
 - .2 "L" type: 1.2 mm (18 gauge).
 - .3 Stirrup-strap type: 15 x 250 x 1.6 mm (5/8" x 10" x 16 gauge).
 - .4 Stud type: 1.2 mm (18 gauge).
 - .5 Wire type: 4.0 mm (9 gauge).
 - .6 Reinforcing steel:
 - .1 Locks, strikes: 1.6 mm (16 gauge).
 - .2 Butts, hinges: 3.4 mm (10 gauge).
 - .3 Surface mounted hardware: 2.7 mm (12 gauge).
 - .7 Flush bolts: 3.4 mm (10 gauge).
 - .8 Glazing stops: 0.9 mm (20 gauge). ULC approved for fire rated doors and frames.
 - .9 Channel reinforcement for glazed and louvre openings: 0.9 mm (20 gauge).
 - .10 Mortar guard boxes: 0.8 mm (22 gauge).
 - .11 Jamb spreaders: 1.2 mm (18 gauge).
- .3 Reinforcement channel: to CSA G40.20/G40.21, Type 44W, coating designation same as specified for door materials.

2.2 DOOR AND PANEL CORE MATERIALS

- .1 Honeycomb Core: Structural small cell 25.4 mm (1") maximum kraft paper honeycomb, 36.3 kg (80 lbs.) per ream minimum, density: 16.5 kg/m³ (1.03 lbs/ft³) sanded to required thickness.
- .2 Fibreglass Core: Loose batt type, density; 24 kg/m³ minimum, conforming to CAN/ULC-S702.
- .3 Temperature Rise Rated (TRR) Core: Composition to provide fire-protection rating and limit temperature rise on unexposed side of door to 250 deg C at 30 or 60 minutes, as determined by BC Building Code requirements, core tested as part of a complete door

and frame assembly, in accordance with CAN4-S104, and listed by a nationally recognized testing agency having a factory inspection service.

- .4 Prepared surfaces to receive finishes that resist corrosion from exposure to weather. Provide with ZF180 coating.

2.3 ADHESIVES

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

2.4 PRIMERS

- .1 Rust inhibitive touch-up only.

2.5 ACCESSORIES

- .1 Primer: to CAN/CGSB-1.181. Door Silencers: Single stud rubber/neoprene.
- .2 Exterior Top Caps: Rigid polyvinylchloride extrusion conforming to CGSB 41-GP-19M.
- .3 Frame Thermal Breaks: Rigid polyvinylchloride extrusion conforming to CGSB 41-GP-19M.
- .4 Removable Glazing Stops: Formed galvanized steel channel, minimum 16 mm high, accurately fitted, butted at corners and fastened to frame sections with counter-sunk tamper proof sheet metal screws.
- .5 Make provisions for glazing as indicated and provide necessary glazing stops.
 - .1 Provide removable stainless steel glazing beads for use with glazing tapes and compounds and secured with countersunk stainless steel screws.
 - .2 Design exterior glazing stops to be tamperproof.
- .6 Fire labels: metal riveted or embossed labels.
- .7 Isolation Coating: Alkali resistant bituminous paint.
- .8 Metallic paste filler: to manufacturer's standard.
- .9 Weather-stripping: Specified in Section 08 71 00.
- .10 Glass: In accordance with Section 08 80 50.

2.6 SYSTEM DESCRIPTION

- .1 Design Requirements:
 - .1 Design exterior frame assembly to accommodate to expansion and contraction when subjected to minimum and maximum surface temperature of -35°C to 35°C.
 - .2 Maximum deflection for exterior steel entrance screens under wind load of 1.2 kPa (25 lbs/ft²) not to exceed 1/175th of span.
- .2 Regulatory Requirements:
 - .1 Steel fire rated doors and frames: labeled and listed by an organization accredited by Standards Council of Canada in conformance with CAN4-S104, for ratings indicated.
 - .2 Provide fire labeled frames for openings requiring fire protection ratings. Test products in conformance with CAN4-S104 and listed by nationally recognized agency having factory inspection services.

- .3 Provide fire labeled doors and frames for those openings requiring fire protection ratings. Test products in conformance with CAN4-S104 and listed by nationally recognized agency having factory inspection service and construct as detailed in Follow-Up Service Procedures/Factory Inspection Manuals issued by listing agency to individual manufacturers.

2.7 FABRICATION - FRAMES

- .1 Exterior Frames:
 - .1 Door Frames: Welded type construction, thermally broken if not fire rated. Knock down frames are not permitted.
- .2 Interior Frames:
 - .1 Door Frames and Window Assemblies: Welded type construction. Knock down frames are **not** permitted.
 - .2 Transom Frames: Welded type construction.
 - .3 Sidelight Assemblies: Welded type construction.
- .3 Mullions for Double Doors: Fixed type, of same profiles as jambs.
- .4 Transom Bars for Glazed Lights: Fixed type, of same profiles as jamb and head.
- .5 Mortised, blanked, reinforced, drilled and tapped for templated hardware, in accordance with templates provided by hardware supplier.
- .6 Protect mortised cut-outs with steel guard boxes for frames installed in masonry and concrete walls.
- .7 Reinforce head of frames wider than 1219 mm.
- .8 Prepare frames for silencers. Provide three single silencers for single doors on strike side. Provide single silencers on frame head at double doors without mullions.
- .9 Configure exterior frames with special profile to receive recessed weather-stripping.
- .10 Provide weather caps to all exterior doors.
- .11 Attach fire rated label to each fire rated door unit.
- .12 Fabricate frames with integral junction boxes for electrically wired hinge, door position switch, and future consideration of electric strike for selected doors as scheduled.
- .13 Manufacturer's nameplates on frames and screens are not permitted.
- .14 Conceal fastenings except where exposed fastenings are indicated.
- .15 Insulate exterior frame components with fibreglass batt insulation.

2.8 FRAME ANCHORAGE

- .1 Provide appropriate anchorage to floor and wall construction.
- .2 Locate each wall anchor immediately above or below each hinge reinforcement on hinge jamb and directly opposite on strike jamb.
- .3 Provide 2 anchors for rebate opening heights up to 1520 mm and one additional anchor for each additional 760 mm of height or fraction thereof.
- .4 Locate anchors for frames in existing openings not more than 150 mm from top and bottom of each jambs and intermediate at 660 mm on centre maximum.
- .5 Add one anchor at head of frames 1830mm or wider.

- .6 Where frames are installed in prepared openings, countersink frame at screw anchor location.

2.9 FRAMES: WELDED TYPE

- .1 Welding in accordance with CSA W59.
- .2 Corner joints to have contact edges closed tight with faces mitred and stops either mitred or butted. Faces and soffits shall be continuously welded and the faces finished smooth. The use of gussets or splice plates as a substitute for welding will not be accepted.
- .3 Cope accurately and securely weld butt joints of mullions, transom bars, centre rails and sills.
- .4 Securely attach floor anchors to inside of each jamb profile.
- .5 Fabrication frame assemblies in largest sections possible. Where field splices are required provide welded joints, ground smooth. Make field splices and joints inconspicuous after assembly. Exposed fasteners not permitted.
- .6 Weld in 2 temporary jamb spreaders per frame to maintain proper alignment during shipment.

2.10 DOOR FABRICATION GENERAL

- .1 Interior Doors: Laminated core construction.
- .2 Provide interior metal doors with flush face and no trims construction.
- .3 Longitudinal Edges:
 - .1 Interior Doors: Continuously welded, filled and sanded with no visible edge seams.
- .4 Mortised, blanked, reinforced, drilled and tapped for templated hardware and electronic hardware, in accordance with templates provided by hardware supplier and to Door and Hardware Institute (DHI) A115 Series requirements
- .5 Reinforce for surface mounted hardware, anchor hinges, thrust pivots, pivot reinforced hinges, or non-templated hardware.
- .6 Make provision for glazing and door louvers where indicated and provide stops.
- .7 Provide astragals for pairs of doors in accordance with ULC requirements but only where specified in Door Schedule and Section 08 71 00 - Door Hardware.
- .8 Where pairs of doors are fitted with top and bottom rod exit devices, doors are to be ULC approved without the use of an astragal.
- .9 Top and Bottom Channels: Inverted, recessed, welded steel channels.
- .10 Provide factory-applied touch-up primer at areas where zinc coating has been removed during fabrication.
- .11 Temperature Rise Rated (TRR): As required, core composition to provide the fire-protection rating and limit the temperature rise on the unexposed side of door to 250°C at 30 or 60 minutes, as determined by governing building code requirements. Core to be tested as part of a complete door assembly, in accordance with CAN4-S104, covering the Standard Method of Tests of Door Assemblies and shall be listed by a nationally recognized testing agency having a factory inspection service.
- .12 Manufacturer's nameplates on doors permitted on hinge side of door concealed from view.

2.11 DOORS: HONEYCOMB CORE CONSTRUCTION

- .1 Form each face sheet for exterior doors from sheet steel of base metal thickness specified above, with polystyrene core laminated under pressure to face sheets.
- .2 Form each face sheet for interior doors from sheet steel of base metal thickness specified above, with honeycomb core, temperature rise rated core where scheduled, laminated under pressure to face sheets.

2.12 DOORS: HOLLOW STEEL CONSTRUCTION

- .1 Form each face sheet for interior and exterior doors from sheet steel of base metal thickness specified above.
- .2 Reinforce doors with vertical stiffeners, securely welded to each face sheet at 150 mm (6") on centre maximum.
- .3 Fill voids between stiffeners of exterior doors with polyurethane core.

2.13 SHOP PRIMING

- .1 Provide touch-up primer at areas where zinc coating has been removed during fabrication or installation.
- .2 For doors and frames fabricated of steel sheet with Z275 (G90) designation galvanized coating apply in factory one coat of zinc-rich primer CAN/CGSB-1.181 to all exposed surfaces. Properly pre-treat and prepare surfaces before application of primer to ensure good primer adhesion.

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 Section 01 70 00: Verify existing conditions before starting work.
- .2 Verify that opening sizes and tolerances are acceptable; check floor area within path of door swing for flatness.
- .3 Verify doors and frames are correct size, swing, rating and opening number.
- .4 Remove temporary shipping spreaders.

3.3 INSTALLATION

- .1 Install doors and frames to CSDMA.
- .2 Install fire-rated doors and frames in accordance with NFPA 80, and local authority having jurisdiction.
- .3 Coordinate with wall construction for anchor placement.
- .4 Coordinate installation of glass and glazing.
- .5 Coordinate installation of doors and frames with installation of hardware specified in Section 08 71 00.
- .6 Frames:

- .1 Set frames plumb, square, level and at correct elevation.
 - .2 Secure anchorages and connections to adjacent construction.
 - .3 Brace frames rigidly in position while building-in. Install temporary horizontal wood spreader at third points of door opening to maintain frame width. Provide vertical support at centre of head for openings over 1200 mm wide. Remove temporary spreaders after frames are built-in.
 - .4 Make allowances for deflection of structure to ensure structural loads are not transmitted to frames.
 - .5 Maintain continuity of air barrier and vapour retarder at exterior openings.
 - .6 Install roll formed steel reinforcement channels between two abutting frames. Anchor to structure and floor.
 - .7 Coordinate installation with Electrical Subcontractor for installation of junction boxes and conduit for electric hardware, wiring, and controls for electronic hardware.
 - .8 Insulate frame cavities when in a wall containing acoustic batt insulation or at exterior wall conditions.
- .7 Doors:
- .1 Install doors and hardware in accordance with hardware templates and manufacturer's instructions and Section 08 71 00 - Door Hardware.
 - .2 Provide even margins between doors and jambs and doors and finished floor and thresholds as follows.
 - .1 Hinge side: 1.0 mm.
 - .2 Latch side and head: 1.5 mm.
 - .3 Finished flooring and thresholds: 13 mm, except where doors are fitted with exit rod devices margin shall be 6 mm.
 - .3 Install louvers, glazing and door silencers.
 - .4 Finish paint in accordance with Section 09 91 00.
 - .5 Adjust operable parts for correct function.

3.4 CAULKING AND SEALING

- .1 At exterior openings, fill head and jamb frame sections with foam sealant. Fill shim space around perimeter of frames with foam sealant.
- .2 For both interior and exterior frames seal joint between frames and adjacent construction with sealant (caulking). Apply sealant around full perimeter of frames, on both sides of opening.
- .3 For frames at exterior openings provide foam backer rod or bond breaker tape behind sealant.
- .4 Install continuous bead of sealant where door frames abut floors.
- .5 Apply sealants in accordance with Section 07 92 00 - Joint Sealing. Provide smooth, neat bead, tooled to slight concave profile.

3.5 FINISH REPAIRS

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

3.6 ERECTION TOLERANCES

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

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Fire resistive rated and non-rated access door and frame units.
- .2 Wall, ceiling, and floor locations.
- .3 Access panels for mechanical and electrical service locations are to be confirmed on site and are not indicated on architectural drawings. Refer to mechanical and electrical for additional information.

1.2 RELATED SECTIONS

- .1 Section 09 21 16 - Gypsum Board Assemblies: Openings in partitions and ceilings.
- .2 Section 09 91 00 - Painting: Field paint finish.
- .3 Section 23 33 00 - Duct Work Accessories: Access doors in ductwork.
- .4 Electrical Specifications: Electrical components requiring access.

1.3 REFERENCES

- .1 UL - Fire Resistance Directory.
- .2 ULC - Fire Resistance Directory.

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Coordinate with other work having a direct bearing on work of this section.
 - .1 Coordinate the work with other work requiring access doors.

1.5 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.
- .3 Shop Drawings: Indicate exact position of all access door units.

1.6 QUALITY ASSURANCE

- .1 Perform Work in accordance with ULC requirements for rated assemblies indicated for rated access doors.

1.7 REGULATORY REQUIREMENTS

- .1 Conform to applicable code for fire rated access doors.
- .2 Provide certificate of compliance from authority having jurisdiction indicating approval of fire rated doors.

1.8 WARRANTY

- .1 Warranty Period for all supplied materials, equipment and installation is two (2) years from the date of Service Commencement.
- .2 Warranty to include replacing and refinishing due to defects or faulty workmanship.

Part 2 Products

2.1 MANUFACTURERS

- .1 Non-Fire Rated Door and Frame Unit: Formed steel:
- .2 Fire Rated Door and Frame Unit: Formed steel, finish; fire rating to suit rating of wall assembly:
 - .1 Basis of Design - Acudor Products, Inc. FB-5060, lockable.
 - .2 Milcor
 - .3 Maxam Metal Products Limited.
 - .4 Other manufacturers offering products meeting or exceeding specified products and requirements may be considered.

2.2 FABRICATION - WALL AND CEILING UNITS

- .1 Plaster wall construction: 1.9 mm (14 Ga.) bonderized steel, flush with wall or ceiling, with concealed flange.
- .2 Tile, ceramic tile, or gypsum construction in washrooms and other special areas: 1.9 mm (14 Ga.) stainless steel flush with wall or ceiling with concealed flange.
- .3 Access panels installed in drywall shall be steel access panels with the same finish as the drywall walls and ceilings.
- .4 Fabricate door panels of 1.9 mm (14 Ga.) single thickness sheet.
- .5 Weld, fill, and grind joints to ensure flush and square unit.
- .6 Hardware:
 - .1 Hinge: 175 degree stainless steel piano hinge with removable pin.
 - .2 Lock: Keyed locks, operated by flush key device. All locks shall be keyed alike. Keyed locks must be strong enough stop attempted breaches

2.3 FINISHES

- .1 Base Metal Protection: Galvanized, hot dipped finish.
- .2 Stainless Steel as noted above and as indicated on drawings at lavatory locations and washrooms.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify existing conditions before starting work.
- .2 Verify that rough openings for door and frame are correctly sized and located.

3.2 INSTALLATION

- .1 Install units to manufacturer instructions.
- .2 Install frames plumb and level in opening. Secure rigidly in place.
- .3 Position unit to provide convenient access to concealed work requiring access.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Furnishing of all labour, materials, services and equipment necessary for the supply and complete installation of accordion folding grilles where indicated.

1.2 RELATED SECTIONS

- .1 Section 05 50 00 - Metal Fabrications: Support framing.
- .2 Section 06 20 00 - Finish Carpentry: Counter and cabinetry installation.
- .3 Section 08 71 00 - Door Hardware: Cylinder core and keys.
- .4 Section 09 21 16 - Gypsum Board Assemblies: Framed opening, suspended ceilings.
- .5 Section 09 91 10 - Painting: Field painting of walls and ceilings.

1.3 REFERENCES

- .1 ASTM A480/A480M - General Requirements for Flat-Rolled Stainless and Heat Resisting Steel Plate, Sheet, and Strip.
- .2 ASTM A653/A653M - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .3 ASTM B221/B221M - Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- .4 UL 325 - Door, Drapery, Gate, Louvre, and Window Operators and Systems.

1.4 SYSTEM DESCRIPTION

- .1 Side-folding aluminum grilles.

1.5 SUBMITTALS

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Provide general construction, component connections and details, and accessories.
- .3 Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details. Include the following paragraph for submission of physical samples for selection of finish, colour, texture, etc.
- .4 Submittals for Closeout: Maintenance Data; indicate lubrication requirements and frequency, periodic and adjustments required.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver materials to project site in original, factory-sealed, unopened packaging bearing manufacturer's name, seals and labels intact and legible with following information.
 - .1 Name of material.
 - .2 Manufacturer's stock number and date of manufacture.
 - .3 Material safety data sheet.

- .2 Arrange delivery and storage on the site with Contractor and schedule deliveries accordingly. Deliver material as required for installation keeping site storage to a minimum.
- .3 Provide all equipment necessary for off-loading of materials to complete the work.
- .4 Protect materials from damage, weather and store in a dry place.
- .5 Handle materials and equipment in strict accordance with manufacturer's recommendations and WHMIS regulations and Data Safety sheets.
- .6 Damaged or deteriorated materials shall be removed from site for recycling.

1.7 WARRANTY

- .1 Refer to Section 01 11 00: Warranty. Warranty Period for all supplied materials, equipment and installation is two (2) years from the date of Service Commencement.
- .2 Warranty to include replacing components due to defects or faulty workmanship.

Part 2 Products

2.1 MANUFACTURERS

- .1 Acceptable Materials/Products: The intent is to match the same model and profile as the existing one located in the Service Room. (shown below)



- .2 Alternate Manufacturers/Products:
 - .1 Amstel, AS200 Lexan Vista.
 - .2 MobilFlex Inc., Model; S-126.
 - .3 Dynamic Closures Corporation, Model; System S-126.
 - .4 The Cookson Company, Inc., Model; Classic S-126.
- .3 Other manufacturers offering products meeting or exceeding specified products and requirements may be considered.

2.2 MATERIALS

- .1 Curtain:
 - .1 51 mm high truss-like plates at top and bottom of closure. Construct of 8 mm diameter vertical rods on 89 mm centers linked by flat horizontal bars 3 mm by

16 mm by 197 mm. Bars are vertically spaced every 305 mm with 11 mm diameter sleeves over alternating rods.

.2 **Materials:**

- .1 Aluminum is to be 6063 aluminum alloy with T-5 temper.
- .2 Locking: Coordinate cylinders with Section 08 71 00, cylinder locks to be operable from both sides for leading post
- .3 Members are to be vertical stiles fabricated from rectangular tubing 33 mm x 62 mm. Members using counter bolts include dust free, stainless top floor sockets.
- .4 Lead and trailing end members to be cylinder controlled lock stiles with self-adjusting, cold rolled steel counter bolts and top bolts through the top of the track into the support. Provide cylinder keyed to building master system.
- .5 Provide intermediate locking members with cold rolled steel counter bolts every 750 mm of curtain.
- .6 Ends of curtain to be fixed to wall jambs.

.7 **Track:**

- .1 Overhead track to be 33 mm wide x 40 mm high and to accept roller trolleys. Rollers to bear on 7 mm thick aluminum surface within the track.
- .2 Top track to be surfaced mounted.

.8 **Finish:**

- .1 Standard factory finish: 10 micron clear anodizing.

.9 **Weight and Stacking:**

- .1 Grille weights 5.9 kg/sq.m.
- .2 Grille support must be able to carry the weight of a fully stacked door at any point along its length. Support is to carry the total weight / the total stacking.

2.3 OPERATION

- .1 Equip grille for operation by hand, install handles.

Part 3 Execution

3.1 PREPARATION AND EXAMINATION

- .1 Verify existing conditions before starting work.
- .2 Examine all conditions under which grilles are to be installed. Notify Contractor of unsatisfactory conditions.
- .3 Verify track layout and grille dimensions, especially the finished floor (or counter) to the underside of the support dimensions, by actual measurements.

3.2 INSTALLATION

- .1 Install in accordance with the manufacturer's shop drawings and instructions.

3.3 SCHEDULE

- .1 Manager Office 107N Size: **GRL-1** 1600mm wide x 1200mm high
- .2 Service Room 109N Size: **GRL-2** 3660mm wide x 1340mm high

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Exterior aluminum frames and doors.
- .2 Vision glass.
- .3 Perimeter sealant.
- .4 Installation of Aluminum Door Hardware. Hardware for aluminum entrance doors to be supplied under Section 08 71 00 and installed under this section.

1.2 RELATED SECTIONS

- .1 Section 07 92 00 - Joint Sealants.
- .2 Section 08 51 00 - Aluminum Windows
- .3 Section 08 71 00 - Door Hardware.
- .4 Section 08 80 50 - Glass and Glazing.

1.3 REFERENCES

- .1 The versions of the standards referenced in this section are those listed in the BC Building Code, current edition at the time of the application for Building Permit; or if they are not referenced in the specified code, they are the latest version of the standard in effect at the time of the application for Building Permit.
- .2 AAMA 611 - Voluntary Specifications for Anodized Finishes Architectural Aluminum.
- .3 ASTM B 211- Standard Specification for Aluminum and Aluminum-Alloy Bar, Rod, and Wire.
- .4 ASTM A 311/A 311M - Standard Specification for Cold-Drawn, Stress-Relieved Carbon Steel Bars Subject to Mechanical Property Requirements
- .5 ASTM E283 - Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
- .6 ASTM E330 - Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
- .7 ASTM B 783 Standard Specification for Materials for Ferrous Powder Metallurgy (P/M) Structural Parts.
- .8 BC Energy Efficiency Regulations for Windows, Glazing, Doors, Skylights, Curtain Walls.

1.4 SYSTEM DESCRIPTION

- .1 Aluminum entrances and storefront system includes tubular aluminum sections, shop fabricated, factory finished, glazing units, related anchorage and attachment devices.
- .2 System Assembly: Site assembled.

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Coordinate with other work having a direct bearing on work of this section.

- .1 Coordinate the Work with installation of components or materials affecting work of this Section.
- .2 Pre-Installation Meeting: Convene one (1) week before starting work of this section if requested by consultant.

1.6 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill.
- .3 Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work and expansion and contraction joint location and details.
- .4 Submit a report, issued by a certified materials testing laboratory, attesting that the entrance system has been tested and conforms with CAN/CSA-A440-M90 performance requirements specified herein.
- .5 Submit two samples of aluminum finish. One to consultant and one to field office.

1.7 CLOSEOUT SUBMITTALS

- .1 Warranty Documentation: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.8 QUALITY ASSURANCE

- .1 Perform Work in accordance with AAMA SFM-1
- .2 Conform to requirements of BC Building Code for accessibility.
- .3 Manufacturer and Installer: Company specializing in manufacturing aluminum glazing systems with minimum three years documented experience.

1.9 DELIVERY, STORAGE, AND PROTECTION

- .1 Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather.

1.10 WARRANTY

- .1 Products supplied shall be free from material defects, in material and workmanship, including oil-canning and delamination of brake shapes, for a period of two (2) years from the date of substantial completion of the project.

Part 2 Products

2.1 MANUFACTURERS

- .1 Acceptable Materials/Products:
 - .1 Kawneer:
 - .1 Exterior Frames: Trifab VersaGlaze 451T
 - .2 Doors: 350T Insulpour Medium Wide Stile Entrances for exterior applications.

- .2 Other manufacturers offering products meeting or exceeding specified products and requirements may be considered.

2.2 MATERIALS

- .1 Extruded Aluminum: ASTM B221.
- .2 Fasteners: Stainless steel.

2.3 COMPONENTS

- .1 Exterior Frames: 51 x 114 mm nominal dimension
- .2 Doors: 57 mm thick, 89 mm wide top rail, 89 mm wide vertical stiles, 254 mm wide bottom rail; 89 mm mid rail; square glazing stops.

2.4 GLASS AND GLAZING MATERIALS

- .1 Glass and Glazing Materials: As specified in Section 08 80 50

2.5 SEALANT MATERIALS

- .1 Sealant and Backing Materials:
 - .1 Perimeter Sealant: Type E or D as specified in Section 07 92 00.

2.6 HARDWARE

- .1 See Section 08 71 00.

2.7 FABRICATION

- .1 Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.
- .2 Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.
- .3 Prepare components to receive anchor devices. Fabricate anchors.
- .4 Arrange fasteners and attachments to conceal from view.
- .5 Reinforce interior horizontal head rail to receive drapery track brackets and attachments.
- .6 Prepare components with internal reinforcement for door hardware.
- .7 Reinforce framing members for imposed loads.

2.8 FINISHES

- .1 Finish Coatings: Conform to AAMA 611.
- .2 Interior and Exterior Exposed Aluminum Surfaces: AAMA-M12C22A41 anodized to clear colour.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify dimensions, tolerances, and method of attachment with other work.
- .2 Verify wall openings and adjoining air and vapour seal materials are ready to receive work of this Section.

3.2 INSTALLATION

- .1 Install system to manufacturer instructions.
- .2 Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- .3 Provide alignment attachments and shims to permanently fasten system to building structure.
- .4 Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- .5 Install hardware using templates provided. Refer to Section 08 71 00 for installation requirements.
- .6 Install glass in accordance with Section 08 80 50, to glazing method required to achieve performance criteria.
- .7 Install perimeter sealant Type, backing materials, and installation criteria in accordance with Section 07 92 00.

3.3 ERECTION TOLERANCES

- .1 Maximum Variation from Plumb: 1.5 mm/m non-cumulative.
- .2 Maximum Misalignment of Two Adjoining Members Abutting in Plane: 0.8 mm.

3.4 ADJUSTING

- .1 Adjust operating hardware for smooth operation.

3.5 CLEANING

- .1 Section 01 74 11: Cleaning installed work.
- .2 Remove protective material from pre-finished aluminum surfaces.
- .3 Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.
- .4 Remove excess sealant by method acceptable to sealant manufacturer.

3.6 PROTECTION OF FINISHED WORK

- .1 Protect finished Work from damage.

END OF SECTION

Part 1 General

1.1 SUMMARY OF WORK

- .1 Install new aluminum windows in existing masonry block walls. Coordinate size with existing mortar joints and new steel angle lintels.

1.2 REFERENCE STANDARDS

- .1 The versions of the standards referenced in this section are those listed in the BCBC, current edition at the time of the application for Building Permit; or if they are not referenced in the specified code, they are the latest version of the standard in effect at the time of the application for Building Permit.
- .2 Aluminum Association (AA)
 - .1 AA DAF 45-2003 (R2009), Designation System for Aluminum Finishes.
- .3 ASTM International (ASTM)
 - .1 ASTM B 211- Standard Specification for Aluminum and Aluminum-Alloy Bar, Rod, and Wire.
 - .2 ASTM A 311/A 311M - Standard Specification for Cold-Drawn, Stress-Relieved Carbon Steel Bars Subject to Mechanical Property Requirements
 - .3 ASTM E283 - Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
 - .4 ASTM E330 - Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
- .4 CSA Group (CSA)
 - .1 AAMA 611 - Voluntary Specifications for Anodized Finishes Architectural Aluminum.
 - .2 CSA A440S1-19 (R2022), Canadian Supplement to AAMA/WDMA/CSA 101/1.S.2/A440, NAFS - North American Fenestration Standard for Windows, Doors, and Skylights.
 - .3 CAN/CSA-A440.2:22 /A440.3:22, Fenestration energy performance/User guide to CSA A440.2, Fenestration energy performance.
 - .4 CAN/CSA-A440.4-19, Window, Door, and Skylight Installation
- .5 South Coast Air Quality Management District (SCAQMD)
 - .1 SCAQMD Rule 1113-A2016, Architectural Coatings.
 - .2 SCAQMD Rule 1168-A2005, Adhesives and Sealants.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Preinstallation Meetings:
 - .1 Convene preinstallation meeting 1 week prior to beginning work of this Section with DCC Representative in accordance with Section 01 31 19 - Project Meetings to:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Coordination with other construction subtrades.
 - .4 Review manufacturer's written installation instructions and warranty requirements.

- .2 Sequencing: sequence with other work in accordance with Section 07 42 13 - Insulated Metal Wall Panels. Comply with manufacturer's written recommendations for sequencing construction operations.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for windows and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of British Columbia, Canada.
 - .2 Indicate materials and details in full size scale for head, jamb and sill, profiles of components, interior and exterior trim, elevations of unit, anchorage details, location of isolation coating, description of related components and exposed finishes fasteners, and caulking. Indicate location of manufacturer's nameplates.
 - .3 Indicate locations, dimensions, openings, and requirements of related work.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for windows for incorporation into manual.
- .3 Warranty Documentation: submit warranty documents specified.

1.6 QUALITY ASSURANCE

- .1 Conform to requirements of CSDMA.
- .2 Certifications: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect windows from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse of pallets, and packaging materials as specified in accordance with Section 01 74 21 – Construction Waste Management and Disposal.

1.8 WARRANTY

- .1 Manufacturer's warranty: Submit, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty in addition to and not limit other rights Owner may have under Contract Documents.
- .2 Products supplied shall be free from material defects, in material and workmanship, including oil-canning and delamination of brake shapes, for a period of two (2) years from the date of substantial completion of the project.

Part 2 Products

2.1 MANUFACTURERS

- .1 Acceptable manufacturers:
 - .1 Kawneer
 - .2 Alumicor
 - .3 Norstar
- .2 Kawneer Series AA 6500 Thermal Windows.

2.2 MATERIALS

- .1 Materials: to AAMA/WDMA/CSA 101/I.S.2/A440 supplemented as follows:
- .2 Windows by same manufacturer.
- .3 Main frame: aluminum.
- .4 Glass: in accordance with Section 08 80 50 - Glazing
- .5 Interior and Exterior aluminum facings: brake formed aluminum sheet metal of type and size as detailed to suit job conditions; minimum 3 mm thick, complete with jamb drip deflectors, and anchoring devices.
- .6 Isolation coating: alkali resistant bituminous paint.
- .7 Sealant and Backing Materials:
 - .1 Perimeter Sealant: Type E or D as specified in Section 07 92 00.
 - .2 VOC limit 250 g/L maximum to SCAQMD Rule 1168.

2.3 WINDOW TYPE AND CLASSIFICATION

- .1 Product type:
 - .1 FW- Fixed window.
- .2 Classification rating: to AAMA/WDMA/CSA 101/I.S.2/A440.

2.4 FABRICATION

- .1 Fabricate in accordance with AAMA/WDMA/CSA 101/I.S.2/A440 supplemented as follows:
- .2 Fabricate units square and true with maximum tolerance of plus or minus 1.5 mm for units with a diagonal measurement of 1800 mm or less, and plus or minus 3 mm for units with a diagonal measurement over 1800 mm.
- .3 Face dimensions detailed maximum permissible sizes.
- .4 Brace frames to maintain squareness and rigidity during shipment and installation.

- .5 Finish steel clips and reinforcement to be stainless steel.

2.5 FINISHES

- .1 Finish Coatings: Conform to AAMA 611.
- .2 Exterior Exposed Aluminum Surfaces: AAMA AA-M12C22A41, Architectural Class 1 Clear Anodic coating anodized to clear colour.
- .3 Interior Exposed Aluminum Surfaces: Anodized to clear colour.
- .4 Shop and Touch-Up Primer for Steel Components: CAN/CGSB 1.40.
- .5 Concealed Steel Items: Galvanized in accordance with ASTM A123/A123M to 610 gm/sq m.
- .6 Apply one coat of bituminous paint to concealed aluminum and steel surfaces in contact with cementitious or dissimilar materials.

2.6 GLAZING

- .1 Glass Materials: As specified in Section 08 80 50 of Types described below:
 - .1 Insulated Glass Units. EG1
- .2 Glazing Materials: Type to suit application to achieve weather, moisture, and air infiltration requirements.

2.7 AIR BARRIER AND VAPOUR RETARDER

- .1 Equip window frames with site installed vapour retarder material for sealing to building air barrier and vapour retarder as follows:
 - .1 Material: identical to, or compatible with, building air barrier and vapour retarder materials to provide required air tightness and vapour diffusion control throughout exterior envelope assembly.
 - .2 Material width: adequate to provide required air tightness and vapour diffusion control to building air barrier and vapour retarder from interior.

Part 3 Execution

3.1 EXAMINATION

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

3.2 INSTALLATION

- .1 Window installation:
 - .1 Install in accordance with AAMA/WDMA/CSA 101/I.S.2/A440.
 - .2 Arrange components to prevent abrupt variation in colour.
- .2 Sill installation:

- .1 Install metal sills with uniform wash to exterior, level in length, straight in alignment with plumb upstands and faces. Use one piece lengths at each location.
- .2 Secure sills in place with anchoring devices located at ends and evenly spaced 600 mm on centre in between.
- .3 Caulking:
 - .1 Seal joints between windows and windowsills with sealant. Bed sill expansion joint cover plates and drip deflectors in bedding compound. Caulk between sill upstand and window-frame. Caulk butt joints in continuous sills.
 - .2 Apply sealant in accordance with Section 07 92 00 - Joint Sealants. Conceal sealant within window units except where exposed use is permitted by Consultant.

3.3 SITE QUALITY CONTROL

- .1 Have manufacturer of products supplied under this Section review Work involved in handling, installation/application, protection and cleaning of its products, and submit written reports in acceptable format to verify compliance of Work with Contract.
- .2 Manufacturer's site services: provide manufacturer's site services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
- .3 Obtain reports within 3 days of review and submit.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials in accordance with Section 01 74 21 – Construction Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.5 PROTECTION

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

END OF SECTION

Part 1 General

- .1 The hardware sets represent the design intent. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the RFP process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

1.1 SUMMARY

- .1 This Section includes commercial door hardware for the following:
 - .1 Swinging doors.
 - .2 Other doors to the extent indicated.
- .2 Door hardware includes, but is not necessarily limited to, the following:
 - .1 Hardware for hollow steel and aluminum doors.
 - .2 Weather-stripping, seals, and door gaskets.
 - .3 Mechanical door hardware.
 - .4 Automatic operators.

1.2 RELATED SECTIONS

- .1 Section 08 13 13 - Standard Metal Doors and Frames.
- .2 Section 08 31 13 - Access Doors and Frames.
- .3 Section 08 35 16 – Folding Grilles: requiring master keyed cylinders
- .4 Section 08 41 13 – Aluminum Framed Storefronts: Hardware for aluminum doors provided under this section.

1.3 REFERENCES

- .1 The versions of the standards referenced in this section are those listed in the BC Building Code, current edition at the time of the application for Building Permit; or if they are not referenced in the specified code, they are the latest version of the standard in effect at the time of the application for Building Permit.
- .2 ANSI A117.1 - Accessible and Usable Buildings and Facilities.
- .3 CAN/ULC-S104-10 - Standard Method for Fire Tests of Door Assemblies.
- .4 CAN/ULC-S132-07 - Standard for Emergency Exit and Emergency Fire Exit Hardware.
- .5 CSDMA (Canadian Steel Door Manufacturers Association).
- .6 DHI (Door and Hardware Institute Canada) - AHC and EHC certification programs.
- .7 DHI (Door Hardware Institute) - A115 series.
- .8 BHMA (Builders Hardware Manufacturers Association) - A156 Series Standards.
- .9 NFPA 80 - Standard for Fire Doors and Other Opening Protectives, 2013 Edition.
- .10 NFPA 252 - Fire Tests of Door Assemblies, 2012 Edition.

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate with other work having a direct bearing on work of this section.
 - .1 Coordinate the work with other directly affected sections involving manufacture or fabrication of internal reinforcement for door hardware and recessed items.
 - .2 Coordinate Owner's keying requirements during the course of the Work.

- .2 Sequencing: Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

1.5 PERFORMANCE REQUIREMENTS

- .1 Finish hardware shall be heavy duty commercial quality hardware. Locksets and latchsets shall be fully mortised Schlage L Series type with lever handles of solid material.

1.6 SUBMITTALS FOR REVIEW

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for door hardware and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Hardware List:
 - .1 Submit contract hardware list.
 - .2 Indicate specified hardware, including make, model, material, function, size, finish and other pertinent information.
- .4 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
- .5 Manufacturer's Instructions: submit manufacturer's installation instructions.

1.7 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 – Close-out Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for door hardware for incorporation into manual.

1.8 MAINTENANCE MATERIALS SUBMITTALS

- .1 Extra Stock Materials:
 - .1 Supply maintenance materials in accordance with Section 01 78 00 – Close-out Submittals.
 - .2 Tools:
 - .1 Supply 2 sets of wrenches for door closers and locksets.

1.9 QUALITY ASSURANCE

- .1 Regulatory Requirements:
 - .1 Hardware for doors in fire separations and exit doors certified by a Canadian Certification Organization accredited by Standards Council of Canada.
- .2 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .3 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience.
- .4 Installer Qualifications: Company specializing in performing the work of this section with minimum three (3) years documented experience.

1.10 REGULATORY REQUIREMENTS

- .1 Conform to applicable code for Products requiring electrical connection. Listed and classified by ULC as suitable for the purpose specified and indicated.

1.11 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Package items of hardware including fastenings, separately or in like groups of hardware, label each package as to item definition and location.
- .4 Storage and Handling Requirements:
 - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect door hardware from nicks, scratches, and blemishes.
 - .3 Protect prefinished surfaces with wrapping.
 - .4 Replace defective or damaged materials with new.

1.12 Warranty

- .1 Provide the following product warranty program for this project (5) years for grade 1 - cylindrical and mortise locksets, (10) years for grade 1 - door closers, (5) years for grade 1 – exit devices, and overhead stops/holders, (1) year warranty for electronics and electromechanical products. Warranty covers products only that are free from defects in workmanship and materials under normal use and service; cost of repair is by others.

Part 2 Products

2.1 SUPPLIERS / MANUFACTURERS

- .1 Standard of acceptance as listed in the hardware schedule at the end of this Specification.

2.2 HARDWARE ITEMS

- .1 Furnish complete set of templates for hardware for metal doors and frames to the metal door and frame subcontractor.
- .2 Furnish complete set of templates for hardware for aluminum doors and frames to the aluminum door and frame subcontractor.
- .3 Silencers: Pressed steel frames to be fitted with three rubber silencers per single door and two silencers per double door.
- .4 Locks and latches:
 - .1 Mortise and preassembled locks and latches: to ANSI/BHMA A156.2, series 2000 preassembled lock, grade 1, designed for function as stated in Hardware Schedule. Keyed as directed by Owner.
 - .2 Lever handles: 630 finish lever handles.
 - .3 Escutcheons: round 32D finish.
 - .4 Normal strikes: box type, lip projection not beyond jamb.
 - .5 Cylinders: 6 pin, 1 1/8" mortise, key into keying system as directed by Owner.

- .6 Finished to 32D or BHMA 626.
- .7 Function: As scheduled.
- .5 Butts and hinges:
 - .1 Butts and hinges: to ANSI/BHMA A156.1.
 - .2 Ball bearing type with non-removable pins.
 - .3 Door between 1500mm and 2200mm high are to have 1 ½ pairs of butts.
 - .4 Doors under 1500mm high to have one pair of butts.
 - .5 Doors over 2200mm high to have two pairs of butts.
 - .6 Sizes of butts to be as follows:

Door Thickness	Door Width	Size of Butts
45mm	Up to 899mm	115 x 102 BB Standard Wt. (3)
	900 to 1066mm	115 x 115 BB Standard Wt. (4)
	1067mm and over	127 x 127 BB Heavy Wt. (4)

- .6 Backset: All mortise lock and latch sets to have a 127mm backset, unless glass panels do not allow such backset.
- .7 Door Closers and Accessories:
 - .1 Door controls (closers): to ANSI/BHMA A156.4.
 - .2 Mount on room side.
 - .3 Attach to doors with screws, no through bolt connections.
- .8 Auxiliary hardware: to ANSI/BHMA A156.16, listed in Hardware Schedule.
 - .1 Doorstop: 626 finish, floor mounted.
- .9 Astragal: overlapping, stainless steel frame with insert.

2.3 DOOR OPERATING TRIM

- .1 Door Push Plates and Pulls: ANSI/BHMA A156.6 door pushes and pull units of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.
 - .1 Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.
 - .2 Manufacturers:
 - .1 Rockwood (RO).

2.4 MORTISE LOCKS AND LATCHING DEVICES

- .1 Mortise Locksets, Grade 1 (Heavy Duty): Provide ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed mortise locksets. Listed manufacturers shall meet all functions and features as specified herein.
 - .1 Manufacturers:
 - .1 Schlage (SCH) - L Series.

2.5 CONVENTIONAL EXIT DEVICES

- .1 Note this article is referring to conventional exit devices and not necessarily the panic hardware in the aluminum doors.

- .2 General Requirements: All exit devices specified herein shall meet or exceed the following criteria:
 - .1 Exit devices shall have a five-year warranty.
 - .2 At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
 - .3 Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.
 - .4 Except on fire rated doors, provide exit devices with hex key dogging device to hold the push-bar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.
 - .5 Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.
 - .6 Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.
 - .1 Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
 - .2 Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.
 - .7 Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.
 - .8 Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.
 - .9 Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
 - .10 Rail Sizing: Provide exit device rails factory sized for proper door width application.
 - .11 Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.

2.6 DOOR CLOSERS

- .1 All door closers specified herein shall meet or exceed the following criteria:
 - .1 General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.
 - .2 Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
 - .3 Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.
 - .4 Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
 - .5 Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.

- .6 Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.
- .2 Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.
 - .1 Heavy duty surface mounted door closers shall have a 30-year warranty.
 - .2 Manufacturers:
 - .1 Sargent Manufacturing (SA) - 351 Series.

2.7 ELECTROMECHANICAL DOOR OPERATORS

- .1 Electromechanical Door Operators (Moderate Traffic): Provide ANSI/BHMA A156.19 Certified Products Directory (CPD) listed low energy operators that are UL325/991 and UL10C certified and comply with requirements for the Americans with Disabilities Act (ADA). Operators shall accommodate openings up to 200 pounds and 48" wide.
 - .1 Provide operators with features as follows:
 - .1 Non-handed with push and pull side mounting.
 - .2 Activation by push button, hands-free or radio frequency devices.
 - .3 Adjustable opening force and closing power.
 - .4 Two-year limited warranty.
 - .5 Wi-Fi interface.
 - .6 Mounting backplate to simplify and speed up installation.
 - .2 Operators shall have the following functionality:
 - .1 Adjustable Hold Open: Amount of time a door will stay in the full open position after an activation.
 - .2 Emergency Interface Relay: Door closes and ignores any activation input until signal is discontinued.
 - .3 Infinite Hold Open: Door will hold open at set position until power is turned off.
 - .4 Latch Assist: At closed position, after an activation, the door is pulled in. After the door has closed, the door is pulled in to assist with latch release/engagement.
 - .5 Obstruction Detection: Door closes if it hits an obstruction while opening; door will reverse to open position if it hits an obstruction while closing. Door will stop once it hits an obstruction and will rest against the obstruction until removed.
 - .6 Open Delay: Delays operator opening for locking hardware.
 - .7 Outside Wall Switch Disable: When contact is closed, outside wall switch is disabled.
 - .8 Power Assist: Senses the door is being opened manually and applies small amount of power to assist the user in opening the door with force less than 5 lbs. The door opens only as far as it is moved manually, then closes once released.
 - .9 Power Close: Additional force to assist door closing between 7° and 2°.

- .10 Push & Go: As the door is manually opened, the operator "senses" movement and opens door to the full-open position.
- .11 Selector Mode Switch: Off disables the signal inputs, on activates the signal inputs, hold open activates the unit to the hold open position.
- .3 Manufacturers:
 - .1 Record 8100

2.8 ARCHITECTURAL TRIM

- .1 Door Protective Trim
 - .1 General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
 - .2 Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
 - .3 Where plates are applied to fire rated doors with the top of the plate more than 16" above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer's catalog and template book for specific requirements for size and applications.
 - .4 Protection Plates: ANSI/BHMA A156.6 protection plates (kick, armor, or mop), fabricated from the following:
 - .5 Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
 - .6 Manufacturers:
 - .1 Rockwood (RO).

2.9 DOOR STOPS AND HOLDERS

- .1 General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.
- .2 Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
 - .1 Manufacturers:
 - .1 Rockwood (RO).
- .3 Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.
 - .1 Manufacturers:
 - .1 Sargent Manufacturing (SA).

2.10 ARCHITECTURAL SEALS

- .1 General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where

indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

- .2 Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.
 - .1 Provide smoke labeled perimeter gasketing at all smoke labeled openings.
- .3 Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.
 - .1 Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NFPA 252, Standard Methods of Fire Tests of Door Assemblies.
- .4 Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.
- .5 Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
 - .1 Manufacturers:
 - .1 Pemko (PE).

2.11 FASTENINGS

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

2.12 FINISHES

- .1 Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
- .2 Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.
- .3 Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

2.13 KEYING

- .1 Prepare detailed keying schedule in conjunction with Owner. Keying System to match existing.
- .2 Supply keys in duplicate for every lock in this Contract.
- .3 Supply 3 master keys for each master key or grand master key group.
- .4 Stamp keying code numbers on keys and cylinders.

- .5 Supply construction cores.
- .6 Hand over permanent cores and keys to Owner.

Part 3 Execution

3.1 EXAMINATION

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

3.2 INSTALLATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.
- .2 Supply metal door and frame manufacturers with complete instructions and templates for preparation of their work to receive hardware.
- .3 Supply manufacturers' instructions for proper installation of each hardware component.
- .4 Install hardware to standard hardware location dimensions in accordance with CSDFMA Canadian Metric Guide for Steel Doors and Frames (Modular Construction).
- .5 Where door stop contacts door pulls, mount stop to strike bottom of pull.
- .6 Use only manufacturer's supplied fasteners.
 - .1 Use of "quick" type fasteners, unless specifically supplied by manufacturer, is unacceptable.
- .7 Remove construction locks when directed by Owner.
 - .1 Install permanent cores and ensure locks operate correctly.
- .8 Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
- .9 Push and pull plates: install 127 mm from edge of door to centre of plate, unless indicated otherwise. Where pulls are mounted back-to-back use #5 mounting.

3.3 FIELD QUALITY CONTROL

- .1 Field Inspection (Punch Report): Reference Division 01 Sections "Closeout Procedures". Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.
 - .1 Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.
- .2 Fire Door Assembly Inspection: Reference Division 01 Sections "Closeout Procedures". Conduct an initial fire door assembly inspection, including documentation reporting, upon completion of door hardware installation according to NFPA 80 Standard for Fire Doors and Other Opening Protectives, paragraph 5.2.4, requirements.

3.4 ADJUSTING

- .1 Adjust door hardware, operators, closures and controls for optimum, smooth operating condition, safety and for weather tight closure.
- .2 Lubricate hardware, operating equipment and other moving parts.

- .3 Adjust door hardware to ensure tight fit at contact points with frames.

3.5 INSPECTION OF WORK

- .1 All seals, door bottoms etc shall be adjusted to ensure compliance with the document noted above.

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11- Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11- Cleaning.
- .3 Clean adjacent surfaces soiled by door hardware installation.
- .4 Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.
- .5 Waste Management: separate waste materials for in accordance with Section 01 74 21- Construction/Demolition Waste Management and Disposal

3.7 DEMONSTRATION

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

3.8 PROTECTION

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

3.9 HARDWARE SCHEDULE

- .1 Provide all hardware components, style, color and finish, quantity, and location as indicated below:
- .2 The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the RFP process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
- .3 Quantities listed are for each pair of doors, or for each single door.
- .4 The supplier is responsible for handing and sizing all products.
- .5 Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.

3.10 SCHEDULE

Hardware Types				
Quantity	Code/Item	Model #		Finish
	P01	Door D01, D03, D04		
	Exterior	Main Entry – Alum		
2	Continuous Hinge	Kawneer by Door supplier – Section 08 41 13		
2	Exit Device	Kawneer 1686CD concealed rod panic with Outside lock and lever handle, with night latch.		628
2	Cylinder	Schlage Cylinder to suit	SCH	626
2	Surface Closer	LCN Allegion 4040XP		EN
2	Concealed Overhead Stop	69xS x door width	GJ	US26D
1	Full height Astragal	357SS 84"	PE	
1	Threshold	by Door supplier – Section 08 41 13		
1	Weatherstrip set	by Door supplier – Section 08 41 13		
2	Door Bottom	by Door supplier – Section 08 41 13		
1	Door position switches			
	P02	Door D02		
	Exterior	Main Entry - ADO		
2	Continuous Hinge	Kawneer by Door supplier – Section 08 41 13		
2	Exit Device	Kawneer 1686CD concealed rod panic with Outside lock and lever handle.		628
2	Cylinder	Schlage Cylinder to suit	SCH	626
2	Concealed Overhead Stop	69xS x dr width	GJ	US26D
1	Surface Closer	LCN Allegion 4040XP		EN
1	Auto Operator	Record 8100	OT	689
2	Full Height Actuator	S-136-3	WIKK	628
1	Full height Astragal	357SS 84"	PE	
1	Threshold	by Door supplier – Section 08 41 13		
1	Weatherstrip set	by Door supplier – Section 08 41 13		
2	Door Bottom	by Door supplier – Section 08 41 13		
1	Door position switches			
	P03	Door D08, D13		
	Interior	Hall – HM		
2	Continuous Hinge	CFM83HD1		C26D
2	Exit Device	Von Duprin Concealed Vertical Rods panic, narrow style design, lever handle. 99L-NL		628
2	Surface Closer	LCN Allegion 4040XP		EN
1	Auto Operator	Record 8100	OT	689
2	Full Height Actuator	S-136-3	WIKK	628
1	Wall Stop	STANDARD METAL S122/S120		
1	Concealed Overhead Stop	69xS x dr width	GJ	US26D
1	Perimeter Seal	350CSPk Pemko		
2	Door Bottom	KNC CT-52		
1	Weatherstrip set			
2	Kick Plate	K1050 F 10" height x width CSK BEV	RO	US32D

S01		D05, D06, D15, D17, D18			
	Interior	Storage / Maintenance Rooms			
3	Hinge	5BB1 HT 114 X 102 NRP			652
1	Lockset	L9080 Storeroom			630
1	Surface Closer	LCN Allegion 4040XP			EN
2	Kick Plate	K1050 F 10" height x width CSK BEV		RO	US32D
1	Wall / Floor stop	STANDARD METAL S122/S120			
S02		D07			
	Interior	Washroom			
3	Hinge	5BB1 HT 114 X 102 NRP			652
1	Push / Pull Plates	70E / 111 x 70C		RO	630
1	One sided Deadbolt with Occupancy Indicator	B571		SCH	630
1	Auto Operator	Record 8100		OT	689
2	Full Height Actuator	S-136-3		WIKK	628
2	Kick Plate	K1050 F 10" height x width CSK BEV		RO	US32D
1	Wall stop	STANDARD METAL S122/S120			
S03		D09, D10			
	Interior	Arena Viewing			
3	Hinge	5BB1 HT 114 X 102 NRP			652
1	Lockset D9	L9070 Classroom			630
1	Lockset D10 electrified	L9080 Storeroom to function with auto operator			630
1	Surface Closer on Door D09	LCN Allegion 4040XP			EN
1	Auto Operator on Door D10	Record 8100		OT	689
2	Full Height Actuator	S-136-3		WIKK	628
2	Kickplate Plate	K1050 F 10" height x width CSK BEV		RO	US32D
1	Wall stop	STANDARD METAL S122/S120			
S04		D11, D12			
	Interior	Training Rooms			
3	Hinge	5BB1 HT 114 X 102 NRP			652
1	Lockset	L9070 Classroom			630
1	Surface Closer	LCN Allegion 4040XP			EN
2	Kick Plate	K1050 F 10" height x width CSK BEV		RO	US32D
1	Wall stop	STANDARD METAL S122/S120			
S05		D14, D16			
	Interior	Office / Service Counter			
3	Hinge	5BB1 HT 114 X 102 NRP			652
1	Lockset	L9050 Office			630
1	Surface Closer	LCN Allegion 4040XP			EN
1	Bumper Plate	K1050 F 32" height x width CSK BEV		RO	US32D
1	Wall stop	STANDARD METAL S122/S120			
1	Overhead Stop on D16	GLYNN JOHNSON "410" SERIES			EN

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Glass and glazing for sections referencing this section for products and installation.
- .2 Mirrors

1.2 RELATED SECTIONS

- .1 Section 06 41 11 - Architectural Cabinetwork
- .2 Section 07 92 00 - Joint Sealants.
- .3 Section 08 11 13 - Standard Metal Doors and Frames.
- .4 Section 08 41 13 - Aluminum Framed Storefronts.
- .5 Section 08 51 00 – Aluminum Windows
- .6 Section 08 88 13 – Fire-Resistive Glazing

1.3 REFERENCES

- .1 The versions of the standards referenced in this section are those listed in the BC Building Code, current edition at the time of the application for Building Permit; or if they are not referenced in the specified code, they are the latest version of the standard in effect at the time of the application for Building Permit.
- .2 ANSI Z97.1 - Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test.
- .3 ASTM C542 - Specification for Lock-Strip Gaskets.
- .4 ASTM C864 - Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.
- .5 ASTM C920 - Elastomeric Joint Sealants.
- .6 ASTM C1036 - Flat Glass.
- .7 ASTM C1048 - Heat-Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass.
- .8 ASTM C1193 - Use of Joint Sealants.
- .9 ASTM C1503 - Silvered Flat Glass Mirror.
- .10 ASTM D412 -Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension.
- .11 ASTM D1149 - Test Method for Rubber Deterioration - Surface Ozone Cracking in a Chamber.
- .12 ASTM D2240 - Test Method for Rubber Property - Durometer Hardness.
- .13 ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
- .14 ASTM E283 - Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Differences Across the Specimen.
- .15 ASTM E773 - Test Method for Accelerated Weathering of Sealed Insulating Glass Units.
- .16 CAN/CGSB 12.1 - Tempered or Laminated Safety Glass.

- .17 CAN/CGSB 12.3 - Flat, Clear Float Glass.
- .18 CAN/CGSB 12.4 - Heat Absorbing Glass.
- .19 CAN/CGSB 12.8 - Insulating Glass Units.
- .20 CAN/CGSB 12.10 - Glass, Light and Heat Reflecting.
- .21 CAN/CGSB 12.20 – Structural Design of Glass for Buildings.
- .22 GANA (Glass Association of North America)
 - .1 GANA Glazing Manual.
 - .2 GANA Laminated Glass Reference Manual.
 - .3 GANA Sealant Manual.
- .23 FGMA Sealant Manual.
- .24 IGMAC Insulating Glass Manufacturers Association of Canada.
- .25 Glazing Contractors Association of BC
- .26 GCA - Glazing Systems Specifications Manual
- .27 BC Energy Efficiency Regulations for Windows, Glazing, Doors, Skylights, Curtain Walls.

1.4 PERFORMANCE REQUIREMENTS

- .1 Interior windows and sidelights shall be constructed of tempered glass, except where indicated in the schedule below.

1.5 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data on Glass Types: Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements.
- .3 Samples: Submit two (2) samples 300 x 300mm in size, exemplifying glass, colouration and design for each type upon consultant request.

1.6 SUBMITTALS FOR INFORMATION

- .1 Section 01 33 00: Submission procedures.
- .2 Manufacturer's Certificate: Certify that sealed insulated glass, meets or exceeds specified requirements.

1.7 QUALITY ASSURANCE

- .1 Perform Work in accordance with GANA Glazing Manual, for glazing installation methods.

1.8 ENVIRONMENTAL REQUIREMENTS

- .1 Do not install glazing when ambient temperature is less than 10 degrees C.
- .2 Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.9 EXTENDED WARRANTY

- .1 The Construction Contractor hereby warrants insulating glass units against failure of seal of enclosed air space and deposits on inner faces of glass detrimental to vision in accordance with General Conditions, but for ten years from date of substantial completion.

Part 2 Products

2.1 MANUFACTURERS

- .1 Basis of Design products are named in this Section; additional manufacturers offering similar setting systems may be incorporated into the work provided they meet the performance requirements established by the named products.
- .2 Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - .1 Vision Glass:
 - .1 AGC Flat Glass North America (formerly AFG or AFGD)
 - .2 AHC Glass (formerly Visteon)
 - .3 Cardinal Glass Industries Inc
 - .4 Garibaldi Glass Industries Inc
 - .5 Guardian Glass
 - .6 Pilkington Glass of Canada
 - .7 Vitro Architectural Glass (formerly PPG Industries)
 - .8 Viracon Inc.

2.2 PERFORMANCE / DESIGN CRITERIA

- .1 Provide continuity of building enclosure vapour and air barrier using glass and glazing materials as follow:
 - .1 Utilize inner light of multiple light sealed units for continuity of air and vapour seal.
- .2 Size glass to withstand wind loads, dead loads and positive and negative live loads as measured in accordance with ANSI/ASTM E330 and in accordance with CAN/CGSB-12.20.
- .3 Limit center-of-glass deflection to the smallest of:
 - .1 Displacement associated with the structural capacity of the glazing unit.
 - .2 $L-100$, where L is the shortest side dimension of the unit measured in inches.
 - .3 Or 19 mm

2.3 MATERIALS

- .1 Clear Float Glass: to CAN/CGSB-12.3, glazing quality, 6 mm minimum thickness.
- .2 Safety glass: to CAN/CGSB-12.1, transparent, 6 mm minimum thickness.

2.4 EXTERIOR GLAZING

- .1 Type EXT-1:
 - .1 Exterior 6mm clear tempered, low-e #2, Guardian SunGuard SN 68
 - .2 Cavity 12.7mm hermetically sealed, argon filled

- .3 Interior 6mm tempered laminated glass
 - .1 3mm clear tempered
 - .2 090 ionoplast interlayer
 - .3 3mm clear tempered
- .4 Anti-spall film on #4 surface
- .2 Exterior steel doors and frames:
 - .1 Glass: EXT-1 insulating glass units.
 - .2 Glazing method: exterior wet/sealant method.
 - .3 See door schedule for locations.

2.5 INTERIOR GLAZING

- .1 Type INT-1, windows, sidelights and doors in low risk areas:
 - .1 12mm clear tempered laminated glass
 - .1 6mm clear tempered
 - .2 1.5mm PVB interlayer
 - .3 6mm clear tempered.
- .2 Type INT-2, Fire-rated glazing materials installed as transoms, borrowed lights, windows in fire-rated frames.
 - .1 FireLite Plus as manufactured by Nippon Electric Glass Company, Ltd., and distributed by Technical Glass Products, www.fireglass.com
 - .1 See Section 08 88 13 - Fire-Resistive Glazing
- .3 Interior steel doors and frames – non fire rated:
 - .1 Glass: 6 mm thick safety glass tempered.
 - .2 Glazing method: interior dry method.
 - .3 See door schedule for locations
- .4 Interior steel doors and frames - fire rated openings:
 - .1 Glass: fire-resistive glazing specified in Section 08 88 13.
 - .2 Glazing method: interior dry method.
 - .3 See door schedule for locations.
- .5 Display Cases:
 - .1 Glass Shelves: 10mm glass tempered.
 - .2 Glass Sliding Doors: 6 mm glass tempered.

2.6 MIRRORS

- .1 Silvered mirror glass: (as noted on drawings) to CAN/CGSB-12.5- M86 Type 1B National Standard of Canada for Mirrors, Silvered of minimum 6 mm tempered glass unless noted otherwise. Safety Backed: Organically coated with a sheet of adhesive backed polyethylene to retain fragments on impact. Mirrors c/w stainless steel 'J' trim and concealed hangers. Refer to Interior Elevations for locations and sizes.

2.7 GLAZING COMPOUNDS

- .1 Silicone Sealant: CAN/CGSB 19.13 single component; chemical curing; capable of water immersion without loss of properties; non-bleeding, non-staining, cured Shore A hardness of 15 to 25.

2.8 MANUFACTURERS - GLAZING ACCESSORIES

- .1 Setting Blocks: ASTM C864, Silicone, 80 to 90 Shore A durometer hardness tested to ASTM D2240, length of 25 mm for each square metre of glazing or minimum 100 mm x width of glazing rabbet space minus 1.5 mm x height to suit glazing method and pane weight and area.
- .2 Spacer Shims: ASTM C864, Silicone, 50 to 60 Shore A durometer hardness tested to ASTM D2240, minimum 75 mm long x one half the height of the glazing stop x thickness to suit application.
- .3 Glazing Tape: Preformed butyl compound; 10 to 15 Shore A durometer hardness tested to ASTM D2240; coiled on release paper; black colour.

2.9 SLIDING GLASS DOORS AT DISPLAY CASE

- .1 Track for glass sliding doors, provide a complete system consisting of tracks, roller, wheels, push lock, silencers, gaskets and end caps. Equal to Richelieu BP15510 set.
- .2 Sealing Profile tape, black, soft PVC. Equal to Richelieu 893072001
- .3 Track set for glass sliding doors Equal to Richelieu 1551210

2.10 EXAMINATION

- .1 Verify existing conditions before starting work.
- .2 Verify that openings for glazing are correctly sized and within tolerance.
- .3 Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and ready to receive glazing.

2.11 PREPARATION

- .1 Clean contact surfaces with solvent and wipe dry.
- .2 Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- .3 Prime surfaces scheduled to receive sealant.
- .4 Install sealant in accordance with manufacturer's written instructions.
- .5 Site confirm all glass sizes prior to fabrication and installation.

2.12 INSTALLATION

- .1 Install as per glazing manufacturer installation guidelines.
- .2 Caulk all around frames
- .3 Insure to protect all glass from damage prior to installation.

2.13 CLEANING

- .1 Section 01 74 11: Cleaning installed work.
- .2 Remove glazing materials from finish surfaces.
- .3 Remove labels after Work is complete.

- .4 Clean glass and adjacent surfaces.

2.14 PROTECTION OF FINISHED WORK

- .1 After installation, mark pane with an 'X' by using removable plastic tape or paste. Do not mark heat absorbing or reflective glass units.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Fire-rated glazing materials installed as vision lights in fire rated doors.
- .2 Fire-rated glazing materials installed as transoms, borrowed lights, windows in fire-rated frames.

1.2 RELATED REQUIREMENTS

- .1 Section 08 11 13 - Standard Metal Doors and Frames: vision lights in rated steel doors and borrowed frames.
- .2 Section 08 80 50 - Glazing: glazing schedule.

1.3 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)
 - .1 ANSI Z97.1-2015: Standard for Safety Glazing Materials Used in Buildings
- .2 Consumer Product Safety Commission (CPSC)
 - .1 CPSC 16 CFR 1201: Safety Standard for Architectural Glazing Materials
- .3 Glass Association of North America (GANA)
 - .1 GANA – Glazing Manual.
 - .2 FGMA – Sealant Manual.
- .4 National Fire Protection Association (NFPA)
 - .1 NFPA 80 (2016), Fire Doors and Windows.
 - .2 NFPA 252 (2017), Fire Tests of Door Assemblies.
 - .3 NFPA 257 (2017), Fire Tests of Window Assemblies.
- .5 Underwriters Laboratories, Inc. (UL)
 - .1 UL 9 (2009), Fire Tests of Window Assemblies.
 - .2 UL 10B (2009) – Fire Tests of Door Assemblies.
 - .3 UL 10C (2016) – Positive Pressure Fire Tests of Door Assemblies.
- .6 Standard Council of Canada
 - .1 ULC Standard CAN4-S104: Fire Tests of Door Assemblies.
 - .2 ULC Standard CAN4-S106: Fire Tests of Window Assemblies.
 - .3 CAN/ULC-S101M: Standard Methods of Fire Endurance Tests.

1.4 PERFORMANCE REQUIREMENTS

- .1 Impact safety rated: Fire-rated glass ceramic laminated clear and wireless glazing material for use in impact safety-rated locations such as doors, transoms and borrowed lites with fire rating requirements ranging from 20 minutes to 3 hours with required hose stream test.
- .2 Passes positive pressure test standards UL 10C and NFPA 252.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Comply with requirements of Section 01 33 00 - Submittal Procedures.

- .2 Product data: Submit manufacturer's technical data for each glazing material required, including installation and maintenance instructions.
- .3 Samples: Submit, for verification purposes, approximately 200 x 200 mm size samples for each type of glass indicated.
- .4 Certificates of compliance from glass and glazing materials manufacturers attesting that glass and glazing materials furnished for project comply with requirements. Separate certification will not be required for glazing materials bearing manufacturer's permanent label designating type and thickness of glass, provided labels represent a quality control program involving a recognized certification agency or independent testing laboratory acceptable to authority having jurisdiction.
- .5 Product Test Listings: From UL indicating fire-rated glass complies with requirements, based on comprehensive testing of current product.

1.6 QUALITY ASSURANCE

- .1 Glazing Standards: GAMA Glazing Manual and FGMA Sealant Manual.
- .2 Fire Protective Rated Glass: Each lite shall bear permanent, non-removable label of UL certifying it for use in tested and rated fire protective assemblies.
- .3 Fire Protective Glazing Products for Door Assemblies: Products identical to those tested per ASTM E2074 and UL 10B, labeled and listed by UL.
- .4 Deliver, store, and handle materials under provisions of Section 01 61 00 - Common Product Requirements.
- .5 Deliver materials to specified destination in manufacturer or distributor's packaging, undamaged, complete with installation instructions.
- .6 Store off ground, under cover, protected from weather and construction activities.

1.7 WARRANTY

- .1 Provide manufacturer's warranty under provision of General Conditions.
- .2 Warranty period: five years.

Part 2 Products

2.1 FIRE-RATED GLAZING MATERIALS

- .1 Fire-resistant glass - impact resistant rated:
 - .1 FireLite Plus as manufactured by Nippon Electric Glass Company, Ltd., and distributed by Technical Glass Products, www.fireglass.com
 - .2 Properties:
 - .1 Thickness: 8 mm overall.
 - .2 Weight: 6.0 kg/sq. m
 - .3 Approximate Visible Transmission: 85 percent.
 - .4 Approximate Visible Reflection: 9 percent.
 - .5 Fire-rating: 20 minutes to 3 hours for doors; 20 minutes to 90 minutes for other applications.
 - .6 Impact Safety Resistance: ANSI Z97.1 and CPSC 16CFR1201 (Cat. I and II).
 - .7 STC Rating: Approximately 38 dB.

- .8 Surface Finish:
 - .1 Standard Grade.
- .9 Positive Pressure Test: UL 10C, NFPA 252, passes.
- .3 Maximum sheet sizes based on surface finish:
 - .1 Standard: 1 219 x 2 438 mm.
- .2 Labeling: Permanently label each piece of FireLite with the FireLite logo, UL logo and fire rating in sizes up to 2.15 sq. m, and with the FireLite label only for sizes that exceed the listing (as approved by the local authority having jurisdiction).
- .3 Fire Rating: Fire rating listed and labeled by UL for fire rating scheduled at opening locations on drawings, when tested in accordance with ULC Standards CAN4 S-104 and CAN4 S-106.
- .4 Substitutions: will be considered during RFP period if requests are submitted in writing.

2.2 GLAZING ACCESSORIES FOR FIRE-RATED GLAZING MATERIALS

- .1 Glazing Tape: Closed cell polyvinyl chloride (PVC) foam, coiled on release paper over adhesive on two sides, maximum water absorption by volume of 2 percent. Glass panels that exceed 0.9 sq. m for 90-minute ratings must be glazed with fire-rated glazing tape supplied by manufacturer.
- .2 Silicone Sealant: One-part neutral curing silicone, medium modulus sealant, Type S; Grade NS; Class 25 with additional movement capability of 50 percent in both extension and compression (total 100 percent); Use (Exposure) NT; Uses (Substrates) G, A, and O as applicable.
 - .1 Acceptable material: Tremco Spectrem 2.
 - .2 For product/system substitution procedures, comply with Section 01 25 13.
- .3 Setting Blocks: Neoprene, EPDM, or silicone; tested for compatibility with glazing compound; of 70 to 90 Shore A hardness.
- .4 Cleaners, Primers, and Sealers: Type recommended by manufacturer of glass and gaskets.

2.3 FABRICATION

- .1 Fabricate glass and other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with recommendations of product manufacturer and referenced glazing standard as required to comply with system performance requirements.

Part 3 Execution

3.1 EXAMINATION

- .1 Examine glass framing, with glazier present, for compliance with the following:
 - .1 Manufacturing and installation tolerances, including those for size, squareness, offsets at corners.
 - .2 Minimum required face or edge clearances.
 - .3 Observable edge damage or face imperfections.
- .2 Do not proceed with glazing until unsatisfactory conditions have been corrected.
- .3 Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings that are not firmly bonded to substrates.

3.2 INSTALLATION (GLAZING)

- .1 Comply with referenced FGMA standards and instructions of manufacturers of glass, glazing sealants, and glazing compounds.
- .2 Protect glass from edge damage during handling and installation. Inspect glass during installation and discard pieces with edge damage that could affect glass performance.
- .3 Set units of glass in each series with uniformity of pattern, draw, bow, and similar characteristics.
- .4 Cut glazing tape to length and set against permanent stops, flush with sight lines to fit openings exactly, with stretch allowance during installation.
- .5 Place setting blocks located at quarter points of glass with edge block no more than 150 mm from corners.
- .6 Glaze vertically into labeled fire-rated metal frames or partition walls with same fire rating as glass and push against tape for full contact at perimeter of pane or unit.
- .7 Place glazing tape on free perimeter of glazing in same manner described above.
- .8 Install removable stop and secure without displacement of tape.
- .9 Install in vision panels in fire-rated doors to requirements of NFPA 80.
- .10 Install so that appropriate UL or FireLite markings remain permanently visible.

3.3 PROTECTION AND CLEANING

- .1 Protect glass from contact with contaminating substances resulting from construction operations. Remove any such substances by method approved by glass manufacturer.
- .2 Wash glass on both faces not more than four days prior to date scheduled for inspections intended to establish date of substantial completion. Wash glass by method recommended by glass manufacturer.
- .3 Waste Management: separate waste materials in accordance with Section 01 74 21- Construction Waste Management and Disposal.

3.4 GLAZING SCHEDULE

- .1 Refer to schedule in Section 08 80 50 - Glazing.
- .2 Refer to drawings for locations.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Gypsum board and joint treatment.
- .2 Gypsum interior sheathing.
- .3 Acoustic insulation.
- .4 Light gauge metal stud wall framing.
- .5 Metal channel ceiling framing.

1.2 RELATED SECTIONS

- .1 Section 06 10 13 - Wood Blocking and Curbing
- .2 Section 06 47 10 - Fiberglass Reinforced Plastic (FRP) Panels
- .3 Section 07 21 16 - Blanket Insulation
- .4 Section 07 84 00 - Firestopping
- .5 Section 09 22 16 – Non-Structural Metal Stud Framing
- .6 Section 10 28 14 - Toilet and Bath Accessories

1.3 REFERENCES

- .1 The versions of the standards referenced in this section are those listed in the BC Building Code, current edition at the time of the application for Building Permit; or if they are not referenced in the specified code, they are the latest version of the standard in effect at the time of the application for Building Permit.
- .2 AWCC: Wall and Ceiling Specifications Standard Manual.
- .3 Northwest Walls and Ceilings Bureau (NWCBC): Recommended Levels for Finishing of Gypsum Board standard.
- .4 ANSI A118.9 - Specifications for Cementitious Backer Units.
- .5 ASTM C475/C475M - Joint Compound and Joint Tape for Finishing Gypsum Board.
- .6 ASTM C645 - Non-Structural Steel Framing Members.
- .7 ASTM C665 - Mineral-Fibre Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
- .8 ASTM C754 - Installation of Steel Framing Members to Receive Screw-Attached Gypsum Board.
- .9 ASTM C1002 - Steel Self-Piercing, Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
- .10 ASTM C1047 - Accessories for Gypsum Wallboard and Gypsum Veneer Base.
- .11 ASTM C1177/C1177M – Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
- .12 ASTM C1278/C1278M - Fiber-Reinforced Gypsum Panel.
- .13 ASTM C1396/C1396M - Gypsum Board.

- .14 ASTM C1629/C1629M – Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fibre-Reinforced Cement Panels.
- .15 ASTM C1658 – Standard Specification for Glass Mat Gypsum Panels.
- .16 ASTM C919, Appendix 3C – Standard Practice for Use of Sealants in Acoustical Applications.
- .17 ASTM E90 - Test Method for Laboratory Measurement of Airborne-Sound Transmission Loss of Building Partitions and Elements.
- .18 ASTM E695 – Standard Test Method of Measuring Relative Resistance of Wall, Floor and Roof Construction to Impact Loading.
- .19 CAN/ULC S101 - Methods of Fire Endurance Tests of Building Construction and Materials.
- .20 CAN/ULC S102 - Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .21 GA-214 (Gypsum Association) - Recommended Levels of Gypsum Board Finish.
- .22 GA-216 (Gypsum Association) - Application and Finishing of Gypsum Panel Products.
- .23 GA-254 - Fire-Resistant Gypsum Sheathing.
- .24 GA-600 (Gypsum Association) - Fire Resistance Design Manual.
- .25 GA-801 (Gypsum Association) - Handling and Storage of Gypsum Panel Products: A Guide for Distributors, Retailers, and Contractors.
- .26 ULC - Fire Resistance Directory.
- .27 CSA Z317 Infection Control During Construction or Renovation of Health Care Facilities, April 2003.

1.4 SYSTEM DESCRIPTION

- .1 Acoustic Attenuation for Identified Interior Partitions: Provide STC ratings as indicated in accordance with ASTM E90.

1.5 SUBMITTALS

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data:
 - .1 Provide data on metal framing, gypsum board, cementitious backer board, joint tape, and joint compound.
 - .2 Provide MSDS on all products within the wall assembly.
 - .3 Provide a letter of certification from the Gypsum manufacturer indicating that the products supplied for this project do not contain hydrogen sulphide, sulphur dioxide, sulphur or any sulphur by-products.

1.6 QUALITY ASSURANCE

- .1 Perform Work in accordance with GA-214, GA-216, and GA-600.
- .2 Installer Qualifications: Company specializing in performing the work of this section with minimum five (5) years experience.
- .3 Handling Gypsum Board: Comply with GA-801.

- .4 Gypsum Board materials supplied for use on this project shall not contain hydrogen sulphide, sulphur dioxide, sulphur or any sulphur by-products.

1.7 REGULATORY REQUIREMENTS

- .1 Conform to applicable code for fire rated assemblies in conjunction with Section 05 41 00 and 09 22 16 as follows:
 - .1 Fire Rated Partitions: Listed assembly by ULC listed Design Assembly and as detailed.
 - .2 Fire Rated Ceilings: Listed assembly by ULC listed Design Assembly and as detailed.
 - .3 Fire Rated Structural Column Framing: Listed assembly by ULC listed Design Assembly as scheduled or detailed.

1.8 ACOUSTICAL PERFORMANCE REQUIREMENTS

- .1 Typical sound transmission class (STC) rating requirements and space adjacencies: refer to drawings for partition types.

1.9 IMPACT RESISTANCE

- .1 The impact resistance, on the side exposed to areas indicated.
- .2 Refer to drawings for locations of interior partitions.

1.10 WARRANTY

- .1 Warranty Period for all supplied materials, equipment and installation is two (2) years from the date of Service Commencement.
- .2 Warranty: Include coverage to correct defective work and for failure to meet specified requirements.

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS

- .1 The following Manufacturers of gypsum drywall are deemed to be acceptable for the supply of gypsum drywall for this project:
 - .1 Canadian Gypsum Company (US Gypsum)
 - .2 Certainteed Gypsum Canada Inc.
 - .3 Georgia Pacific.
 - .4 Westroc Inc.
 - .5 Winroc.
 - .6 Pabco Gypsum

2.2 FRAMING MATERIALS

- .1 Studs and Tracks: Specified in Section 09 22 16.
- .2 Furring, Framing, and Accessories: Specified in Section 09 22 16.
- .3 Fasteners: ASTM C1002.
- .4 Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.

2.3 CEILING SUSPENSION SYSTEM

- .1 Main Runner Channels:
 - .1 Cold formed steel channels with rust inhibitive coating.
 - .2 Size: 38 x 19 mm.
 - .3 Gauge: 1.22 mm
- .2 Hanger Rods and Tie Wires:
 - .1 Wire: 3.6 mm galvanized wire.
 - .2 Rods: 4.8 mm diameter zinc coated or cadmium plated steel rods with rust inhibitive coating.
 - .3 Inserts: develop full strength of hangers they support.
 - .4 Tie wires: Minimum 1.291 mm, class 1 zinc coat, soft tempered.

2.4 GYPSUM BOARD MATERIALS

- .1 Gypsum Board: ASTM C1396/C1396M, paper-faced; 1220 mm wide, maximum available length in place; tapered edges, ends square cut.
 - .1 Regular core, 13 mm and 16 mm thick.
 - .2 Fire rated core, 13 mm and 16 mm thick.
- .2 Gypsum Ceiling Board ASTM C1396/C1396M, paper-faced, regular core, 13 mm thick; 1220 mm wide, maximum available length in place; tapered edges, ends square cut.
- .3 Impact-Resistant Gypsum Board: ASTM C1629, within ASTM C1629 scores a Level 2 for Hard Body Impact, paper-faced, glass fibre-reinforced mats and core, impact resistant; maximum available length in place; tapered edges, ends square cut. Soft body impact penetration to ASTM E695. Regular and moisture resistant core.
 - .1 Regular core, 13 mm and 16 mm thick.
 - .2 Fire rated core, 16 mm thick.
 - .1 Mould resistance: when tested in accordance with ASTM D3273 Standard Test Method for Resistance to Growth of Mould on the Surface of Interior Coatings in an Environmental Chamber, the panels score a 10.
- .4 Moisture Resistant Gypsum Board: MMRGWB ASTM C1658/C1658M, moisture and mould resistant core and fibreglass facers, maximum available length in place; tapered edges, ends square cut. Mould resistance: to ASTM D3273, Standard Test Method for Resistance to Growth of Mould on the Surface of Interior Coatings in an Environmental Chamber, score 10.
 - .1 Regular core, 16 mm thick.
 - .2 Fire rated core, 16 mm thick.
- .5 Water Resistant Gypsum Board: ASTM C1278/C1278M, glass fibre-reinforced, paperless face; maximum available length in place; tapered edges, ends square cut.
 - .1 Regular core, 16 mm thick.
 - .2 Fire rated core, 16 mm thick.
- .6 Gypsum Tile Backer Board: ASTM C1278/C1278M, paperless, water-resistant gypsum/cellulose-fibre reinforced composition, 13 mm thick, 915 mm wide; maximum available length in place; square edges, ends square cut.

2.5 ACOUSTIC ACCESSORIES

- .1 Acoustic Insulation: As specified under Section 07 21 16 - Blanket Insulation.
- .2 Acoustical sealant: to ASTM C834.
 - .1 Acceptable material: Tremco Tremflex 834, Chem-Calk 600; Sheetrock Acoustical Sealant; CertainTeed QuietSeal Pro.
- .3 Putty Pads: Quiet Putty 380

2.6 ACCESSORIES

- .1 Corner Beads: GA-216; Metal corner bead.
- .2 Edge Trim: GA-216; Type J or U casing bead.
- .3 Joint Materials: GA-216
 - .1 Joint Tape: ASTM C475 and ASTM C840, 50.8 mm spark perforated paper tape, made from 100% recycled paper, of type recommended by manufacturer of gypsum board products. Fiber glass tape is not acceptable.
 - .2 Joint compound: ASTM C475 and ASTM C840, asbestos-free, all-purpose, premixed: Low-VOC, free of antifreeze, vinyl adhesives, preservatives, biocides, and other slow-releasing compounds, casein, latex base; slow setting; bedding and finishing compounds of type recommended by manufacturer of gypsum board. Standard of acceptance: CGC "Durabond" Setting Compound; Georgia-Pacific "Ready Mix" Sandable 20, 45, 90 Setting Compound; BPB Canada "ProFin" Joint Compounds or equivalent.
 - .1 For areas receiving High Build Epoxy Coatings specified under Section 09 96 59, provide Durabond 90 joint compound or equivalent.
 - .3 Mould resistant joint compound: to ASTM C475, asbestos free, mould resistant. Acceptable product: DensArmor Cote all-purpose, ready-mix joint compound, and DensArmor sandable setting compounds.
 - .4 Wall smoothing coating: sandable, high solid content, flat latex base coat designed to minimize surface texture differences between gypsum board face paper and joint compound.
 - .5 Corner and casing beads, edge trim: To ASTM C1047, Minimum 0.455 mm metal core thickness (26 gauge) galvanized sheet steel with Z275 zinc finish to ASTM A525M-86, type with perforated flanges, or metal/paper flange combination of type to be finished with joint compound.
 - .6 Coved Corner Beads: Pre-formed metal/paper profile, 19 mm inside corner radius or pre-formed metal/paper profile 38 mm outside corner. Acceptable materials: Beadex SLIC and Danish Profiles.
 - .7 Control/Expansion Joints: To ASTM C1047, Control joint #093, 3 m lengths, roll-formed zinc with a tape protected 6 mm opening, 11 mm deep.
 - .8 Gypsum Board and Sheathing Fasteners: ASTM C1002, Type S12 and GA-216.

- .9 Cementitious Board Fasteners: Board manufacturer's purpose made screws, corrosion resistant steel, self-drilling points, counter-sink heads to prevent strip-out, for steel substrate.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify existing conditions before starting work.
- .2 Verify that site conditions are ready to receive work and opening dimensions are as indicated on reviewed shop drawings.

3.2 FURRING FOR FIRE RATINGS

- .1 Install furring as required for fire resistance ratings indicated and to GA-600 requirements.

3.3 CEILING FRAMING INSTALLATION

- .1 Install in accordance with GA-216.
- .2 Coordinate location of hangers with other work.
- .3 Install ceiling framing independent of walls, columns, and above ceiling work.
- .4 Reinforce openings in ceiling suspension system which interrupt main carrying channels or furring channels, with lateral channel bracing. Extend bracing minimum 600 mm past each end of openings.
- .5 Laterally brace entire suspension system.

3.4 ACOUSTIC ACCESSORIES INSTALLATION

- .1 Comply with manufacturer's instructions for particular conditions of installation in each case.
- .2 Batts may be friction-fit in place until the interior finish is applied. Install batts to fill entire stud cavity. If stud cavity is less than 2400 mm in height, cut lengths to friction-fit against floor and ceiling tracks.
- .3 Walls with penetrations require that insulation be carefully cut to fit around outlets, junction boxes and other irregularities. Place acoustic insulation in partitions tight within spaces, around cut openings, behind and around electrical and mechanical items within or behind partitions, and tight to items passing through partitions.
- .4 Where walls are not finished on both sides or insulation does not fill the cavity depth, supplementary support must be provided to hold product in place.
- .5 Where insulation must extend higher than 2400 mm, temporary support shall be provided to hold product in place until the finish material is applied.
- .6 Install acoustic sealant at gypsum board perimeter at:
 - .1 Base Layer.
 - .2 Face Layer.
 - .3 Caulk all penetrations of partitions by conduit, pipe, duct work, and rough-in boxes.

3.5 GYPSUM BOARD INSTALLATION

- .1 Install gypsum board in accordance with GA-216 and GA-600.
- .2 Erect single layer board with ends and edges occurring over firm bearing. Provide square edge to the floor surface.
- .3 Erect single layer fire rated gypsum board, with edges and ends occurring over firm bearing.
- .4 Provide Impact-Resistant Gypsum Board to a minimum of 1.2m above finished floor level in all corridors.
- .5 Set the bottom edge of wallboard a minimum of 12 mm above finished floor level. Apply sealant in gap.,
- .6 Use screws when fastening gypsum board to metal furring or framing.
- .7 Double Layer Applications: Secure second layer to first with fasteners.
- .8 Place second layer parallel to first layer. Offset joints of second layer from joints of first layer.
- .9 Treat cut edges and holes in moisture resistant gypsum board and exterior gypsum soffit board with sealant.
- .10 Place control joints consistent with lines of building spaces.
- .11 Place corner beads at external corners. Use longest practical length. Place edge trim where gypsum board abuts dissimilar materials.
- .12 Install backing board over metal studs in accordance with manufacturer's written instructions.
- .13 Install J or U casing bead where gypsum board butts to dissimilar materials.
- .14 Install moisture resistant gypsum board behind wet wall panel system in showers and other wet areas (areas exposed to liquid and moisture).
- .15 In addition to areas noted above, install moisture resistant gypsum board at all plumbing fixture rough-in locations where plumbing penetrates wall assembly, to both sides of wall assembly and a minimum of 1200 mm each side of the penetration.

3.6 SOUND RATED/ACOUSTICALLY INSULATED PARTITIONS

- .1 Install acoustic insulation in sound rated and sound insulated partitions and ceiling assemblies, of thickness indicated or required to provide sound rating indicated.
- .2 Install insulation tight between studs, full height of partition.
- .3 Cut and trim insulation to fit tight around protrusions, electrical boxes, and other obstructions. Leave no voids or gaps. Do not compress batts.
- .4 Apply 6 mm – 9 mm round bead of acoustical sealant to seal perimeter of sound rated partitions to prevent noise transmission and to provide required sound rating
- .5 Seal sound-rated partitions:
 - .1 On both sides where facings abut dissimilar materials;
 - .2 Around perimeter, in the angle formed by panels and abutting dissimilar materials;
 - .3 At intersections;
 - .4 At panel terminations in door and window frames; and
 - .5 At control joint locations before attaching the control joint to the panels.

- .6 Seal full perimeter of openings for electrical boxes, ducts, conduit and other cut-outs and penetrations in partitions where perimeter sealed with acoustical sealant.
- .7 Seal joints around penetrations in sound rated partitions using glass fibre insulation to fill joints completely.
- .8 Apply continuous beads of acoustical sealant around all openings formed for outlets, lights, etc.
- .9 Cut gypsum panels with 3 mm maximum relief at perimeter to receive sealant. Install before sealant skins.
- .10 Extrude a full bead of acoustical sealant into each joint between first layer of wallboard and floor or other adjoining surface.
- .11 Sound dampening putty:
 - .1 Seal around back of outlet and switch boxes with sound dampening putty.
 - .2 Clean surfaces of dust, dirt and other foreign matter that may inhibit adhesion.
 - .3 Cover back and all sides of boxes with putty and overlap and seal putty to studs or back of gypsum board.
 - .4 Cut putty pads to fit and seal around conduits and wiring entering box ensuring full sound seal.
 - .5 Pleat extra material at corners.
 - .6 Press putty pads firmly against substrate ensure full adhesion and coverage.

3.7 JOINT TREATMENT

- .1 Finish in accordance with GA-214 Level 1, 4 as scheduled.
- .2 Feather coats on to adjoining surfaces so that camber is maximum 0.8 mm.
- .3 Taping, filling, and sanding is not required at surfaces behind adhesive applied ceramic tile.
- .4 Fill and finish joints and corners of cementitious backing board.

3.8 TOLERANCES

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

3.9 SCHEDULES

- .1 Level of finish for final decoration for walls and ceilings:
 - .1 Level 1: Above finished ceilings concealed from view.
 - .2 Level 4: Walls and partitions exposed to view, and where wall protection is applied.
 - .3 Level 4: Ceilings exposed to view.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Formed metal framing of studs and furring, at interior locations.
- .2 Framing accessories.
- .3 Concealed blocking for support of toilet and bath accessories, wall cabinets and door frames.
- .4 Installation of metal door frames.

1.2 RELATED SECTIONS

- .1 Section 06 10 13 – Wood Blocking and Curbing
- .2 Section 07 21 16 - Blanket Insulation
- .3 Section 08 31 13 - Access Doors and Frames
- .4 Section 09 21 16 - Gypsum Board Assemblies

1.3 REFERENCES

- .1 The versions of the standards referenced in this section are those listed in the BC Building Code, current edition at the time of the application for Building Permit; or if they are not referenced in the specified code, they are the latest version of the standard in effect at the time of the application for Building Permit.
- .2 ASTM A123/A123M - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- .3 ASTM A653/A653M - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .4 ASTM C645 - Non-Structural Steel Framing Members.
- .5 ASTM C754 - Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
- .6 ASTM C1002 - Steel Self-Piercing, Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
- .7 CAN/CGSB-1.181 - Ready-Mixed, Organic Zinc-Rich Coating.

1.4 SYSTEM DESCRIPTION

- .1 Interior Walls: Metal stud framing assembly with batt type acoustic insulation specified in Section 07 21 16, interior gypsum board specified in Section 09 21 16.
- .2 Size components to withstand an assumed average lateral pressure of 240 Pa.
- .3 Maximum Allowable Deflection: 1:180 of span.
- .4 Maximum Total Allowable Deflection: 30mm.
- .5 Wall Assembly:
 - .1 Design assembly to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.

1.5 DESIGN REQUIREMENTS

- .1 The work of this Section shall be designed by a qualified professional engineer registered or licensed in Province of B.C.
- .2 Design framing for wall, partition, and suspended ceilings assemblies to resist safely and effectively all loads and effects of seismic loads in accordance with British Columbia Building Code, latest Edition.
- .3 Design framing for walls and partitions for Acoustical Performance Requirements as indicated in Wall Type Schedule.
- .4 Conform to the Association of Wall and Ceiling Contractor's Specification Standards Manual (AWCC).

1.6 QUALITY ASSURANCE

- .1 Perform Work in accordance with ASTM C754.

1.7 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Provide shop drawings prepared under supervision of professional engineer registered in the Province of British Columbia.
 - .1 Shop drawings for seismic restraint of partitions shall be sealed by a professional engineer registered in the Province of British Columbia.
 - .2 Indicate prefabricated work, component details, stud layout, and accessories or items required of other related work.
 - .3 Describe method for securing studs to tracks, and for blocking and reinforcement to framing connections.
 - .4 Provide calculations for loadings and stresses of specially fabricated framing, under the Professional Structural Engineer's seal.
- .3 Letters of Assurance:
 - .1 The Engineer sealing the shop drawings shall submit to the Consultant, as required by the BC Building Code, the following:
 - .1 Schedule B-1 Assurance of Professional Design and Commitment for Field Review.
 - .2 Schedule B-2 Summary of Design and Field Review Requirements.
 - .3 Schedule C-B Assurance of Professional Field Review and Compliance.
 - .4 The Engineer sealing the shop drawings shall provide field reviews of the installation and shall provide sufficient reviews in order to provide letters of professional assurance. Written inspection reports shall be submitted to the Consultant promptly as field reviews occur.

1.8 ADMINISTRATIVE REQUIREMENTS

- .1 Section 01 30 00 - Coordination:
 - .1 Coordinate with other work having a direct bearing on work of this section.

Part 2 Products

2.1 RECYCLED CONTENT

- .1 Steel stud, furring, and suspension materials: Minimum 25% post-consumer, 50% post-industrial, 75% total recycled content.

2.2 STUD FRAMING MATERIALS

- .1 Framing Assembly Components: ASTM C645.
- .2 Typical walls: ASTM A653/A653M, non-load bearing rolled steel, channel shaped, punched for utility access, depth as scheduled. Typical walls: 0.792mm (20 ga.) steel studs.
 - .1 Walls supporting wall-hung millwork or similar elements: minimum 0.9 mm (20 ga.) steel studs, unless otherwise determined by metal stud framing design Engineer.
 - .2 Walls supporting heavy loads (e.g. sinks and equipment): minimum 1.2 mm (18 ga.) steel studs.
 - .3 Walls in offices and similar areas not requiring extensive services: as per 2.2.2.1.
 - .4 Provide thicker gauge studs where required by engineering design.
 - .5 Acoustic (STC-rated) walls: as per 2.2.2.1.
 - .1 Acoustic Walls supporting wall-hung elements: Provide additional support framing designed by the metal stud framing design Engineer to be independent of wall studs to support wall-hung loads. Additional support framing shall be designed to not degrade the acoustical properties of the wall assembly.
 - .2 Tracks and Headers: Same material and thickness as studs, bent leg retainer notched to receive studs.
 - .3 Deflection Tracks: 50 mm high "U" shaped tracks or nested tracks.
 - .4 Furring Channels and Bracing Members: "Hat" shaped. Size: 70 mm wide x 22 mm deep; 35 mm face width. Thickness to suit purpose. Channels to have knurled face and hemmed legs.
 - .5 Fasteners: ASTM C1002, self-drilling, self-tapping screws.
 - .6 Sheet Metal Backing: 1.2 mm thick galvanized steel plate To ASTM A924, galvanized to ASTM A853, Z180 coating.
 - .7 Acoustic Sealant: As specified in Section 09 21 16.
 - .8 Touch-Up Primer for Galvanized Surfaces: CAN/CGSB 1.181.

2.3 FABRICATION

- .1 Fabricate assemblies of framed sections to sizes and profiles required.
- .2 Fit, reinforce, and brace framing members to suit design requirements.
- .3 Fit and assemble in largest practical sections for delivery to site, ready for installation.

2.4 FINISHES

- .1 Studs:
 - .1 Galvanize to minimum Z180 (G60) coating class.
- .2 Tracks and Headers: Same finish as studs.
- .3 Accessories: Same finish as framing members.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify that rough-in utilities are in proper location.

3.2 ERECTION

- .1 Align and secure top and bottom runners at 600 mm on centre.
- .2 Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.
- .3 Install studs vertically as scheduled.
- .4 Align stud web openings horizontally.
- .5 Secure studs to tracks. Do not weld.
- .6 Stud splicing: Not permissible.
- .7 Fabricate corners using a minimum of three studs.
- .8 Double stud at wall openings, door and window jambs, not more than 50 mm from each side of openings.
- .9 Install pressed steel door frames and pressed steel glazed light frames.
- .10 Brace stud framing assembly rigid.
- .11 Coordinate erection of studs with requirements of door frames, window frames, and access panels; install supports and attachments.
- .12 Wood blocking:
 - .1 Install wood blocking specified in Section 06 10 13 to steel stud cavities at all millwork locations.
- .13 Unless indicated otherwise construct partitions full-height extending through the ceiling to the structure above. Refer to Drawings for indication of partitions extending to finished ceiling only. Maintain clearance under structural building members to avoid deflection transfer to studs. Provide extended leg ceiling runners.
- .14 Coordinate placement of insulation in stud spaces after stud frame erection.

3.3 IMPACT RESISTANT WALL BOARD

- .1 Studs complying with ASTM C645 receiving ARGWB or IRGWB shall be not less than 0.792mm thick (20 ga.).

3.4 ERECTION TOLERANCES

- .1 Section 01 73 00: Tolerances.
- .2 Maximum Variation from True Position: 3 mm in 3 m.
- .3 Maximum Variation from Plumb: 3 mm in 3 m.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Porcelain Wall tile

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)
 - .1 ANSI A108/A118/A136.1:2017, American National Specifications for the Installation of Ceramic Tile
 - .2 Terrazzo Tile and Marble Association of Canada (TTMAC)
 - .1 Tile Maintenance Guide.
 - .2 Tile Specification Guide 09 30 00, Tile Installation Manual.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals and product data in accordance with Section 01 33 00- Submittal Procedures.
- .2 Include manufacturer's information on:
 - .1 Porcelain tile, marked to show each type, size, and shape required.
 - .2 Chemical resistant mortar and grout (Epoxy and Furan).
 - .3 Latex cement mortar and grout.
 - .4 Commercial cement grout.
 - .5 Organic adhesive.

1.4 ENVIRONMENTAL CONDITIONS

- .1 Maintain air temperature and structural base temperature at ceramic tile installation area above 10°C for 48 hours before, during, and 48 hours after, installation.

1.5 MAINTENANCE DATA

- .1 Submit maintenance data for tile for incorporation into maintenance manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Include list of materials used on project by definition and manufacturer for setting materials, grouts, sealers and cleaning compounds. Provide recommended maintenance materials and procedures including stain removal.
- .3 Include one copy of the latest edition of the TTMAC Maintenance Guide.

1.6 EXTRA MATERIALS

- .1 Provide extra materials consisting one full carton of each colour of tile installed on project.
- .2 Extra materials to be same production run as installed materials. Package each type of tile separately and mark each package as to contents.
- .3 Deliver maintenance materials to site and store where directed. Provide written receipt, signed by Construction Contractor, verifying delivery.

1.7 WASTE MANAGEMENT AND DISPOSAL

- .1 Comply with Section 01 74 00 - Cleaning and Waste Processing

Part 2 Products

2.1 TILE

- .1 Porcelain Wall Tile:
 - .1 **PT-1** Porcelain Daltile Tile
Series: Color Wheel
Pattern: Color Wheel Linear
Size: 4" X 12"
Finish: Matte Emerald,
Color Code: 0715
Epoxy Grout: Ardex WA Epoxy,
Colour: Silver Shimmer - 19
 - .2 For tile exhibiting colour variations within each type or series, verify that tile has been blended in factory and packaged accordingly so that tile units taken from one package show the same range in colours as those take from other packages of same type and series. If not factory-blended, either return to manufacturer for blending or blend tiles at project site before installing.

2.2 MORTAR AND ADHESIVE MATERIALS

- .1 Latex-Portland cement mortar: to ANSI A118, premixed polymer modified mortar requiring only the addition of water.
 - .1 Acceptable material: Mapei Ultraflex, Flextile Versatile 52, Laticrete 254,
- .2 Water: potable and free of minerals that are detrimental to mortar and grout mixes.

2.3 GROUT

- .1 Epoxy grout: to ANSI A118, 100% solids, two-component, stain resistant, water-soluble, two-component epoxy grout. Having colour and characteristics to match epoxy bond coat. Colours selected by the Design Consultant.:

2.4 ACCESSORIES

- .1 Sealant: as specified in Section 07 92 00 - Joint Sealing.
- .2 Grout sealer: silicone based, clear, low viscosity penetrating sealer of type recommended by grout manufacturer.
- .3 Metal edge protection:
 - .1 Schluter Jolly A80AT

Part 3 Execution

3.1 EXAMINATION

- .1 Verify existing conditions are ready to receive work.

3.2 PREPARATION

- .1 Protect surrounding work from damage or disfiguration.

- .2 Prepare surfaces in accordance with manufacturer's instructions whose setting materials or additives are being used.
- .3 Prime substrate when recommended by manufacturer.
- .4 Caulk plumbing penetrations and abutments to dissimilar materials with flexible sealant.

3.3 APPLICATION

- .1 Do tile work in accordance with TTMAC Tile Installation Manual, except use more stringent requirements of manufacturer or these specifications.
- .2 Apply tile to clean and sound surfaces.
- .3 Fit tile around corners, fitments, fixtures, and other built-in objects. Maintain uniform joint appearance. Cut edges smooth and even.
- .4 Maximum surface tolerance 1:800.
- .5 Make joints between tile uniform, plumb, straight, true, even, and flush with adjacent tile. Ensure sheet layout not visible after installation. Align patterns.
- .6 Lay out tiles so perimeter tiles are minimum 1/2 size.
- .7 Spread setting materials using properly sized trowels matched to tile sizes and setting materials, as recommended in TTMAC Tile Installation Manual.
- .8 Ensure bond material coverage of at least 95% and that material is evenly disbursed over back of tile. Ensure corners and edges are fully supported by bonding material.
- .9 Twist and slide tile firmly into position to ensure proper bond.
- .10 Keep 2/3 of depth of grout joints free of setting material.
- .11 Allow minimum 24 h after installation of tiles, before grouting.
- .12 Force grout into joints to ensure dense finish.
- .13 Clean installed tile surfaces after installation and grout has cured. Follow manufacturer's recommendations for grout and residue removal.
- .14 Apply grout sealer to grouted joints after grout is cured and dry.
- .15 Protect wall tiles and bases from impact, vibration, heavy hammering on adjacent and opposite walls for at least 14 days after installation.

3.4 WALL TILE

- .1 Mortar: latex-Portland cement mortar.
- .2 Grout: Epoxy Grout. Mapei 27 Silver
- .3 Make joints approximately 3 mm wide.
- .4 Make internal angles square.
- .5 Provide metal edge strips where ceramic tile abuts floor base, and at external corners.

3.5 CLEANING

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

- .3 Waste Management: separate waste materials for in accordance with Section 01 74 21-
Construction Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at
appropriate facility.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Suspended metal grid ceiling system and perimeter trim.
- .2 Acoustic panels.

1.2 RELATED SECTIONS

- .1 Section 09 21 16 – Gypsum Board Assemblies
- .2 Section 21 10 00 - Fire Suppression Sprinkler Systems
- .3 Section 23 37 00 - Air Outlets.
- .4 Section 26 50 00: Light fixtures in ceiling system.
- .5 Division 27: Speakers, cameras, microphones, DAS Antennas, WIFI access points, and other telecommunication and multimedia equipment in ceiling system.
- .6 Section 28 31 00 - Fire Alarm and Voice Communication.

1.3 REFERENCES

- .1 The versions of the standards referenced in this section are those listed in the BC Building Code, current edition at the time of the application for Building Permit; or if they are not referenced in the specified code, they are the latest version of the standard in effect at the time of the application for Building Permit.
- .2 ASTM A641 – Specification for Steel Sheet, Zinc-Coated (galvanized) Carbon Steel Wire
- .3 ASTM A653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galv-annealed) by the Hot-Dip Process
- .4 ASTM A1008 – Standard Specification for Steel, Sheet, Cold Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
- .5 ASTM C635 - Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
- .6 ASTM C636/C636M - Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.

- .7 ASTM D610 – Standard Test Method for Evaluating Degree of Rusting on Painted Steel Surfaces
- .8 ASTM E580/E580M - Application of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Requiring Moderate Seismic Restraint.
- .9 ASTM E1264 - Classification of Acoustical Ceiling Products.
- .10 CAN/ULC-S702-14 - Standard for Mineral Fibre Thermal Insulation for Buildings.
- .11 CISCA (Ceilings & Interior Systems Construction Association) – Ceilings Systems Handbook
- .12 CISCA (Ceilings & Interior Systems Construction Association) – Acoustical Ceilings – Use and Practice
- .13 CISCA (Ceilings & Interior Systems Construction Association) – Guidelines For Seismic Restraint Direct Hung Suspended Ceiling Assemblies
- .14 International Code Council-Evaluation Services Report - Seismic Engineer Report
- .15 AWCCBC (Association of Wall and Ceiling Contractors of British Columbia).
- .16 UL - Fire Resistance Directory.
- .17 ULC-FR-14 - Fire Resistance Directory (2014 Edition).
- .18 Ceiling finish for infection control purposes will comply with Section 5.7.1 and CSA Z8000-18, Section 12.2.5.4 Ceilings.

1.4 SYSTEM DESCRIPTION

- .1 Suspension System: Rigidly secure acoustic ceiling system including integral mechanical and electrical components with maximum deflection of 1:240.

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Sequencing:
 - .1 Sequence work to ensure acoustic ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
 - .2 Install acoustic units after interior wet work is dry.

1.6 DESIGN REQUIREMENTS

- .1 Suspension systems for acoustic tile shall be designed by a Professional Engineer registered in British Columbia to conform to the seismic restraint requirements of ASTM E580 Standard Practice for Application of Ceiling Suspension Systems for Acoustical Tile and Lay in Panels. Seismic requirements shall be in accordance with the B.C. Building Code.

1.7 SUBMITTALS FOR REVIEW

- .1 Product Data: Provide data on metal grid system components, acoustic units and moldings.
- .2 Samples: Submit two (2) samples full size illustrating material and finish of acoustic units. Provide one sample to consultant and one to field office.
- .3 Samples: Submit two (2) samples each, 300 mm long, of each suspension system type main runner, cross runner and perimeter moldings. Provide one sample to consultant and one to field office.

- .4 Provide shop drawings prepared under supervision of professional engineer registered in the Province of British Columbia. Indicate grid layout and related dimensioning, junctions with other work or ceiling finishes, seismic bracing, interrelation of mechanical and electrical items related to system.

1.8 QUALITY ASSURANCE

- .1 Conform to AWCCBC requirements.

1.9 LETTERS OF ASSURANCE

- .1 Have the Engineer responsible for sealing the engineered shop drawings submit to the Consultant, British Columbia Building Code Schedule B-1 Assurance of Professional Design and Commitment for Field Review and Schedule B-2 Summary of Design and Field Review Requirements with the shop drawings.
- .2 Engineer to provide field review of the installation and submit to the Consultant British Columbia Building Code Schedule C-B Assurance of Professional Field Review and Compliance upon completion of the work.

1.10 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Stock Materials: Refer to Section 01 78 30.

1.11 ENVIRONMENTAL REQUIREMENTS

- .1 Maintain uniform temperature of minimum 16 degrees C, and maximum humidity of 40 percent prior to, during, and after acoustic unit installation.

Part 2 Products

2.1 MANUFACTURERS - SUSPENSION SYSTEM

- .1 Acceptable Materials/Products: Certain Teed Ceilings, Web: www.certainteed.com/ceilings
 - .1 Alternates may be considered.
- .2 Other manufacturers offering products meeting or exceeding specified products, colours, patterns, and requirements may be considered. Proposed substitutions shall closely match scheduled colours and patterns or they may be rejected by the Consultant.

2.2 MATERIALS - SUSPENSION SYSTEM

- .1 Non-fire Rated Grid:
 - .1 ASTM C635, intermediate duty; exposed T; components die cut and interlocking.
 - .2 Provide ASTM C635, heavy duty exposed T grid system where required by ceiling panel manufacturer.
- .2 Grid Materials: Commercial quality cold rolled steel with galvanized coating.
- .3 Grid Finish: Steel: Colour as scheduled by Consultant.
- .4 Exposed Grid Surface Width: 24 mm (15/16 inch). Refer to drawings for locations.
- .5 Accessories: perimeter moldings: Manufacturer's standard angle molding, and perimeter molding.
- .6 Support Channels and Hangers: Galvanized steel; size and type to suit application and ceiling system flatness requirement specified.
 - .1 Tie wire: ASTM A641 / A641M

- .1 Diameter: minimum 1.291 mm;
- .2 Coating: Class 1 zinc
- .3 Coating: Class 1 zinc; and Tempered soft
- .2 Wire hangers: ASTM A641 / A641M
 - .1 Diameter: minimum 3.26 mm;
 - .2 Coating: Class 1 galvanized; and Tempered soft
- .3 Furring anchorages: ASTM C754
 - .1 Diameter: minimum 1.291 mm;
 - .2 Coating: galvanized; and Standard wire type clips, bolts, nails or screws.
- .4 Hanger attachments:
 - .1 Composite deck anchors: "X-CW Ceiling Wire Assembly" by Hilti or acceptable alternative as reviewed by the Authority; and
 - .2 Attachment to structural steel components: comply with ASTM C754.
- .5 Carrying channels: ASTM C645, cold-rolled commercial-grade steel.
 - .1 Minimum base metal thickness: 0.455 mm, not painted(a).5.1.1 GWB thickness: 0.836 mm (white)
 - .2 Dimensions of primary carrying member in suspended ceilings and of horizontal stiffeners or bracing in metal stud systems: 38 mm in height with 19 mm flanges.
- .7 Grid Suspension System for Ceilings:
 - .1 ASTM C645-compliant direct-hung system composed of commercial-quality, cold-rolled steel main beams and cross-furring members that interlock with the following characteristics:
 - .1 Main tees: fire-rated heavy duty classification with integral reversible splice with knurled face;
 - .2 Cross members: fire-rated members with knurled face;
 - .3 Cross tees: 38 mm in height by 1220 mm nominal in length with 38 mm face;
 - .4 Accessory cross tees: complete with knurled faces;
 - .5 Wall mouldings: single web with knurled face;
 - .6 Accessories: transition clips, splice clips, wall attachment clips, splice plates and dome hubs for specific applications;
 - .7 Finish: hot-dip galvanized.
 - .8 Hold Down Clips: Purpose made steel clips to hold down ceiling tile.
 - .9 Seismic Accessories: Accessories, mouldings, braces and clips to provide seismic restraint.

2.3 MANUFACTURERS - ACOUSTIC UNITS

- .1 Acceptable Materials/Products:
 - .1 Refer to drawings for locations
 - .2 Materials noted in item 2.4. below.
- .2 Other manufacturers offering products meeting or exceeding specified products, colours, patterns and requirements may be considered. Proposed substitutions shall closely match scheduled colours and patterns, or they may be rejected by the Consultant.

2.4 MATERIALS – ACOUSTICAL UNITS

- .1 Acoustical Ceiling Tiles – **ACT-1:**
 - .1 Manufacturer: Armstrong
 - .2 Product Line: Ultima lay-in, High NRC .85/ CAC 35
 - .3 Size: 610 mm x 1220 mm x 19mm
 - .4 Type Number 2083
 - .5 Edge: Square lay-in 24mm
 - .6 Suspension system: Prelude ML 24mm Exposed Tee, white
 - .7 Or approved alternate.
- .2 Acoustical Ceiling Tiles – **ACT-2:**
 - .1 Manufacturer: Armstrong
 - .2 Product Line: Armstrong Kitchen Zone 672
 - .3 Size: 610 mm x 1220 mm x 16mm
 - .4 Edge: Square
 - .5 Color: White
 - .6 Class A Fire Rating
 - .7 Suspension system: Armstrong Prelude XL15/16" Exposed Tee, white
 - .8 Or approved alternate.

Refer to drawings for location.

2.5 DESIGN CRITERIA

- .1 Maximum deflection of L/360 of span to ASTM C635 deflection test
- .2 Finished ceiling suspension systems shall be square with adjoining walls and level within 1:1000
- .3 Complete suspension systems shall support all superimposed loads, such as lighting fixtures, diffusers grilles and speakers. Provide additional hangers as necessary. Coordinate with work of other Subcontractors.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify that layout of hangers will not interfere with other work.

3.2 INSTALLATION - LAY-IN GRID SUSPENSION SYSTEM

- .1 Install suspension system to manufacturer instructions and ASTM C636, and as supplemented in this section.
- .2 Install system capable of supporting imposed loads to a deflection of 1/240 maximum.
- .3 Locate system on room axis according to reflected plan.
- .4 Install after major above ceiling work is complete. Coordinate the location of hangers with other work.
- .5 Provide hanger clips during steel deck erection. Provide additional hangers and inserts as required.
- .6 Coordinate ceiling installation with light fixtures.

- .7 Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- .8 Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- .9 Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability. Support fixture loads by supplementary hangers located within 150 mm of each corner; or support components independently.
- .10 Do not eccentrically load system or produce rotation of runners.
- .11 Perimeter Molding:
 - .1 Install edge molding at intersection of ceiling and vertical surfaces.
 - .2 Use longest practical lengths.
 - .3 Mitre corners.
 - .4 Provide at junctions with other interruptions.

3.3 INSTALLATION - ACOUSTIC UNITS

- .1 Fit acoustic units in place, free from damaged edges or other defects detrimental to appearance and function.
- .2 Lay directional patterned units one way with pattern parallel to longest room axis. Fit border trim neatly against abutting surfaces.
- .3 Install units after above ceiling work is complete.
- .4 Install acoustic units level, in uniform plane, and free from twist, warp, and dents.
- .5 Cutting Acoustic Units:
 - .1 Cut to fit irregular grid and perimeter edge trim.
 - .2 Cut square reveal edges to field cut units.
- .6 Lay acoustic insulation for a distance of 1200 mm either side of acoustic partitions that do not extend full height to underside of structure above.

3.4 ERECTION TOLERANCES

- .1 Maximum Variation from Flat and Level Surface: 3 mm in 3 m.
- .2 Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

3.5 SCHEDULE

- .1 Refer to Drawings for locations.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Rubber resilient athletic flooring complete with logo as indicated.

1.2 RELATED SECTIONS

- .1 Section 03 30 00 – Cast-In-Place Concrete -refer to Structural Drawings
- .2 Section 08 71 00 – Door Hardware: Thresholds.

1.3 INFORMATIONAL SUBMITTALS

- .1 Submit samples in accordance with Section 01 33 00 – Submittal Procedures
- .2 Submit duplicate 300 mm X 300 mm sample pieces of Stamina.
- .3 Submit Safety Data Sheets for installation adhesives, cleaners and sealers.
- .4 Submit layout drawing of flooring sheets to Consultant for review prior to starting any work.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit three copies of the following:
 - .1 Manufacturer maintenance instructions.
 - .2 Manufacturer material warranty.
 - .3 Installer installation warranty.

1.5 QUALITY ASSURANCE

- .1 Floor System Manufacturer Qualifications.
 - .1 Manufacturer shall be an established firm experienced in field and have been in business for a minimum of ten (10) years; North West Rubber Sportfloor® or an approved equal.
- .2 Floor Contractor / Installer Qualifications.
 - .1 Flooring contractor shall be experienced in the flooring field and approved by the manufacturer.
 - .2 Flooring contractor shall be proficient in installing this type of rubber flooring and have completed at least three projects of similar magnitude and complexity.

1.6 EXTRA MATERIALS

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

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver Stamina flooring undamaged with manufacturer's labels intact.
- .2 Store Stamina in a protected area on site a minimum of 48 hours prior to installation in order to acclimatize to room conditions. (Extreme cold or hot climate may require additional time.)
- .3 Store Stamina materials flat, blocked off floor.
- .4 Prevent damage or contamination to Stamina from water, moisture, freezing, excessive heat, direct sunlight and construction dust or dirt.
- .5 Protect flooring materials from construction activities. Provide tarpaulins or plastic coverings blocked to allow ventilation and prevent contamination from dust or debris.

1.8 ENVIRONMENTAL REQUIREMENTS

- .1 Do not install when the moisture vapor emission rate (MVER) exceeds 2.27 kg per 92.9 m² (5 lbs per 1,000 sq.ft) per 24 hours, when using the anhydrous calcium chloride test (ASTM F1869).
- .2 Do not install when the relative humidity of concrete slabs exceeds 75% (ASTM F2170).
- .3 Use only when the substrate temperature is between 10°C and 32°C (50°F and 90°F), and when the ambient relative humidity is below 65%.

1.9 FIELD CONDITIONS

- .1 Product Installation:
 - .1 Maintain temperatures during installation within range recommended by manufacturer, but not less than 65 deg F (18 deg C) in spaces to receive flooring 48 hours prior, during and 48 hours after installation.
 - .2 After installation, maintain temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 85 deg F (29 deg C).
 - .3 Prohibit traffic during flooring installation and for at least 48 hours after flooring installation.
- .2 Install flooring only after other finishing work, including painting and overhead work, has been completed.

1.10 WARRANTY

- .1 Supply manufacturer's standard limited warranty against defects in materials or workmanship prorated for 5 years for Stamina mat from date of sale with the Original Purchaser.
- .2 Warranty is void if damaged or irregular materials have been installed without prior notification and adjustments made by manufacturer.
- .3 Warranty is not applicable in heavy use areas, (i.e., players' benches, penalty boxes, pivot points or other areas where excessive wear will occur because of the nature of use).

Part 2 Products

2.1 MANUFACTURERS

- .1 Basis-of-Design Manufacture: Subject to compliance with requirements, provide North West Rubber Sports Flooring installed with full-spread adhesive. Contact North West Rubber 437-216- 0423, Aiden Jeckel or approved equal. **RT** in Room Finish Schedule.

2.2 MATERIALS

- .1 Rubber Flooring:
 - 1. Construction: 100% recycled vulcanized rubber throughout.
 - 2. Size: 1.22 m x 1.83 m
 - 4. Thickness: 10mm
 - 5. Texture: Smooth top, textured bottom.
 - 6. Color: Black with EPDM rubber color speckles added. Allow for 5 colors, to be confirmed with client.

- .2 Material Properties:

Hardness Shore A	ASTM D2240	75 +/- 5
Wear Layer Thickness	ASTM F410	>.050 (Passes)
Static Load Resistance	ASTM F970	0.002 (Passes)
Resistance to Chemicals	ASTM F925	Good
Resistance to Heat	ASTM F1514	4.29 (Passes)
Abrasion Resistance	ASTM D3389	0.16 gr. (Passes)
Dimensional Stability	ASTM F2199	0.12 (Passes)
Critical Radiant Flux	ASTM E648-03	Class II
Co-efficient of Friction	ASTM C1028	>.80 dry >.64 wet
Moisture Absorption	ASTM D570	0.27%
Thickness	ASTM F386	Avg. 0.002 Passes
Size	ASTM F2055	Avg. 0.004 Passes
Squareness	ASTM F2055	Avg. 0.003 Passes
Quality of Cut	ASTM F511	Avg. 0.003 Passes
Qualifies for LEED Points		Yes
Anti-microbial/Anti-fungal Properties		Yes

- .3 Acceptable product: SportFloor® Stamina mat as manufactured by: North West Rubber, 33850 Industrial Avenue, Abbotsford, BC Canada V2S 7T9
 Phone: 1-800-663- 8724 Fax: 1-604-859-2009 Email: marketing@northwestrubber.com.

2.3 ACCESSORIES

- .1 Beveled Edging: Black rubber transition ramp edging as available from flooring manufacturer.
- .2 Adhesive: SportFloor® 1 or 2-part Urethane Adhesive as recommended by

- .3 manufacturer for Stamina.
Trowelable patching compound for standard slab surface preparation: Latex-modified, hydraulic-cement-based formulation provided by flooring manufacturer.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify the Following:
 - .1 The area in which the indoor resilient athletic flooring will be installed is dry, weather-tight and in compliance with specified requirements.
 - .2 Permanent heat, lighting and ventilation systems are installed and operable.
 - .3 Other work, including overhead work, that could cause damage, dirt, dust or otherwise interrupt installation has been completed or suspended.
 - .4 No foreign materials or objects are present on the substrate and that it is clean and ready for preparation and installation.
 - .5 Tests to verify that the moisture evaporative rate or substrate relative humidity is within the specified ranges.
 - .6 The concrete slab surface pH level is within the specified range.
 - .7 The concrete slab surface deviation is no greater than 3.2 mm within 3 m when measured according to ASTM E 1155.

3.2 PREPARATION

- .1 Prepare substrates according to manufacturer's written recommendations to ensure proper adhesion of resilient athletic flooring system.
- .2 Concrete Substrates: Prepare according to ASTM F 710.
 - .1 Verify that substrates are dry and free of sealers, curing compounds and other additives. Remove coatings and other substances that are incompatible with adhesives using mechanical methods recommended by manufacturer.
 - .2 Alkalinity Testing: Perform pH testing according to ASTM F 710. Proceed with installation only if pH readings are between 7.0 and 8.5.
- .3 Moisture Testing: Perform ASTM F -1869 relative humidity test and proceed with installation only after substrates have maximum relative humidity (RH) of 95%
- .4 Place flooring and installation materials into spaces where they will be installed at least 48 hours before installation. Install flooring materials only after they have reached the same temperature as space where they are to be installed.
- .5 Sand the surface of the concrete slab.
- .6 Sweep and then vacuum substrates immediately before installation. After cleaning, examine substrate for moisture, alkaline salts, grit, dust or other contamination. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 SHEET ATHLETIC FLOORING INSTALLATION

- .1 General:
 - .1 Comply with resilient athletic flooring manufacturer's installation instructions.
 - .2 Take necessary precautions to minimize noise, odors, dust and inconvenience during installation.
 - .3 Installation of flooring should not begin until the work of all other trades has been completed, especially overhead trades.
 - .4 Examine floor areas to be covered and report any deficiencies to the contractor. Do not proceed with installation until substrates and conditions comply with manufacturer's requirements for installation.
 - .5 Ensure floor substrate is clean and dry by using test methods recommended by flooring manufacturer.
 - .6 Ensure building area for flooring application is maintained at minimum 15° C (60°F), maximum 24°C (75°F) and at maximum 65% relative humidity for minimum 48 hours before installation, during installation and for minimum 72 hours after completion of work.
 - .7 Fit flooring neatly and tightly to vertical surfaces, equipment anchors, floor outlets, and other interruptions of floor surface.
 - .8 Extend flooring into toe spaces, door reveals, closets, and similar openings unless otherwise indicated.
- .2 Lay out flooring as follows:
 - .1 Minimize number of seams and place them inconspicuous areas.
 - .2 Locate seams as shown on approved Shop Drawings
- .3 Adhered Flooring: Attach products to substrates using a full-spread of adhesive applied to substrate to comply with adhesive and flooring manufacturer instructions.

3.4 LOGO

- .1 Lay out logo as indicated on drawings.
- .2 Logo, cut pieces from colored tiles to be insert into the flooring material, colors to be confirmed.

3.5 CLEANING AND PROTECTION

- .1 Perform the following operations after completing resilient athletic flooring installation:
 - .1 Initial Cleaning: Refer to Manufacturer's printed Installation Manual for cleaning procedures.
 - .2 Do not proceed with cleaning until 72 hours minimum for glued down installations.
 - .3 Remove marks and blemishes from flooring surfaces.
 - .4 Sweep and then vacuum flooring.
- .2 Prohibit foot traffic on floor for 24 hours after installation.
- .3 Protect flooring from abrasions, indentations, and other damage from subsequent operations and placement of equipment, during remainder of construction period.
- .4 Provide ventilation to installation area during installation and for minimum 72 hours after completion of work.

- .5 Other Trades: It is the responsibility of the general contractor to protect the surface from damage by other trades before acceptance by the owner or the owner's authorized agent.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Resilient sheet flooring vinyl.
- .2 Resilient flash-cove and rubber base.

1.2 RELATED SECTIONS

- .1 Section 09 21 16 - Gypsum Board Assemblies: Wall materials to receive application of base.

1.3 REFERENCES

- .1 The versions of the standards referenced in this section are those listed in the BC Building Code, current edition at the time of the application for Building Permit; or if they are not referenced in the specified code, they are the latest version of the standard in effect at the time of the application for Building Permit.
- .2 ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
- .3 ASTM F1861- Resilient Wall Base.
- .4 ASTM F1913 - Vinyl Sheet Floor Covering Without Backing.
- .5 ASTM F1344 - Homogeneous vulcanized rubber, type 1, grade 1
- .6 CAN/ULC S102 - Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .7 ASTM D 2047 - Static coefficient of friction
- .8 ASTM F1303 - Standard Specification for Sheet Vinyl Floor Covering with Backing
- .9 ASTM F 1066 - Standard Specification for Vinyl Composition Floor Tile
- .10 United States Environmental Protection Agency (EPA) Standards for acceptable VOC concentration and emission rates.
- .11 National Floor Covering Association (NFCA) Specification Standards Manual. US Federal Specification RR-T-650d.
- .12 ASTM F710 - 19 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring

1.4 SUBMITTALS FOR REVIEW

- .1 Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns and colours available.
- .2 Samples:
 - .1 Submit two (2) samples, 300 x 300 mm in size illustrating colour and pattern for each floor material for each colour specified. Provide one sample to consultant and one to field office.
 - .2 Submit two (2) 300 mm long samples of base and stair material for each colour specified. Provide one sample to consultant and one to field office.

1.5 CLOSEOUT SUBMITTALS

- .1 Operation and Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Stock Materials: 10% of material for maintenance.

1.7 DELIVERY, STORAGE, AND PROTECTION

- .1 Protect roll materials from damage by storing on end.
- .2 Store all materials within the manufacturer's product data sheet temperature range.

1.8 SITE CONDITIONS

- .1 Store materials for three (3) days in area of installation to achieve temperature stability.
- .2 Maintain ambient temperature required by adhesive manufacture three (3) days prior to, during and forty-eight (48) hours after installation of materials.

1.9 QUALITY ASSURANCE

- .1 Installer qualifications: engage an installer who has no less than 3 years experience in installation of systems similar in complexity to those required for this project. Installers must be certified and in good standing with the flooring manufacturer to install any specified products.
- .2 All preparation, materials, and workmanship will be in strict accordance with NFCA requirements and material manufacturer's written recommendations and detail requirements for conditions of work that apply, and guarantee / Warranty Periods noted herein. Comply with the NFCA Specification Standards Manual.
- .3 Any preparation, materials, and workmanship that do not meet NFCA requirements will be repaired or replaced in accordance with Quality Assurance requirements at no additional cost to the Authority.
- .4 All Work will be done under the Quality Assurance (QA) Program and will be reviewed in strict accordance with NFCA QA requirements by a qualified inspection agency assigned by the Provincial Floor Covering Trade Association having jurisdiction.

Part 2 Products

2.1 MATERIALS – RESILIENT SHEET FLOORING

- .1 Resilient sheet flooring:
 - .1 Homogeneous sheet vinyl, colour and pattern dispersed uniformly throughout full thickness of product, 2.0 mm thick.
 - .2 Acceptable material: Altro
 - .3 Colour of heat welded seams as manufacturer recommendation; provide sample for consultant review.
- .2 Resilient Sheet Flooring, non-skid-wet rooms: Manufacture: Altro, Aquarius resilient flooring type **RF-1**

2.2 MATERIALS – FLASH-COVE (INTEGRAL BASE)

- .1 Resilient Sheet Flash Cove – Colour as per 2.1.1. above. Pattern as per finishes plan.
- .2 Form flash coved bases 150 mm high, straight cut, with cove former, finished with metal J-cap and apply silicone caulking to any gaps to address infection control requirements.
- .3 Pre-Fabricated Cove Base: fabricated from same materials and dye lots as resilient flooring, in maximum practical lengths, with 38 mm x 38 mm formed aluminum reinforcing bonded to back of base material.

- .1 Acceptable Manufacturers:
 - .1 [FlashCove](#) Prefabricated Bases Inc., Telephone: 905-475-0915

2.3 MATERIALS – RUBBER BASE

- .1 Rubber Base (**RB-1**) – Johnsonite –Location as per finishes plan.
- .2 Resilient Base: to ASTM F1861, and as follows:
 - .1 Type: TP – rubber, thermoplastic
 - .2 Group: 1 – solid
 - .3 Style: B – Cove
 - .4 Thickness: 3.17 mm.
 - .5 Height: 150mm
 - .6 Colour to be selected.
 - .7 Length: 36.5 meter rolls.

2.4 ACCESSORIES

- .1 Subfloor filler and leveller: trowelable non-shrink, water resistant, cementitious underlayment. Minimum compressive strength 4200 P.S.I. (29 Mpa) after 28 days cure.
 - .1 Acceptable material: Elsro Ardex K-55, Mapei Plani/Patch, EP Para-Patch System.
 - .2 Gypsum based products are not permitted.
- .2 Alternative leveller: Johnsonite Subfloor Leveller system, LS-40-D.
- .3 Caulking: Altro Gunnseal; colour selected by Consultant
- .4 Transitions Strips: at resilient flooring to connecting floor material: Resilient flooring to be flush with adjacent material. Prepare floor for flooring installation by feathering back minimum of 2'-0" from connection, or as required. Acceptable material: Schluter, Schiene, brushed stainless steel.
- .5 Edge strips, reducers, thresholds: rubber or vinyl, manufacturer's standard, colours selected from full range by Consultant.
- .6 Heat Welding Rods: by same manufacturer as sheet flooring. Colours to match manufacturer's recommended weld rod. Allow for multiple colour selection.
- .7 Cove Former: type recommended by resilient flooring material manufacturer and sized to suit.
- .8 Primers: Waterproof, low-VOC emitting; types recommended by flooring manufacturer.
- .9 Adhesives: Solvent based, water soluble, low-VOC emitting; types recommended by flooring manufacturer.
- .10 Metal cove cap. Provide flash-cove floor base at all locations with vinyl or rubber flooring. Flash cove base will be straight cut, with cove former, finish with metal J-cap and apply silicone caulking to any gaps.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify concrete floors are dry to a maximum moisture content of 7 percent and alkalinity limit of pH 9, and exhibit negative carbonization, or dusting. Refer to manufacturer's guidelines for environmental requirements.

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

3.2 PREPARATION

- .1 Remove sub-floor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with sub-floor filler to achieve smooth, flat, hard surface.
- .2 Prohibit traffic until filler is cured.
- .3 Vacuum clean substrate.
- .4 Refrain from using indelible ink on subfloor for marking or measurements.
- .5 Provide seaming diagrams for review by consultant.
- .6 Prep subfloor as per ASTM F710-19.
- .7 Float entire floor with self leveling compound if required to meet ASTM F710-19.
- .8 Provide flatness and levelness remediation as required to meet floor finish requirements. Measure for floor flatness (FF) and floor levelness (FL) tolerances for floors to ASTM E1155.
- .9 Provide overall value of FF 36 / FL 20. Correct the slab surface if the actual F (FF) or F (FL) number for the floor installation measures less than required. Correct defects in the defined traffic floor by grinding or removal. Apply leveling compound approved by the flooring product manufacturer to remediate, as required. Remeasure corrected areas by the same process.

3.3 INSTALLATION - SHEET FLOORING

- .1 Install sheet flooring to manufacturer instructions.
- .2 Spread only enough adhesive to permit installation of materials before initial set.
- .3 Set flooring in place, press with heavy roller to attain full adhesion.
- .4 Lay flooring with joints and seams parallel to building lines to produce minimum number of seams.
- .5 Install sheet flooring parallel to length of room. Provide minimum of 1/3 full roll width. Double cut sheet; provide continuously heat welded seal.
- .6 Terminate flooring at centreline of door openings where adjacent floor finish is dissimilar.
- .7 Install edge strips at unprotected or exposed edges, and where flooring terminates
- .8 Scribe flooring to floor outlets, etc. to produce tight joints.
- .9 Install flooring in pan type floor access covers. Maintain floor pattern.
- .10 Install feature strips, edge strips, where indicated. Fit joints tightly.
- .11 Heat-Welded Seams: Rout joints and use welding bead to permanently fuse sections into a seamless floor covering. Prepare, weld, and finish seams to produce surfaces flush with adjoining floor covering surfaces in accordance with the flooring manufacturer's printed instructions and ASTM F 1516.
- .12 Heat weld new flooring to existing floor product where applicable.
- .13 Apply sealant to the base of all door frames.
- .14 Joints that are not heat welded to be sealed using a water-tight polyurethane based adhesive

3.4 INSTALLATION – INTEGRAL BASE

- .1 Install integral (flash) cove, of dimension shown on the Drawings, constructed in accordance with manufacturer's printed instructions. Support floor covering at horizontal and vertical junction with cove strip. On masonry and other irregular surfaces, fill voids behind base with filler/wall patch. Butterfly interior and exterior corners. Provide stainless steel cap at top edges of base unless detailed otherwise.

3.5 INSTALLATION – RESILIENT BASE

- .1 Lay out base to keep number of joints at minimum. Use roll material only. Use single piece between internal corners and obstructions such as door jambs.
- .2 Clean substrate and prime with one coat of adhesive. Apply adhesive to back of base, 100% coverage of 7/8th height of material.
- .3 Set base against wall and floor surfaces tightly by using 3 kg hand roller.
- .4 Install straight and level to variation of 1:1000.
- .5 Scribe and fit to door frames and other obstructions. Use premoulded end pieces at flush door frames. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- .6 Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- .7 Do not stretch resilient base during installation.
- .8 On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- .9 Job-Formed Corners:
 - .1 Do not use premoulded corners. Back groove and adhere to wall surface with contact cement extending minimum 300 mm both ways from corner.
 - .2 Outside Corners: Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends.
 - .3 Inside Corners: Use straight pieces of maximum lengths possible.

3.7 CLEANING

- .1 Remove access adhesive from floor, base, and wall surfaces without damage.
- .2 Finish flooring with high-speed buffing as per manufacturer's specification. Do not apply sealer or wax.

3.8 PROTECTION OF FINISHED WORK

- .1 Prohibit traffic after installation of flooring in accordance with manufacturer's product data and installation sheets.

3.9 SCHEDULES

- .1 Refer to Floor Finishes Plans for product locations, layout, and details.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Surface preparation and field application of paints and coatings.
- .2 Scope: Finish all interior and exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including but not limited to the following:
 - .1 Interior walls, ceilings, and bulkheads.
 - .2 Doors frames and hollow metal doors.
 - .3 Exterior surfaces where renovation work occurs.
 - .4 Other new items as shown.
- .3 Do Not Paint or Finish the Following Items:
 - .1 Items fully factory-finished unless specifically so indicated; materials and products having factory-applied primers are not considered factory finished.
 - .2 Data cables
 - .3 Cable trays.
 - .4 Device boxes
 - .5 Items indicated to receive other finishes.
 - .6 Items indicated to remain unfinished.
 - .7 Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
 - .8 Floors, unless specifically so indicated.
 - .9 Glass.
 - .10 Concealed pipes, ducts, and conduits.
 - .11 Existing exposed ducts, pipes, and hangers.
 - .12 Concealed ceiling spaces and walls above drywall and T-bar ceilings.
 - .13 Any new mechanical ductwork or piping with insulation.
 - .14 Surfaces scheduled as having "No Finish" in Room Finish Schedules.

1.2 RELATED SECTIONS

- .1 Section 05 50 00 - Metal Fabrications
- .2 Section 08 11 13 – Standard Metal Doors and Frames.
- .3 Section 09 21 16 – Gypsum Board Assemblies

1.3 REFERENCES

- .1 AWWA (American Water Works Association) - C218 - Standard for Coating the Exterior of Aboveground Steel Water Pipelines & Fittings.
- .2 AWWA (American Water Works Association) - D102 - Coating Steel Water Storage Tanks.
- .3 ASTM D6386 American Galvanizers Association.
- .4 NACE (National Association of Corrosion Engineers) - Industrial Maintenance Painting.
- .5 MPI (Master Painters Institute) - Specifications Manual.
- .6 SSPC (The Society for Protective Coatings) (formerly SSPC - Steel Structures Painting Council) - Steel Structures Painting Manual.
- .7 MPI (Master Painters Institute) Architectural Painting Specification Manual and Maintenance Repainting Manual.

1.4 SUBMITTALS FOR REVIEW

- .1 Samples:
 - .1 Submit the following samples in the sizes indicated:
 - .1 Draw Down Cards: Submit two (2) sets of 'draw down cards' for each colour a minimum of 30 calendar days prior to commencement of painting. Provide one set to consultant and one set to field office.
 - .1 Draw Down Cards are to be provided upon completion of the work for their inclusion in the Operation and Maintenance Manuals.
 - .2 Product List:
 - .1 Submit a Schedule of Finishes listing manufacturer's product name and colour for each paint system.
 - .3 Product Data:
 - .1 Provide data on all finishing products.

1.5 SUBMITTALS FOR INFORMATION

- .1 Section 01 33 00: Submission procedures.
- .2 Installation Data: Manufacturer's special installation requirements indicating special surface preparation procedures, substrate conditions requiring special attention.

1.6 QUALITY ASSURANCE

- .1 Applicator Qualifications:
 - .1 Provide the work of this Section, executed by a competent installer having:
 - .1 Minimum of five (5) years experience in the application of products, systems and assemblies specified.
 - .2 All materials, preparation and workmanship shall conform to requirements of the latest edition of the Architectural Painting Specification Manual by the Master Painters Institute (MPI) (hereafter referred to as the MPI Painting Manual) as issued by the local MPI Accredited Quality Assurance Association having jurisdiction.
 - .3 All paint manufacturers and products used shall be as listed under the Approved Product List section of the MPI Painting Manual. Paint materials will be rated under Environmental Notation System (ENS) with acceptable VOC ranges as listed in the MPI Approved Product List under "E" ranges.
 - .4 Conform to all applicable Standards, including the material and workmanship requirements of MPI Architectural Painting Specification Manual. Provide the MPI Accredited Quality Assurance Association's two (2) year guarantee or a 100% two (2) year maintenance bond in accordance with MPI Painting Manual requirements. Maintenance bond to warrant that painting work has been performed in accordance with MPI Manual requirements.

1.7 REGULATORY REQUIREMENTS

- .1 Conform to applicable code for flame and smoke rating requirements for finishes.

1.8 DELIVERY, STORAGE, AND PROTECTION

- .1 Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

- .2 Container label to include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, colour designation, and written instructions for mixing and reducing.
- .3 Store paint materials at minimum ambient temperature of 7 degrees C and a maximum of 32 degrees C, in ventilated area, and as required by manufacturer's written instructions.

1.9 ENVIRONMENTAL REQUIREMENTS

- .1 Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- .2 Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.
- .3 Minimum Application Temperatures for Latex Paints: 7 degrees C for interiors; 10 degrees C for exterior; unless required otherwise by manufacturer's written instructions.
- .4 Minimum Application Temperature for Varnish and Finishes: 18 degrees C for interior or exterior, unless required otherwise by manufacturer's written instructions.
- .5 Provide lighting level of 860 lx measured mid-height at substrate surface.

Part 2 Products

2.1 ACCEPTABLE MATERIALS

- .1 All paint materials will be rated under the Environmental Notation System (NTS) with acceptable VOC ranges as listed in the MPI Approved Products List under E ranges.
- .2 Except as specified herein, paint, varnish, stain, enamel, lacquer, and fillers shall be of a type and brand listed under "Product Listings" as covered in the MPI Manual, latest edition, for specific uses.
- .3 Only materials (primers, paints, coatings, varnishes, stains, lacquers, fillers, etc.) listed in the latest edition of the MPI Approved Product List (APL) and for interior systems, listed as Institutional Low-odor, Low-VOC or High Performance Architectural Latex systems are acceptable for use on this project. All such material shall be from a single manufacturer for each system used.
- .4 Indoor Air Quality - Interior applications: Use only materials having a minimum MPI "Environmentally Friendly" E2 rating based on VOC (EPA Method 24) content levels.
- .5 Paint materials such as linseed, oil, shellac, turpentine, and any of the above materials not specifically mentioned herein but required for work with the finish specified shall be highest quality product of an approved manufacturer.
- .6 Paints and materials to be lead and mercury free and shall have a low VOC content where possible or where required by authorities having jurisdiction.
- .7 Where required, paints and coatings shall meet the flame spread requirements of local authorities having jurisdiction.
- .8 No recycled content paints and primers will be allowed on interior applications.

2.2 MIXING AND TINTING

- .1 Perform colour tinting operations prior to delivery of paint to site. On-site tinting of painting materials is allowed only with Design Consultant's written permission.
- .2 Paste, powder or catalyzed paint mixes shall be mixed in strict accordance with manufacturer's written instructions.

- .3 Where thinner is used, addition shall not exceed paint manufacturer's recommendations. Do not use kerosene or any such organic solvents to thin water-based paints.
- .4 Thin paint for spraying according in strict accordance with paint manufacturer's instructions. If directions are not on container, obtain instructions in writing from manufacturer and provide copy of instructions to Design Consultant
- .5 Re-mix paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity.

2.3 GLOSS/SHEEN RATINGS

- .1 Paint gloss is defined as sheen rating of applied paint.
- .2 Gloss levels in accordance with MPI Architectural Painting Specifications Manual, defined as follows:

Gloss Level	Description	Gloss @ 60°	Sheen @ 85°
G1	traditional matte finish - flat	Max. 5 units	Max. 10 units
G2	high hide sheet flat - 'velvet-like'	Max. 10 units	10 - 35 units
G3	traditional 'eggshell-like'	10 - 25 units	10 - 35 units
G4	'satin-like'	20 - 35 units	Min. 35 units
G5	traditional semi-gloss	35 - 70 units	
G6	traditional gloss	70 - 85 units	
G7	high gloss	< 85 units	

2.4 EXTERIOR FINISH SYSTEMS

- .1 Galvanized Metal (Premium Grade) Factory Primed:
 - .1 MPI EXT 5.3L POLYURETHANE, PIGMENTED (over epoxy primer)(High Contact/Traffic)
 - .2 EXT 5.3L is a high performance, 2 component aliphatic polyurethane finish applied over an epoxy primer. Consisting of the following coat numbers and grades:
 - .1 Premium Grade Coat #1: Epoxy Galvanized Primer MPI#101 – MPI approved basis of design product: Corotech – Surface tolerant Epoxy Mastic Coating or approved MPI equivalent
 - .2 Premium Grade Coat #2: Polyurethane MPI#174 – MPI approved basis of design product: Corotech Aliphatic Acrylic Urethane Semi-Gloss or approved MPI equivalent
 - .3 Premium Grade Coat #3: Polyurethane MPI#174 – MPI approved basis of design product: Corotech Aliphatic Acrylic Urethane Semi-Gloss or approved MPI equivalent
- .4 Galvanized Metal
 - .1 EXT. 5.3B Alkyd Gloss Level 5 Finish. MPI #11
 - .2 Finish to be used for exterior galvanized steel, including but not limited to pressed steel frames and hollow metal doors; roof top ducts, vents and piping.

2.5 INTERIOR FINISH SYSTEMS

- .1 Concrete Horizontal Surfaces:
 - .1 INT 3.2C Epoxy - E2 or E3 rated products.
- .2 Concrete Masonry Units:
 - .1 INT 4.1C High Performance Acrylic (3 coats)
- .3 Structural Steel and Metal Fabrications:
 - .1 INT 5.1S Institutional Low odor/Low VOC, semi gloss, or
 - .2 INT 5.1B W.B. Light Industrial Coating, semi gloss.
- .4 Galvanized Metal High Contact/High Traffic Areas (Doors, Frames, Railings, Pipes, etc.):
 - .1 INT 5.3M Institutional Low odor/Low VOC, semi gloss.
- .5 Gypsum Board: All areas except for areas specified below:
 - .1 INT 9.2N Light Institutional Epoxy, Low odor/Low VOC. Acceptable substitution: 9.2L WB Light Industrial Coating (MPI #151).
 - .1 Walls: Topcoat sheen locations:
 - .1 All rooms to be eggshell unless otherwise indicated.
 - .2 Ceilings and bulkheads: Eggshell, G3.
 - .3 Note: Provide vapour barrier primer/sealer paint where indicated, MPI#61.
 - .2 INT 9.2M - Institutional Low Odour/VOC, over waterborne primer sealer, low VOC primer.
 - .1 Ceilings to be eggshell, gloss level G3.
- .6 Gypsum Board: Epoxy Finished Surfaces for areas subject to cleaning with alcohol and harsh cleaning products:
 - .1 INT 9.2E Water-based Epoxy (tile-like) finish, Gloss Level 5.
- .7 Gypsum Board and plywood backer boards: Fire retardant surfaces for Comm. Rooms:
 - .1 INT9.2H – Pigmented fire retardant coating (UOC rated).
- .8 Concrete Floors: sealer as per Section 03 35 00.
- .9 Paint – Fire Resistant: noted for electrical panel backboards: Flame Control Coatings No. 20-20 class A flat latex fire retardant paint, two coats, sand between coats.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify existing conditions before starting work.
- .2 Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- .3 Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- .4 Test shop applied primer for compatibility with subsequent cover materials.
- .5 Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces is below the following maximums:
 - .1 Plaster and Gypsum Wallboard: 12 percent.
 - .2 Masonry, Concrete, and Concrete Unit Masonry: 12 percent.
 - .3 Interior Wood: 15 percent, measured in accordance with ASTM D2016.
 - .4 Exterior Wood: 15 percent, measured in accordance with ASTM D2016.

.5 Concrete Floors: 8 percent.

3.2 PREPARATION

- .1 Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.
- .2 Correct defects and clean surfaces which affect work of this section. Remove existing coatings that exhibit loose surface defects.
- .3 Seal with shellac and seal marks which may bleed through surface finishes.
- .4 Impervious Surfaces: Remove mildew by scrubbing with solution of tri-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- .5 Aluminum Surfaces Scheduled for Paint Finish: Remove surface contamination by steam or high-pressure water. Remove oxidation with acid etch and solvent washing. Apply etching primer immediately following cleaning.
- .6 Asphalt, Creosote, or Bituminous Surfaces Scheduled for Paint Finish: Remove foreign particles to permit adhesion of finishing materials. Apply latex based sealer or primer.
- .7 Insulated Coverings: Remove dirt, grease, and oil from canvas and cotton.
- .8 Concrete Floors: Remove contamination, acid etch, and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.
- .9 Gypsum Board Surfaces: Fill minor defects with filler compound. Spot prime defects after repair.
- .10 Galvanized Surfaces: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.
- .11 Concrete and Unit Masonry Surfaces Scheduled to Receive Paint Finish: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.
- .12 Plaster Surfaces: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.
- .13 Uncoated Steel and Iron Surfaces: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Spot prime paint after repairs.
- .14 Shop Primed Steel Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Prime metal items including shop primed items.
- .15 Interior Wood Items Scheduled to Receive Paint Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats.
- .16 Interior Wood Items Scheduled to Receive Transparent Finish: Wipe off dust and grit prior to sealing, seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after sealer has dried; sand lightly between coats.

- .17 Exterior Wood Scheduled to Receive Paint Finish: Remove dust, grit, and foreign matter. Seal knots, pitch streaks, and sappy sections. Fill nail holes with tinted exterior caulking compound after prime coat has been applied.
- .18 Exterior Wood Scheduled to Receive Transparent Finish: Remove dust, grit, and foreign matter; seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes with tinted exterior caulking compound after sealer has been applied.
- .19 Exterior galvanized metals will follow MPI guideline 5.3 GALVANIZED METAL (NOT CHROMATE PASSIVATED) and ASTM D6386 as recommended by the American Galvanizers Association.
- .20 Wood and Metal Doors Scheduled for Painting: Seal top and bottom edges with primer.

3.3 APPLICATION

- .1 Apply products to manufacturer instructions.
- .2 Do not apply finishes to surfaces that are not dry.
- .3 Apply each coat to uniform finish.
- .4 Apply each coat of paint slightly darker than preceding coat unless otherwise approved.
- .5 Sand wood lightly between coats to achieve required finish.
- .6 Vacuum clean surfaces free of loose particles. Use tack cloth just prior to applying next coat.
- .7 Allow applied coat to dry before next coat is applied.
- .8 Where clear finishes are required, tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.
- .9 Prime concealed surfaces of interior woodwork with primer paint.
- .10 Prime concealed surfaces of interior woodwork scheduled to receive stain or varnish finish with gloss varnish reduced 25 percent with mineral spirits.

3.4 FINISHING MECHANICAL AND ELECTRICAL EQUIPMENT

- .1 Refer to Section 23 05 53 and Section 26 05 53 for schedule of colour coding and identification banding of equipment, duct work, piping, and conduit.
- .2 Paint shop primed equipment. Paint shop prefinished items occurring at interior areas.
- .3 Remove unfinished louvres, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- .4 Prime and paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, except where items are prefinished.
- .5 Paint interior surfaces of air ducts, and convactor and baseboard heating cabinets that are visible through grilles and louvres with one coat of flat black paint, to visible surfaces. Paint dampers exposed behind louvres, grilles, and convactor and baseboard cabinets to match face panels.
- .6 Paint exposed conduit and electrical equipment occurring in finished areas.
- .7 Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.
- .8 Colour code equipment, piping, conduit, and exposed duct work in accordance with requirements indicated. Colour band and identify with flow arrows
- .9 Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

- .10 Paint exterior roof top ducts, vents and piping.

3.5 CLEANING

- .1 Collect waste material which may constitute a fire hazard, place in closed metal containers and remove daily from site.

3.6 SCHEDULE

- .1 Use eggshell, G3 for all walls unless noted otherwise.
- .2 Use semi-gloss for all door frames and metal doors, G5.
- .3 Use eggshell for all ceilings and bulkheads, G3.

3.7 SCHEDULE - COLOURS

- .1 Colours: TBD
- .2 Locations: Refer to drawings.

3.8 MAINTENANCE MATERIALS

- .1 Turn over 1 gallon of each colour in unopened containers.

END OF SECTION

Part 1 General

1.1 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures
- .2 Manufacturer's printed product literature, specifications, and data sheets.
- .3 Shop drawings: Indicate location, type, size, panel arrangement, backing, hardware, anchors, mounting details, frame or trim and accessories, colours.
- .4 Manufacturer's installation instructions.

1.2 REGULATORY REQUIREMENTS

- .1 Surface burning characteristics of materials: listed and labeled by an organization accredited by Standards Council of Canada.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Comply with Section 01 74 21 - Construction Waste Management and Disposal.

Part 2 Products

2.1 MATERIALS

- .1 Adhesive: type recommended by manufacturer.
- .2 Joint reinforcement: concealed mechanical jointing system to provide straight, rigid, continuously supported, tight butt, flush joints at surface
- .3 Anchor clips, brackets and fasteners: concealed type recommended by whiteboard manufacturer for fixed mounting.
- .4 Perimeter trim: extruded aluminum channel, width to suit board thickness, with overlap of 6 mm onto panels. Clear anodized finish.

2.2 WHITEBOARDS (MARKERBOARDS)

- .1 Acceptable material: Panel Products Porcelain Enamel; Allmar; Shanahan's Alliance Porcelain Steel; Versaceram 2FB Whiteboard - 24 gauge.
- .2 Porcelain enamel matte finish writing surface bonded to 24 gauge galvanized steel sheet on 12 mm fibreboard core with aluminum foil backing.
- .3 Fabricate whiteboards to sizes indicated; one piece construction fully assembled, with perimeter trim.
- .4 Make finished panels flat and rigid and fit with joint reinforcement.
- .5 Fit joints between abutting panels with joint reinforcement except where covering trim is required.
- .6 Install trim on panels in factory. Make mitres and joints to hair-line fit, free of rough edges. Use concealed brackets to reinforce and hold joints tight and flush. Exposed fasteners not permitted.
- .7 Factory fit assemblies too large for shipment to site in one piece, disassemble for delivery and site assembly.

2.3 TACKBOARDS – FRAMED

- .1 Acceptable material: Panel Products Claridge; Shanahan's Industries.
- .2 Tack surface: 6 mm thick, high density linoleum sheet, homogeneous tackable surface consisting of linseed oil, granulated cork, rosin binders and dry pigments calendared onto a natural burlap backing with color extending through full thickness of material. Colours selected by Consultant
- .1 Acceptable material: Forbo Bulletin Board
- .3 Backing: hardboard 9 mm thick
- .4 Fabricate tackboards of linoleum facing laminated to backing board.
- .5 Fabricate tackboards to sizes indicated; one piece construction fully assembled, with perimeter trim.
- .6 Make finished panels flat and rigid and fit with joint reinforcement.
- .7 Fit joints between abutting panels with joint reinforcement except where covering trim is required.
- .8 Install trim on panels in factory. Make mitres and joints to hair-line fit, free of rough edges. Use concealed brackets to reinforce and hold joints tight and flush. Exposed fasteners not permitted.

2.4 QUANTITIES

- .1 Based on items indicated on the drawings, the Construction Contractor shall be responsible to quantity and provide all visual display boards shown.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify existing conditions are ready to receive work.

3.2 INSTALLATION

- .1 Install visual display boards in accordance with manufacturer's instructions, parallel to floor with uniform vertical surface, plumb and level, to provide rigid, secure surface.
- .2 Install whiteboards using concealed hangers and fasteners.
- .3 Provide rigid, secure attachment using properly sized fasteners, appropriate for stresses and loads.
- .4 Mechanical attachment:
 - .1 Concrete or solid masonry: lag screw and expansion bolts or screws and lead plugs.
 - .2 Hollow masonry: toggle bolts or equivalent
 - .3 Stud walls: screw fasteners, secured into stud or solid blocking. Toggle bolts not permitted.
- .5 Remove manufacturer's labels, tags, stickers and other identifying markings from exposed surfaces.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11- Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11- Cleaning.
- .3 Waste Management: separate waste materials for in accordance with Section 01 74 21- Construction Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Plastic compartments, overhead braced, floor mounted partitions.
- .2 Urinal screens; wall mounted with pilaster brace.

1.2 RELATED SECTIONS

- .1 Section 06 10 00 - Rough Carpentry for partition panel support.
- .2 Section 10 28 13 - Toilet and Bath Accessories.

1.3 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM A167-99 (2009), Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - .2 ASTM E84-08, Standard Test Method for Surface Burning Characteristics of Building Materials.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-71.20-M88, Adhesive, Contact, Brushable.

1.4 SUBMITTALS

- .1 Submit shop drawings indicate fabrication details, plans, elevations, hardware, and installation details.
- .2 Samples
 - .1 Submit 300 x 300 mm samples of panel showing finish on both sides, two finished edges and core construction.
 - .2 Submit representative samples of each hardware item, including brackets, fastenings and trim.

1.5 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for phenolic laminate for incorporation into manual specified.

1.6 STORAGE AND PROTECTION

- .1 Deliver, store, handle and protect materials in accordance with Section 01 00 50 – General Instructions.
- .2 Protect finished laminated plastic surfaces during shipment and installation. Do not remove until immediately prior to final inspection.

1.7 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 – Construction Waste Management and Disposal

1.8 WARRANTY

- .1 Provide a fifteen (15) year warranty to include coverage for failure to meet specified requirements.

Part 2 Products

2.1 MATERIALS

- .1 Solid phenolic partitions.
 - .1 Acceptable material:
 - .1 Pionite
 - .2 Colour to be selected.
 - .3 Pattern and Color Name: TBD
 - .4 Finish: Textured/Suede
 - .5 Thickness: 19mm
 - .6 Core material: Black
 - .2 Laminated plastic sheets: High pressure laminate.
 - .3 Laminated plastic adhesive: to CAN/CGSB-71.20.
 - .4 Stainless steel sheet metal: to ASTM A167, Type 309 with #4 satin finish.
 - .5 Sealer: water resistant sealer or glue as recommended by laminate manufacturer.
 - .6 Headrails: 5 mm thick, satin finished, extruded anodized aluminum, anti grip design.
 - .7 Pilaster shoe one piece: 0.8 mm stainless steel, Type 304, satin finish, 100 mm high.
 - .8 Attachment: stainless steel tamper proof type screws and bolts.

2.2 COMPONENTS

- .1 Continuous wall and connecting brackets: Type 304 stainless steel satin finish.

2.3 URINAL SCREENS

- .1 Flat-Panel Urinal Screen: Match panel style, construction and thickness.
- .2 Brackets: Full-height continuous type; manufacturer's standard design; stainless steel.
- .3 Pilaster Brace: Match panel pilaster's style, construction and thickness.

2.4 FABRICATION

- .1 Doors, 19mm thick panels and screens: 13 mm thick, solid phenolic laminate panels, to sizes indicated.
- .2 Pilasters: 19 mm thick, constructed same as panels, to sizes indicated.

- .3 Laminate plastic to core material ensuring core and laminate profiles coincide to provide continuous support and bond over entire surface.
- .4 Edge finish of composite laminated plastic panels to be black phenolic core. Chamfer exposed edges uniformly at approximately 20°.
- .5 Provide internal reinforcement at areas of attached hardware and fittings.
 - .1 Temporarily mark location of reinforcement for grab bars.

Part 3 Execution

3.1 INSTALLATION

- .1 Install compartments to manufacturer instructions and in accordance with CAN/CSA- B651.
- .2 Install compartments secure, rigid, plumb, and level.
- .3 Maintain 12 mm space between wall and panel or end pilaster.
- .4 Attach fixing brackets securely to adjacent construction using properly sized fasteners, appropriate for stresses and loads.
 - .1 Concrete or Solid Masonry: Lag screw and expansion bolts or screws and plugs.
 - .2 Hollow Masonry: Toggle bolts or equivalent.
 - .3 Stud Walls: Screw fasteners, secured into stud or solid blocking. Toggle bolts not permitted.
- .5 Attach panels and pilasters to brackets with through type tamper proof sleeve bolts and nuts. Locate head rail joints at pilaster centre lines.
- .6 Provide for adjustment of floor-braced pilasters variations with screw jack through steel saddles made integral with pilaster. Conceal floor fixings with stainless steel shoes.
- .7 Equip doors with two (2) hinges, one (1) latch set, out-swinging door with pull, and door stop/bumper.
- .8 Install door strike and keeper with door bumper on each pilaster in alignment with door latch.
- .9 Adjust and align hardware for easy, proper function. Set door open position at full open.
- .10 Install hardware, grab bars, and other washroom accessories.
- .11 Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.2 ERECTION

- .1 Partition erection.
 - .1 Install partitions secure, plumb and square.
 - .2 Leave 12 mm space between wall and panel or end pilaster.

- .3 Anchor mounting brackets to masonry or concrete surfaces using screws and shields: to hollow walls using bolts and toggle type anchors.
 - .4 Attach panel and pilaster to brackets with through type sleeve bolt and nut.
 - .5 Provide for adjustment of floor variations with screw jack through steel saddles made integral with pilaster. Conceal floor fixings with stainless steel shoes.
- .2 Floor supported and overhead braced partition erection.
- .1 Attach pilasters to floor with pilaster supports and level, plumb, and tighten installation with levelling device.
 - .2 Secure pilaster shoes in position.
 - .3 Secure head rail to pilaster face with not less than two fasteners per face.

3.4 ADJUSTING

- .1 Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 5 mm.
- .2 Adjust hinges to position doors in partial opening position when unlatched. Return out swinging doors to closed position.
- .3 Adjust adjacent components for consistency of line or plane.

3.5 CLEANING

- .1 Clean surfaces after installation using manufacturer's recommended cleaning procedures.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Toilet and washroom accessories.
- .2 Grab bars.
- .3 Miscellaneous hospital specialties.
- .4 Attachment hardware.

1.2 RELATED SECTIONS

- .1 Section 08 80 50 - Glass and Glazing: Wall mirrors.
- .2 Section 09 21 16 - Gypsum Board Assemblies: Preparation of substrate and adjacent work to receive work of this section.
- .3 Section 10 21 20 - Solid Phenolic Partitions

1.3 REFERENCES

- .1 The versions of the standards referenced in this section are those listed in the BC Building Code, current edition at the time of the application for Building Permit; or if they are not referenced in the specified code, they are the latest version of the standard in effect at the time of the application for Building Permit.
- .2 ASTM A123/A123M - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- .3 ASTM A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- .4 ASTM A269 - Seamless and Welded Austenitic Stainless-Steel Tubing for General Service.
- .5 ASTM A1008/A1008M - Steel, Sheet, Cold-Rolled Carbon, Structural, High-Strength Low Alloy and High Strength Low Alloy with Improved Formability.
- .6 ASTM B456 - Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Coordinate with other work having a direct bearing on work of this section.
- .2 Coordinate the work with the placement of internal wall reinforcement to receive anchor attachments.

1.5 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Provide data and manufacturer's cut sheets on accessories describing size, finish, details of function.

1.6 REGULATORY REQUIREMENTS

- .1 Conform to the B.C. Building Code, Section 3.8 - Building Requirements for Persons with Disabilities.

1.7 PERFORMANCE REQUIREMENTS

- .1 Accessories shall be commercial / institutional grade.
- .2 Washroom accessory installation shall facilitate regular routine maintenance and cleaning of walls and adjacent areas.
- .3 All accessories shall be mounted and installed using concealed fasteners and fixings and to appropriate backing and reinforcement.

1.8 WARRANTY

- .1 Warranty Period for all supplied materials, equipment and installation is two (2) years from the date of service commencement.
- .2 Warranty: Include coverage to correct defective work and for failure to meet specified requirements.

1.9 QUANTITIES

- .1 Based on items indicated on the drawings, the Construction Contractor shall be responsible to quantity and provide all items shown on drawings.

Part 2 Products

2.1 MATERIALS

- .1 Sheet Steel: ASTM A1008/A1008M.
- .2 Stainless Steel Sheet: ASTM A167, Type 304.
- .3 Tubing: ASTM A269, stainless steel.
- .4 Fasteners, Screws, and Bolts: Stainless steel, tamper-proof.
- .5 Expansion Shields: Fibre, lead, or rubber as recommended by accessory manufacturer for component and substrate.

2.2 PRODUCTS

- .1 A – Toilet Paper Dispenser: Bobrick B-2892
- .2 B1 - Grab Bars – side wall: Bobrick B-5898.99, 760 x 760
- .3 B2 - Grab Bars – rear wall: Bobrick B-5806.99, 610 length.
- .4 B3 - Grab Bars – vertical wall: Bobrick B-5806.99, 610 length.
- .5 C - Sanitary Napkin Disposal: Surface mounted; satin stainless steel Bobrick B-270.
- .6 D - Soap Dispenser: See Mechanical
- .7 E - Surface mounted; Paper Towel Dispenser/Waste Receptacle, Bobrick B-3979
- .8 F– Coat/Towel Hook: Bobrick B-6827.
- .9 G– Mop and Broom Holders - S.S., lengths as indicated, minimum of 5 holders in all housekeeping rooms. Bobrick B-224 x 36.
- .10 H - Surface mounted, stainless steel shelf, 455 L x 150 D, Bobrick B-296 x 18
- .11 J – Baby Change Table: Diaper changing station: horizontal surface mounted unit, polyethylene body, smooth concave changing area, 927 mm wide x 575 mm deep x 83 mm high, nylon safety strap, stainless steel bag hook, safety instructions in both

official languages, graphic illustration. Koala Kare Products, KB300-SS KB300-01SS
Grey

- .12 T – Wall Mounted air hand dryer: Dyson Airblade V, HU02, 307174-01 (sprayed nickel LV)

2.3 FABRICATION

- .1 Weld and grind joints of fabricated components, smooth.
- .2 Form exposed surfaces from single sheet of stock, free of joints. Form surfaces flat without distortion. Maintain surfaces without scratches or dents.
- .3 Fabricate grab bars of tubing, free of visible joints, return to wall with end attachment flanges. Form bar with 38 mm clear of wall surface. Knurl grip surfaces.
- .4 Shop assemble components and package complete with anchors and fittings.
- .5 Provide steel anchor plates, adapters, and anchor components for installation.

2.4 KEYING

- .1 Supply three (3) keys for each accessory to Owner.
- .2 Master key all accessories to Owner requirements.

2.5 FINISHES

- .1 Galvanizing: ASTM A123/A123M, to 380g/sq m. Galvanize ferrous metal and fastening devices.
- .2 Shop Primed Ferrous Metals: Pre-treat and clean, spray apply one coat primer and bake.
- .3 Enamel: Pre-treat to clean condition, apply one coat primer and minimum two coats epoxy baked enamel.
- .4 Chrome/Nickel Plating: ASTM B456, Type SC 2 finish.
- .5 Stainless Steel: No. 4 satin luster finish.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify existing conditions before starting work.
- .2 Verify that field measurements are as indicated on product data.
- .3 Verify that site conditions are ready to receive work and dimensions are as indicated on shop reviewed drawings and manufacturer's instructions.
- .4 Verify exact location of accessories for installation.

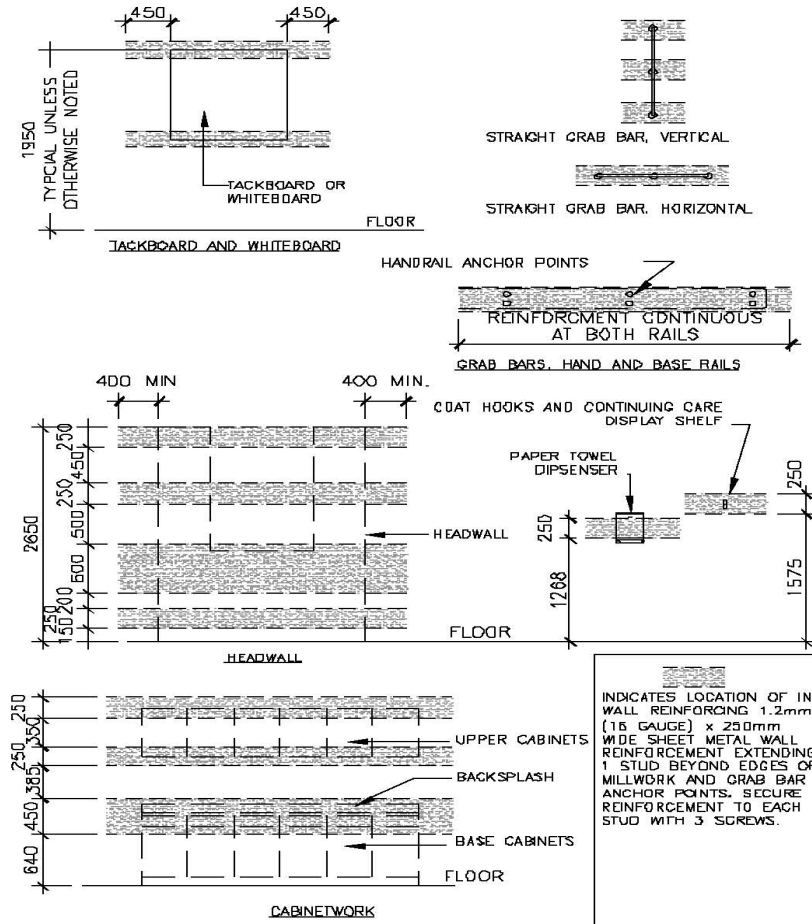
3.2 PREPARATION

- .1 Deliver inserts and rough-in frames to site for timely installation.
- .2 Provide templates and rough-in measurements as required.

3.3 INSTALLATION

- .1 Install accessories to manufacturer instructions.

- .2 Install plumb and level, securely and rigidly anchored to substrate.
- 3.4 The dimensions shown below is a guide only. Follow mounting heights shown on room elevations and schedules.



END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 Specification Section 20 05 00 is intended to cover items that are common to Division 20, 21, 22, 23 and 25.
- .2 Work in Divisions 20, 21, 22, 23 and 25 will include all drawings and all sections of the specifications that form the Contract Documents, including all addenda, and including Division 00 and Division 01, whether defined in Division 20, 21, 22, 23 and 25 or elsewhere, or whether defined in mechanical drawings or elsewhere.
- .3 Provide complete, fully tested, and operational mechanical systems to meet the requirements described herein, in complete accordance with applicable codes and ordinances.
- .4 Provide project management and on-site supervision to undertake administration, meet schedules, ensure timely performance, ensure coordination, establish orderly completion and the delivery of a fully commissioned installation.
- .5 Provide materials and equipment, of specified design, performance, and quality; and current models with published certified ratings for which replacement parts are readily available.
- .6 Review Contract Documents and notify the Consultant of issues of conflict that require clarification prior to submitting Proposal.
 - .1 Failure by the Contractor to secure clarification does not relieve the Contractor to comply with the intent of the design and/or the Contract Documents.
- .7 Connect to equipment specified in other Sections and to equipment supplied and installed by other Contractors or by the Owner.
- .8 Unless specified otherwise, the Owner shall be responsible for routine maintenance defined by the manufacturer's instructions during the warranty period.
 - .1 The Owner will be responsible for supplying replaceable components such as filters during the warranty period.

1.2 APPLICABLE CODES AND STANDARDS

- .1 Refer to Section 20 05 01, Codes, Bylaws and Standards.
- .2 Where multiple versions of the same code are published, the most recent version shall be applied, unless noted otherwise by provincial building codes and local by-laws.

1.3 QUALITY ASSURANCE

- .1 Manufacturers shall specialize in development and production of the products specified.
- .2 Employ only Tradespeople holding valid Provincial Trade Qualification Certificates.
 - .1 Tradespeople shall perform only work that their certificate permits.
 - .2 Certificates shall be available for inspection by the Consultant.
- .3 All Work shall be in accordance with well-established practice and standards accepted and recognized by the Consultant and the Trade.
- .4 The Consultant 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.

- .5 All work shall be in accordance with the Project Drawings and Specifications and their intent, complete with all necessary components, including those not normally shown or specified, but required for a complete installation.
- .6 The most stringent requirements of this section and other mechanical sections shall govern.
 - .1 Should inconsistencies exist such as the drawings disagreeing within themselves or with the specifications, the better quality and/or greater quantity of work or materials shall be estimated upon, performed, and furnished unless otherwise ordered by the Consultant in writing during the RFP period.
- .7 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards
- .8 Scope Definitions:
 - .1 "Provide" shall mean to "Supply, Install, and Commission".
 - .2 "As Indicated" means that the item(s) specified are shown on the drawings.
 - .3 "The Consultant" shall mean Stantec Consulting Ltd.
- .9 Contract Documents, including the Specifications and Drawings, are generally diagrammatic and approximately to scale unless detailed otherwise.
 - .1 They establish scope, material and installation quality and are not detailed installation instructions.
- .10 Drawings and specification are complimentary in nature and combined, create a complete set of construction documents.
 - .1 Any item called for by one and not by the other shall be interpreted as being called for by both.
- .11 Any discrepancy between drawings and specifications leaving in doubt the true intent of work shall be brought to the attention of the Consultant immediately.
- .12 Follow manufacturer's recommended installation details and procedures for equipment, supplemented by requirements of Contract Documents.
 - .1 Provide adequate access space for maintenance and service, and clearances required by code and by the Authority.
- .13 Install material and equipment generally in locations and routes shown, close to building structure with minimum interference with other services or free space.
 - .1 Remove and replace improperly installed equipment as determined by the Consultant.

1.4 RELATED REQUIREMENTS

- .1 Refer to and comply with the following sections:
 - .1 Proposal Requirements and General Conditions - Division 00 and Division 01
 - .2 Procurement and Contracting Requirements - Division 00
 - .3 General Requirements - Division 01
 - .4 Temporary Facilities - Division 01
 - .5 Warranty - Division 01
 - .6 Submittals - Division 01
 - .7 Execution and Closeout Requirements - Division 01
 - .8 Painting - Division 09
 - .9 Common Work for Mechanical Systems – Division 20
 - .10 Fire Suppression Systems - Division 21

- .11 Plumbing Systems - Division 22
- .12 Heating, Ventilation and Air Conditioning Systems - Division 23
- .13 Controls and Instrumentation - Division 25
- .14 Electrical - Division 26/27

1.5 PERMITS, FEES, AND INSPECTIONS

- .1 Obtain all required permits and comply with all provincial, municipal, and other legal regulations and by-laws applicable to the work.
- .2 Include all costs to obtain all permits and to pay for all fees and charges, including inspection charges by the authorities that issue the permits; coordinate all related inspections, permits, fees and inspections for Division 20, 21, 22, 23 and 25.
- .3 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.

1.6 REQUESTS FOR INFORMATION

- .1 Where the Contractor determines that more information is required to complete the scope of work, submit a written "Request for Information" to the Consultant before making assumptions as to intent.

1.7 RESPONSIBILITIES

- .1 Visit the site before RFP closing.
 - .1 Examine all local and existing conditions on which the work is dependent.
 - .2 No consideration will be granted for any misunderstanding, of work to be done, resulting from failure to visit the site.
- .2 Ensure that equipment does not transmit noise and/or vibration to other parts of the building, because of poor installation practice.
- .3 Where the Contract Documents do not contain sufficient information for the proper selection of equipment for Proposal, notify the Consultant during the RFP period. If clarification is not obtainable, allow for the most expensive arrangement.
 - .1 Failure to do this shall not relieve the Contractor of responsibility to provide the intended equipment.
- .4 Examine carefully the mechanical, electrical, structural, and architectural drawings and confirm that the work under this Sub-Contract can be satisfactorily carried out without changes to the building as shown on these plans.
- .5 Be responsible for prompt installation of this work in advance of concrete pouring or similar work.
 - .1 Provide and set sleeves where required.
- .6 During freezing weather, protect all materials in such a manner that no harm can be done to installations already in place and/or to materials and equipment on the job.
- .7 On completion of the work, all tools and surplus and waste materials shall be removed, and the work left in a clean and perfect condition.

1.8 PRODUCT CONSISTENCY

- .1 All products utilized on the project shall be as per the shop drawing submissions.
- .2 All products of a similar nature used in a similar system or application shall be of the same manufacturer throughout the project.

1.9 STANDARD OF ACCEPTANCE

- .1 Standard of Acceptance or Basis of Design means that an item named and specified by manufacturer and/or catalogue number forms part of specification and sets standard regarding performance, quality of material and work practices and when used in conjunction with a referenced standard, shall be deemed to supplement the standard.
- .2 The price submitted for this contract shall be based on the use of materials and equipment as specified or as contained within the acceptable manufacturers listed in each section.
- .3 Acceptable Product manufacturers are listed in Sections 21 99 65, 22 99 65, 23 99 65, and 25 99 65.
- .4 Where two or more manufacturers are listed, the manufacturer's name shown underlined or shown with a model name and/or number was used in preparing the design.
 - .1 Proposals may be based on any one of those named if they meet all aspect of the drawings and specifications.
- .5 Where other than the underlined manufacturer or scheduled/specified manufacturer is selected or approved, include for the cost of any resulting work (both under this Division and other Divisions) and any necessary redesign of installation or structure.
 - .1 Submit redesign drawings for review with Shop Drawings.
 - .2 Maintain installation, access, and servicing clearances.
 - .3 Redesign drawings shall be to scale and of a standard equal to the Project Drawings.
- .6 Where two or more items of equipment and/or material, of the same type, are required, provide products of a single manufacturer.
- .7 Install and test all equipment and material, in accordance with the detailed recommendations of the manufacturer.
- .8 A visible manufacturer's nameplate shall indicate, at a minimum, the manufacturer's name, model number, serial number, capacity data, electrical characteristics, and approval stamps.

1.10 ADDITION OF ACCEPTABLE MANUFACTURERS/SUB-TRADES

- .1 Comply with requirements in Division 01 to request additional acceptable manufacturers or sub-trades.
- .2 Material/products considered to satisfy the specification, but of a manufacturer other than those named in Section 21 99 65, 22 99 65, 23 99 65, and 25 99 65 Acceptable Products/Manufacturers may be submitted to the Consultant for consideration not later than ten (10) working days prior to RFP closing or closing of the RFP depository subtrade tender, whichever is earlier.
- .3 The addition of acceptable manufacturers or sub-trade names, to the specifications, will only be by formal addendum.

1.11 ALTERNATE MATERIALS AND EQUIPMENT

- .1 The Contractor shall, in his quotation, indicate the degree of approval obtained from the Consultant.
 - .1 If the product has been approved as an "Alternate Only", this shall be stated in the quotation and the difference from the base Proposal price indicated.
- .2 Alternatives to specified products shall be equal in performance and materials to the specified product in every respect, operate as intended, meet the space, capacity, and noise requirements outlined.

- .3 The Contractor shall be fully responsible for all costs for work or materials required by the trades or other contractors to accommodate use of other than specified materials or equipment including redesign costs.

1.12 AVAILABILITY OF EQUIPMENT AND MATERIALS

- .1 Make known in writing to the Consultant ten (10) days prior to the RFP closing date any materials specified that are required to complete the work which are not locally supplied or are not currently available or will not be available for use as called for herein.
 - .1 Failing to do so will be interpreted that the most expensive alternate has been included in the Proposal price.

1.13 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.
 - .1 Do not scale the drawings.
 - .2 Obtain accurate dimensions from the Architectural and Structural drawings.
- .2 Consult the architectural drawings and details for exact locations of fixtures and equipment.
 - .1 Obtain this information from the Consultant where definite locations are not indicated.
- .3 Take field measurements, where equipment and material dimensions are dependent upon building dimensions.
- .4 Where imperial units have been indicated in brackets [] following the requirements in SI units, the conversion is approximate and provided for convenience.
 - .1 The SI units shall govern.

1.14 DRAWINGS AND SPECIFICATIONS

- .1 The responsibility and scope of each sub trade rests solely with the General Contractor.
 - .1 Extras will not be considered based on the grounds of difference in interpretation of specifications as to which trade involved is to provide certain specifications or materials.
- .2 Refer to architectural drawings for building dimensional data and construction details.
- .3 Drawings and specifications are complementary each to the other, and what is called for by one shall be binding as if called for by both.
- .4 Should any discrepancy appear between drawings and specifications which leaves the Contractor in doubt as to the true intent and meaning of the plans and specifications, obtain a ruling from the Consultant in writing or by Addendum, before submitting Proposal.
 - .1 If this is not done, it will be assumed that the most expensive alternate has been included in the contractor's Proposal pricing.
- .5 Where errors or discrepancies appear in catalogue numbers, provide the material in accordance with the system requirements and to the standard of the specifications.
- .6 Prior to construction start, examine all contract documents, including all drawings and specifications, and work of other trades to ensure that work can be satisfactorily carried out without changes to building.
- .7 The scope of work in this division shall include all work defined in the Contract Documents, including work which may exceed the minimum requirements of codes and standards that are referenced in the Contract Documents.

1.15 METRIC CONVERSION

- .1 All units in this division are expressed in SI units. Soft metric conversions are used throughout.
- .2 Submit all shop drawings and maintenance manuals in SI units.
- .3 On all submittals use the same SI units as stated in the specification.
- .4 Equivalent Nominal Diameters of Pipes - Metric and Imperial
 - .1 Where pipes are specified with metric dimensions and only Imperial sized pipes are available, provide equivalent nominal Imperial sized pipe as indicated in the table, and provide adapters to ensure compatible connections to all metric sized fittings, equipment and piping.
 - .2 When CSA approved SI Metric pipes are available and are provided, the contractor shall provide adapters to ensure compatible connections between the SI Metric pipes and all new and existing pipes, fittings, and equipment.
 - .3 Record accurately on "as-built" drawings the type of pipe (i.e., Metric or Imperial) installed.
 - .4 Pipes - Equivalent Nominal Diameters:
 - .1 3 mm – 1/8"
 - .2 6 mm – 1/4"
 - .3 10 mm – 3/8"
 - .4 12,13,15 mm – 1/2"
 - .5 19, 20 mm – 3/4"
 - .6 25 mm – 1"
 - .7 30, 32 mm – 1-1/4"
 - .8 38, 40 mm – 1-1/2"
 - .9 50mm – 2"
 - .10 65 mm – 2-1/2"
 - .11 70, 75, 80 mm – 3"
 - .12 100 mm – 4"
 - .13 150 mm – 6"
 - .14 200 mm – 8"
 - .5 Ducts - Equivalent Nominal Diameters:
 - .1 The metric duct size increments are expressed as 25mm = 1".

1.16 RFP INQUIRIES

- .1 All Contractor queries during the RFP period shall be made in writing to the Consultant.
- .2 Contractor queries will be collected, and suitable addenda will be issued for clarification.
- .3 No verbal information will be issued by the consultant's office during RFP period.
- .4 All RFP queries may be e-mailed or couriered to the Consultant's office.
 - .1 No telephone questions will be answered.

1.17 INSTALLATION REQUIREMENTS

- .1 Install material and equipment generally in locations and routes shown, close to building structure with minimum interference with other services or free space.
- .2 Remove and replace improperly installed equipment as determined by the Consultant.

- .1 Field verify all dimensions, service clearances, maintenance clearances, equipment handling requirements, invert elevations, and other similar measurements prior to any fabrication and installation.
- .2 Notify the Consultant of any discrepancies that require resolution.
- .3 Confirm invert elevations and locations of connection to utilities before any excavation work is started.
- .4 Remove and replace improperly installed mechanical work, or work that requires modifications due to coordination issues, maintenance access or conflicts.
- .5 Review architectural drawings and confirm that plumbing fixtures defined on Architectural Drawings are consistent with plumbing fixtures defined on mechanical drawings.
 - .1 Mechanical work shall include supply and installation for all fixtures defined in the Contract Documents.
- .6 Refer to Architectural Drawings and Structural Drawings for elevations, sections, details, dimensions and information such as fire separations, expansion joints, roof construction, wall construction, that has impact on the mechanical installation.
- .7 Examine Contract Documents prepared by all disciplines and confirm that work can be installed as defined.
 - .1 No allowance will be made for changes unless the Consultant has been notified in writing prior to RFP close.
- .8 Prepare dimensioned shop drawings showing sleeving, recesses, furring and openings to coordinate mechanical work with other trades.
- .9 Prepare dimensioned shop drawings for congested areas such as shafts, corridors and spaces that require special attention to complete the installation.
- .10 Make all piping connection to equipment specified in other sections and to equipment supplied and installed by other Contractors or by the Owner.
 - .1 Install shut-off valves, vents, drains, unions, flanges, traps, fittings.

1.18

CONCEALMENT

- .1 Conceal all piping, ductwork and conduit in partitions, walls and ceiling spaces, unless otherwise noted.
- .2 Do not install piping or conduit in outside walls or roof slabs unless specifically directed, in which case, install them with the building insulation between them and the outside face of the building.

1.19

SCHEDULING

- .1 Coordinate with Division 1, Construction Schedule.
- .2 Incorporate within the Construction Schedule, a complete and realistic schedule, integrated with, and recognizing the reliance on, other divisions of the work.
 - .1 Consider the lead time for the review of operating and maintenance manuals, commissioning, verification of system operation by the Consultant and the demonstration and instruction to the Owner.
- .3 The schedule shall include but not limited to the following items:
 - .1 Installation and testing of piping systems and equipment.
 - .2 Installation and cleaning of duct systems and equipment.
 - .3 Chemical cleaning and treatment of piping.
 - .4 Control system installation.

- .5 Air/Water balancing
- .6 Connection of electrical services to equipment by electrical contractor.
- .7 Start-up of mechanical equipment and systems.
- .8 Check-out of control systems.
- .9 Commissioning of mechanical systems (Division 20, 21, 22, 23 and 25).
- .10 Demonstration of systems and equipment to the Consultant.
- .11 Demonstration of systems and equipment to Owner.
- .12 Preparation of maintenance manuals and as-built Record Drawings.
- .13 Submission of the various documents required prior to substantial performance.

1.20 MATERIALS

- .1 Materials and equipment installed shall be new, full weight and of quality specified.
 - .1 Use same brand or manufacturer and model for each specific application.
- .2 Each major component of equipment shall bear manufacturer's name, address, catalog, and serial number in a conspicuous place.
- .3 Replace materials or work below specified quality and relocate work wrongly placed to satisfaction of the Consultant and at no cost to the Owner.
- .4 Install materials and equipment in a quality manner providing good work practices by competent tradepeople.

1.21 ASBESTOS

- .1 All material / products installed shall be free of asbestos.

1.22 ASBESTOS DURING RENOVATIONS

- .1 If the Contractor, during renovations, should discover asbestos (or material suspected to be asbestos) on piping, ductwork, etc., he shall immediately cease all work in that area and contact the General Contractor or Owner's representative.
- .2 Removal of all asbestos products shall be carried out in accordance with the applicable codes by an approved Contractor experienced in this specialty.

1.23 BUILDING OPERATION DURING CONSTRUCTION

- .1 Before interrupting major services notify the Owner well in advance and arrange an acceptable schedule for the interruptions.
- .2 Before interrupting any services complete all preparatory work as far as reasonably possible and have all necessary materials on site and prefabricated (where practical) and work continuously to keep the length of interruption to a minimum.
- .3 Include for the cost of all work that may be required out of regular hours to minimize the period of service interruption when connecting into the existing systems.
- .4 To minimize operational difficulties for the building staff, the various trades must cooperate with the Owner throughout the entire construction period and particularly ensure that noise is minimized.
- .5 Convenient access for the staff and public to the building must be always maintained.
 - .1 Minor inconvenience and interruption of services may be tolerated, provided advance notice is given, but the Contractor will be expected to coordinate his work, in consultation with the Owner, so the operation of the facility can be maintained as nearly normal as possible.

1.24 EXISTING SERVICES

- .1 Work includes changes to existing building and changes at junction of old and new construction.
 - .1 Route pipes, ducts, conduits, and other services to avoid interference with existing installation where possible or relocate existing to accommodate the new services.
- .2 Relocate existing pipes, ducts, and any other equipment or services required for proper installation of new work, including as required for temporary removal and re-installation to suit new installation work.
 - .1 Provide temporary service connections, as required, to accommodate service relocations.
- .3 Protect all existing services encountered, even when the removal of concealing surfaces reveals existing services other than what is shown on the drawings.
- .4 Work with the Owner's staff to trace the originating source and points served.
 - .1 Obtain instructions from the Consultant when existing services require relocation or modifications, other than those already indicated in the Contract Documents.
- .5 Remove existing plumbing fixtures, equipment, piping, ductwork, low voltage wiring, and equipment to suit new construction for the renovation portions of the project.
 - .1 Cut back and cap drain, vent and water outlets, and conduits not being used.
- .6 Arrange work to avoid shutdowns of existing services.
 - .1 Where shutdowns are unavoidable, obtain the Owner's approval of the timing, and work to minimize any interruptions.
- .7 Shutdowns, to permit connections, will be carried out by maintenance staff.
- .8 Be responsible for any damages to existing systems by this work.
- .9 Site Impact Notices:
 - .1 The interruption of utility services to permit tie-ins shall be arranged through the Owner's representative.
 - .2 Application must be received in writing at least seven (7) calendar days prior to the date required for the shutdown.
 - .3 The Owner reserves the right to withhold permission for a reasonable period with respect to any shutdown if the shutting-off of a service will interfere with important operations.

1.25 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver and store materials in original packaging with manufacturer's labels.
- .2 Protect materials against damage from weather and construction activities.

1.26 COORDINATION

- .1 Check drawings of all trades to verify space and headroom limitations for work to be installed.
- .2 Coordinate work with all trades and make changes to facilitate a satisfactory installation.
- .3 Make no deviations to the design intent involving extra cost to the Owner, without the Consultant's written approval.
- .4 The drawings indicate the general location and route to be followed by the piping and ductwork.
 - .1 Where details are not shown on the drawings or only shown diagrammatically:

- .1 The pipes and ductwork 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.
- .2 Service lines shall run parallel to building lines.
- .3 All ducts and pipes in the ceiling shall be kept as tight as possible to beams or other limiting members at high level.
- .4 All pipes and ducts shall be coordinated in elevation to ensure that they are concealed in the ceiling or structural space provided unless detailed otherwise on drawings.
- .5 Work out jointly all interference problems on the site with other trades and coordinate all work before fabricating or installing any material or equipment.
 - .1 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.
 - .2 Advise the Consultant of space problems before fabricating or installing any material or equipment.
 - .3 On completion of the work demonstrate to the Consultant that all equipment installed can be properly and safely serviced and replaced where applicable.
 - .4 Remove and replace improperly installed equipment to satisfaction of the Consultant at no extra cost.
 - .1 Extras for improper coordination and removal of equipment to permit remedial work will not be allowed.

1.27

COORDINATION OF WORK

- .1 Cooperate and coordinate with other trades on the project.
 - .1 Phase work in sequence with the General Contractor.
- .2 Refer to electrical, mechanical, structural, and architectural drawings when setting out work.
 - .1 Consult with respective Divisions in setting out locations for ductwork, equipment, and piping, so that conflicts are avoided and symmetrical even spacing is maintained.
- .3 Where dimensional details are required, work with the applicable architectural and structural drawings.
- .4 Full size and detailed drawings shall take precedence over scale measurements from drawings.
- .5 Coordinate with the Contractor and Electrical Trade all requirements for electrical services to mechanical components and equipment.
 - .1 Motor voltages will be defined in Division 26.
- .6 Using shop drawing data, prepare a comprehensive list to define all specific electrical requirements needed by the Division 20, 21, 22, 23 and 25 work to complete the installation.
 - .1 Coordinate with Electrical Trade.
- .7 Prepare and submit drawings to the Contractor and the Structural Consultant defining mechanical system support loads and support details. Include definition of pipe and/or loads on structural elements and anchor arrangements.

1.28

EXAMINATION OF SITE

- .1 Portions of this project include renovations to the existing facility.
- .2 Before submitting Proposal, visit and examine the site and note all characteristics and features affecting the work.

- .1 Report discrepancies to the Consultant seven (7) days prior to RFP closing.
- .3 No allowances will be made for any difficulties encountered or any expenses incurred because of any conditions of the site or item existing, thereon, which are visible or known to exist at the time of RFP closing.
- .4 Failure to advise the Consultant of discrepancies will assume contractor accepts documents as presented without potential of additional costs.

1.29 EQUIPMENT RESTRAINT

- .1 It is the responsibility of equipment manufacturers to design their equipment so that the strength and anchorage of internal components of the equipment exceeds the force level used to restrain and anchor the unit itself to the supporting structure.

1.30 HOISTS AND SCAFFOLDS

- .1 Provide all necessary interior movable or roller scaffolds, platforms, lifts and ladders for the installation of the mechanical work.

1.31 EQUIPMENT SUPPORTS, PLATFORMS, LADDERS, AND BASES

- .1 Provide all required stands and supports for equipment and materials supplied. Work to be done by firms specializing in these fields.
 - .1 Submit shop drawings for steel and concrete work, prepared by the Contractor's Supporting Professional Engineer (Delegated Design).
- .2 Supports:
 - .1 Construct equipment supports of structural steel or steel pipe. Securely brace.
 - .1 Employ only welded construction.
 - .2 Bolt mounting plates to the structure.
 - .2 Support ceiling hung equipment with rod hangers and/or structural steel.
 - .3 Fabricate piping and equipment supplementary supporting steel from steel and provided by this Division.
- .3 Concrete Bases (Housekeeping Pads):
 - .1 This Division shall lay out concrete bases and curbs required under Divisions 21, 22, 23 and 25.
 - .1 Coordinate with Division 03.
 - .2 All concrete work is under Division 03 including the following:
 - .1 Concrete housekeeping bases for mechanical equipment, which are in direct contact with floor slab.
 - .1 The General Contractor shall be responsible for framing, structural support, and concrete work.
 - .3 Constructed using plywood form work and 20 Mpa [3000 psi] concrete.
 - .4 Bases and curbs shall be keyed to the floor and incorporate reinforcing bars and/or steel mesh.
 - .1 Chamfer edges of bases at 45 degrees.
 - .5 Dowel to concrete floor slab with not less than 13 mm [1/2"] diameter steel rods.
 - .1 Refer to structural drawings for additional information and requirements
 - .6 Plan dimensions:

- .1 150 mm [6"] larger all around than base of apparatus for non-seismic applications,
- .2 200 mm [8"] larger all around than base of apparatus for seismically restrained equipment, and
- .3 finished to make smooth, neat surfaces with corners chamfered 25 mm [1"].
- .7 Height conforming to following table;
 - .1 Stationary Equipment, not motorized: 100mm [4"]
 - .2 Motorized Equipment: 150mm [6"]
- .8 Equipment with bedplates shall have metal wedges placed under the edges of the bedplates to raise them 25 [1"] above the base after levelling.
 - .1 The wedges shall be left permanently in place.
 - .2 Fill the space between the bedplate and the base with non-shrink grout.
- .4 Installation:
 - .1 Locate supporting steel to permit removal of parts for service or repair, and to allow clear access to valves, fittings, and equipment,
 - .2 Set equipment on supporting frames and brackets and install hangers, anchor bolts, vibration mountings and snubbers.
 - .3 Set equipment base plates on housekeeping pads on minimum 13 mm [1/2"] epoxy grout and fill hollow portion of base with concrete.
 - .4 Install anchor bolts, vibration mountings and snubbers between equipment and housekeeping pad.
 - .5 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.
 - .6 Provide anchorage, dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.
 - .7 Make field connections with bolts to CAN/CSA-S16.1, or weld.
 - .8 Supply items for casting into concrete or building into masonry to appropriate trades together with setting templates.
 - .9 Touch-up field welds, bolts and burnt or scratched surfaces after completion of erection with primer.
 - .10 Where gratings or trench covers are cut in field or damaged, touch up with zinc rich paint.

1.32 ANCHOR BOLTS AND TEMPLATES

- .1 Supply anchor bolts and templates for installation by other divisions.

1.33 MISCELLANEOUS METALS

- .1 Be responsible for all miscellaneous steel work relative to Division 20, 21, 22, 23, 25 of the Specifications, including but not limited to:
 - .1 Support of equipment.
 - .2 Hanging, support, anchoring, guiding and relative work as it applies to piping, ductwork, fans and mechanical equipment.
 - .3 Seismic restraint devices - refer to Section 20 05 49.
 - .4 Pipe anchor and/or support posts.

- .5 All metal framing for supporting, hanging, anchoring, and guiding mechanical equipment shall be designed and approved by a structural engineer licenced to practice in the province having jurisdiction on the project.
 - .1 Provide shop drawings, sealed and signed, for metal work.
- .6 All steel work shall be primed, and undercoat painted, ready for finish under Division 9. Refer to drawings for details.
- .2 Provide backing plates for all wall mounted equipment.
 - .1 Backing Plates shall be adequate to support the intended use and shall be a minimum 12 mm [1/2"] in thickness.

1.34 DIELECTRIC COUPLINGS

- .1 Provide dielectric couplings on all "OPEN" systems, wherever pipes of dissimilar metals are joined.
- .2 Provide insulating unions for pipe sizes 50mm [2"] and under and flanges for pipe sizes 65mm [2.5"] and larger.
- .3 Provide felt or rubber gaskets to prevent dissimilar metals contact.

1.35 LUBRICATION OF EQUIPMENT

- .1 Lubricate all new equipment prior to being operated, except sealed bearings, which shall be checked.
- .2 Use the manufacturer recommended lubricants for the service for which the equipment is specified.
- .3 Extend lubricating connections and sight glasses to the outside of housings, where lubricating positions are not readily accessible.
- .4 Submit a check list, showing that all operated equipment has been lubricated prior to and during any temporary heating period and the demonstration and instruction period.

1.36 INSPECTION OF WORK

- .1 The Consultant representative will inspect all work prior to it being concealed. All piping below ground must be approved prior to covering.
- .2 All work shall be approved by all authorities having jurisdiction.
- .3 All openings shall be sealed appropriately in particular in fire rated walls and floors. Sealing shall be inspected prior to covering.

1.37 PROVISIONS FOR MAINTENANCE

- .1 Provide unions and flanges to permit equipment maintenance and disassembly and to minimize disturbance to piping and duct systems and without interfering with building structure or other equipment.
- .2 Provide means of access for servicing equipment including permanently lubricated bearings.
- .3 Install all work to be readily accessible for adjustment, operation, and maintenance.
 - .1 Furnish access doors where required in building surfaces for installation by building trades.
 - .2 Refer to Section 20 05 33 Access Doors.
- .4 Install piping in racks with clearance in between pipes equal to the pipe diameter.
 - .1 Where piping is stacked, provide a minimum 300 mm clearance in between stacks.

- .5 Install maintainable components such as valves, motors, traps, air vents, dampers, filters, coils in a manner to facilitate proper access for maintenance.
- .6 Locate flanges/unions to allow equipment removal without interruption to piping work.
- .7 Allow adequate space for removal of equipment and components from the mechanical room space.
- .8 Provide extensions to grease cups, lubrication fittings for bearings, etc. to outside of fan cabinets.
- .9 Allow minimum clearance in front of electrical components, such as motor control centers, starters, VFDs, control panels in accordance with applicable codes.

1.38 ENERGY CONSUMPTION

- .1 Consultant may reject equipment submitted for approval or review on basis of performance or energy consumed or demanded.

1.39 PERFORMANCE VERIFICATION OF INSTALLED EQUIPMENT

- .1 Installed mechanical equipment whose performance is questioned by the Consultant, may be subject to performance verification as specified herein.
- .2 When performance verification is requested, equipment shall be tested to determine compliance with specified performance requirements.
- .3 The Consultant will determine by whom testing shall be carried out.
 - .1 When requested, the contractor shall arrange for services of an independent testing agency.
- .4 Testing procedures shall be reviewed by the Consultant.
- .5 Maintain building comfort conditions when equipment is removed from service for testing purposes.
- .6 Promptly provide the Consultant with all test reports.
- .7 Should test results reveal that originally installed equipment meets specified performance requirements, Owner will pay all costs resulting from performance verification procedure.
- .8 Should test results reveal that equipment does not meet specified performance requirements, equipment will be rejected, and the following shall apply:
 - .1 Remove rejected equipment. Replace with equipment, which meets requirements of Contract Documents including specified performance requirements.
 - .2 Replacement equipment will be subject to performance verification as well; using the same testing procedures on originally installed equipment.
 - .3 Contractor shall pay all costs resulting from performance verification procedure.

1.40 CUTTING, PATCHING, DIGGING, CANNING, AND CORING

- .1 Lay out all cutting, patching, digging, canning, and coring required to accommodate the mechanical services. Coordinate with other Divisions.
- .2 Refer to structural drawings for permissible locations of openings and permissible opening sizes in concrete floors and walls.
 - .1 Openings through structural members of the building shall not be made without the approval of the Consultant.
- .3 Be responsible for correct location and sizing of all openings required under Division 21, 22, 23 and 25, including pipe sleeves and duct openings.

- .1 Allow oversized openings for fire dampers and pipe penetrations where insulation is specified.
- .4 Verify the location of existing service runs and steel reinforcing within existing concrete floor and walls prior to core drilling and/or cutting.
 - .1 Repairs to existing services and structural components damaged due to core drilling and cutting is included in this section of the work.
- .5 All openings shall be core drilled or diamond saw cut.
- .6 The performance of actual cutting, patching, digging, canning and coring is specified under other Divisions.
- .7 Cast holes larger than 100mm [4"] in diameter.
 - .1 Field-cut holes smaller than 100mm [4"] if location is approved.
- .8 Patch and make good building where damaged from equipment installation, improperly located holes etc.
 - .1 Work to be performed by the trade or contractor responsible for that type of work.

1.41 DUCT AND PIPE MOUNTED CONTROL EQUIPMENT

- .1 The following automatic control equipment will be supplied by the Controls Contractor but installed by the appropriate trade sections of the Mechanical Contract:
 - .1 Automatic control dampers.
 - .2 Static pressure sensors.

1.42 MAINTENANCE OF BEARINGS

- .1 "Turn over" rotating equipment at least once a month from delivery to site until start-up.
- .2 "Run-in" sleeve type bearings in accordance with manufacturer's written recommendation. After "run-in", drain, flush out and refill with new charge of oil or grease.
- .3 Protect bearings, shafts and sheaves against damage, corrosion, and dust accumulation during building construction.

1.43 DEMOLITION

- .1 Reference Standards
 - .1 Unless otherwise specified, carry out demolition work in accordance with CAN/CSA-S350, Code of Practice for Safety in Demolition of Structures.
- .2 Existing Conditions
 - .1 Visit and examine the site and note all characteristics and irregularities affecting the work of this section.
- .3 Protection
 - .1 Cease operations and notify the Prime Consultant immediately for special protective and disposal instructions when any asbestos materials are uncovered during the work of this section.
 - .2 Prevent debris from blocking surface drainage inlets and mechanical and electrical systems, which remain in operation.
- .4 Salvageable Materials
 - .1 Except as otherwise indicated, salvageable materials from areas of demolition shall become the property of the Owner at his discretion.

- .1 All material removed from the building not handed over to the Owner for salvage under this project shall be removed from site and disposed of as required by any applicable disposal regulations.
- .5 Existing Services
 - .1 Disconnect and cap all mechanical services in accordance with requirements of local authority having jurisdiction.
 - .1 Natural gas supply lines shall be removed by the gas company or by a qualified tradesperson in accordance with gas company instructions.
 - .2 Maintain all building services as required during demolition/removal of existing.
- .6 Demolition
 - .1 Carry out demolition in a manner to cause as little inconvenience to the adjacent occupied building area as possible.
 - .1 Coordinate the activity with the Owner and/or the Consultant.
 - .2 Carry out demolition in an orderly and careful manner.
 - .3 All removal of existing equipment, pipes and ductwork that may affect occupied areas of the building to be done outside of regular office hours or as scheduled with the Owner.

1.44 SALVAGE

- .1 All piping, ducting and equipment, which becomes redundant and is no longer required due to the work in this Contract, shall be completely removed.
- .2 All existing items which need to be removed, and which have a reasonable salvage value, such as fans, furnaces, air terminals, plumbing fixtures, etc., shall be carefully removed.
 - .1 The Owner shall have first right of refusal.
 - .2 If the Owner accepts any items, the Contractor shall move those items to the Owner's designated storage place on site.
 - .1 These items shall not become the property of the Contractor.
 - .2 Obtain a written receipt from the Owner detailing each of the items handed over.
 - .3 If the Owner declines any items, the Contractor shall remove those items from the site.
 - .1 The Contractor shall be responsible for all costs of removal and disposal of the materials and equipment that are not accepted by the Owner.

1.45 TEMPORARY OR TRIAL USAGE

- .1 Temporary or trial usage requested by the Owner of mechanical equipment supplied under contract shall not represent acceptance.
 - .1 Operate and maintain all equipment and systems during trial usage.
- .2 Repair or otherwise rectify damage caused by defective materials or installation during temporary or trial usage.
- .3 For all ventilation systems, the operation of the system shall be pre-tested by running the units in a 100% outside air, 100% exhaust air mode once all distribution ductwork is installed.
 - .1 Inspect filters bi-monthly; change filters if pressure drop exceeds manufacturer's recommended operating limit.

1.46 TEMPORARY HEATING

- .1 Refer to Division 01, Temporary Heating, Cooling and Ventilating.
- .2 If it is desired to use any of the building's mechanical systems to provide temporary heat or ventilation during construction, submit a formal request, with full details, to the Consultant.
 - .1 Obtain written permission from the Consultant prior to any building systems being utilized.
 - .2 The agreement shall include payment schedule for utilities, spare parts listing, and confirmation of warranty.
- .3 The main air handling supply units shall not be used for temporary heat.
- .4 Radiant panels may not be used for temporary heating.
- .5 Use of permanent systems for temporary heat shall not modify terms of warranty.
 - .1 Equipment Manufacturers shall certify that equipment is in "new" condition at start of warranty period.
- .6 During the temporary heating period, comply with the following conditions:
 - .1 Maintain the systems.
 - .2 Lubricate all equipment operated.
 - .3 Operate with proper safety devices and controls installed and fully operational.
 - .4 Where air systems are used during temporary heating, provide filter media on return and exhaust air outlets.
- .7 Thoroughly clean and overhaul permanent equipment used during the construction period, replace worn or damaged parts before final inspection.
- .8 Before handing the systems over to the Owner, comply with the following conditions:
 - .1 Replace all panel type air filters installed under this contract with new filters.
 - .2 Re-clean ductwork and heating/cooling coils as necessary and provide a report from the approved duct cleaning agency certifying that the ductwork and equipment is clean.

1.47 SPARE PARTS

- .1 Provide spare parts as follows:
 - .1 One set of V-belts for each piece of machinery.
 - .2 One set of air filters for each filter bank installed (pre and final filters).

1.48 PAINTING

- .1 Clean exposed bare metal surfaces supplied under Division 20, 21, 22, 23 and 25 removing all dirt, dust, grease and millscale.
 - .1 Apply at least one coat of corrosion resistant primer paint to all supports and equipment fabricated from ferrous metal.
- .2 After equipment has been installed and piping and insulation is completed, clean rust and oil from exposed iron and steel work provided under this Division, whether or not it has been factory prime painted.
- .3 Paint all pipe hangers and exposed sleeves, in exposed areas, with a rust inhibiting primer, as they are installed.
- .4 Repaint all marred factory finished equipment supplied under Division 20, 21, 22, 23 and 25, which is not scheduled to be repainted, to match the original factory finish.

- .5 In "occupied" areas of building touch up any damage to prime coat resulting from shipping or installation and leave ready for final painting under Finishes, Division 9.
- .6 In "un-occupied" areas of the building such as mechanical equipment rooms, boiler rooms, fan rooms, crawl spaces, pipe tunnels and penthouses:
 - .1 Paint exposed galvanized metal surfaces with one coat of zinc dust galvanized primer and one coat of 100% Alkyd base enamel in an approved colour.
 - .2 Paint exposed iron or steel work with one coat of chrome oxide phenolic base primer and one coat of 100% Alkyd base enamel in an approved colour.
- .7 Natural gas and fire protection piping shall be painted for identification purposes over their entire lengths throughout all exposed areas and in the mechanical room(s) as follows:
 - .1 Gas: Yellow, C.G.S.B. 505-101
 - .2 Fire: Red, C.G.S.B. 509-102
- .8 Coordinate with Division 9.
- .9 Painting of all equipment and materials, supplied under Division 20, 21, 22, 23 and 25, installed in mechanical equipment areas and inside finished areas of the building or exposed outside the building, is included under Division 9 of the Specification.
- .10 Painting by Division 9 shall be in accordance with the following Colour Schedule for Mechanical Equipment Areas.
 - .1 All colours and materials shall be reviewed with the Architect and Consultant before application.
 - .2 Air Handling Units
 - .1 First Primer Coat: Damp-proof Red
 - .2 Second Primer Coat: Zinc Chromate
 - .3 Finish Colour: Grey
 - .3 Air Compressor, bases, and motors
 - .1 First Primer Coat: Damp-proof Red
 - .2 Second Primer Coat: Zinc Chromate
 - .3 Finish Colour: Blue
 - .4 Exposed Misc. Metal (supplied under this contract)
 - .1 First Primer Coat: Damp-proof Red
 - .2 Second Primer Coat: Zinc Chromate
 - .3 Finish Colour: To be determined on site
 - .5 Piping (uninsulated)
 - .1 fire lines (standpipes, sprinklers)
 - .1 Primer Coat: Red Primer
 - .2 Finish Colour: Red
 - .2 natural gas, propane
 - .1 Primer Coat: Red Primer
 - .2 Finish Colour: Yellow
 - .3 services other than above
 - .1 Primer Coat: Red Primer
 - .2 Finish Colour: White

1.49 PROTECTION OF WORK AND EQUIPMENT

- .1 Protect equipment and materials, stored or in place, from the weather, moisture, dust, and physical damage.
- .2 Protect equipment and material in storage, on site and after installation until final acceptance. Leave factory covers in place.
 - .1 Prevent entry of foreign material into piping and duct systems.
- .3 All mechanical equipment stored on site shall be kept in a dry, heated, and ventilated storage area.
- .4 Protect equipment with polyethylene covers and crates.
- .5 Secure covers over equipment openings and open ends of piping, ductwork, and conduits, as installation work progresses.
- .6 Equipment having operating parts, bearings, or machined surfaces, showing signs of rusting, pitting or physical damage will be rejected.
- .7 Refinish damaged or marred factory finish.
- .8 Protect bearings and shafts during installation.
 - .1 Grease shafts and sheaves to prevent corrosion. Supply and install necessary extended nipples for lubrication purposes.
- .9 Mask machined surfaces.
- .10 Operate, drain, and flush out bearings and refill with new change of oil before final acceptance.
- .11 Air systems to have air filters installed before fans are operated. Install new air filters before system acceptance.
- .12 Provide, install, and maintain 30% efficient temporary filters to return and exhaust air openings from ceiling spaces to prevent air born dust from entering ducts, plenums, and coils.
 - .1 Install filters to return air grilles when fans are operated, and building is not at a clean condition.
- .13 Ensure that existing equipment to be turned over to the Owner or reused is carefully dismantled and not damaged or lost.
 - .1 Do not reuse existing materials and equipment unless specifically indicated.

1.50 CLEANING AND ADJUSTMENTS

- .1 Conduct final cleaning.
- .2 Thoroughly clean piping, ducts and equipment of dirt, cuttings, and other foreign substances.
- .3 Thoroughly clean exterior surface of exposed piping, and vacuum external surfaces of exposed ducts and interior surfaces of air handling units.
 - .1 Clean strainers in piping systems and install clean filters in air handling systems.
- .4 Refer to Section 23 33 05 Duct Cleaning for detailed requirements.
- .5 Remove tools and waste materials on completion of work and leave work in clean and perfect condition.
- .6 Calibrate components and controls and check function and sequencing of systems under operating conditions.
- .7 Supply lubricating oils and packing for proper operation of equipment and systems until work has been accepted.

1.51 COORDINATION WITH DIVISION 26/27 WORK

- .1 Provide motors or mechanical equipment with voltage and phase characteristics as defined in Division 26/27.
- .2 Comply with the requirements in Section 20 05 03, Electric Motors.
- .3 Prior to ordering any motor driven mechanical equipment, meet with the electrical trade and he shall confirm all electrical interface requirements with mechanical components.
- .4 Division 20, 21, 22, 23 and 25 (Mechanical) Trade shall:
 - .1 Submit a list of all motor specifications and electrical connections to mechanical equipment, outlets, components, panels, and point source requirements.
 - .1 Maintain list up-to-date and make available for site review.
 - .2 Include motor list in O&M Manuals.
 - .3 Supply and install all low voltage (24 V) control devices, temperature control systems including direct digital central systems defined in Division 25 Series, Controls.
 - .4 Supply and set in place all variable frequency drives that are defined in Section 20 05 04, Variable Speed Drives, including start-up and commission.
 - .5 Supply and install all low and live voltage wiring associated with automatic control systems defined in Division 25 Series, Controls.
 - .6 Provide CSA labeling on all mechanical equipment with electrical components.
 - .7 Provide all on-site interconnecting wiring for connecting loose electrical components supplied with mechanical equipment.
- .5 Division 26/27 (Electrical) Trade will:
 - .1 Supply and install all electrical components which are required, but not part of Division 20, 21, 22, 23 and 25 supplied packaged equipment.
 - .2 Provide wiring interface from distribution equipment to variable frequency drives (VFDs) and from VFDs to motors.
 - .3 Extend power wiring from electrical centers to packaged equipment that contains electrical components.
 - .4 Refer to Division 26/27.

1.52 WARRANTY

- .1 Comply with warranty requirements defined in Division 01.
- .2 Warranty starts on the day of Substantial Completion/Substantial Performance for all systems and equipment.
- .3 Use of installed equipment during construction shall not shorten or alter the warranty period as specified in the General Conditions.
- .4 Take note of any extended warranties specified.
- .5 Refer to Section Division 25 for Control System warranty requirements.
- .6 Furnish a written warranty stating that all work executed under this Division will be free from defects of material and installation for a period of one (1) year from the date of substantial performance, which shall include one (1) complete summer and one (1) complete winter of uninterrupted operation even if that extends the time period beyond substantial performance beyond one (1) year.
- .7 Warranty shall include any part of equipment, units or structures furnished hereunder that show defects in the works under normal operating conditions and/or for the purpose of which they were intended.

- .8 The Contractor shall agree that they will, at their own expense, promptly investigate any mechanical or control malfunction, and repair or replace all such defective work, and all other damages thereby which becomes defective during the time of the guaranty-warranty.

1.53 OWNER REQUIREMENTS DURING WARRANTY

- .1 Unless specified otherwise, the Owner shall be responsible for all routine maintenance requirements as required in the manufacturer's instructions.
- .2 The Owner shall be responsible for supplying filters, grease, and belts.

Part 2 Products

2.1 NOT APPLICABLE

- .1 Refer to Division 20, 21, 22, 23 and 25 sections for Product information

Part 3 Execution

3.1 NOT APPLICABLE

- .1 Refer to Division 20, 21, 22, 23 and 25 sections for Execution information

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 Specification Section 20 05 01 provides guidance on providing a complete, fully tested, and operational mechanical systems to meet the requirements, in complete accordance with applicable codes, bylaws and standards.

1.2 RELATED REQUIREMENTS

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.
- .2 In conjunction with Division 01, this Section is intended to apply to all work in Division 20, 21, 22, 23 and 25.
- .3 Refer to and comply with the following sections:
- .4 General Requirements - Division 01
- .5 Common Work for Mechanical Systems – Division 20
- .6 Fire Suppression Systems - Division 21
- .7 Plumbing Systems - Division 22
- .8 Heating, Ventilation and Air Conditioning Systems - Division 23
- .9 Controls and Instrumentation - Division 25
- .10 Electrical - Division 26/27

1.3 APPLICABLE CODES AND STANDARDS

- .1 Divisions 20, 21, 22, 23, and 25 work shall conform to the following codes, regulations and standards, and all other codes in effect at the time of award of Contract, and any others having jurisdiction.
- .2 Where multiple versions of the same code are published, the most recent version shall be applied, unless noted otherwise by provincial building codes and local by-laws.
 - .1 The latest revision of each code and/or standard shall generally apply unless local building codes reference a previous version, or otherwise specified in the contract documents.
 - .2 Where the contract documents indicate requirements more stringent requirement than any applicable code and/or standard, the contract documents shall be implemented.
 - .1 In no instance shall the standard established by the drawings and specifications be reduced by code or otherwise.
 - .3 Where multiple standards apply, the most stringent requirement shall be incorporated into the work.
- .3 Installation shall be subject to design approval, inspection, and test of the Authority Having Jurisdiction.
- .4 All products shall be approved by and be identified with the label or mark of a recognized testing agency as applicable, e.g ULC, cUL, ETL, CSA, etc.
- .5 Furnish all notices, obtain all necessary permits related to Division 20, 21, 22, 23 and 25 work.
 - .1 All installation, work practices, and testing shall conform to the following standards as a minimum:

- .2 Local Municipal Bylaws
 - .1 Building By-laws.
 - .2 Fire By-laws.
 - .3 Plumbing By-laws.
 - .4 Noise Control By-laws.
- .3 ANSI/ASME
 - .1 ASME/ANSI B31.9 Building Services Piping
- .4 Canadian Standards Association
 - .1 CAN/CSA-B149.1 Natural Gas and Propane Installation Code.
 - .2 CAN/CSA-C22.1 Canadian Electrical Code, Part I
 - .3 CAN/CSA-C22.2 Test methods for electrical wires and cables
- .5 National Fire Protection Association
 - .1 NFPA 10 Standard for Portable Fire Extinguishers
 - .2 NFPA 13 Standard for the Installation of Sprinkler Systems
 - .3 NFPA 90A Standard for the Installation of Air-Conditioning and Ventilating Systems
 - .4 NFPA 90B Standard for the Installation of Warm Air Heating and Air-Conditioning Systems
 - .5 NFPA 101 Life Safety Code
- .6 Provincial Codes
 - .1 Provincial Building Code
 - .2 Provincial Plumbing Code
 - .3 Provincial Fire Code
 - .4 Provincial Safety Authority Safety Standards Act
 - .5 Provincial Safety Authority Power Engineers, Boiler, Pressure Vessel, and Refrigeration Safety Regulation
 - .6 Provincial Amendment to Canadian Electrical Code
 - .7 Provincial Electrical Safety Regulation
 - .8 Provincial Electrical Safety Branch Bulletins
 - .9 Provincial Gas Safety Regulation
 - .10 Provincial Code Amendments, Gas Safety Act & Regulations
 - .11 Provincial Occupational Health & Safety (OHS) Regulations
 - .12 Provincial Safety Standards Act
- .7 Underwriter's Laboratories of Canada
 - .1 CAN/ULC-S110 Test for Air Ducts
 - .2 CAN/ULC-S111 Fire Test for Air Filter Units
 - .3 CAN/ULC-S112 Fire Test of Fire-Damper Assemblies
 - .4 CAN/ULC-S112.1 Leakage Rated Dampers for Use in Smoke Control Systems
 - .5 CAN/ULC-S115 Fire Tests of Fire Stop Systems
 - .6 ULC/ORD C199P Combustible Piping for Sprinkler Systems
- .8 SMACNA Publications
 - .1 SMACNA 001 Guidelines for seismic restraints of mechanical systems
 - .2 SMACNA 006 HVAC Duct Construction Standards, Metal and Flexible

- .3 SMACNA 008 IAQ Guidelines for Occupied Buildings Under Construction
- .4 SMACNA 012 HVAC Air Duct Leakage Test Manual
- .5 SMACNA 014 HVAC Systems Commissioning Manual
- .6 SMACNA Fire, Smoke, and Radiation Damper Installation Guide
- .9 ASHRAE Standards
 - .1 ASHRAE Standard 62.1 Ventilation for Acceptable Indoor Air Quality
 - .2 ASHRAE/IES Standard 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings
 - .3 ASHRAE Standard 202 The Commissioning Process for Buildings and Systems.
 - .4 ASHRAE/NIBS Guideline 0 The Commissioning Process
 - .5 ASHRAE Guideline 1.1 HVAC&R Technical Requirements For The Commissioning Process
 - .6 ASHRAE Guideline 1.3 Building Operations and Maintenance Training for The HVAC&R Commissioning Process
 - .7 ASHRAE Guideline 1.4 Procedures for Preparing Facility Systems Manuals
 - .8 ASHRAE Guideline 1.5 The Commissioning Process for Smoke Control Systems
- .10 Miscellaneous Standards
 - .1 Thermal Insulation Association of Canada – TIAC Best Practices Guide
 - .2 Provincial Insulation Contractors Association –Insulation Contractors Association Standards Manual
 - .3 Master Insulators’ Association
 - .4 Environment Canada Canadian Environment Protection Act
 - .5 Environmental Protection Agency EPA 625 Radon Prevention in the Design and Construction of Schools and Other Large Buildings

Part 2 Products

2.1 NOT APPLICABLE

- .1 Not used

Part 3 Execution

3.1 NOT APPLICABLE

- .1 Not used

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section provides General, Product, and Execution Requirements for all motor driven equipment defined in Division 20, 21, 22 and 23 sections.
- .2 Motors shall be suitable for horizontal or vertical mounting, and belt or direct drive applications.
- .3 Provide ground straps for all motors operating via a variable speed drive.

1.2 RELATED REQUIREMENTS

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.
- .2 In conjunction with Division 01, this Section is intended to apply to all work in Division 20, 21, 22, 23 and 25.
- .3 Refer to and comply with the following sections:
 - .1 General Requirements - Division 01
 - .2 Common Work for Mechanical Systems – Division 20
 - .3 Fire Suppression Systems - Division 21
 - .4 Plumbing Systems - Division 22
 - .5 Heating, Ventilation and Air Conditioning Systems - Division 23
 - .6 Controls and Instrumentation - Division 25
 - .7 Electrical - Division 26/27

1.3 APPLICABLE CODES AND STANDARDS

- .1 Motors shall be UL listed and CSA certified.
- .2 All equipment, materials, installation, and testing shall conform to the following standards as a minimum:
 - .1 Provincial Building Code
 - .2 Local Building By-Laws
 - .3 Provincial Safety Authority
 - .4 CSA C22.1 Canadian Electrical Code.
- .3 Motors to be designed, manufactured, and tested in accordance with standards of:
 - .1 All motors shall be in accordance with latest version of the NEMA standards, and CSA C390.
 - .2 All motors shall be premium efficient, "Inverter Duty" in accordance with NEMA Standard MG-1. NEMA, ANSI, IEEE, and ASTM,
 - .3 Motors shall comply with the applicable portions of the Canadian Electric Code.
- .4 Motors designed to IEC Standards are not acceptable.

1.4 QUALITY ASSURANCE

- .1 Motors connected to VFD(s) shall be wound using inverter spike resistant magnet wire capable of 1600V.
- .2 The noise level of each motor shall comply with NEMA standards, less than 80 dBA at 1 meter.

- .3 Motors powered by variable speed drive controllers,
 - .1 Shall be EEMAC Class B with Type F insulation, shall have a 1.15 service factor and shall be suitable to be driven by PWM variable speed drive controllers.
 - .2 The motor manufacturer shall submit in writing confirmation that the motors are designed to withstand voltage peaks of 1400 volts and a voltage rate of rise of 2000 volts / microsecond at a frequency of 20 kHz.
 - .3 Motors, driven by VFD equipment, shall utilize dielectric grease on bearings and shall incorporate a motor shaft grounding system utilizing stainless steel brushes.
 - .4 Provide ground straps for all motors operating via a variable speed drive.
- .4 Provide all motors with thermal overload protection.
 - .1 Coordinate with Electrical contractor.
- .5 Production Tests:
 - .1 Each motor shall receive a routine commercial test per NEMA MG-1.12.
 - .2 Prototype test reports shall be for each rating.
- .6 Sound Level:
 - .1 The noise level of each motor shall comply with NEMA MG-1.12.49.
- .7 Vibration Level:
 - .1 The vibration level of each motor shall not exceed those values listed in NEMA MG-1.12.05.

1.5 SUBMITTALS

- .1 Comply with Section 20 05 05 Documentation and Submittals.
- .2 Shop drawings
 - .1 Submit shop drawings in accordance with Division 01 and Division 20 05 05 Documentation and Submittals.
 - .2 Shop drawings are required for all materials and equipment.
 - .3 Submit shop drawings indicating motor manufacturer, frame size, voltage, full load amps, insulation class, motor grade, and dimensions.
 - .4 Submit data of test method used and motor efficiencies with shop drawings.
 - .5 Submit a copy of typical Warranty Certificate.
- .3 Maintenance data
 - .1 Submit Maintenance Data in accordance with Division 1 and Section 20 05 05 Documentation and Submittals.
 - .2 Submit manufacturer's recommended maintenance tasks for a one-year period. Include maintenance schedules and lubrication products.
 - .3 Submit operating and maintenance data for inclusion into the manuals.

Part 2 Products

2.1 STANDARD OF ACCEPTANCE

- .1 Manufacturers: Refer to Section 20 99 65
- .2 All motors as listed shall be premium efficiency inverter grade, in compliance with NEMA Standard MG-1, Section IV, Part 31.

2.2 ELECTRIC MOTORS - GENERAL

- .1 Provide motors for all mechanical equipment.
- .2 Test performance equal to or better than level required by Energy Efficiency regulations when tested to CSA 390 M Energy Efficiency Test Methods for Three Phase Induction Motors, or IEE 112b Standard Test Procedure for Polyphase Induction Motors and Generators.
- .3 Motors shall meet the following requirements of ASHRAE 90.1
 - .1 Fans with motors greater than 0.55 kW [0.75 hp] shall be provided with automatic controls complying with Section ASHRAE 90.1 section 6.4.3.3.1, that are capable of and configured to shut off fans when not required (except for systems intended to operate continuously – refer to control sequences)
 - .2 Fan Motor Selections
 - .1 For each fan less than 4.5 kW [6 hp], the selected fan motor shall be no larger than the first available motor with a nameplate rating greater than 1.5 times the bhp.
 - .2 Exceptions: Motors equipped with electronic speed control devices or fans with a nameplate electrical input power of less than 0.89 kW [1.2 bhp].
 - .3 Fractional Horsepower Fan Motors
 - .1 Motors less than 0.75 kW [1 hp] shall have a minimum motor efficiency of 70% rated in accordance with DOE 10 CFR 431 per ASHRAE 90.1 6.5.3.6.
- .4 Electric motors manufactured alone or as a component of another piece of equipment (between 0.75 kW and 149kW) shall comply with ASHRAE 90.1 Table 10.8.1 for NEMA Design A motors, NEMA Design B motors, and IEC Design N motors and Table 10.8-2 for NEMA Design C motors and IEC Design H motors.
- .5 General purpose small electric motors with a rated motor power of 0.19 kW and less than 2.23 kW shall have a minimum average full-load efficient that is not less than as shown in ASHRAE 90.1 Table 10.8-3 for polyphase small electric motors and Table 10.8-4 for capacitor-start capacitor-run small electric motors and capacitor-start induction-run small electric motors.
- .6 Motors shall be capacitor start type when they may be manually cycled from a starting switch located in a finished space.
- .7 Motors exposed to outdoor temperature shall be lubricated with lubricants suitable for operation at 6C below the lowest temperature recorded by ASHRAE or the Climatic Information (Supplement to the National Building Code), for the location in which they are installed.
- .8 Refer to equipment schedules and Division 26 for voltage/phase of specific motors.

2.3 VOLTAGE AND FREQUENCY

- .1 Motors less than 375 W (½ HP):
 - .1 single phase,
 - .2 continuous duty,
 - .3 resilient mount, and
 - .4 built-in thermal overload protection.
- .2 Motors of 375 W (½ HP) and 560 W (¾ HP):
 - .1 three phase squirrel cage induction type,
 - .2 NEMA Design B

- .3 Motors 745 W (1 HP) and larger for sine wave power supply
 - .1 Three phase motors for service with magnetic starters
 - .1 Open Drip Proof (ODP), NEMA T frame assembly
 - .2 NEMA Premium efficiency, general purpose duty type,
 - .3 suitable for horizontal, vertical or belt-driven mounting
 - .4 NEMA Design B, squirrel cage, induction type
 - .5 class B insulation, at 40°C (104°F) ambient temperature.
 - .6 service factor,
 - .7 3 leads for single voltage service.
 - .8 Two speed motors: six (6) lead motors.
 - .9 Five lead two-speed motors are not acceptable.
 - .2 Three phase motors for service with adjustable speed drives
 - .1 Motors 745 W (1 HP) and larger suitable for pulse width modulated wave form.
 - .2 Totally Enclosed Fan Cooled (TEFC), NEMA T frame assembly
 - .3 NEMA Premium efficiency, inverter duty type,
 - .4 suitable for horizontal, vertical or belt-driven mounting
 - .5 NEMA Design B, squirrel cage, induction type
 - .6 Fabricated and nameplated in accordance with NEMA MG-1 Part 31 for;
 - .1 200% of full load starting torque
 - .2 Class F triple build winding insulation
 - .3 continuous duty
 - .4 40°C (104°F) ambient temperature
 - .7 service factor,
 - .8 3 leads for single voltage service.
- .4 Motor designed for grounding of stray rotor currents by application of electrically conductive bearing grease or rotor bearing brush assembly.
 - .1 All motors shall be designed and manufactured to operate with $\pm 10\%$ voltage and $\pm 5\%$ frequency variations of the nameplate ratings.
 - .2 Combined voltage and frequency variation shall not exceed $\pm 10\%$.
 - .3 Confirm voltages for all motors with Division 26.
 - .4 Motor nameplate rating:
 - .1 Not less than input brake horsepower of driven equipment at specified operating condition,
 - .2 Suitable for starting conditions.
- .5 Motor Characteristics:
 - .1 Torques
 - .1 Motors shall meet or exceed the locked rotor (starting) and minimum breakdown torques specified in NEMA standard for Design B for the ratings specified.
 - .2 Currents
 - .1 Locked rotor (starting) currents shall not exceed NEMA Design B maximum values for the specified rating. Motors shall be capable of a 20 second stall at six (6) times full load current without injurious heating to the motor components.

- .3 Speed
 - .1 1800 RPM unless specifically scheduled otherwise.
- .4 Efficiency
 - .1 Motors shall be Premium Efficient design and have a minimum and nominal full load efficiency which will meet or exceed the values listed in NEMA MG1-12.55 Table 12-6B when tested in accordance with NEMA test standard MG1-12.54.1, IEEE Test Procedure 112, Method B using accuracy improvement by segregated loss determination including stray load loss measurements.
- .5 Power Factor
 - .1 The power factor of 3600 and 1800 rpm, 3 through 250 HP ratings at full load, at full voltage shall be a minimum of 85%. Six-pole ratings will be excluded from this requirement.
- .6 Service Factor and Ambient
 - .1 Standard motors will be rated for a 1.15 service factor in a 40°C [104°F] ambient temperature.

2.4 INSULATION

- .1 Standard motors shall have a full Class F non-hygroscopic insulation system.
- .2 Standard motors shall be dipped and baked in polyester varnish to consolidate the winding.
- .3 Motors on equipment serviced by Variable Speed Drives (VSDs) shall utilize Inverter Grade Insulation which consists of a minimum Class F or better insulation materials with additional phase insulating material, extra end turn bracing, and Class H spike resistant wire, capable to withstand 2000-volt transients without premature motor failure and no cable limitations in motor application. Provide stainless steel brushes to ground the shaft.

2.5 CONSTRUCTION

- .1 Provide all motors with terminal boxes, suitable for power connections.
- .2 Provide screw adjustable bases on all belt-connected motors.
- .3 Enclosures
 - .1 Construct Totally Enclosed Fan Cooled (TEFC) and Open Drip Proof (ODP) motors to NEMA T-frame, NEMA F1 Assembly.
 - .2 Provide Totally Enclosed Fan Cooled (TEFC) motors on fan equipment within air streams.
 - .3 Mount motor nameplate on enclosure with information described in NEMA Standard MG1-20.60.
 - .1 Nameplates shall be of stainless steel and stamped per NEMA Standard MG1-10.40.
 - .2 Nameplate information shall include the nominal efficiency value per standard MG1-12.54.2 and nameplate information described in the most current NEMA Standard MG1-20.
 - .4 Horsepower/frame relationship shall conform to the latest NEMA standard for T-frame motors.
 - .5 Conduit box shall be cast iron, diagonally split and rotatable in 90° increments.
 - .1 Four (4) hex head bolts shall be used to secure conduit box to frame.
 - .2 Four (4) hex head bolts shall be used for the conduit box cover.
 - .6 External hardware shall be zinc cadmium plated to resist corrosion.
 - .7 External full gloss epoxy enamel paint shall withstand industrial environments.

- .4 Motor stator winding:
 - .1 made up with copper magnet wire coated with moisture resistant Class F, non-hygroscopic varnish with thermal rating of not less than 150C for 30,000 hours life when tested in accordance with IEEE No. 57.
 - .2 insulation resistance greater than 100 megaohms when measured at 25°C measured with 1000-volt megger for 600V motors and 500V megger for 208V motors.
 - .3 held in stator slots that have had sharp edges and burs removed prior to winding insertion.
 - .4 coils phase insulated using Nomex paper, laced down.
 - .5 connection leads mechanically secured and silver soldered.
 - .6 designed for operation in either direction of rotation.
- .5 Motor shafts and rotors
 - .1 Shafts:
 - .1 precision machined from high-strength carbon steel
 - .2 "standard long" for units 200-hp and smaller, for both direct connected drive duty and V-belt drives.
 - .2 rotor assemblies to be die cast aluminum, keyed, and shrunk or pressed to shaft using full shaft diameter for full length of rotor.
 - .3 shaft extension run out not to exceed 0.001" dial indicator reading measuring at right angles to shaft axis.
- .6 Bearings
 - .1 All motors shall have anti-friction bearings, sized for L-10 life of at least 50,000 hours under minimum V belt heave sizes for maximum loading conditions (see NEMA Standard MG1-14.43) or 150,000 hours L-10 life for a direct connected load.
 - .2 Bearings shall be double-shielded, vacuum degassed steel ball bearings selected for electric motor service.
 - .3 Bearing housings shall be greaseable with provisions for purging old grease.
 - .4 Bearings shall be lubricated with a premium dielectric, moisture resistant grease of a temperature range of -29°C/20°F to +149°C/300°F.
 - .5 Cast iron inner bearing caps.
 - .6 All fasteners and motor hardware shall be zinc cadmium plated.
 - .7 lubricated at factory, after assembly, using Zerk fittings to fill grease chamber and pipe extension

2.6 ELECTRIC MOTORS – PREMIUM EFFICIENCY

- .1 All motors shall be provided with NEMA Design Type B, premium efficiency classification with non-wicking leads.
- .2 All motor efficiencies shall comply with ASHRAE 90.1, minimum.
- .3 Premium efficiency open drip-proof motors shall have the following typical full load minimum efficiencies (nominal):
 - .1 1 HP motors:
 - .1 3600 2-pole efficiency: 77.0
 - .2 1800 rpm 4-pole efficiency: 85.5
 - .3 1200 rpm 6-pole efficiency: 82.5
 - .2 2 HP motors:

- .1 3600 2-pole efficiency: 85.5
- .2 1800 rpm 4-pole efficiency: 86.5
- .3 1200 rpm 6-pole efficiency: 87.5
- .3 3 HP motors:
 - .1 3600 2-pole efficiency: 86.5
 - .2 1800 rpm 4-pole efficiency: 89.5
 - .3 1200 rpm 6-pole efficiency: 88.5
- .4 5 HP motors:
 - .1 3600 2-pole efficiency: 86.5
 - .2 1800 rpm 4-pole efficiency: 89.5
 - .3 1200 rpm 6-pole efficiency: 89.5
- .5 10 HP motors:
 - .1 3600 2-pole efficiency: 89.5
 - .2 1800 rpm 4-pole efficiency: 91.7
 - .3 1200 rpm 6-pole efficiency: 91.7
- .4 Premium efficiency totally enclosed fan cooled motors shall have the following typical full load minimum efficiencies (nominal).
 - .1 1 HP motors:
 - .1 3600 2-pole efficiency: 77.0
 - .2 1800 rpm 4-pole efficiency: 85.5
 - .3 1200 rpm 6-pole efficiency: 82.5
 - .2 2 HP motors:
 - .1 3600 2-pole efficiency: 85.5
 - .2 1800 rpm 4-pole efficiency: 86.5
 - .3 1200 rpm 6-pole efficiency: 88.5
 - .3 3 HP motors:
 - .1 3600 2-pole efficiency: 86.5
 - .2 1800 rpm 4-pole efficiency: 89.5
 - .3 1200 rpm 6-pole efficiency: 89.5
 - .4 5 HP motors:
 - .1 3600 2-pole efficiency: 88.5
 - .2 1800 rpm 4-pole efficiency: 89.5
 - .3 1200 rpm 6-pole efficiency: 89.5
 - .5 10 HP motors:
 - .1 3600 2-pole efficiency: 90.2
 - .2 1800 rpm 4-pole efficiency: 91.7
 - .3 1200 rpm 6-pole efficiency: 91.0

2.7 MOTOR OVERCURRENT PROTECTION

- .1 Provide motor thermal protection devices in motors.

2.8 SLIDING BASES FOR MOTORS WITH BELT DRIVES

- .1 Construction:

- .1 fabricated from steel as a single unit with double supported slide and two adjusting bolts.
- .2 finished with coating as specified above for motor exterior.

2.9 PERMISSIBLE VIBRATION

- .1 Vibration velocity to be not more than 0.05 inches/second measured at bearing housing.

2.10 SOUND PRESSURE LEVEL

- .1 Not more than 85dbA, measured at 3 metres in accordance with IEEE publication No. 85.
- .2 Motor manufacturer to ensure that motor is compatible with type of adjustable frequency generation to be supplied, and that system will be capable of providing rated torque over frequency range from 15 to 60 Hz while operating within motor temperature rise specification.
- .3 Motor to be capable of operating between 60 Hz and 90 Hz with torque reducing at drive frequency above 60 Hz

2.11 BELT DRIVES

- .1 Provide V-belt drive for each motor driven device which is not direct connected. Keep overhung loads on prime mover shafts within manufacturer's design guidelines.
- .2 Minimum drive rating shall be 150% of nameplate rating of motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.
- .3 Match drive and driven sheaves.
- .4 Sheaves for motors up to 5.6 kW (7.5 hp) with not more than two belts:
 - .1 Cast iron or steel secured to shafts with removable keys.
 - .2 Provide adjustable pitch on motor, fixed pitch on driven device, giving plus or minus 10% speed range,
 - .3 Selected to meet specified operating condition at mid position in pitch adjustment.
- .5 Sheaves for motors 7.5 kW (10 hp) and larger or drives with three or more belts
 - .1 Cast iron or steel with split tapered bushing and keyway.
 - .2 Provide fixed pitch drive sheaves with split tapered bushing and keyway. Provide final drive sheaves of size to suit final balancing.
- .6 Belts:
 - .1 Select for service factor of 2.0 based on installed motor horsepower.
 - .2 V-belts shall conform to the American Belt Manufacturers standards. Multiple belts shall be matched sets.
 - .3 Capable of carrying load with one belt broken.
- .7 Motor slide rails:
 - .1 Adjustment plates for centre line alignment
 - .2 Belt tension adjusting screws.
- .8 Installation
 - .1 Tension belts to manufacturer's recommendations before start-up and after first 100 hr of operation using calibrated belt tensioning gauge.
 - .2 Provide replacement pulleys and belts during start-up and balancing to suit field operating conditions.
- .9 Provide one spare set of belts for each piece of equipment with each belt separately identified for the equipment item to be served.

2.12 SHAFT COUPLINGS

- .1 Shaft couplings shall be of the pin or jaw neoprene insert type, gear type, or flexing steel insert type and shall allow coupling inserts to be easily removed without disassembly of the equipment.

2.13 DRIVE AND COUPLING GUARDS

- .1 Provide removable protective guards on all exposed V-belt drives and shaft couplings in accordance with OSHA and Provincial Workplace Health and Safety Authority.
- .2 Guards for drives shall have:
 - .1 1 mm [18-gauge] expanded metal screen welded to 25 mm [1"] steel angle frame.
 - .2 mm [16-gauge] thick galvanized sheet metal tops and bottoms.
 - .3 Removable side[s] for servicing.
 - .4 38 mm [1-1/2"] dia. holes on both shaft centres for insertion of tachometer.
 - .5 Sectionalize if necessary, so one person can handle removal.
- .3 Provide means to permit lubrication and use of test instruments with guards in place.
- .4 Fabricate and install belt guards for V-belt drives to permit movement of motors for adjusting belt tension and for belt slap.
- .5 Provide removable "U" shaped guards for flexible couplings with 2.5 mm [12-gauge] thick galvanized frame and 1.2 mm [18-gauge] thick expanded mesh face.
- .6 Provide guards on all unprotected fan inlets and outlets. Guards to be provided by fan manufacturer.
 - .1 Minimum 20 mm (: in) galvanized wire mesh or expanded metal screen with net free area of guard not less than 80% of fan opening
- .7 Secure guards to equipment allowing for ease of removal.
- .8 Prime coat guards and finish paint to match equipment.

2.14 TESTING

- .1 Test motor in accordance with IEEE 112 "Polyphase Induction Motors and Generators" to conform with NEMA MG-1.

Part 3 Execution

3.1 ELECTRIC MOTORS

- .1 Unless otherwise noted starters and protection devices will be included under the Electrical Division of the Specification.
- .2 Where starters are included in this Division as an integral part of packaged equipment, they shall contain thermal overload protection in all ungrounded lines.
- .3 Equipment, which has more than one voltage rating, shall be fed from a single power source through a disconnect switch.
- .4 If delivery of specified motor will delay delivery or installation of any equipment, install an acceptable motor for temporary use.
 - .1 Final acceptance of equipment will not be given until specified motor is installed.

3.2 COORDINATION

- .1 Submit motor list to electrical trade for review and compatibility, including motor size, voltage, phase and VFD integration (where applicable).

- .2 Assist Division 26 to ensure proper connection, correct thermal overload protection and correct motor controls.
- .3 Refer to drawings, specifications and addenda that list motor driven equipment and supply integral motors suitable for drive interface.
- .4 Refer to Division 26 and confirm voltage/phase requirements for motors.

3.3 SHIPPING

- .1 Ship motors from factory;
 - .1 packed in Styrofoam or similar material or
 - .2 fastened to hardwood skid or pallet for fork truck handling
 - .3 protected against dirt and moisture during transit and outdoor storage.
 - .4 clearly identified with permanent ink marking on packing.
- .2 Motors attached to equipment:
 - .1 protected against dirt and moisture during transit and outdoor storage.
 - .2 rotated by hand at one-month intervals.

3.4 SETTING AND ALIGNMENT

- .1 Employ a certified millwright to align all V-belt drives and/or shaft coupling drives prior to initial start-up.
 - .1 The millwright shall also check that centrifugal fan wheels are properly centered on fan shafts.
- .2 Align shaft couplings, using a dial indicator, to within +/-0.051 mm [0.002"] after grouting is complete and the piping system is operational.
- .3 Align V-belt drives using a straight edge.
- .4 Submit a certificate from the millwright employed, certifying that all shaft couplings and V-belt drives have been aligned and centrifugal fan wheels centered prior to initial start-up and checked again after final system balance adjustment.

3.5 WARRANTY

- .1 All motors shall be warranted three (3) years against defects in material and installation from date of final acceptance.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section provides General, Product, and Execution Requirements for securing and assembling all Documentation and Submittals for all mechanical systems and equipment provided.
- .2 Complete and transmit documentation for review to the Consultant at project milestones.
 - .1 Detailed Price Breakdowns
 - .2 Progress Claims
 - .3 Equipment Lists
 - .4 Contract Price Breakdowns
 - .5 Shop Drawings
 - .6 Operating and Maintenance Manuals.
 - .7 Record Drawings.
 - .8 Vendor related equipment start-up reports.
 - .9 Closeout Submittals
 - .10 Certificate of Substantial Performance
 - .11 Certificate of Total Performance

1.2 RELATED REQUIREMENTS

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.
- .2 In conjunction with Division 01, this Section is intended to apply to all work in Division 20, 21, 22, 23 and 25.
- .3 Refer to and comply with the following sections:
 - .1 General Requirements - Division 01
 - .2 Common Work for Mechanical Systems – Division 20
 - .3 Fire Suppression Systems - Division 21
 - .4 Plumbing Systems - Division 22
 - .5 Heating, Ventilation and Air Conditioning Systems - Division 23
 - .6 Controls and Instrumentation - Division 25
 - .7 Electrical - Division 26/27

1.3 QUALITY ASSURANCE

- .1 Refer to Section 20 05 00 General Mechanical Provisions, Quality Assurance for additional details.
- .2 Work specified in this section shall be performed by an Independent Agency specializing in this type of work.
- .3 Submit sample of work by the Independent Agency prior to acceptance by the Consultant.

Part 2 Products

2.1 DETAILED PRICE BREAKDOWNS

- .1 Proposal Price Breakdown:
 - .1 Within ten (10) days after the award of contract submit price breakdowns similar to the Price Breakdown Forms included in Section 20 99 60.
 - .2 Submit a separate breakdown for each section of the mechanical work listed on the Progress Claim Summary Form in Section 20 99 60.
- .2 Proposed Change, Notice of Change, Contemplated Change, etc.:
 - .1 Provide detailed itemized time and materials breakdowns to assess and evaluate each item indicated in the request for quotation.
 - .2 Indicate number of hours and labour rates, along with quantity of materials and unit costs.
 - .3 Each supplier and sub-contractor shall be detailed separately.
 - .4 Indicate mark-ups and allowances separately.

2.2 CONTRACT PRICE BREAKDOWN

- .1 Submit a breakdown of the contract price similar to the Price Breakdown Forms included in Section 20 99 60
- .2 Submit the breakdown well before first progress claim for review and approval by the Consultant.
- .3 Provide material and labour breakdown for each item, and a grand total
- .4 Provide additional breakdown as requested by the Consultant.

2.3 PROGRESS CLAIMS

- .1 For each progress claim, submit a progress claim summary based on the Progress Claim Summary Form included in Section 20 99 60.
- .2 Submit detailed price breakdowns for each section of the mechanical work listed on the Progress Claim Summary Form and for each change order item being claimed.

2.4 SHOP DRAWINGS AND PRODUCT DATA

- .1 Shop Drawings General
 - .1 Shop drawings are required for all materials and equipment.
 - .2 Submit Shop Drawings for each requirement requested in specification Sections and as consultant may reasonably request.
 - .3 The term "Shop Drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Trade Contractor to illustrate details of a portion of Work.
 - .4 Shop drawings shall be reviewed, signed, and processed as described in Division 1, Submittals.
 - .5 Submit shop drawings to the Consultant as listed in Sections:
 - .1 General Mechanical – Section 20 99 65
 - .2 Fire Suppression – Section 21 99 65
 - .3 Plumbing – Section 22 99 65
 - .4 HVAC – Section 23 99 65

- .5 Controls and Instrumentation – Section 25 99 65
- .6 Submit shop drawings with reasonable promptness and in orderly sequence so as to not cause delay in Work.
 - .1 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.
- .7 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes, and other information necessary for completion of Work.
 - .1 Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of Section under which adjacent items will be supplied and installed.
 - .2 Indicate cross references to design drawings and specifications.
- .8 Work affected by submittal shall not proceed until the review process is complete.
- .9 Installed materials and equipment shall meet specified requirements regardless of whether shop drawings are reviewed by the Consultant.
- .10 Prior to submission to the Consultant, the Shop Drawings shall be reviewed by the General Contractor and Mechanical Contractor.
 - .1 By this review, the Contractor certifies that he has determined and verified the following:
 - .1 Measurements are verified with field installation space requirements.
 - .2 “Handing” of equipment for access and maintenance is correct.
 - .3 Access for maintenance requirements is defined.
 - .4 Field connections for wiring, controls, piping, and ductwork connections are defined.
 - .5 Electrical service connections and characteristics are defined.
 - .6 Work required by other trades is defined.
- .11 Shop drawings which do not bear the contractors and sub-trades ‘Reviewed’ stamp, initials and date will be rejected and sent back as ‘not reviewed’.
- .12 Adjustments made on Shop Drawings by Consultant are not intended to change Contract Price.
 - .1 If adjustments affect value of Work, state such in writing to the Consultant prior to proceeding with Work.
- .13 Make changes in Shop Drawings as Consultant may require, consistent with Contract Documents.
 - .1 When resubmitting, notify Consultant in writing of any revisions other than those requested.
- .14 The shop drawing review by the Consultant will provide the following certification: "Review by Stantec is for the sole purpose of ascertaining general conformity with design."
 - .1 Contractor is responsible for dimensions, fabrication and construction methods, coordination of sub trades, detail design of components, and errors or omissions on shop drawings."
- .15 If upon review, no errors or omissions are discovered or if only minor corrections are made, copies will be returned, and fabrication and installation of Work may proceed.

- .1 If Shop Drawings are rejected, noted copy will be returned and re-submission of corrected Shop Drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.
- .16 If shop drawings are rejected technically after 3 submissions, the Contractor at no additional expense to the Owner shall revert to the specified product and manufacturer for this project.
- .17 Keep one (1) copy of shop drawings and product data, on site, available for reference.
- .2 Shop Drawing Format
 - .1 Submit all shop drawings in electronic (PDF) format, complete with appropriate cover sheets, transmittals, and stamps.
 - .2 Submissions shall include transmittal letter containing:
 - .1 Date.
 - .2 Project title and number.
 - .3 Name and address of:
 - .1 Trade Contractor
 - .2 Supplier
 - .3 Manufacturer
 - .4 Identification and quantity of each shop drawing, product data and sample.
 - .5 Other pertinent data.
 - .3 Include blank page for review comments and multiple consultant stamps.
 - .4 An assembly of related components, e.g., grilles, registers and diffusers or plumbing fixtures, shall be submitted with an index of contents indicating
 - .1 Tag,
 - .2 Manufacturer,
 - .3 Capacity, and
 - .4 Model number.
- .3 Shop Drawing Content
 - .1 Identify each piece of equipment as related to specification section and project equipment schedules, clearly mark each shop drawing with the identical name and/or number.
 - .2 Identify materials and equipment by manufacturer, trade name, and model number. Include copies of applicable brochure or catalogue material.
 - .3 Do not assume applicable information is available in the Consultant's office.
 - .1 Advertising literature will cause shop drawings to be returned marked "Revise and Resubmit."
 - .2 Maintenance and operating manuals are not suitable submittal material for shop drawings.
 - .3 Where equipment is identified by name or number on the drawings or specification, clearly mark each shop drawing with the identical name and/or number.
 - .4 Data shall be specific and technical.
 - .5 Clearly mark each sheet of submittal material (using arrows, underlining, or circling) to show differences from what is specified, particularly sizes, types, model numbers, rating, capacities, and options actually being proposed.
 - .1 Cross out non-applicable material.

- .2 Specifically note on the submittal specified features such as special tank linings, pump seals, materials, or painting.
- .6 Installed materials and equipment shall meet specified requirements regardless of whether or not shop drawings are reviewed by the Consultant.
- .7 The shop drawings/product data shall include:
 - .1 All scheduled data.
 - .2 All information shall be given in S.I. units.
 - .3 Dimensional and technical data sufficient to check if equipment meets requirements.
 - .4 Weights with mounting point loads, wiring diagrams, piping requirements, service connection data and motor sizes.
 - .5 Mounting arrangements.
 - .6 Detailed drawings of bases, supports and anchor bolts.
 - .7 Capacity and performance characteristics indicated on performance curves for fans and pumps.
 - .8 Sound Power Data, where requested.
 - .9 Motor efficiencies on motors 1H.P. and larger.
 - .10 List of the manufacturers and figure numbers for all valves, traps and strainers.
 - .11 Control explanation and internal wiring diagrams for packaged equipment.
 - .12 Control system drawings including a written description of control sequences relating to the schematic diagrams.
 - .1 Refer to additional requirements in Division 25.
- .4 Shop Drawing Coordination
 - .1 Where mechanical equipment requires electrical connections, power or other services, the shop drawings shall also be circulated through the Electrical Contractor or other "services" contractor(s) prior to submission to the Consultants.
 - .2 Submit as a shop drawing, an electrical equipment list for any equipment supplied by the mechanical contractor or their subtrades.
 - .1 The list is to be submitted in a timely fashion so that the electrical contractor can utilize the list as a final check prior to ordering motor control centres, starters, or disconnects.
 - .3 The Shop Drawing Coordination list shall indicate the following:
 - .1 The power kW [horsepower] size and number of motors.
 - .2 The minimum circuit amps (MCA) for packaged equipment such as roof top units.
 - .3 The voltage and phase of the motors.
 - .4 Whether or not a VSD / VFD, starter or a disconnect is included as part of the package.

2.5 OPERATING AND MAINTENANCE MANUALS

- .1 General
 - .1 Employ an approved independent contractor specializing in operating and maintenance manuals to prepare instruction manuals covering the operation and maintenance of the mechanical systems and equipment installed under this contract.
 - .2 Refer to Division 01, Operating and Maintenance Data.

- .3 Refer to Division 01, Project Record Documents.
- .4 Instructions shall be clearly written in language easily understood by the Operating and Maintenance personnel.
 - .1 Include only specific information pertinent to the equipment installed. Advertising literature and brochures of a general nature will be rejected.
- .5 Secure and assemble all necessary literature describing the operation and maintenance of all equipment provided.
 - .1 Complete and transmit documentation for review to the Consultant at project milestones.
- .6 Refer to Division 25 Instrumentation and Controls for Building Management System manual requirements.
 - .1 Descriptive sequence of operation of automatic control system, with "as-built" control schematics indicating the final settings.
 - .2 Control equipment maintenance bulletins.
 - .3 Interlock wiring diagrams.
- .2 Format
 - .1 Provide pdf electronic copies of Operations and Maintenance Manuals divided into individual files per Division and Volume # as required to minimize file size (to allow files to be easily opened by the Owner).
 - .2 Provide two (2) hard copies once the electronic copies have been reviewed and accepted by the Owner.
- .3 Hard Copy Manuals
 - .1 Each set of manuals shall include as many binders as required to accommodate the project information.
 - .2 Binders shall be 216mm x 280mm, three (3) post, expanding spine type, with metal piano hinges and bound with heavy fabric.
 - .3 Maximum binder thickness when filled shall not exceed 100mm, including a space allowance for 10% additional data.
 - .4 Binder color shall be blue, Ontario buckram fabric, color #OBV460.
 - .5 Project title and identification shall be silk screened on the front cover and spine. All lettering and borders shall be white.
 - .6 Binder spine identification to include Volume #, Set #, Title, Description, Facility Name and Facility Location.
 - .7 A front title page shall identify the Project, the Owner, the Architect and the Mechanical Consultant.
 - .1 In addition, the names of the General Contractor, Mechanical, Sheet Metal, Controls and Sprinkler Sub-Contractors, with addresses and telephone numbers shall be listed.
 - .8 Instructions shall be clearly written in English language, easily understood by the Operating and Maintenance personnel.
 - .1 Include only specific information pertinent to the equipment installed.
 - .2 Advertising literature and brochures of a general nature will be rejected.
 - .9 Contractor to submit a proof of the cover layout for review prior to ordering binders.
 - .10 Contractor shall forward all necessary data including approved shop drawings and manufacturers brochures to the O&M Manual Agency for inclusion in the Manual.

- .11 All information within the hard copy manual shall be included within the Digital Manual.
 - .1 At the Owner's / Consultant's discretion the following exceptions may be made so that the manual may be available for use by the Owner at an earlier date:
 - .2 The final Balance Report may be provided as a later submission in Portable Document Format (PDF).
 - .1 In this case, Balance Report(s) may be kept separate from the Digital Manual.
 - .3 The final Commissioning Report may be provided as a later submission in Portable Document Format (PDF).
 - .1 In this case, the Commissioning Report(s) may be kept separate from the Digital Manual.
- .4 Divider Tabs
 - .1 The divider tabs shall be laminated mylar plastic and colored according to division and section.
 - .2 Plastic tabs with typewritten card inserts will not be accepted.
 - .3 Each tab to include tab number and title printed on the tab.
 - .4 An index shall be provided, and the manual shall be divided by index dividers including but not limited to the following major sections.:
 - .5 The coloring for tabs for individual sections is as follows:
 - .1 Green - Air Systems
 - .2 Brown - Control Systems
 - .3 Blue - Cooling Systems
 - .4 Red - Fire Protection
 - .5 Orange - Heating Systems
 - .6 Purple - Plumbing Systems and non-medical gases
 - .7 Yellow - Miscellaneous Systems
- .5 Manual Divisions
 - .1 Organize each manual into the following divisions.
 - .1 Systems Description
 - .2 Operation Division
 - .3 Maintenance and Lubrication Division
 - .4 Contract Documentation Division
- .6 Operations Division
 - .1 The operations division shall have all data organized into sections according to the system category with individual divider tabs as follows:
 - .1 AIR - Air Systems
 - .2 CTL - Control Systems
 - .3 CLG - Cooling Systems
 - .4 FPN - Fire Protection Systems
 - .5 HTG - Heating Systems
 - .6 MIS - Miscellaneous Systems
 - .7 PLG - Plumbing Systems
 - .2 Organize data for each system category (section) into individual sub-systems.

- .1 Provide an index for each system category and a divider tab for each individual system.
- .3 For each individual sub-system include the following:
 - .1 System Description
 - .1 Provide a comprehensive description of the operation of each system including the function of each item of equipment within the systems and all reset schedules and seasonal adjustments.
 - .2 Provide details of system type, composition, areas served, location in the building, design criteria and function of major components.
 - .3 All equipment arranged to operate together as one system shall be considered part of that system description.
 - .2 System Schematics
 - .1 Provide individual system schematics for each system listed above.
 - .2 Include mechanical equipment and component identification using BMS system mnemonic, as well as design designation.
 - .3 Use these specific naming conventions on all references through the O&M Manual.
 - .3 Operating Instructions
 - .1 Provide, in "operator" layman language, the specific instructions for start-up, shutdown and seasonal change-over of each system component.
 - .2 Include exact type and specific location of each switch and device to be used in the system operation.
 - .3 Identify safety devices and interlocks that must be satisfied in order for the equipment to start.
 - .4 List conditions to be fulfilled before attempting equipment start-up, i.e. valves position correct, glycol mixture concentration proper, piping filled with fluid, filters/strainers in place, etc.
 - .4 Equipment Identification
 - .1 Provide data for each system component.
- .4 Electrical Switchgear
 - .1 Electrical switchgear schedule, indicating circuit number, panel location and disconnect location for each item of equipment.
- .7 Maintenance and Lubrication Division
 - .1 Organize data into the following sections with divider tabs:
 - .1 Maintenance Tasks and Schedules
 - .2 Spare Parts
 - .3 Suppliers And Contractors
 - .4 Tags And Directories
 - .2 Maintenance Tasks and Schedules
 - .1 Organize data according to the system category, with further breakdown into individual systems as used in the operations division of the manual.
 - .2 Provide section index and divider tabs for each system category.
 - .3 Summarize maintenance tasks from manufacturers maintenance brochures, for each component of each system in the following format:
 - .1 Daily
 - .2 Weekly

- .3 Monthly
 - .4 Semi-annually
 - .5 Annually
 - .6 When required.
- .3 Spare Part List
 - .1 Organize data according to the system category, with further breakdown into individual systems as used in the operations division of the manual.
 - .2 Provide section index and divider tabs for each system category.
 - .3 Summarize from manufacturers maintenance brochures the recommended spare parts for each component of each system.
 - .4 Suppliers and Contractor List
 - .1 Provide summary of Suppliers and Contractors for each component of each system.
 - .2 List name, address, and telephone number of each.
 - .5 Tags and Directories
 - .1 Provide a copy of the Mechanical Drawing, List, Valve Tag List, Piping Identification Schedule, and all other directories as specified in the contract documents.
 - .6 Equipment Schedules
 - .1 Belt schedule, indicating size and number of belts required.
 - .2 Labelling and identification schedules including colour coding.
 - .3 Valve schedule, including location, service, normal position, and area served.
 - .4 Air filter schedule indicating model no, size, number of filters required and servicing instructions (i.e.) static pressure readings, etc. for each filter bank.
 - .8 Contract Documentation Division
 - .1 Organize all data required by the construction contract into sections, with divider tabs, as follows:
 - .1 Drawings List
 - .2 Shop Drawings and Product Data
 - .3 Certifications
 - .4 Warranties and Bonds
 - .5 Maintenance Brochures
 - .6 Reports
 - .2 Shop Drawings and Product Data
 - .1 Provide copies of all final shop drawings and product data required by the contract documents.
 - .1 Include section index and divider tabs.
 - .2 Maximum of twenty-five (25) sheets or one (1) system shop drawing per tab.
 - .3 Certifications
 - .1 Include copies of all pressure tests for piping and ductwork systems, equipment alignment certificates, local authority inspection reviews, backflow prevention certification, and fire protection certifications.

- .2 Include section index and divider tabs with maximum of twenty-five sheets (25) or one report per tab.
 - .1 Back flow device test reports.
 - .2 Checklists for start-up (MF151, 152,153).
 - .3 Certificate of Testing and Balancing (MF170).
 - .4 Certificate of Duct Cleanliness (MF171).
 - .5 Certificate of Fire Damper Installation (MF172).
 - .6 Certificate of Penetrations through separations (MF173).
 - .7 Certificate of Seismic Restraint Installation (MF174).
 - .8 Certificate of Vibration Isolation Installation (MF175).
 - .9 Checklists for Demonstrations (MF181, 182, 183).
 - .10 Certificate of Substantial Performance (MF190).
 - .11 Chemical cleaning and treatment report for piping systems.
 - .12 Chlorination report for water mains.
 - .13 Commissioning reports/checklists.
 - .14 Extended warranty certificates.
 - .15 Gas Inspection - Certificate of inspection.
 - .16 Sprinkler flushing certificates.
 - .17 Sprinkler Contractor's materials and test certificate.
 - .18 Plumbing inspection certificate.
- .4 Warranties and Bonds
 - .1 Include one copy each of the Contractor's warranty, manufacturers' warranties longer than one (1) year, the bond, and any service contract provided by the contractor.
 - .2 Provide section index.
- .5 Maintenance Brochures
 - .1 Include copies of all manufacturers' printed maintenance brochures pertaining to each product, equipment, or system.
 - .2 Provide section index and divider tabs.
 - .3 Maximum of twenty-five (25) sheets or one system brochure per tab.
- .6 Reports
 - .1 Include copies of all reports relating to the testing, adjusting and balancing of equipment and systems, water treatment reports and manufacturer's start-up reports, as required by the contract specification sections.
- .9 Submissions and Approvals
 - .1 For review submissions BlueBeam Studio, BlueBeam Project, SharePoint or any mutually determined sharing platform (that the Owner is able to use) will be considered an acceptable process for making submissions.
 - .2 First Draft Submission
 - .1 Contractor shall submit a draft pdf copy of the operations and maintenance manuals for format review at the 50% construction completion stage.
 - .2 The draft submission shall include the following information:
 - .1 A table of contents for the complete manual.
 - .2 Index of each division of the manual.

- .3 Index of each section of the operations and maintenance divisions.
 - .4 A sample operations division write-up for a typical system, including sample schematic.
 - .5 A sample maintenance division write-up for the same typical system.
 - .6 Sample proof of binder covers and spines.
- .3 On completion of review of the first draft pdf submission, the consultant will return a stamped "Shop Drawing" copy of the pdf manual with review comments for resubmission.
- .1 Provisional Edition (PDF and Hardcopy)
 - .1 The contractor shall submit a pdf and hard copy of the provisional edition of the manual at the 75% construction completion stage.
 - .2 The provisional edition shall be complete in all respects, except for reports and certificates to be produced during the facility start-up phase.
 - .3 This manual shall have the same physical format, including divider tabs and indices, as the final edition of the manual.
 - .4 This provisional edition may be bound in standard 3-ring loose leaf binders.
 - .5 The provisional edition shall be kept on site as an interim reference for all parties engaged in the facility start-up phase and shall be used to familiarize and train the operating staff.
 - .6 The second copy shall be returned to the contractor with review comments.
 - .7 The Contractor shall update contents of the site copy of the provisional edition manual as new information is generated during the facility start-up phase.
 - .2 Final Edition
 - .1 Prior to final acceptance, the Contractor shall submit four (4) copies of the final edition of the manual.
 - .2 This final edition shall include all outstanding project information and conform to all requirements listed in this document.
- .10 Digital format manuals shall be supplied on a mutually acceptable SharePoint style system, CD or USB drives.
- .1 The digital version content and organization for each manual shall be arranged in a manner identical to the hard copy version.
 - .2 Utilize Portable Document Format (PDF).
 - .3 The information shall be organized into sections in a user-friendly format that is easy to search for specific information.
 - .4 An indexing system shall be included that remains on an expandable portion of the screen and allows the end user to scroll through the manual information that appears on the main portion of the screen.
 - .5 The final Digital copies shall be copied to electronic media with a custom label.
 - .6 The custom label shall include:
 - .1 Project Name
 - .2 Location of Project
 - .3 Date of Assembly
 - .4 name of Mechanical Consultant

- .5 titled "Operating & Maintenance Manual for Mechanical Systems."
- .7 The Digital Manual shall be enhanced with the following features
 - .1 Bookmarks
 - .2 Internet Links
 - .3 Internal Document Links
 - .4 Optical Character Recognition (OCR).
 - .5 Refer to Scanning Requirements and Organizational Requirements listed below.
- .8 Scanning Requirements:
 - .1 All pages contained within the hard copy manual are to be scanned and/or digitized to PDF. Include table of contents with links to the referenced pages.
 - .2 Provide a minimum 300 DPI for all scanned pages.
 - .3 All scanned material may be searched for text with minimum 60% Optical Character Recognition (OCR).
 - .4 All scanned shop drawings are to be scanned to a minimum 216mm x 279mm [8.5" x 11"] size. If the original page size is 279mm x 432mm [11" x 17"], the digital copy shall also be 279mm x 432mm [11" x 17"].
 - .5 Rotation of scanned page images/texts shall be displayed within +/- 20 degrees.
- .9 Organizational Requirements:
 - .1 Digital Manual shall be organized in the same manner as the approved Hard Copy Manual (e.g., Tabs 1.1, 1.2, 1.3, 2.0, 3.0, etc.) via folder or files. .
 - .2 Digital manual shall not be provided as a single PDF.
 - .3 Bookmark all major tabs and subsections
 - .4 Bookmark each set of shop drawings
 - .5 Link the Table of Contents page to the referenced sections
 - .6 Insert an introduction / summary page for all sections indicating major subsections.
 - .1 Link these pages to their referenced sections
 - .7 Link the system descriptions to the referenced schematic drawings.
 - .8 Insert internet links and internal document links to mechanical equipment manufacturers / suppliers / contractors official websites; and to mechanical equipment shop drawings.
 - .9 Use the following colour code for links:
 - .1 Internet links shall be light blue with underline,
 - .2 Internal document links shall be dark blue (excludes AutoCAD schematic links)
 - .3 Links to other PDF files shall be dark green.
- .10 It is the responsibility of the Mechanical Contractor to provide high quality documentation for scanning.
- .11 The digital version of the manuals and the hard cover version shall be prepared by the same company.
- .12 Digital Manual shall be reviewed by the Mechanical Consultant for content and layout prior to final submission.

2.6 RECORD DRAWINGS

- .1 Comply with requirements indicated in Division 1 – Project Record Documents.
- .2 Maintain one hard copy set of contract drawings, including all supplementary and revision drawings on site, solely for the purpose of recording, in red, any change and/or deviation from the Contract Drawings as it occurs.
- .3 Include elevations and detailed locations of buried services.
- .4 The set of drawings will be provided to the contractor by the Consultant at the Contractor's cost.
- .5 The marked-up set of drawings will be reviewed on site monthly by the consultant during the construction process.
 - .1 This review will form a requirement for approval of the monthly progress claim.
- .6 Back filling shall not occur until underground services dimensions are marked on the on-site record set.
- .7 The Record Drawings shall include, but not limited to, the following changes and shall be recorded daily:
 - .1 Size, location, arrangement, routing and extent of ductwork, piping, terminal units, equipment, fixtures, clean-outs, valves, rough-in, etc. above and below grade inside the building and including dimensioned locations of buried piping from building walls
 - .2 Sewer and water lines which are placed beneath floor slabs shall be located such that each point of entry, change in direction, and irregularity is located by dimension from column grid lines on the record drawings. Depth below slabs shall be given.
 - .3 Location of smoke, fire/smoke, and fire dampers.
 - .4 Location of all heat traced piping and associated controllers.
 - .5 Location of back flow preventers.
 - .6 Location of water hammer arrestors.
 - .7 Sanitary Sewers:
 - .1 Invert elevations and locations to be recorded at each clean-out.
 - .8 Storm Drains & Sewers:
 - .1 Invert elevations to be recorded at each manhole, clean-out, changes of direction and every 30 m [100 ft.] run.
 - .9 All services located below ground level and in or below a building slab.
 - .10 All valve stations, trap stations, coils dampers and ductwork not easily accessible.
 - .11 Location, tagging, and numbering of all valves as specified in Section 23 05 53
 - .12 Submit to Consultant for approval and make all corrections as directed.
 - .13 Enter dimensions from building line to all buried services, including coordinates of manholes, catch basins, tanks, outside shut-off valves, and other similar elements.
- .8 Record Drawings
 - .1 Each "record" drawing shall bear the Contractor's identification, the date of record and the notation "We hereby certify that these drawings represent the "Work Record of Construction". The Contractor's signature and company seal shall be placed below that notation.

2.7 PROJECT CLOSE-OUT REQUIREMENTS

- .1 The project closeout requirements are specifically listed in each section of this specification.

- .2 Refer to detailed specifications in each section for further requirements.
 - .1 Also refer to Section 20 99 60 Mechanical Forms for list of required Division 23 HVAC, Division 21 Fire Suppression, Division 22 Plumbing and Division 25 Controls Systems substantial completion submissions.
- .3 Items designated with an asterisk (*) are required to be submitted one week prior to required date of Schedule C-B.
- .4 All life safety systems must be operational and tested and demonstrated to the Owner and the Consultant prior to issuance of Schedule C-B.
- .5 The following is a summary of those requirements.
 - .1 Controls:
 - .1 Controls system completion report (check sheets).
 - .2 Controls system final electrical approval certificate.
 - .3 As built control drawings.
 - .4 Control training signed off by Owner (Indicate dates of training in letter and attendance).
 - .5 List of control manuals and documents turned over.
 - .6 *Provide historical trend log data for all control points.
 - .1 Trend logs shall cover a one-week period with hourly samples for all points.
 - .2 Points shall be grouped together on graphs where applicable, e.g., all points connected to an air handling unit, or heat exchanger shall be together.
 - .3 The controls contractor shall review each set of trend data and provide detailed high level written commentary regarding performance of each item, including suggestions for improvement.
 - .4 Submit trend log graphs to the Commissioning agency for detailed review and comment.
 - .5 Submit trend logs with detailed comments from both agencies to the Consultant after verification of proper operation of all control sequences.
 - .2 HVAC
 - .1 *The Contractor's Supporting Professional Seismic Engineer's (Delegated Design) Letters of Assurance and final inspection report
 - .2 *Gas fired appliances/gas line/pressure piping certificate.
 - .3 *Registration certificates for all pressure vessels.
 - .4 *Fire damper test report letter and schedule.
 - .5 **As-built" record drawings.
 - .6 *Letter confirming that all penetrations of rated assemblies have been firestopped in conformance with CAN4-S115, on the firestopping installing agencies letterhead.
 - .7 *Flushing and cleaning of piping report.
 - .8 *Pressure test reports for all piping systems on contractor's letterhead.
 - .9 Duct cleaning certificate.
 - .10 Demonstrations to Owner signed off by Owner.
 - .11 Air and Water Balance reports.
 - .12 Manufacture start-up reports
 - .13 Air handling unit start-up reports

- .14 Commissioning report
- .15 Vibration isolation report.
- .16 Identification Schedules.
- .17 VSD / VFD start-up reports
- .3 Miscellaneous
 - .1 List of incomplete or deficient work prepared by each sub trade.
 - .2 Contractor's Letter of Guarantee
 - .3 Signed-off substantial completion inspection report.
 - .4 List of spare parts signed off by Owner.
- .4 Plumbing
 - .1 Manufacture start-up reports
 - .2 *The Contractor's Supporting Professional Seismic Engineer's (Delegated Design) Letters of Assurance and final inspection report
 - .3 *Final plumbing acceptance inspection report from city/municipality.
 - .4 *Pressure test reports for all piping systems on contractor's letterhead.
 - .5 *Letter confirming that all penetrations of rated assemblies have been firestopped in conformance with CAN4-S115, on the firestopping installing agencies letterhead.
 - .6 *Backflow Prevention Assembly Test Reports for each backflow prevention device, signed by the tester
 - .7 **"As-built" record drawings.
 - .8 Chlorination certificates for potable water systems.
 - .9 Gas inspector's final certificate.
 - .10 Demonstrations to Owner signed off by Owner.
 - .11 O&M information.
 - .12 Commissioning report
 - .13 Final gas inspection acceptance inspection.
 - .14 *Inside water service chlorination report.
 - .15 Identification Schedules.
 - .16 Balancing reports for domestic hot water recirculation systems.
- .5 Sprinkler System
 - .1 *The Contractor's Supporting Professional Fire Protection Engineer's (Delegated Design) Letters of Assurance and final inspection report
 - .2 *The Contractor's Supporting Professional Seismic Engineer's (Delegated Design) Letters of Assurance and final inspection report
 - .3 *Letter confirming that all penetrations of rated assemblies have been firestopped in conformance with CAN4-S115, on the firestopping installing agencies letterhead.
 - .4 *Final sprinkler acceptance inspection report from municipality.
 - .5 **"As-built" record drawings and supporting documents.
 - .6 Sprinkler material and test certificate.
 - .7 Demonstrations to Owner signed off by Owner.
 - .8 Manufacture start-up reports
 - .9 Commissioning report

- .10 Valve tag chart and low point drains.
- .11 Back flow prevention test reports.
- .12 O&M information.
- .13 Spare sprinklers, cabinet, and wrench.
- .6 Other reports including:

2.8 SUBSTANTIAL PERFORMANCE REQUIREMENTS

- .1 The contractor shall submit the following documentation to the Consultant a minimum of 5 working days prior to the project occupancy site walk-through or occupancy date, whichever is scheduled first.
 - .1 The dates will be established by the project architect, project manager or Certified Professional.
- .2 It is the contractor's responsibility to provide all documentation to the Consultant in a timely manner.
 - .1 If all documentation is not received, the Consultant may not be able to issue their associated Letter of Assurance in support of the building occupancy application and any associated consequences shall become the responsibility of the contractor.
- .3 Before the Consultant is requested to inspect 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 (including calibration of instruments and balancing of systems) is complete, operational, clean and all required submissions have been completed.
 - .1 Use Form MF190 in Section 20 99 60 for this purpose.
 - .3 A complete list of incomplete or deficient items shall be provided. If, in the opinion of the Consultant, this list indicates the project is excessively incomplete, a substantial completion inspection will not be performed.
- .4 The work will not be considered to be ready for use or substantially complete until the following requirements have been met:
 - .1 All reported deficiencies have been corrected.
 - .2 Testing and balancing completed.
 - .3 Operating and Maintenance Manuals completed.
 - .4 "As-built" record drawing ready for review.
 - .5 System Commissioning has been completed and has been verified by the Consultant.
 - .6 All demonstrations to the owner have been completed.
 - .7 All documents required by Section 20 99 60 have been submitted.
- .5 Letters of assurance will not be issued until the following requirements have been met:
 - .1 All items listed in .1 and .2 above have been completed.
 - .2 Certificate of Fire Damper Installation (MF172).
 - .3 Certificate of Penetrations through Separations (MF173).
 - .4 Gas Inspection - Certificate of inspection.
 - .5 The Contractor's Supporting Professional Seismic Engineer's (Delegated Design) letters of assurance and final inspection report.
 - .6 Certificate of Substantial Performance (MF190).
 - .7 Signed off copy of final inspection report.

- .8 Sprinkler and fire alarm test verification, sprinkler materials and test certificate and the Contractor's Supporting Professional Seismic Engineer's (Delegated Design) letters of assurance.
- .9 Plumbing inspection report / card.
- .10 Certificate of Backflow Prevention Device.

2.9 CERTIFICATE OF SUBSTANTIAL PERFORMANCE

- .1 Comply with Division 00 and Division 01:
 - .1 Closeout Requirements
 - .2 Project Record Documents
- .2 Submit report signed by the Contractor's Supporting Professional Fire Protection Engineer (Delegated Design) registered in the Province where the project is located confirming that the automatic sprinkler installation and standpipe systems are installed and tested, consistent with the intent of the Contract Documents.
- .3 In addition to the requirements of Division 00 and Division 01, and prior to application for a "Certificate of Substantial Performance" of the work, the contractor shall certify the following in writing to the Consultant:
 - .1 The systems are installed and suitable for operation for the purpose intended.
 - .2 Heating ventilation and cooling systems are capable of operation with safety devices and alarm controls functional and automatic controls in operation and the owner's personnel have had their initial training programs.
 - .3 All equipment within mechanical rooms is installed.
 - .4 All unit heaters, cabinet unit heaters, and fan coil units are installed and electrical connection made.
 - .5 All fans, pumps and equipment are installed, and electrical connections made.
 - .6 All contractor system start-up and test sheets have been completed and submitted for review.
 - .7 All radiant panels are installed.
 - .8 All fire stop flaps, fire dampers, and smoke dampers are installed and checked for operation; submit report.
 - .9 All ducted supply/return/exhaust grilles are installed.
 - .10 All supply air, return air, exhaust air, fresh air, and combustion air ductwork is installed and cleaned.
 - .11 All thermal and acoustic insulation is installed.
 - .12 All static pressure tests are complete.
 - .13 All access doors are suitably located, and equipment easily accessible including plumbing cleanouts.
 - .14 All fire protection including sprinklers and fire extinguisher brackets are installed and operational.
 - .15 All piping is installed, painted and clearly identified complete with flow arrows.
 - .16 Systems are chemically cleaned, flushed, and water treatment initiated.
 - .17 Temporary filters are installed, and fan plenums cleaned.
 - .18 All equipment is checked for operation, alignment, amperage draw and rotation.
 - .19 Air and water systems balance is completed, and the reports have been submitted for review.

- .20 All equipment is lubricated as per manufacturer's data.
- .21 All plumbing fixtures are installed, solidly supported and in operation. Domestic water lines are flushed and disinfected.
- .22 All necessary tests and start-up procedures on equipment have been made, including those required by authorities.
- .23 The building automation system seven (7) day acceptance test has been successfully completed.
- .24 Automatic sprinkler systems have been tested and signed by the Contractor's Supporting Professional Fire Protection Engineer (Delegated Design) and submitted.
- .25 Documentation required by the following sections has been submitted:
 - .1 Documentation and Submittals - Section 20 05 05
 - .2 Systems Demonstration and Owner's Instruction - Section 20 05 06
- .26 Following information has been submitted:
 - .1 Mechanical Contractor shall certify (by sign-off) that each deficiency listed in all inspection reports has been corrected or defined as a seasonal deficiency with a cost allowance.
 - .2 Final draft of O&M Manuals.
 - .3 Final certificates from Authorities Having Jurisdiction.
 - .4 System cleaning reports.
 - .5 Reports from manufacturer on noise and vibration control devices.
 - .6 Completed record drawings.
 - .7 Vendors equipment start-up reports in related sections and as required in Section 20 05 05 - Documentation and Submittals.
- .27 Training Seminars for all systems is complete.
- .4 Identify any systems which cannot be installed and/or placed in operation for reasons beyond the normal control of the contractors and submit a statement of the value of the remaining work required to complete the project.
- .5 Within ten (10) days of receipt of a written application for a "Certificate of Substantial Performance", the Consultant shall visit the site to confirm that all requirements noted above are complete.
 - .1 Mechanical Contractor shall attend this site review and provide a copy of the O&M Manual.
- .6 If, after the Consultant's site visit the application for a "Certificate of Substantial Performance" is not approved, the contractor shall reapply in accordance with the Consultant's site visit report and pay for costs of re-inspection services.

2.10 CERTIFICATE OF TOTAL PERFORMANCE

- .1 Comply with the requirements of Division 00 and Division 01.
- .2 Prior to application for a statement of "Total Performance", the Contractor shall certify the following in writing to the Consultant:
 - .1 All controls have been calibrated and set.
 - .2 Warranty forms are mailed to manufacturer. (Provide copy of original warranty for equipment which has a warranty period of longer than one year).
 - .3 Temporary filters are removed, and permanent filters are installed.

- .4 Completed and accepted Operating and Maintenance (O&M) Manuals have been submitted to Owner.
- .5 Completed and accepted final air and water Balancing Reports have been included in the O&M Manuals.
- .6 The Owner has received instructions in the operation and maintenance of the system.
- .3 Within ten (10) days after receipt of a written application for a "Certificate of Total Performance", the Consultant shall visit the site.
- .4 The Consultant shall provide one (1) visit for the purpose of reviewing the application for a "Certificate of Total Performance".
 - .1 Subsequent visit if required, shall be at the expense of the contractor.

2.11 DEFICIENCY HOLDBACKS AND DEFICIENCY INSPECTIONS

- .1 Work under this Division which is still outstanding when substantial performance is certified will be considered deficient and a sum equal to at least twice the estimated cost of completing that work will be held back.
- .2 It is expected that outstanding work will be completed in an expeditious manner and the entire holdback sum will be retained until the requirements for Total Performance of Division 20, 21, 22, 23 and 25 work have been met and verified.

Part 3 Execution

3.1 GENERAL

- .1 Submit documents to the Consultant for approval prior to transmitting to the Owner.

3.2 RECORD DRAWINGS

- .1 Enter dimensions from building line to all buried services.
- .2 Service connections to water and sewer lines entering a building shall be recorded as to horizontal dimension from a convenient building element with suitable depth elevations relating to main floor level and sea level datum.
- .3 Sewer and water lines which are placed beneath floor slabs shall be located such that each point of entry, change in direction, and irregularity is located by dimension from column grid lines on the record drawings. Depth below slabs shall be given.
- .4 Each "record" drawing shall bear the Contractor's identification, the date of record and the notation "We hereby certify that these drawings represent the "Work Record of Construction". The Contractor's signature and company seal shall be placed below that notation.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section provides General, Product, and Execution Requirements for Commissioning, Demonstration, and Instruction to the Owner.
- .2 Be responsible for the performance and commissioning of all systems and equipment supplied under the Sections of Division 20, 21, 22, 23 and 25.
- .3 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.
 - .1 It is the activation of the completed installation.
- .4 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

1.2 RELATED REQUIREMENTS

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.
- .2 In conjunction with Division 01, this Section is intended to apply to all work in Division 20, 21, 22, 23 and 25.
- .3 Refer to and comply with the following sections:
 - .1 General Requirements - Division 01
 - .2 Common Work for Mechanical Systems – Division 20
 - .3 Fire Suppression Systems - Division 21
 - .4 Plumbing Systems - Division 22
 - .5 Heating, Ventilation and Air Conditioning Systems - Division 23
 - .6 Controls and Instrumentation - Division 25
 - .7 Electrical - Division 26/27

1.3 QUALITY ASSURANCE

- .1 Refer to Section 20 05 00 General Mechanical Provisions, Quality Assurance for additional details.
- .2 Standard of Acceptance:
 - .1 For list of acceptable Commissioning Agencies, refer to Section 20 99 66.
 - .2 Refer to Section 20 05 00 for Addition of Acceptable Manufacturers/Sub-trades.
 - .3 Installation shall be in accordance with well-established practice and standards accepted and recognized by the Consultant.
- .3 Inspect and confirm within 48 hours that all delivered mechanical equipment:
 - .1 Matches the approved shop drawings,
 - .2 Is free from defects,
 - .3 Is free from damages that occurred during shipping and delivery,
 - .4 Includes all required accessories and pieces necessary for the complete installation.

- .4 Training:
 - .1 Provide on-site orientation by a system technician who is fully knowledgeable of the specific installation details of the project.
 - .2 This orientation shall, at a minimum, consist of a review of the project record drawings, and a walk through of the facility to identify equipment and device locations.

1.4 APPLICABLE CODES AND STANDARDS

- .1 The commissioning shall be executed in accordance with the intent of:
 - .1 ASHRAE Standard 202 - The Commissioning Process for Buildings and Systems.
 - .2 ASHRAE/NIBS Guideline 0 - The Commissioning Process
 - .3 ASHRAE Guideline 1.1 - HVAC&R Technical Requirements For The Commissioning Process
 - .4 ASHRAE Guideline 1.3 - Building Operations and Maintenance Training for The HVAC&R Commissioning Process
 - .5 ASHRAE Guideline 1.4 - Procedures for Preparing Facility Systems Manuals
 - .6 CSA Z320-11 - Commissioning Process for Buildings and Systems (ANSI Approved; IES Co-sponsored)

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 various phases of the commissioning, testing, balancing and demonstration process.
- .2 Commissioning is concluded when air and water systems have been balanced and the installation is in full working order and acceptable for use.
- .3 The work shall include the following:
 - .1 Balancing of the air systems as specified in this section.
 - .2 Balancing of the liquid systems as specified in this section.
 - .3 Set up air diffusers, registers and grilles for optimum distribution/comfort.
 - .4 Set up constant volume and variable volume fans.
 - .5 Plug all air pressure and flow measuring holes.
 - .6 Adjust vibration isolators and earthquake restraints for optimum performance.
 - .7 Verification and certification of the sealing of all HVAC penetrations through fire separations (rated & non-rated) and sound separations. Forms in Section 20 99 60 shall be used for this purpose.
 - .8 Verification of water tightness of all roof and exterior wall penetrations.
 - .9 Set up all automatic control dampers and automatic temperature control devices.
 - .10 Testing and debugging of B.M.S. (Building Management System).
 - .11 Set up and test all alarm and protective devices.
- .4 At the conclusion of commissioning, demonstrate the operation of the systems to the Consultant and then to the Owner's Operating Staff.
 - .1 For demonstration and instruction to Operating staff requirements, refer to this section of the specification and also to Division 25.

- .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, fusible link fire dampers, smoke dampers, control dampers and damper operators.
 - .2 Location of and opening and closing of all access panels.
 - .3 Operation of all automatic control dampers and automatic temperature control devices.
 - .4 Operation of all alarm and protective devices.
 - .5 Operability of randomly selected fire dampers.
 - .6 Operation of all equipment and systems under each mode of operating, and failure, including:
 - .1 B.M.S. (Building Management System) control features.
 - .2 Automatic controls.
 - .3 Air handling units.
 - .4 All heat recovery systems.
 - .5 Heat exchangers/immersion heaters.
 - .6 Pumps.
 - .7 Cabinet unit heaters.
 - .8 Unit heaters.
 - .9 Fans.
 - .10 Coils.
- .6 At the completion of the commissioning, testing, balancing and demonstration submit the following to the Consultant:
 - .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.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section provides General, Product, and Execution Requirements for Materials Testing where required by the specification, the Owner, the Consultant, or the Authority Having Jurisdiction.
- .2 Provide Materials Testing to demonstrate its proper and safe operation including, but not limited to, the following systems:
 - .1 Test domestic cold, hot, and recirculation water piping.
 - .2 Test sanitary sewer piping.
 - .3 Test storm sewer piping.
 - .4 Test all sewer vent piping.
 - .5 Test sprinkler system piping.
 - .6 Test low velocity ducts.
 - .7 Test medium and high velocity ducts.
 - .8 Test natural gas piping/propane piping.

1.2 RELATED REQUIREMENTS

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.
- .2 In conjunction with Division 01, this Section is intended to apply to all work in Division 20, 21, 22, 23 and 25.
- .3 Refer to and comply with the following sections:
 - .1 General Requirements - Division 01
 - .2 Common Work for Mechanical Systems – Division 20
 - .3 Fire Suppression Systems - Division 21
 - .4 Plumbing Systems - Division 22
 - .5 Heating, Ventilation and Air Conditioning Systems - Division 23
 - .6 Controls and Instrumentation - Division 25
 - .7 Electrical - Division 26/27

1.3 APPLICABLE CODES AND STANDARDS

- .1 Refer to Section 20 05 01, Codes, Bylaws and Standards.
- .2 All equipment, materials, installation, and testing shall conform to the following standards as a minimum:
 - .1 Provincial Building Code
 - .2 Local Building By-Laws
 - .3 Provincial Safety Authority

1.4 QUALITY ASSURANCE

- .1 Refer to Section 20 05 00 General Mechanical Provisions, Quality Assurance for additional details.

- .2 Employ only Tradespeople holding valid Provincial Trade Qualification Certificates.
- .3 Test equipment and material where required by specification, Consultant, Owner, or Authority Having Jurisdiction to demonstrate its proper and safe operation.
- .4 Test procedures in accordance with applicable portions of ASME, ASHRAE, SMACNA, NFPA, BCTS, TSSA. and other recognized test codes.
- .5 Perform tests on site to the satisfaction of the Owner and the Consultant.
- .6 Piping, fixtures, or equipment shall not be concealed or covered until installation is inspected and approved by the Consultant.
 - .1 Provide written notice to the Consultant at least three (3) days in advance of tests or concealing of piping.
- .7 Coordinate with Consultant at start of the project, those tests that will require witnessing by the Consultant.
- .8 Submit sample test certificate forms for review two (2) weeks prior to any testing on site.

1.5 SUBMITTALS

- .1 Refer to Section 20 05 05 Documentation and Submittals for additional requirements.
- .2 Refer to Section 20 99 60 Mechanical Forms and submit all documentation therein that is applicable to this Specification Section.
- .3 Obtain certificates of approval and acceptance, complying with rules and regulations from Authorities Having Jurisdiction.
 - .1 Submit copies to be included in Operating and Maintenance Manuals.
- .4 Perform tests as specified. Include test certificates in Operating and Maintenance Manuals.
- .5 Occupancy Documentation Requirements
 - .1 Refer to Division 01 and Section 20 05 05 Documentation and Submittals.

1.6 LIABILITY

- .1 Take charge of plant during tests, assume responsibility for damages in the event of injury to personnel, building or equipment and bear costs for liability, repairs, and restoration in this connection.

Part 2 Products

2.1 NOT APPLICABLE

- .1 Not used

Part 3 Execution

3.1 PRESSURE TESTS

- .1 Provide equipment, materials and labor for tests and pay expenses.
- .2 Carry out tests for at least an 8-hour consecutive period and maintain pressure with no appreciable pressure drop.
 - .1 Where leakage occurs, repair and re-test (at least an 8-hour consecutive period) and pay all necessary costs for re-witnessing.
- .3 Provide the following tests for each system:

- .1 Closed Loop Piping Systems:
 - .1 Test to 1.5 times maximum working pressure or 1034 kPa [150 psig], whichever is greater, water pressure measured at system low point.
- .2 Drainage and Venting Systems:
 - .1 Test by filling with water to produce water pressure to 31 kPa [4.5 psig] minimum and 62 kPa [9 psig] maximum.
- .3 Water Piping:
 - .1 Test to 1.5 times maximum working pressure or 1035 kPa [150 psig] whichever is greater, water pressure measured at system low point.
- .4 Natural Gas:
 - .1 Test as required by current edition of CAN/CGA 149.1 and Authority Having Jurisdiction.
- .5 Sprinkler System:
 - .1 Test as required by current edition of NFPA 13 and Authority Having Jurisdiction.
- .6 Ductwork:
 - .1 Check for audible leaks.
 - .2 Test for tightness as specified by the SMACNA Manuals with maximum leakage of 0.5% at any branch or main duct at 3.0 kPa [12" WG] static pressure for round ductwork and 2.0 kPa [8" WG] static pressure for rectangular ductwork.
- .4 Check systems during application of test pressure including visual check for leakage of water test medium.
- .5 Should tests indicate defective work or variance with specified requirements, make changes immediately to correct the defects.
 - .1 Correct leaks by re-making joints in screwed fittings, cutting out and re-welding welded joints, re-making joints in copper lines.
 - .2 Do not caulk.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section provides General, Product, and Execution Requirements for Performance Testing of equipment.

1.2 RELATED REQUIREMENTS

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.
- .2 In conjunction with Division 01, this Section is intended to apply to all work in Division 20, 21, 22, 23 and 25.
- .3 Refer to and comply with the following sections:
 - .1 General Requirements - Division 01
 - .2 Common Work for Mechanical Systems – Division 20
 - .3 Fire Suppression Systems - Division 21
 - .4 Plumbing Systems - Division 22
 - .5 Heating, Ventilation and Air Conditioning Systems - Division 23
 - .6 Controls and Instrumentation - Division 25
 - .7 Electrical - Division 26/27

1.3 APPLICABLE CODES AND STANDARDS

- .1 Refer to Section 20 05 01, Codes, Bylaws and Standards.
- .2 All equipment, materials, installation, and testing shall conform to the following standards as a minimum:
 - .1 Provincial Building Code
 - .2 Local Building By-Laws
 - .3 Provincial Safety Authority

1.4 QUALITY ASSURANCE

- .1 Refer to Section 20 05 00 General Mechanical Provisions, Quality Assurance for additional details.
- .2 Use factory trained representatives and submit manufacturer's check sheets for starting all systems and equipment.
- .3 Personnel involved in starting, testing, balancing, and adjusting procedures shall be experienced in the design and operation of mechanical equipment and systems being checked and shall be able to interpret results of the readings and tests.
- .4 Assume all liabilities associated with starting, testing, and balancing procedures.
- .5 Testing and certification of each backflow prevention device shall be by an "Approved Cross Connection Installation Specialist".
 - .1 One (1) copy of the certificate to be submitted to the Water Purveyor, and one copy is to be inserted in each O&M Manual.
- .6 Prior to starting, testing, balancing, adjusting, and cleaning processes, verify with the Consultant any tests required to be witnessed.

- .1 Provide sufficient notice to the Consultant prior to commencement of procedures.
- .7 The Consultant shall be allowed to witness any testing, adjusting, starting, balancing, and cleaning procedures.
- .8 Assume all costs associated with starting and testing, including the supply of testing or cleaning medium.
- .9 Prior to starting equipment or systems, secure and review manufacturer's installation, operation, and starting instructions.
 - .1 Read in conjunction with procedures defined herein.
- .10 Use manufacturer's or supplier's starting personnel where required to ensure integrity of manufacturer's warranty.
- .11 Compare installations to published manufacturer's data and record discrepancies.
 - .1 Items potentially detrimental to equipment performance shall be corrected prior to equipment starting.
- .12 Some processes involved in starting procedures defined in this section may be duplications of authority's verification.
 - .1 To facilitate expedient completion of project, arrange for authorities to assist or witness these procedures.
- .13 All starting, testing, and procedures shall be in accordance with applicable portions of ASME, ASHRAE, AABC, CSA, NFPA, SMACNA, ASTM, ASPE and, as required and outlined in these specifications.

Part 2 Products

2.1 NOT APPLICABLE

Part 3 Execution

3.1 GENERAL

- .1 Conduct performance tests to demonstrate equipment and systems meet specified requirements after mechanical installations are completed and pressure tested.
 - .1 Conduct tests as soon as conditions permit.
 - .2 Make changes, repairs, and adjustments required prior to operating tests.
- .2 Meet with Division 26/27 manufacturers, suppliers, and other specialists as required to ensure all phases of work are properly coordinated prior to commencement of each testing procedure.
 - .1 Establish all necessary manpower requirements.
- .3 Operate and test motors and speed switches for correct wiring and sequences and direction of rotation.
 - .1 Check and record overload heaters in motor starters.
- .4 Confirm voltages and operating amperages at full load.
- .5 Failure to follow instructions pertaining to correct starting procedures may result in re-evaluation of equipment by an Independent Testing Agency selected by Owner at Contractor's expense.
 - .1 Should results reveal equipment has not been properly started, equipment may be rejected, removed from site, and replaced.

- .2 Replacement equipment shall also be subject to full starting procedures, using same procedures specified on the originally installed equipment.

3.2 START-UP

- .1 Before starting the plant, provide a certificate stating that the plant is ready for start-up and the following conditions have been met.
 - .1 All safety controls installed and fully operational.
 - .2 Permanent electrical connections made to all equipment.
 - .3 All air filters installed.
 - .4 Use forms similar to those in Section 20 99 60 for this purpose.

3.3 PROCEDURES

- .1 Procedure shall be identified in the following five (5) distinct phases:
 - .1 Pre-Starting:
 - .1 Visual inspection.
 - .2 Starting:
 - .1 Actual starting procedure.
 - .3 Post-Starting:
 - .1 Operational testing, adjusting, or balancing, and equipment run-in phase.
 - .4 Pre-Interim Acceptance of the Work:
 - .1 Final cleaning, re-testing, balancing, and adjusting, and necessary maintenance.
 - .5 Post-Interim Acceptance of the Work:
 - .1 Repeat tests and fine-tuning resulting from corrective action of deficiency clean-up.
- .2 Check specified and shop drawing data against installed data.
- .3 Check the installation is as defined by Contract Documents and as per manufacturer's recommendations including manufacturer's installation check sheets.

3.4 START-UP AND PERFORMANCE REPORTS

- .1 Required reports
 - .1 Provide the following Start-Up and Performance Testing reports:
 - .1 Equipment start-up report
 - .2 Authorities report
 - .3 Controls / BMS operation report
- .2 Equipment start-up report
 - .1 Provide a test report in spreadsheet format which summarizes the following data for each piece of equipment which is powered or has automatic controls:
 - .1 equipment ID and name,
 - .2 motor rotation (bump test) - result and initialed by contractor,
 - .3 equipment Start-Up report status - status and initialed by contractor,
 - .4 manufacturer Start-Up report status – status and initialed by contractor,
 - .5 test completion date.

- .2 Provide a test report in spreadsheet format which summarizes the following data for testing of piping systems:
 - .1 system name
 - .2 system limits (if system is not tested in its entirety),
 - .3 type of test (pneumatic, hydrostatic),
 - .4 pressure at start of test,
 - .5 pressure at end of test,
 - .6 duration of test,
 - .7 contractor dated and initialed,
 - .8 backflow preventers have been tested - status and initialed by contractor,
- .3 Equipment/System Start-Up Test Report
 - .1 Provide a separate start-up report for each piece of the following equipment.
 - .2 The SMACNA "Systems Ready to Balance Check List", where applicable, may be used for this report.
 - .1 HVAC Units
 - .2 Duct Systems
 - .3 Sprinkler systems (to NFPA 13)
 - .4 Manufacturer's Start-Up Test
 - .1 Provide a separate start-up report for each piece of the following equipment, utilizing the manufacturer's start-up check list.
 - .2 This report may be prepared by the manufacturer's service representative:
 - .1 chemical water treatment - pipe cleaning,
 - .2 packaged HVAC equipment,
 - .3 variable speed drives,
 - .4 Building Automation Systems.
- .3 Authorities review
 - .1 Submit copies of authorities-having-jurisdiction inspection and test reports, including:
 - .2 Plumbing and drainage municipal inspector reports
- .4 Controls / Building Management System
 - .1 Provide controls test reports.

3.5 REPORT SUBMISSIONS

- .1 Deficiencies
 - .1 Immediately report to the Consultant, any deficiencies in the systems or equipment performance resulting in design requirements being unobtainable.
- .2 Draft report
 - .1 On completion of the start-up, testing, adjusting, and balancing of all systems, submit to the Consultant, two (2) typewritten copies of a full report on all tests, adjustments, and balancing performed.
 - .2 Attachments including systems schematics with numbered terminals for referring to data above.

- .3 Spot checks
 - .1 After review of the Draft Report by the Consultant and at the Consultants direction, retest up to 30% of all measurements in locations as directed by the Consultant, at no cost extra to the contract.
 - .2 If results indicate unusual testing inaccuracy, omissions, or incomplete balancing/adjustment, in the opinion of the Consultant, re-balance entire affected system(s) at no increase in Contract Price.
- .4 Interim report
 - .1 After completion of any retesting described above, submit three (3) typewritten copies of the interim report, in a 3-hole "D" style binder, and two (2) CD or DVD electronic copies in pdf format.
- .5 Final report
 - .1 Submit to Consultant following completion of alternate season testing and balancing.
 - .1 Submit three (3) typewritten copies, and two (2) CD or DVD electronic copies in pdf format.
- .6 Additional testing
 - .1 The Consultant may request such additional testing in connection with this project as he/she deems necessary.

3.6 **CONTRACTOR TESTING RESPONSIBILITIES**

- .1 For additional details refer to Section 20 22 00 - Testing, Adjusting and Balancing
- .2 For each test, a test form is to be filled out, witnessed, kept on site for the consultant to verify at any time during construction and then they are to be included in the final submission of the contractor O&M manuals.
- .3 The Contractor is required to provide the following tests as part of his construction contract, including but not limited to,
 - .1 Air Systems
 - .1 Fans
 - .1 Check radiated and discharge sound power levels.
 - .2 Determine rpm, air flow rates, static pressure, and record on the fan curves.
 - .3 Conduct fan performance test for total system volume on main air supply and exhaust units.
 - .2 Air Outlets
 - .1 Take sound readings at specified air flows at outlets.
 - .2 Operating room outlets to be tested as per Class I Microbiology Clean Air Act.
 - .3 Fire, Smoke and Combination Fire-smoke Dampers
 - .1 Test each damper to ensure proper blade movement and damper closure.
 - .2 Verify damper accessibility for changing of the fusible links.
 - .4 Ductwork
 - .1 Low pressure supply, return and exhaust ductwork is to be tested by sound and feel for leakage.
 - .5 Unit Heater, Air Curtains, Fan Coil Units etc.
 - .1 Inlet/outlet air flows and temp.

- .2 Inlet/outlet water flows and temp.
- .3 Air and water pressure drop across the unit.
- .4 Fan speed setting.
- .5 Check acoustic performance.
- .2 Fire Protection System
 - .1 Sprinkler Systems
 - .1 Record incoming water pressure to building once a day for 10 days.
 - .2 Test sprinkler system as per NFPA 13.
 - .2 Fire Extinguishers
 - .1 Check that no pressure drop occurs over a 20-day period.
- .3 Plumbing Systems
 - .1 Domestic Hot, Cold and Recirculation Water
 - .1 Pressure Test: Refer to Section 20 06 07 Materials Testing
 - .2 Conduct pipe flushing and cleaning program with all fixtures in place.
 - .3 Conduct a water analysis after shock treatment of piping system.
 - .2 Drainage System
 - .1 Pressure Test: Refer to Section 20 06 07 Materials Testing
- .4 Building Automation
 - .1 Conduct system 7-day performance test to prove communication, loop tuning and control sequences.
- .5 Variable Speed Drives

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section provides General, Product, and Execution Requirements to bring the work to an operating state and ready for balancing.
- .2 Provide all required Coordination with the Balancing Agency as indicated, including, but not limited to:
 - .1 All ventilation systems.
 - .2 All domestic hot water recirculation systems.
 - .3 All mechanical equipment.

1.2 RELATED REQUIREMENTS

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.
- .2 In conjunction with Division 01, this Section is intended to apply to all work in Division 20, 21, 22, 23 and 25.
- .3 Refer to and comply with the following sections:
 - .1 General Requirements - Division 01
 - .2 Common Work for Mechanical Systems – Division 20
 - .3 Fire Suppression Systems - Division 21
 - .4 Plumbing Systems - Division 22
 - .5 Heating, Ventilation and Air Conditioning Systems - Division 23
 - .6 Controls and Instrumentation - Division 25
 - .7 Electrical - Division 26/27

Part 2 Products

2.1 NOT APPLICABLE

- .1 Not used

Part 3 Execution

3.1 INSTALLATION

- .1 Bring the work to an operating state and ready for balancing, including:
 - .1 Clean equipment and ductwork.
 - .2 Install air terminal devices.
 - .3 Provide temporary filters in air handling equipment and carry out a rough air balance to ensure all equipment performs required function.
 - .4 Replace temporary filters with specified filters prior to final balancing.
 - .5 Verify lubrication of equipment.
 - .6 Install permanent instrumentation.

- .7 Complete the "start-up" of equipment.
- .8 Ensure all strainers are clean and complete prior to fluid system balancing.
- .9 Check rotation and alignment of rotating equipment and tension of belted drives.
- .10 Set control points of automatic apparatus, check-out sequence of operation.
- .11 Make available control diagrams and sequence of operation.
- .12 Clean work, remove temporary tags, stickers, and coverings.
- .13 Make available one (1) electronic copy of Maintenance Manuals to the Balancing Agency for use in balancing.
- .14 Provide Balancing Agency a complete set of mechanical drawings and specifications.
- .2 Cooperate with the Balancing Agency as follows:
 - .1 Make corrections as required by Balancing Agency.
 - .2 Allow Balancing Agency free access to site during construction phase.
 - .1 Inform Balancing Agency of any major changes made to systems during construction and provide a complete set of record drawings for their use.
 - .3 Provide and install any additional balancing dampers and other materials requested by the balancing agency and/or necessary to properly adjust or correct the systems to design flows.
 - .4 Provide and install revised pulleys and sheaves for rotating equipment and shave pump impellers, as required to properly balance the systems to design flows.
 - .1 Obtain requirements from balancing agency.
 - .5 Operate automatic control system and verify setpoints during balancing.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section provides General, Product, and Execution Requirements for Duct and Pipe thermometers, pressure gauges, and ports/taps as shown on drawings and/or specified herein.
- .2 Thermometers and gauges that require connections to the building's BMS system are specified in Division 25 Controls and Instrumentation.
- .3 Provide local temperature and pressure indication as follows and as noted on the drawings.

1.2 RELATED REQUIREMENTS

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.
- .2 In conjunction with Division 01, this Section is intended to apply to all work in Division 20, 21, 22, 23 and 25.
- .3 Refer to and comply with the following sections:
 - .1 General Requirements - Division 01
 - .2 Common Work for Mechanical Systems – Division 20
 - .3 Fire Suppression Systems - Division 21
 - .4 Plumbing Systems - Division 22
 - .5 Heating, Ventilation and Air Conditioning Systems - Division 23
 - .6 Controls and Instrumentation - Division 25
 - .7 Electrical - Division 26/27

1.3 APPLICABLE CODES AND STANDARDS

- .1 Refer to Section 20 05 01, Codes, Bylaws and Standards.
- .2 All equipment, materials, installation, and testing shall conform to the following standards as a minimum:
 - .1 Provincial Building Code
 - .2 Local Building By-Laws
 - .3 Provincial Safety Authority
- .3 ASME B40.200 Thermometers, Direct Reading, and Remote Reading
- .4 ASME B40.100 Pressure Gauges and Gauge Attachments
- .5 ASME PTC 19.3 TW – Thermowells

1.4 QUALITY ASSURANCE

- .1 Refer to Section 20 05 00 General Mechanical Provisions, Quality Assurance for additional details.

1.5 SUBMITTALS

- .1 Comply with Division 01 and Section 20 05 05 Documentation and Submittals.
- .2 Shop Drawings

- .1 Submit shop drawings in accordance with Division 01 and Section 20 05 05 Documentation and Submittals.
- .2 Shop drawings are required for all materials and equipment.
- .3 Submit manufacturer's catalogue literature for:
 - .1 Thermometers
 - .2 Pressure gauges
 - .3 Other equipment as required
- .3 Product Options and Substitutions
 - .1 Refer to Division 01 and Section 20 05 00, for requirements pertaining to product options and substitutions.

Part 2 Products

2.1 GENERAL

- .1 Selection criteria:
 - .1 Normal operating reading shall be between half and two thirds of full-scale range
 - .2 Expected maximum and minimum readings shall be within scale range.
 - .3 Thermometers shall have both Celsius and Fahrenheit scales.
 - .4 Pressure gauges shall have both kPa and psig scales.

2.2 THERMOMETER WELLS

- .1 Install all pipe mounted thermometers and pipe mounted temperature sensors in separable wells with thermal conductivity paste.
- .2 Construction:
 - .1 Body material:
 - .1 in copper pipe: brass.
 - .2 in steel pipe: stainless steel.
 - .2 threaded connection, manufactured from bar stock or forged brass with cap and chain, compatible with temperature sensors used.
 - .3 pressure rating: 2000 kPa [300 psig] at 121°C [250°F]
 - .4 C.R.N. registered

2.3 THERMOMETERS – PIPE MOUNTED (STEM)

- .1 Standard of Acceptance
 - .1 Refer to Section 20 99 65
- .2 Minimum Requirements:
 - .1 Mercury content is not acceptable
 - .2 All thermometers shall be in accordance with Canadian General Standards Board CGSB 14.4.
 - .3 Pipe mounted stem type, adjustable angle type.
 - .4 Refer to flow schematics for location of pipe mounted thermometers and wells.

- .3 Case:
 - .1 Stem type - cast aluminum alloy, either anodized or coated with baked enamel. The case shall be provided with a clear glass or heat resistant plastic window.
- .4 Scale:
 - .1 Stem type - 225 mm [9"] scale length.
 - .2 White background with temperature range in black.
 - .3 Dual Celsius and Fahrenheit scales.

2.4 PRESSURE GAUGES – PIPING (DIAL)

- .1 Standard of Acceptance:
 - .1 Refer to Section 20 99 65
- .2 Minimum Requirements:
 - .1 Mercury content is not acceptable
 - .2 All gauges to be in accordance with ANSI B40.1 Grade "A" level.
 - .3 115mm [4.5"] cast aluminum, black steel or stainless-steel case, with stainless steel or chrome plated face ring.
 - .4 White background with pressure range in black.
 - .5 Dual kilopascal and psig scale.
 - .6 Phosphor bronze bourdon tube, silver brazed tip and socket
 - .7 6mm [1/4"] lower connection.
 - .8 Dual scales kPa and psig.
 - .9 Rotary type bushed movement; silicone dampened to prevent pointer oscillation.
 - .10 Gauges to be registered with Provincial Boiler and Pressure Vessel Safety Branches with CRN number.
 - .11 ULC listed for use on fire protection systems.
 - .12 Accuracy shall be 1% of full scale over the middle half of the scale.
- .3 Accessories:
 - .1 Install a needle valve ahead of each gauge.

Part 3 Execution

3.1 GENERAL

- .1 Select thermometers and gauges so that normal operating point is approximately mid-point of instrument range.

3.2 THERMOMETERS

- .1 Install all thermometers in separable wells.
- .2 In pipes 50mm [2"] and smaller, install the separable well so as to minimize the restriction to flow by installing in a section of oversized pipe, or in a tee.
- .3 Install wells as indicated for use with test thermometers.
- .4 Install in locations as indicated and on inlet and outlet of:
 - .1 Domestic hot water – inlet and outlet

- .2 Where shown on drawings or required for daily visual checks by plan maintenance.
- .5 Use extensions where thermometers are installed through insulation.

3.3

PRESSURE GAUGES:

- .1 Use extensions where pressure gauges are installed through insulation.
- .2 Install needle valves on pressure gauges.
 - .1 For differential pressure gauge, provide needle valve on each sensing line.
- .3 Install in locations as indicated and,
 - .1 Pumps
 - .2 Expansion tanks
 - .3 Domestic cold water to standpipe and/or sprinkler
 - .4 Domestic hot water tanks,
 - .5 Suction and discharge of pumps.
 - .6 Upstream and downstream of pressure reducing valves.
 - .7 Where shown on drawings or required for daily visual checks by plan maintenance.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section provides General, Product, and Execution Requirements for hangers, supports and anchors for the Fire, Plumbing and HVAC Mechanical systems.
- .2 Provide all required Hangers, Supports, and Anchors as indicated, including, but not limited to:
 - .1 Duct hangers and supports.
 - .2 Pipe hangers and supports.
 - .3 Pipe anchors.

1.2 RELATED REQUIREMENTS

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.
- .2 In conjunction with Division 01, this Section is intended to apply to all work in Division 20, 21, 22, 23 and 25.
- .3 Refer to and comply with the following sections:
 - .1 General Requirements - Division 01
 - .2 Common Work for Mechanical Systems – Division 20
 - .3 Fire Suppression Systems - Division 21
 - .4 Plumbing Systems - Division 22
 - .5 Heating, Ventilation and Air Conditioning Systems - Division 23
 - .6 Controls and Instrumentation - Division 25

1.3 APPLICABLE CODES AND STANDARDS

- .1 Refer to Section 20 05 01, Codes, Bylaws and Standards
- .2 All equipment, materials, installation, and testing shall conform to the following standards as a minimum:
 - .1 Provincial Building Code
 - .2 Local Building By-Laws
 - .3 Provincial Safety Authority
 - .4 Duct hangers shall conform to SMACNA Duct Manuals.
 - .5 Manufacturers Standardization Society of Valve and Fittings Industry (MSS)
 - .6 MSS SP-58 Pipe Hangers and Supports - Materials Design and Manufacture
 - .7 MSS SP-69 Pipe Hangers and Supports - Selection and Application
 - .8 MSS SP-77 Guidelines for Pipe Support Contractual Relationships
 - .9 MSS SP-90 Guidelines for Terminology for Pipe Hangers and Supports

1.4 QUALITY ASSURANCE

- .1 Refer to Section 20 05 00 General Mechanical Provisions, Quality Assurance for additional details.

1.5 SUBMITTALS

- .1 Comply with Division 01 and Section 20 05 05 Documentation and Submittals.
- .2 Submit shop drawings of each factory fabricated component.
- .3 Shop Drawings
 - .1 Submit shop drawings in accordance with Division 01 and Section 20 05 05 Documentation and Submittals.
 - .2 Shop drawings are required for all materials and equipment.
 - .3 Submit samples of hangers with shop drawing submittal when requested.
 - .4 Submittals shall include:
 - .1 upper attachment.
 - .2 hanger rods.
 - .3 pipe attachment.
 - .4 riser clamps.
 - .5 shields and saddles.
 - .6 inserts.
 - .5 Submit details for supports, guides, and anchors for glass, fibre-reinforced plastic, and plastic piping systems.
 - .6 Submit design drawings for custom fabricated trapeze hangers, sealed by the Contractor's Supporting Professional Seismic Engineer (Delegated Design) licensed in the project location jurisdiction.
 - .1 Shop drawing details shall include:
 - .1 construction detail drawings for each loading condition,
 - .2 span deflection calculations,
 - .3 building attachment load calculations and type.
 - .2 Provide services of the Contractor's Supporting Professional Seismic Engineer (Delegated Design) who sealed the custom trapeze hanger shop drawings to conduct a general review of the completed installation on site.

Part 2 Products

2.1 GENERAL

- .1 Provide hangers and supports to secure equipment in place, prevent vibration, protect appropriate against damage from earthquake, maintain grade, provide for expansion and contraction, and accommodate insulation.
- .2 The Contractor shall arrange and pay for the services of a Supporting Professional Seismic Engineer (Delegated Design) to provide all required engineering services necessary for the complete design, sizing and detailing of all anchors and anchor supports to structure required for the project.
 - .1 Submit details to the Consultant for review.
- .3 Provide insulation protection saddles on all insulated piping.
- .4 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS-SP58.
- .5 Support from (top of) structural members.

- .1 Where structural bearings do not exist or inserts are not in suitable locations, suspend hangers from steel channels or angles.
- .2 Provide supplementary structural members, as necessary.
- .6 Do not suspend from metal deck.
- .7 Hangers for copper pipe shall be copper plated or plastic dipped unless pipe hangers bear on piping insulation (cold services).
- .8 Hangers and strut located outdoors shall be hot dip galvanized after fabrication in accordance with ASTM A123.
 - .1 All hanger hardware shall be hot dip galvanized or stainless steel. Zinc plated hardware is not acceptable for outdoor or corrosive use.
- .9 Hangers and strut located in corrosive areas shall be type 316 stainless steel with stainless steel hardware.

2.2 ATTACHMENTS

- .1 Steel Beam (bottom flange):
 - .1 Cold piping 50mm [2"] and under: malleable iron C clamp
 - .1 Standard of Acceptance: Grinnell/Anvil fig. 61
 - .2 Cold piping 65mm [2-1/2"] and larger and all hot piping: malleable iron beam clamp
 - .1 Standard of Acceptance: Grinnell/Anvil fig. 292.
- .2 Steel Beam (top):
 - .1 Cold piping 50mm [2"] and under: malleable iron "top of beam" C clamp
 - .1 Standard of Acceptance: Grinnell/Anvil Fig. 61.
 - .2 Cold piping 65mm [2-1/2"] and larger and all hot piping: steel jaw, hook rod with nut, spring washer and plain washer
 - .1 Standard of Acceptance: Grinnell/Anvil fig. 227.
- .3 Steel Joist:
 - .1 Cold piping 50mm [2"] and under: steel washer plate with double locking nuts
 - .1 Standard of Acceptance: Grinnell/Anvil fig. 60.
 - .2 Cold piping 65mm [2-1/2"] and larger and all hot piping: steel washer plates with double locking nut, carbon steel clevis and malleable iron socket
 - .1 Standard of Acceptance: Grinnell/Anvil: washer plate, fig. 60; clevis, fig. 66; socket, fig. 290.
- .4 Steel Channel or Angle (bottom):
 - .1 Cold piping 50mm [2"] and under; malleable iron C clamp
 - .1 Standard of Acceptance: Grinnell/Anvil fig. 86.
 - .2 Cold piping 65mm [2-1/2"] and larger and all hot piping; universal channel clamp
 - .1 Standard of Acceptance: Grinnell/Anvil fig. 226.
- .5 Steel Channel or Angle (top):
 - .1 Cold piping 50mm [2"] and under: malleable iron "top of beam" C clamp
 - .1 Standard of Acceptance: Grinnell/Anvil fig. 61.
 - .2 Cold piping 65mm [2-1/2"] and larger and all hot piping: steel jaw, hook rod with nut, spring washer and plain washer
 - .1 Standard of Acceptance: Grinnell/Anvil fig. 227.

2.3 MIDDLE ATTACHMENTS (ROD)

- .1 Carbon steel black (electro-galvanized/cadmium plated for mechanical rooms) continuous threaded rod
 - .1 Standard of Acceptance: Grinnell/Anvil fig. 146 or Myatt fig. 434.

2.4 PIPE ATTACHMENTS

- .1 Cold piping, steel or cast iron: hot piping steel, with less than 25 mm [1"] horizontal movement; hot piping, steel, with more than 300 mm [12"] middle attachment (rod) length: adjustable clevis
 - .1 Standard of Acceptance: Grinnell/Anvil fig. 260.
- .2 Cold copper piping; hot copper piping with less than 25 mm [1"] horizontal movement; hot copper piping with more than 300 mm [12"] middle attachment (rod) length: adjustable clevis copper plated
 - .1 Standard of Acceptance: Grinnell/Anvil fig. CT-65.
- .3 Suspended hot piping, steel, and copper, with horizontal movement in excess of 25 mm [1"]; hot steel piping with middle attachment (rod) 300 mm [12"] or less; pipe roller
 - .1 Standard of Acceptance: Grinnell/Anvil fig. 174 or Grinnell/Anvil fig. 181 up to NPS 6 and Grinnell/Anvil fig. 171 NPS 8 and larger.
- .4 Bottom supported hot piping, steel and copper: pipe roller stand
 - .1 Standard of Acceptance: Grinnell/Anvil fig. 271.

2.5 RISER CLAMPS

- .1 Steel or cast-iron pipe: galvanized carbon steel
 - .1 Standard of Acceptance: Grinnell/Anvil fig. 261 or Myatt fig. 182.
- .2 Copper pipe: carbon steel copper finished
 - .1 Standard of Acceptance: Grinnell/Anvil fig. CT-121.

2.6 SADDLES AND SHIELDS

- .1 Cold piping 50mm [2"] and under: protection shield with pipe insulation under shield with uninterrupted vapour barrier
 - .1 Standard of Acceptance: Kingspan "K Block" – high density insulation
- .2 Cold piping 65mm [2-1/2"] and over: protection shield with high density insulation under shield with uninterrupted vapour barrier
 - .1 Standard of Acceptance: Kingspan "K Block" – high density insulation.
- .3 Hot piping 75mm [3"] and under: insulation over pipe hanger.

2.7 TRAPEZE HANGERS

- .1 Performance:
 - .1 Manufactured:
 - .1 to product load listings.
 - .2 Custom fabricated:
 - .1 maximum deflection between supports: 1/250 (0.4%) of span
 - .2 minimum factor of safety: 5 times load to ultimate tensile or compressive strength.

- .2 Construction:
 - .1 Carbon steel shapes, to suit load application:
 - .1 hollow steel section,
 - .2 equal leg EI section, or
 - .3 double C channel "strong-back", with welded clips.
 - .3 Hanger rods:
 - .1 as specified above, and
 - .2 minimum two support rods,
 - .3 rods selected for minimum factor of safety of 5 times load to ultimate tensile or compressive strength of rod.
 - .4 Pipe restraint:
 - .1 restrain pipes from lateral movement with:
 - .1 bolt-on angle brackets or pipe U-bolts for manufactured hangers,
 - .2 welded-on angles for fabricated hangers.
 - .5 Finish:
 - .1 electro-galvanized finish in mechanical rooms and outdoors.
 - .2 black steel finish in other areas.

2.8 WALL SUPPORTS

- .1 Horizontal pipe adjacent to wall:
 - .1 Angle iron wall brackets with specified hangers.
- .2 Vertical pipe adjacent to wall.
 - .1 Exposed pipe wall support for lateral movement restraint
 - .1 Standard of Acceptance: Grinnell/Anvil fig. 262 or 263.
 - .2 Channel type support
 - .1 Standard of Acceptance: Burndy, Canadian Strut, Cantruss or Unistrut.

2.9 FLOOR SUPPORTS

- .1 Horizontal pipe.
 - .1 Do not support piping from the floor unless specifically indicated.
- .2 Vertical pipe.
 - .1 Mid-point of risers between floor slabs - adjustable fabricated steel supports. Refer to Section 23 05 49 Seismic Restraints.
- .3 Steel or cast-iron pipe:
 - .1 floor supported, black carbon steel riser clamps to MSS SP-58, type 42, ULC listed, field-welded pipe lugs.
 - .2 suspended, black carbon steel riser clamps to MSS SP-58, type 42, ULC listed, 4 or 6 bolt pattern, field-welded pipe lugs.
- .4 Copper pipe:
 - .1 carbon steel, copper finished, riser clamps to MSS SP-58, type 8.

2.10 CONSTANT LOAD SUPPORTS

- .1 Performance:

- .1 maintains constant support load under variable hanger displacements.
- .2 selected for piping loads and estimated travel under service conditions, with a minimum safety factor of 25 mm [1 in] extra travel or 20% of total travel, whichever is greater.
- .2 Construction:
 - .1 to WW-H-171E, ANSI/MSS SP-69 and 58
 - .2 carbon steel housing and spring,
 - .3 combination hanger moment arm and balancing spring design,
 - .4 horizontal and vertical arrangements,
 - .5 load adjustment and load indicator scale,
 - .6 factory set for load and travel,
 - .7 welding to ASME Section IX
 - .8 welded attachment points
 - .9 finish: semi-gloss primer coat.

2.11 RODDING FOR MECHANICAL JOINT PIPE

- .1 Plain end cast iron and asbestos cement drain waste and vent pipe, 125mm [5"] and over,
 - .1 bell clamps and rodding at each joint
 - .2 bell clamp and rodding at each tee branch

2.12 DUCT HANGERS AND SUPPORTS

- .1 Refer to Section 23 31 00.
- .2 As a minimum, conform to Standards in SMACNA.

Part 3 Execution

3.1 GENERAL REQUIREMENTS

- .1 Provide hangers and supports to secure equipment in place, prevent vibration, maintain grade, provide for expansion and contraction.
- .2 Install supports of strength and rigidity to suit loading without unduly stressing building.
 - .1 Locate adjacent to equipment to prevent undue stresses in piping and equipment.
- .3 Select hangers and supports for the service and in accordance with manufacturer's recommended maximum loading.
 - .1 Hangers shall have a safety factor of 5 to 1.
- .4 Fasten hangers and supports to building structure.
- .5 Do not weld piping, ductwork or equipment supports to building metal decking or building structural steel supports unless prior written approval has been obtained from the Structural Consultant.
- .6 Obtain approval prior to using percussion type fastenings.
- .7 Use of ductwork, piping or equipment for hanger supports and use of perforated band iron, wire or chain as hangers is not permitted.
- .8 Install rubber vibration isolators on piping supports within drywall partitions.

3.2 PIPE HANGER ROD DIAMETER AND SPACING

- .1 Support piping and conduit directly from or on structural building elements.
 - .1 Do not support pipe or conduit directly from other services such as ducts.
- .2 Adjust hanger spacing noted below to suit specific pipe manufacturer's recommendations (specifically related to plastic pipe).
- .3 Recommended maximum space between hangers for straight horizontal pipes and tubes are indicated in the table below.
 - .1 The values do not apply where loads are concentrated with flanges, valves, specialties, etc.
 - .2 Support loads of this type with hangers on both sides of the load.
- .4 Spacing and middle attachment (rod) diameter as specified in paragraphs below or as in table below, whichever is more stringent.
 - .1 Plumbing piping:
 - .1 Most stringent requirements of the Plumbing Code or Authority Having Jurisdiction.
 - .2 Fire protection:
 - .1 To applicable fire code; toggle hangers are unacceptable.
 - .3 Gas Piping:
 - .1 Refer to Natural Gas and Propane Code CAN/CGA-B149.1.
 - .4 Within 300 mm [12"] of each horizontal elbow, tee, joints, etc.
- .5 Pipe Hanger Rod Diameter and Spacing:
 - .1 12 mm [½"] piping
 - .1 Rod diameter: 10mm [3/8"]
 - .2 Maximum Spacing, Steel Pipe: 1.8m [6']
 - .3 Maximum Spacing, Copper Pipe: 1.5m [5']
 - .2 19 mm [¾"] and 25mm [1"] piping
 - .1 Rod diameter: 10mm [3/8"]
 - .2 Maximum Spacing, Steel Pipe: 2.4m [8']
 - .3 Maximum Spacing, Copper Pipe: 1.8m [6']
 - .3 32mm [1-1/4"] and 38mm [1-1/2"] piping
 - .1 Rod diameter: 10mm [3/8"]
 - .2 Maximum Spacing, Steel Pipe: 3m [10']
 - .3 Maximum Spacing, Copper Pipe: 1.8m [6']
 - .4 50mm [2"] piping
 - .1 Rod diameter: 10mm [3/8"]
 - .2 Maximum Spacing, Steel Pipe: 3m [10']
 - .3 Maximum Spacing, Copper Pipe: 3m [10']
 - .5 65mm [2-1/2"] to 100mm [4"] piping
 - .1 Rod diameter: 12mm [1/2"]
 - .2 Maximum Spacing, Steel Pipe: 3m [10']
 - .3 Maximum Spacing, Copper Pipe: 3m [10']
 - .6 125mm [5"] to 200mm [8"] piping

- .1 Rod diameter: 16mm [5/8"]
- .2 Maximum Spacing, Steel Pipe: 3m [10']
- .3 Maximum Spacing, Copper Pipe: 3m [10']

3.3 HANGER INSTALLATION

- .1 Adjust hangers to equalize hanger loads, to support piping true to line and grade, and to minimize loads transferred through connections to equipment and outlets
- .2 Offset hanger so that rod is vertical in operating position.
- .3 Install hanger to provide minimum 12 mm [1/2"] clear space between finished covering and adjacent work.
- .4 Use oversize hangers to accommodate pipe insulation thickness.
 - .1 For pipes up to 50 mm [2"] use high density rigid pipe insulation at hanger location, with an insulation protection shield.
 - .2 For pipes 65 mm [2 1/2"] and over, use insulation protection saddle.
- .5 Place a hanger within 300 mm [12"] of each horizontal elbow.
- .6 Use hangers which are vertically adjustable 40 mm [1 1/2"] minimum after piping is erected.
- .7 Support riser piping independently of connected horizontal piping.
- .8 Support cast iron horizontal drainage pipe near each hub and on each side of gasket and clamp joints, with 1500 mm [60"] maximum spacing between hangers.
- .9 Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- .10 For beam clamps, extend hanger rod tight to underside of beam with top bolt and washer.
- .11 Where practical, support riser piping independently of connected horizontal piping.
- .12 Install plastic inserts between steel studs and piping.
- .13 Support plastic piping in accordance with manufacturers recommendations.

3.4 DUCT HANGERS AND SUPPORTS

- .1 Support ductwork in accordance with SMACNA, and as a minimum as follows.
- .2 Low Pressure Duct Hangers and Supports
 - .1 Support ductwork with rods and angle iron trapeze hangers as follows:
 - .2 Max Duct Dimension: up to 900mm [36"]
 - .1 Companion Flange Angle: 32mm x 32mm x 3.2mm [1-1/4"x1-1/4" x 1/8"]
 - .2 Support Spacing: 2.4m [8']
 - .3 Rod Diameter: 10mm [3/8"]
 - .4 Support Angle: 38mm x 38mm x 3.2mm [1-1/2" x 1-1/2 x 1/8"]

3.5 PRIMING

- .1 If not galvanized, prime coat exposed steel hangers and supports.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section provides General, Product, and Execution Requirements for Penetrations, Flashings, and Seals.
- .2 Provide all required Penetrations, Flashings, and Seals as indicated, including, but not limited to:
 - .1 Pipe and duct penetrations through fire rated and non-rated walls and floors.
 - .2 Fire-stopping
 - .3 Escutcheons
 - .4 Flashing for mechanical piping and ducts.
 - .5 Sleeving for mechanical piping and ducts.
- .3 Furnish all labour, material, equipment, and services necessary to supply and install firestopping and smoke seals around mechanical service piping, controls wiring, and duct penetrations through fire rated wall and floor assemblies, as indicated and as specified.

1.2 RELATED REQUIREMENTS

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.
- .2 In conjunction with Division 01, this Section is intended to apply to all work in Division 20, 21, 22, 23 and 25.
- .3 Refer to and comply with the following sections:
 - .1 General Requirements - Division 01
 - .2 Common Work for Mechanical Systems – Division 20
 - .3 Fire Suppression Systems - Division 21
 - .4 Plumbing Systems - Division 22
 - .5 Heating, Ventilation and Air Conditioning Systems - Division 23
 - .6 Controls and Instrumentation - Division 25

1.3 APPLICABLE CODES AND STANDARDS

- .1 Refer to Section 20 05 01, Codes, Bylaws and Standards.
- .2 All equipment, materials, installation, and testing shall conform to the following standards as a minimum:
 - .1 Provincial Building Code
 - .2 Local Building By-Laws
 - .3 Provincial Safety Authority
 - .4 CAN4-S115-M, Standard Method of Fire Tests of Firestop Systems.
 - .5 ASTM E814 Standard Method of Fire Tests and Through-Penetration Firestops.
 - .6 1997 Certifications Listings Intertek Testing Services N.A. Ltd. (Warnock Hersey).
 - .7 Underwriters Laboratories of Canada. Listing of Equipment and Materials Vol. 3 Fire Resistance Ratings -Revision 4/95.

1.4 **QUALITY ASSURANCE:**

- .1 Refer to Section 20 05 00 General Mechanical Provisions, Quality Assurance for additional details.
- .2 The work of this Section shall comply with Division 7 - Thermal and Moisture Protection.
- .3 The work of this section shall be carried out only by an approved specialist firm, employing skilled trades people experienced in firestopping and smoke seal application and approved, licensed, and supervised by the manufacturer of fire stopping materials.
- .4 All work to be of the highest quality according to best trade practice and in strict accordance with manufacturer's printed specifications.

1.5 **SUBMITTALS**

- .1 Comply with Division 01 and Section 20 05 05 Documentation and Submittals.
- .2 Shop Drawings
 - .1 Submit shop drawings in accordance with Division 01 and Section 20 05 05 Documentation and Submittals.
 - .2 Submit shop drawings for all equipment and materials
 - .3 Submit shop drawings to show proposed material, reinforcement, anchorage, fastenings, and method of installation.
 - .4 Submit manufacturers' product data for materials and prefabricated devices.
 - .1 Include assembly/location design system number references with copies of test information.
 - .2 Construction details should accurately reflect actual job conditions.
 - .5 For building assemblies which do not correspond to any previously tested and rated assemblies, submit proposals based on related designs using accepted fireproofing design criteria.

Part 2 Products

2.1 **FLASHING AND COUNTERFLASHING**

- .1 Steel Flashing: 0.5 mm [26-gauge] galvanized steel.
- .2 Lead Flashing: 24.4 kg/m² [5 lb./ft²] sheet lead for waterproofing, 4.88 kg/m² [1 lb./ft²] sheet lead for soundproofing.
- .3 Caps: Steel, 0.8mm [22-gauge] minimum, 1.6 mm [16-gauge] at fire resistance structures.

2.2 **SLEEVES**

- .1 Pipes through Floors: Form with steel pipe sleeves.
- .2 Pipes through Beams, Walls, Fireproofing, Footings, Potentially Wet Floor: Form with steel pipe.
- .3 Ducts: Form with galvanized steel.
- .4 Size large enough to allow for movement due to expansion and to provide for continuous insulation.

2.3 **FIRE STOPPING AND SMOKE SEAL MATERIALS**

- .1 Refer to Division 7, Thermal and Moisture Protection, for additional requirements.

- .2 Asbestos-free materials and systems capable of maintaining an effective barrier against flame, smoke, and gases in compliance with requirements of ULC CAN4-S115 and not to exceed opening sizes for which they are intended.
- .3 Service penetration assemblies and design numbers: Certified by ULC in accordance with CAN4-S115 and listed in ULC Guide No. 40 U19. 1997 Certification Listings Intertek Testing Services N.A. Ltd. (Warnock Hersey).
- .4 Service penetration firestop components: Certified by ULC in accordance with CAN4-S115 and listed in ULC Guide No. 40 U19.13 and ULC Guide No. 40 U19.15 under the Label Service of ULC or equivalent approved tests by Warnock Hersey.
- .5 Fire resistance rating of installed fire stopping assembly shall be not less than the fire resistance rating of surrounding floor and wall assembly.

2.4 FIRE STOPS

- .1 Refer to Division 7, Thermal and Moisture Protection, for additional requirements.
 - .1 Standard of Acceptance:
 - .1 Hilt, 3M
 - .2 Refer to Section 20 99 65
 - .2 Rated caulking for pipe penetration through fire rated floors and walls:
 - .1 Sealant shall be thixotropic, intumescent, non-slump, non-volatile.
 - .2 Firestop material shall provide a 2h rating and shall comply with ASTM-E814, UL1479, ASTM-E119, UL723, ASTM-E84, UL263 and CAN4-5115.
 - .3 Rated fire stop for PVC and CPVC plastic pipe:
 - .1 Standard of Acceptance:
 - .1 Hilti; 3M
 - .2 Refer to 20 99 65
 - .2 Intumescent collars, suitable for use on PVC or CPVC pipes penetrating 1h or 2h rated wall or floor, tested to CAN4-S115, UL Listed.

Part 3 Execution

3.1 GENERAL REQUIREMENTS

- .1 Refer to Division 7 for additional requirements.
- .2 Provide and set sleeves or block-outs required for equipment, including openings required for placing equipment.
- .3 Provide sleeves for all piping through rated assemblies.
 - .1 In non-rated assemblies, provide sleeves for all domestic hot, domestic cold, and domestic recirculation piping.
 - .2 Sleeves to be sized to allow insulation to pass through and to project through both sides of wall.
- .4 Provide sleeves for all piping through ceilings, floors, and footings.
- .5 Provide sleeves for duct penetrations through walls, ceilings, floors, and footings.
 - .1 Provide locations and dimensions for block-outs imbedded material if provided by others.

- .6 Core drill openings for pipes in new masonry or poured concrete construction where sleeves have been omitted.

3.2 FLASHING

- .1 Flash and counterflash where mechanical equipment passes through weather or waterproofed walls, floors, and roofs.
- .2 Solder at joints, flash into floor drains and turn up 150 mm [6"] into walls or to top of curbs and caulk into joints.
- .3 Flash and counter-flash where mechanical equipment passes through weather or waterproofed walls, floors, decks, patios, and roofs.
- .4 Flash vent and soil pipes projecting 75 mm [3"] minimum above finished roof surface with lead worked 25 mm [1"] minimum into hub, 200 mm [8"] minimum clear on side with minimum 600 x 600 mm [24" x 24"] sheet size.
 - .1 For pipes through outside walls turn flange back into wall and caulk.
- .5 Flash floor drains over finished areas with lead 250 mm [10"] clear on sides with minimum 900 x 900 mm [36" x 36"] sheet size.
 - .1 Fasten flashing to drain clamp device.

3.3 SLEEVES

- .1 Extend sleeves through potentially wet floors 25 mm [1"] above finished floor level.
 - .1 Caulk sleeves full depth and provide floor plate.
- .2 Piping and ductwork passing through floor, ceiling, or wall, close off space between duct and sleeve with non-combustible insulation.
 - .1 Caulk both sides.
- .3 Piping passing through perimeter walls below grade, mechanical room floor, roof, or wall, close off space between pipe and sleeve with synthetic rubber compound mechanical type seals.
- .4 Sleeves provided through walls or floors where liquids could potentially pass from one side to the other, provide sleeves with a 25 mm [1"] 'flange' welded to the external face of the sleeve at the mid-point of the thickness of the structure to provide a water stop.
- .5 Install chrome plated escutcheons where piping passes through finished surfaces.

3.4 SERVICE PENETRATIONS IN RATED FIRE SEPARATIONS

- .1 Provide pipe sleeves for all piping passing through fire-rated walls and floors.
 - .1 Sleeves to be concentric with pipe.
- .2 Shop drawings:
 - .1 Submit shop drawings of listed assemblies for each type of penetration through a rated assembly.
- .3 Install fire stop caulking on pipe penetrations through fire rated floors and walls.
 - .1 Refer to Architectural documents for definition of rated construction components.
- .4 All piping, tubing, ducts, wiring, conduits, etc. passing through rated fire separations shall be smoke and fireproofed with ULC approved materials in accordance with CAN4-S115-11 (R2016) and ASTM E814 standards and which meet the requirements of the building code in effect.

- .1 This includes new services, which pass through existing rated separations, and all existing services, which pass through a new rated separation or existing separations whose rating has been upgraded.
- .5 Sleeves shall be sized to suit fire stopping methods employed for bare pipes, conduits, insulated pipes, and bare and insulated ducts without fire dampers.
 - .1 Sleeves shall be sized to suit conditions of approval given in manufacturers installation instructions for fire and smoke dampers.
- .6 Fire resistance rating of installed firestopping assembly shall not be less than fire resistance rating of surrounding assembly indicated on Architectural drawings.
- .7 All smoke and fire stopping shall be installed by a qualified Contractor who shall submit a letter certifying that all work is complete and in accordance with this specification.
 - .1 Mechanical Form MF173 in Section 20 99 60 can be used for this purpose.
- .8 Install fire stopping and smoke seal material and components in accordance with ULC certification and manufacturer's instructions in formed, sleeved or cored penetrations.
 - .1 Install firestop device on all plastic pipe penetrations through rated walls and ceilings.
 - .2 Refer to Architectural documents for definition of rated construction components. Refer also to the Provincial Building Code.
- .9 Combustible pipe penetrations through fire separations that are required to have a fire resistance rating shall be as follows:
 - .1 Intumescent firestopping material contained in a metal housing that is certified for firestopping use.
 - .2 Installation shall be implemented in full compliance with the certified installation procedures.
 - .3 Standard of Acceptance:
 - .1 FGC Fireguard Corp. DONUT Firestop for flat surfaces; 3M Brand (Intumescent) Fire Barrier, Dow Corning Fire Stop Intumescent Wrap for Q-deck.
- .10 Sleeves for fire-rated floor slabs in wet or dry areas shall be as noted on the Standard Details.
- .11 Pack future-use sleeves with mineral wool insulation and then seal with ULC approved fire stop sealant for rated fire separations.
- .12 Sleeves for interior partition (i.e. drywall) shall be as noted on the Standard Details.
- .13 Sleeves for interior concrete or block walls shall be steel pipe or removable plastic pipe.

3.5 SERVICE PENETRATIONS IN NON-RATED SEPARATIONS

- .1 Pipes and ducts passing through separations that have no fire resistance (non-rated separations) do not require a sleeve, but the insulation at the separation shall be wrapped with 0.61 [24 ga] thick galvanized sheet steel band to which to apply the flexible caulking compound to, to achieve a tight seal.
- .2 Sleeves for concrete perimeter walls and foundation walls shall be cast iron sleeve or Schedule 40 steel pipe with annular fin continuously welded at midpoint and protruding 150 mm [6"] beyond sleeve diameter.
 - .1 Annular fin shall be embedded into centre of wall.
- .3 Sleeves for non-rated floor slabs in wet or dry areas shall be steel pipe.
- .4 Sleeves for interior concrete or block walls shall be steel pipe or removable plastic pipe.

3.6 ESCUTCHEONS AND PLATES

- .1 Provide on pipes passing through finished walls, partitions, floors, and ceilings.
- .2 Plates shall be stamped steel, split type, chrome plated, or stainless steel, concealed hinge, complete with springs, suitable for external dimensions of piping/insulation.
 - .1 Secure to pipe or finished surface.
 - .2 For all pipes passing through suspended ceilings and uninsulated piping passing through walls.
 - .3 Outside diameter shall cover opening or sleeve.
- .3 Where pipe sleeve extends above finished floor, escutcheons or plates shall clear sleeve extension.
- .4 Do not install escutcheons and plates in concealed locations.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section provides General, Product, and Execution Requirements for Access Doors.
- .2 Provide all required Access doors in walls, floors, and ceilings as indicated, including, but not limited to:
 - .1 Access for maintenance and/or adjustment purposes of all mechanical system components and accessories
 - .2 Access for inspection of life safety or operating devices
 - .3 and access where specifically indicated.
- .3 Supply flush mounted access doors for installation by Building Trades in furred ceilings and walls

1.2 RELATED REQUIREMENTS

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.
- .2 In conjunction with Division 01, this Section is intended to apply to all work in Division 20, 21, 22, 23 and 25.
- .3 Refer to and comply with the following sections:
 - .1 General Requirements - Division 01
 - .2 Common Work for Mechanical Systems – Division 20
 - .3 Fire Suppression Systems - Division 21
 - .4 Plumbing Systems - Division 22
 - .5 Heating, Ventilation and Air Conditioning Systems - Division 23
 - .6 Controls and Instrumentation - Division 25

1.3 QUALITY ASSURANCE

- .1 Refer to Section 20 05 00 General Mechanical Provisions, Quality Assurance for additional details.
- .2 Follow manufacturer's recommended installation details and procedures for equipment, supplemented by requirements of Contract Documents.

1.4 SUBMITTALS

- .1 Comply with Division 01 and Section 20 05 05 Documentation and Submittals.
- .2 Comply with Section 23 05 00 Common Work for HVAC Systems, Submittals
- .3 Comply with Section 22 05 00 Common Work for Plumbing Systems, Submittals
- .4 Refer to Section 20 99 60 Mechanical Forms and submit all documentation therein that is applicable to this Specification Section.
- .5 Shop Drawings
 - .1 Submit shop drawings in accordance with Division 01 and Section 20 05 05 Documentation and Submittals.
 - .2 Submit shop drawings for all equipment and materials
 - .3 Submit coordinated shop drawings of proposed access door locations.

- .6 Product Options and Substitutions
 - .1 Refer to Division 01 and Section 20 05 00, for requirements pertaining to product options and substitutions.

Part 2 Products

2.1 ACCESS DOORS

- .1 General:
 - .1 Supply flush mounted access doors, for installation by Building Trades in furred ceilings and walls, for:
 - .1 Maintenance and/or adjustment purposes of all mechanical system components and accessories
 - .2 Inspection of life safety or operating devices
 - .3 Where specifically indicated, including,
 - .1 Valves
 - .1 Valve Chart: Provide a valve tag chart inside the access cover indicating service and valve tag for all valves accessed through access door.
 - .2 Plumbing equipment
 - .3 Volume and splitter dampers
 - .4 Fire dampers
 - .5 Cleanouts and traps
 - .6 Control components
- .2 Size:
 - .1 Unless otherwise noted, access doors shall be minimum:
 - .1 600mm x 600mm [24" x 24"] for body entry
 - .2 300mm x 450mm [12" x 18"] for hand entry
 - .3 200mm x 200mm [8" x 8"] for cleanout access.
 - .4 150mm x 150mm [6"x 6"] for cleanout access located behind mirrors.
 - .5 Access doors in building surfaces shall be at least as large as duct access panels accessed through them and shall be oversized when necessary.
 - .6 Size to suit masonry modules when located in a masonry wall.
- .3 Access doors in rated fire separations and firewalls shall have a compatible fire rating and a ULC label with tamper-proof latch.
 - .1 Door shall be filled with minimum 50 mm [2"] thick fire rated insulation to suit rating.
 - .2 Door shall have automatic closer, be self-latching, no straps, and contain an interior latch release.
- .4 Access doors shall be:
 - .1 Flush mounted with 180 degree opening door, round safety corners, concealed frame, flange, and full-length piano hinges.
 - .2 Provide plaster lock and anchor straps and tabs to suit wall or ceiling construction type.
 - .3 Provide full stud framing behind drywall around access door flange.

- .4 Constructed of stainless steel with neoprene gasketed door in damp and high humidity areas
- .5 Constructed of steel, prime coated, except:
- .6 All access doors shall be fitted with tamper resistant Torx head cam locks.
- .7 Frame shall be 1.5 mm (16 ga.) steel. Door shall be 0.9 mm (18 ga.) steel, welded pan type.
- .5 Refer to Division 08 for additional access hatch requirements.
- .6 Location Types and Finishes:
 - .1 Refer to architectural drawings for location types and special size requirements.
 - .2 Type 1 Access Doors:
 - .1 Standard of Acceptance
 - .1 Acudor UF-5000
 - .2 Refer to Section 20 99 65 for acceptable manufacturers.
 - .2 For areas with staff only access, except where noted otherwise (e.g. type 4 in wet areas).
 - .3 Base metal shall be steel with primer coat of rust inhibitive electrostatic powder baked gray enamel, suitable for field painting.
 - .3 Type 2 Access Doors:
 - .1 Standard of Acceptance
 - .1 Acudor BP-58
 - .2 Refer to Section 20 99 65 for acceptable manufacturers.
 - .2 For all areas accessible by public and staff.
 - .3 For feature wall construction, recessed concealed frame, wall type to complement and conform with the architectural module, treatment, or paneling.
 - .1 The size shall and style conform to adjacent finishes, to achieve minimum specified sizes.
 - .4 Tile, ceramic tile, marble, terrazzo, wall protection, plaster or wet wall construction in washrooms and other special areas: flush with wall or ceiling type with concealed flange.
 - .5 Door panel shall be recessed to receive ceiling or wall material to give finished appearance showing only hinge and latch.
 - .6 Door:
 - .1 Aluminum extrusion, 0.064" thick, mill finish, with drywall inserted into door panel.
 - .2 Concealed hinge, removeable door panel
 - .7 Frame:
 - .1 Recessed aluminum extrusion, 1.6mm [0.064"] thick, mill finish
 - .2 Provides similar edge to gypsum board bead against which wall or ceiling surface can be finished.
 - .4 Type 3 Access Doors:
 - .1 Standard of Acceptance
 - .1 Acudor Model ARVB
 - .2 Refer to Section 20 99 65 for acceptable manufacturers.
 - .2 Access doors with back box.

- .3 For Staff only access areas.
- .4 For locations where serviceable equipment (e.g. trap primers, solenoid valves, backflow preventors, thermostatic mixing valves, etc.) is installed inside wall cavity,
- .5 Back boxes shall be an integral part of the access door, as an assembly, with fully welded seams, and corners.
- .6 Size as required for the application, and special sizes as indicated on the architectural drawings.
- .7 Base metal shall be steel with primer coat of rust inhibitive electrostatic powder baked gray enamel, suitable for field painting.
- .5 Type 4 Access Doors:
 - .1 For Staff only access areas.
 - .2 Similar to Type 1 except constructed of stainless steel with neoprene gasketed door in damp and high humidity areas
 - .3 For wet areas, equipment washdown areas, staff shower rooms, soiled utility rooms, etc.
- .7 Access doors are not required in removable ceilings.

Part 3 Execution

3.1 INSTALLATION

- .1 Install access doors at all concealed cleanouts, traps, unions, expansion joints, valves, air vents, water hammer arrestors, special equipment, trap primers, vacuum breakers, and any other equipment for which subsequent periodic access will be required during the life of said equipment.
- .2 Locate access doors so that all concealed items are readily accessible for adjustment, operation, maintenance, and replacement.
 - .1 Refer to Architectural ceiling plans for proposed access door locations.
 - .2 Any changes from the locations, shown on the Architectural reflective ceiling plan, will need to be approved by the Consultant.
- .3 Locate in service areas and storage rooms wherever possible.
- .4 Do not locate in paneled, feature or special finish walls or ceilings, without prior approval of the Consultant.
 - .1 If so, match the feature wall module sizes.
- .5 Installation shall be by Building Trades in furred ceilings and walls.
 - .1 Coordinate accordingly.
- .6 At time of instruction of owners operating staff, hand-over and obtain signed receipt for 4 sets of each type of key used to lock access doors.
- .7 Mark removable ceiling tiles used for access with color coded pins.
 - .1 Refer to Section 20 05 53, Identification for Mechanical Systems.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section provides General, Product, and Execution Requirements for vibration isolation on all motor driven equipment, piping, and ductwork.
- .2 Arrange and pay for the services of the Contractor's Supporting Professional Seismic Engineer (Delegated Design), licensed in the Province where the project is located, and who specializes in the restraint of building elements.
- .3 Sound and vibration transmitted from mechanical systems to occupied spaces by any path other than airborne shall be less than airborne transmissions.
 - .1 This specification is considered minimum requirements to meet this criterion.
- .4 Obtain all relevant equipment information and provide shop and placement drawings for all vibration isolation elements and steel bases for review before materials are ordered.
- .5 Supply labor and materials required to anchor and isolate motor driven mechanical equipment as indicated on the drawings and specified herein and guarantee the function of the materials and equipment supplied.
- .6 Supply labor and materials required to isolate piping systems connected to motor driven equipment.
- .7 Provide restraints for equipment mounted on vibration isolation to limit movement during start-up and normal operation.
- .8 Provide attachment to both the equipment and the structure meeting the specified forces involved.
 - .1 Attachment details to the structure to be reviewed by the structural consultant for the project.
- .9 Vibration isolation equipment shall be selected to maintain noise levels in building in accordance with acoustical consultant's requirements.

1.2 RELATED REQUIREMENTS

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.
- .2 In conjunction with Division 01, this Section is intended to apply to all work in Division 20, 21, 22, 23 and 25.
- .3 Isolator and base type designations shall comply with the appropriate chapter of current ASHRAE Applications Handbook, as a minimum.
- .4 Refer to and comply with the following sections:
 - .1 General Requirements - Division 01
 - .2 Common Work for Mechanical Systems – Division 20
 - .3 Fire Suppression Systems - Division 21
 - .4 Plumbing Systems - Division 22
 - .5 Heating, Ventilation and Air Conditioning Systems - Division 23
 - .6 Controls and Instrumentation - Division 25

1.3 APPLICABLE CODES AND STANDARDS

- .1 Refer to Section 20 05 01, Codes, Bylaws and Standards.

- .2 All installation, execution, and testing shall conform to the following standards as a minimum:
 - .1 Applicable Provincial Building Code and local municipal by-laws
 - .2 SMACNA - Seismic Restraint Manual Guidelines for Mechanical Systems
 - .3 NFPA 13 - Installation of Sprinkler Systems
 - .4 ASHRAE Handbook – HVAC Applications
 - .5 VISCMA (The Vibration Isolation and Seismic Control Manufacturers Association)

1.4 REGULATORY REQUIREMENTS

- .1 Supply isolators and seismic restraints meeting the structural requirements of the applicable Provincial Building Code and municipal Building By-Laws, with respect to seismic snubbers, or provide equivalent requirements where integral seismic restraint is provided in isolators / bolting.
- .2 Vibration isolator housings are considered a safety guard with respect to isolated equipment and any contained compressed springs.
 - .1 Include "Fail Safe" seismic restraint in all vibration isolation designed to hold mechanical equipment and springs in place.
- .3 Anchorage of all equipment shall be certified by Contractor's Supporting Professional Seismic Engineer (Delegated Design), who specializes in seismic restraint of resiliently mounted systems.
- .4 All seismic integral isolation mounts or snubbers shall be O.S.H.P.D. (Office of Statewide Health and Planning Department – State of California) approved and the associated OSHPD number clearly indicated on the seismic device.
 - .1 Where OSHPD certification is not available for a restraint device, results of tests consistent with OSHPD procedures and approvals shall be submitted and certified by the Contractor's Supporting Professional Seismic Engineer (Delegated Design).

1.5 QUALITY ASSURANCE

- .1 Refer to Section 20 05 00 General Mechanical Provisions, Quality Assurance for additional details.
- .2 All vibration isolators and bases shall be supplied by an approved supplier except for isolators which are factory installed and are standard equipment with the machinery.
- .3 The work shall be carried out in accordance with the specification and, where applicable, in accordance with the manufacturer's instructions and only by trades people experienced in this type of work.

1.6 SUBMITTALS

- .1 Shop Drawings
 - .1 Submit shop drawings in accordance with Division 01 and Section 20 05 05 Documentation and Submittals.
 - .2 Submit shop drawings for all equipment and materials
 - .3 Provide shop and placement drawings for all vibration isolation elements for review before materials are ordered.
 - .1 The drawings shall bear the stamp and signature of the responsible supplier's technical representative.
 - .4 Show fabrication details, location and size of anchor bolts and concrete requirements for inertia bases.

- .5 Submit product data sheets for isolation components.
- .2 Maintenance Manuals
 - .1 Refer to Division 01 and Section 20 05 05 Documentation and Submittals.
 - .2 Submit operating and maintenance data for inclusion into the manuals.
 - .3 Submit manufacturer's recommended maintenance tasks for a one-year period. Include maintenance schedules and lubrication products.

Part 2 Products

2.1 GENERAL

- .1 Provide vibration isolation equipment by one manufacturer.
- .2 Standard of Acceptances
 - .1 Refer to section 20 99 65
- .3 Ensure isolation systems have a vertical natural frequency no higher than one third of the lowest forcing frequency, unless otherwise specified.
 - .1 Use dynamic stiffness correction factors for elastomers and do not exceed 60 durometer.
- .4 Isolators and restraining devices, which are factory supplied with equipment, shall meet the requirements of this section.
- .5 Use ductile materials in all vibration and seismic restraint equipment.
- .6 Supply all isolators fully assembled and clearly labelled with full instructions for installation by the contractor.
- .7 Spring isolators located out of doors or in humid areas shall have anti-corrosion paint applied to housings and neoprene coated springs, unless otherwise indicated on drawings.
- .8 Design springs in accordance with the Society of Automotive Engineers' Handbook Supplement 9 entitled "Manual on Design and Application of Helical and Spiral Springs - SAE".
 - .1 Provide neoprene isolators and components using maximum 60 duro "Bridge bearing quality neoprene", as defined by CSA Standard CAN3-S6.
 - .2 Ensure design of isolation and restraint elements allows adequate clearance to avoid binding.
- .9 Design springs "iso-stiff" ($k_x/k_y = 1.0$ to 1.5) with a working deflection between 0.3 and 0.6 of solid deflection.
- .10 Provide hot dipped galvanized housings and neoprene coated springs, or other acceptable weather protection, for all isolation equipment located out of doors or in areas where moisture may cause corrosion.

2.2 STATIC DEFLECTIONS

- .1 Select isolators at the supplier's optimum recommended loading and do not load beyond the limit specified in the manufacturer's literature.
- .2 The required static deflection of isolators for equipment exceeding 0.35 kW [0.5 HP] is indicated below.
 - .1 Spring isolators shall be "open spring".
 - .2 Closed spring isolators shall only be used where specified.
 - .3 Machine Speed 400 to 600 rpm:

- .1 Slab on grade: 25 mm [1"]
- .2 Structural slab: 50 mm [2"]
- .3 Normal: 100 mm [4"]
- .4 Machine Speed 600 to 800 rpm:
 - .1 Slab on grade: 12 mm [$\frac{1}{2}$ "]
 - .2 Structural slab: 25 mm [1"]
 - .3 Normal: 50 mm [2"]
 - .4 Critical: 100 mm [4"]
- .5 Machine Speed 800 to 1100 rpm:
 - .1 Slab on grade: 5 mm [$\frac{1}{4}$ "]
 - .2 Structural slab: 12 mm [$\frac{1}{2}$ "]
 - .3 Normal: 25 mm [1"]
 - .4 Critical: 50 mm [2"]
- .6 Machine Speed 1100 to 1500 rpm:
 - .1 Slab on grade: 3 mm [$\frac{1}{8}$ "]
 - .2 Structural slab: 4 mm [$\frac{3}{16}$ "]
 - .3 Normal: 5 mm [$\frac{1}{4}$ "]
 - .4 Critical: 12 mm [$\frac{1}{2}$ "]

2.3 OPEN SPRING ISOLATORS

- .1 Springs shall be "Iso-Stiff" having equal stiffness in the horizontal and vertical planes with a working deflection between 0.3 and 0.6 of solid deflection.
- .2 Spring mounts shall be complete with levelling devices, minimum 6 mm [$\frac{1}{4}$ "] clearance thick neoprene sound pads, and zinc chromate plated hardware.
- .3 Sound pads shall be sized for a minimum deflection of 1.2 mm [0.05"] clearance and shall meet the requirements for neoprene isolators.

2.4 CLOSED SPRING ISOLATORS

- .1 Compression springs shall be used both for hangers and floor mount isolators.
- .2 Springs shall be stable under operating conditions.
- .3 Housings shall incorporate a minimum 6 mm [$\frac{1}{4}$ "] clearance thick sound pad sized for a minimum static deflection of 1.2 mm [18 ga] meeting the requirements for neoprene isolators.
- .4 Floor mount units shall incorporate neoprene side stabilizers with a minimum 6 mm [$\frac{1}{4}$ "] clearance.

2.5 NEOPRENE ISOLATORS

- .1 All neoprene isolators shall be tested to ASTM specifications.
- .2 Where a ribbed pad is used, the height of the ribs shall not exceed 0.7 times the width of the rib.
 - .1 A steel layer shall be used to distribute the load in a multi-layered unit.
- .3 Neoprene pads or elements shall be selected at the manufacturer's optimum recommended loading and shall not be loaded beyond the limit specified in the neoprene manufacturer's literature.

- 2.6 SPRING HANGERS**
- .1 Hangers capable of a 10° misalignment shall be provided unless otherwise specified.
- 2.7 ISOLATORS - TYPE 1, PADS**
- .1 Standard of Acceptance:
 - .1 Mason WMW, Super W pads
 - .2 Mason Industries Type HG Hemi-Grommets
 - .3 EAR Grommets
 - .2 Neoprene or neoprene / steel / neoprene pad isolators.
 - .1 Select Type 1 pads for a minimum 2.5 mm [0.1"] static deflection or greater.
 - .2 Use hold down bolts selected for seismic loads.
 - .3 Isolate bolts from base of unit using neoprene hemi-grommets.
 - .4 Avoid over-compressing grommets (e.g. use Hilti HVA adhesive set bolts, or equal, with steel washers and lock nuts, adjusted finger tight to the hemi-grommets).
 - .5 Size bolt and hemi-grommet for minimum lateral clearance. Use grommets only on light-weight equipment.
- 2.8 ISOLATORS - TYPE 2, RUBBER FLOOR MOUNTS**
- .1 Standard of Acceptance
 - .1 Mason BR, maximum 50 durometer.
 - .2 Rubber/neoprene-in-shear isolators designed to meet specified seismic requirements. Select isolators for a 4 mm [0.15"] minimum static deflection, and bolt to structure. In the case of rubber isolators, provide protection in the design of the isolator to avoid contact of the rubber element to oil in the mechanical room.
- 2.9 ISOLATORS - TYPE 3, SPRING FLOOR MOUNTS**
- .1 Standard of Acceptance:
 - .1 Mason SSLFH, Mason SSLR (for chillers and fluid coolers/cooling towers only).
 - .2 Spring mounts complete with levelling devices, selected to achieve 25mm deflection under load. Springs to incorporate a minimum 6 mm [1/4"] thick neoprene sound pad or cup having a 1.3 mm [0.05"] minimum deflection under load. Design isolator to meet specified seismic requirements.
- 2.10 ISOLATORS - TYPE 3A, SPRING FLOOR MOUNTS**
- .1 As per Type 3 except 50mm deflection.
- 2.11 ISOLATORS - TYPE 4, HANGER MOUNTS**
- .1 Standard of Acceptance:
 - .1 Mason HD (non- spring), WDNHS (with spring)
 - .2 Spring hangers, c/w 6 mm [1/4"] thick neoprene cup/bushing sized for 1.3 mm [0.05"] minimum deflection, or neoprene hangers.
- 2.12 ISOLATORS - TYPE 4A, HANGER MOUNTS**
- .1 As per Type 4 except 50mm deflection.

2.13 ISOLATORS - TYPE 6, SEISMIC SNUBBERS.

- .1 Standard of Acceptance:
 - .1 Mason Z-1225.
- .2 Seismic snubbers c/w minimum 3mm [1/8"] neoprene bushing and 6mm [1/4"] air gap. Snubber to act omni-directionally.
 - .1 Ensure bushing can easily be turned by hand after installation

2.14 CLOSED CELL FOAM GASKETS / NEOPRENE GROMMETS - TYPE 7

- .1 Standard of Acceptance:
 - .1 American National Rubber-EPDM-SBR blend SCE 41 type neoprene.
 - .2 Mason Industries Type HG Hemi-Grommets.
- .2 20 mm [3/4"] thick continuous perimeter closed cell foam gasket to isolate base of package type equipment, AHU's, exhaust fans, etc. from concrete floors / roof curbs. Select width for nominal 3psi loading under weight of equipment and allow for 25% compression 5mm [3/16"].
 - .1 Increase width of curb using steel shim if necessary to accommodate gasket. For light equipment such as exhaust fans, deflection should be a minimum of 0.05".
 - .2 Contractor to check fire rating requirements specified for project.

Part 3 Execution

3.1 GENERAL

- .1 Provide vibration isolation on all motor driven equipment with motors of 1/2 HP and greater power output (as indicated on the motor nameplate) and on piping and ductwork, as specified herein.
 - .1 For equipment less than 1/2 HP, provide vibration isolation grommets at the support points.
- .2 Provide seismic restraint for all equipment including all seismic restraint related hardware (bolts and anchors) from point of attachment to equipment through to and including attachment to structure.
 - .1 The required anchors shall be indicated on the shop drawings and shall be clearly identified for the correct location and so as to be readily identified after installation.
 - .2 Provide clear instructions for their installation.
 - .3 Refer to Section 20 05 49, Seismic Restraints.
- .3 Place isolators under equipment so that the minimum distance between adjacent corner isolators is at least equal to the height of the centre of gravity of the equipment.
 - .1 Include height of centre of gravity on shop drawings.
 - .2 Otherwise, design for increased forces on the supports, and submit design calculations with shop drawings for approval.
- .4 Follow structural consultant's instructions for drilled inserts re: installation of anchors.
- .5 Coordinate with Section 23 33 00 "Duct Connectors – Vibration Isolation" for all ductwork connections to fans or plenums.
- .6 Coordinate with Electrical Division 26 for the provision of a minimum 180o hanging loop of flexible conduit for all electrical connections to isolated equipment.

3.2 APPLICATION

- .1 Deflections 12 mm [$\frac{1}{2}$ "] and over shall use steel spring isolators.
- .2 Deflections 6 mm [$\frac{1}{4}$ "] and under shall use neoprene isolators.
- .3 All equipment mounted on vibration isolators shall have a minimum clearance of 50 mm [2"] to other structures, piping, equipment, etc.
 - .1 All isolators shall be adjusted to make equipment level.
- .4 Adjustable, horizontal stabilizers on close spring isolators shall be adjusted so that the side stabilizers are clear under normal operating conditions.
- .5 All piping connections to isolated equipment shall be supported resiliently for the following distances or to the nearest flexible pipe connector:
 - .1 Pipe Size: 50 - 65 mm [2" - 2 $\frac{1}{2}$ "]
 - .1 Distance: 4.5m [15'-0"]
 - .2 Pipe Size: 75 - 100 mm [3" - 4"]
 - .1 Distance: 7.0m [23'-0"]
- .6 The three closest hangers to the vibration source shall be selected for the lesser of a 25 mm [1"] static deflection or the static deflection of the isolated equipment.
 - .1 The remaining isolators shall be selected for the lesser of the 50 mm [2"] static deflection or 1/2 the static deflection of the isolated equipment.
- .7 Spring hangers shall be installed without binding.
- .8 Adjust isolators as required and ensure springs are not compressed.
- .9 Provide neoprene side snubbers or retaining springs where side torque or thrust may develop.
- .10 Where movement limiting restraints are provided, they shall be set in a position with minimum 6 mm [$\frac{1}{4}$ "] air gap.
 - .1 Restraints, isolator equipment and attachment points shall be designed to withstand the impact of the isolated equipment subjected to an acceleration not exceeding 3 g without permanent distortion or damage.
- .11 Wiring connections to isolated equipment shall be flexible.

3.3 INSTALLATION

- .1 Execute the work in accordance with the specifications and the manufacturer's instructions and only by workmen experienced in this type of work.
- .2 For all equipment mounted on vibration isolators, provide a minimum clearance of 50 mm [2"] to other structures, piping, equipment, etc.
- .3 Before bolting isolators to the structure, start equipment and balance the systems so that the isolators can be adjusted to the correct operating position before installing (seismically rated) anchors and/or welding.
- .4 After installation and adjustment of isolators verify deflection under load to ensure loading is within specified range and isolation is being obtained.
- .5 Where hold down bolts for isolators or seismic restraint equipment penetrate roofing membranes, provide "gum cups" and sealing compound to maintain waterproof integrity of roof.
 - .1 Ensure sealing compound is compatible with isolator components such as neoprene.
 - .2 Co-ordinate with roofing section of specifications and with roofing subcontractor.
- .6 Use Type 1 pads only where specified.

- .7 Select Type 4 spring hangers for a minimum static deflection of 25 mm [1"] for all ceiling hung fans, and air handling units, emergency generator exhaust piping and silencers, steam PRV's and any other vibrating sources.
- .8 Isolate pumps and axial fans rotating at more than 1170 RPM on type 2 isolators.
- .9 Use the lowest RPM scheduled for two-speed equipment in determining isolator deflection.
- .10 Where ductwork, piping, etc., connected to or serving noise generating equipment, is routed through walls, floors, piping chases, etc. position ductwork, piping, etc. to avoid contact with the concrete structure, future framing, drywall, and other finishes which may radiate noise.
 - .1 Use Type 2 mounts.
 - .2 Submit proposed details to meet this requirement.
- .11 Make no connections between mechanical room equipment and drywall partitions, adjoining occupied spaces.
 - .1 Mount all equipment designed for wall mounting on non-critical, block work or concrete walls.
 - .2 Connect hangers to concrete structure only.
 - .3 Where structure is steel, connect to major structural beams only, or to structural angles with gussets attached to concrete shear walls.
 - .4 Do not attach to light framing members such as OWSJ's.
 - .5 Do not connect to edge of beam flange (e.g. with clips).
 - .6 Weld nut or threaded sleeve to bottom flange at centre, directly below web, to accommodate threaded hanger rod.
- .12 Be responsible for ensuring that flexible duct connections (see Section 23 33 00) are installed with a minimum of 40 mm [1-1/2"] metal-to-metal gap.
 - .1 Use flanges to ensure that flexible connectors are clear of the airstream.
- .13 Isolate variable frequency drive controller using isolators or soft grommets such that structure borne noise transmission to occupied space is less than airborne noise transmission.
 - .1 Controller supplier to provide all isolation, including wiring connections, to control flanking noise transmission.
 - .2 Provide isolation meeting all seismic requirements.
- .14 Provide stabilizing springs limiting movement at flexible connections to 25% of fabric width under steady state conditions and 40% at start up.
- .15 Slab on grade mounted equipment:
 - .1 For equipment mounted on a slab on grade mount on type 3A isolators unless otherwise specified.

3.4 INSPECTIONS

- .1 The supplier shall assist the Contractor as necessary during the course of installation of isolation equipment.
- .2 The supplier shall inspect the complete installation after system startup and establish that the isolators for each piece of equipment are properly installed and adjusted. Correct any mal-performance.
 - .1 The supplier shall submit a statutory declaration to the Consultant stating that the complete vibration isolation installation is installed in accordance with his drawings and instructions and operates to his satisfaction.
 - .2 Form MF175 in Section 20 99 60 should be used for this purpose.

- .3 A qualified representative of the isolator manufacturer shall inspect the isolated equipment after installation and submit a concise report stating any deficiencies in the installation. Comply with Section 20 05 08, Equipment Testing and Start-up.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section provides General, Product, and Execution Requirements for Seismic Restraints for all mechanical systems and equipment.
- .2 Arrange and pay for the services of the Contractor's Supporting Professional Seismic Engineer (Delegated Design), licensed in the Province where the project is located, and who specializes in the restraint of building elements.
- .3 Provide restraints on all piping, ductwork and equipment, which is part of the building mechanical service systems to prevent injury or hazard to persons and equipment and to retain equipment in its normal position in the event of an earthquake, all in general accordance with SMACNA Guidelines.
- .4 Provide design, selection and provision of materials, installation instructions, installation, and inspection of seismic restraint of mechanical piping, ductwork, fire protection and equipment.
- .5 Provide all seismic restraint related hardware, (including bolts and anchors) from point of attachment to equipment through to and including attachment to structure.
- .6 This specification covers equipment, which is not specifically covered in SMACNA.
- .7 Seismic restraints may only be omitted where permitted by SMACNA and the Provincial Building Code.
- .8 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.
- .9 The requirements under this Section are in addition to the requirements for equipment, piping and duct supports and vibration isolation specified in other Sections.

1.2 RELATED REQUIREMENTS

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.
- .2 In conjunction with Division 01, this Section is intended to apply to all work in Division 20, 21, 22, 23 and 25.
- .3 Refer to and comply with the following sections:
 - .1 General Requirements - Division 01
 - .2 Common Work for Mechanical Systems – Division 20
 - .3 Fire Suppression Systems - Division 21
 - .4 Plumbing Systems - Division 22
 - .5 Heating, Ventilation and Air Conditioning Systems - Division 23
 - .6 Controls and Instrumentation - Division 25

1.3 APPLICABLE CODES AND STANDARDS

- .1 Restraints shall meet the requirements of the Provincial Building Code and the local by-laws.
- .2 All installation, execution, and testing shall conform to the following standards as a minimum:
 - .1 SMACNA - "Seismic Restraint Manual Guidelines for Mechanical Systems"
 - .2 NFPA 13 - "Installation of Sprinkler Systems"

- .3 ASHRAE - "HVAC Applications, Seismic and Wind Restraint Design"
- .4 VISCMA (The Vibration Isolation and Seismic Control Manufacturers Association)
- .5 Manufacturers Standardization Society of Valve and Fittings Industry (MSS): MSS SP-127 Bracing for Piping Systems Seismic - Wind - Dynamic Design, Selection, Application.

1.4 **QUALITY ASSURANCE**

- .1 Refer to Section 20 05 00 General Mechanical Provisions, Quality Assurance for additional details.
- .2 Follow manufacturer's recommended installation details and procedures for equipment, supplemented by requirements of Contract Documents.
- .3 Installer Qualifications
 - .1 Drilled-in anchors shall be installed by a Contractor with at least five years of experience performing similar installations.
- .4 Installer Training:
 - .1 Conduct a thorough training with the manufacturer or the manufacturer's representative for the Installer on the project.
 - .1 Training shall 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/torquing
- .5 Request and arrange for a construction review by the Consultant of the completed seismic restraint installation before any ceilings are installed.

1.5 **SUBMITTALS**

- .1 Comply with Division 01 and Section 20 05 05 Documentation and Submittals.
- .2 Comply with Section 23 05 00 Common Work for HVAC Systems, Submittals
- .3 Comply with Section 22 05 00 Common Work for Plumbing Systems, Submittals
- .4 Refer to Section 20 99 60 Mechanical Forms and submit all documentation therein that is applicable to this Specification Section.
- .5 Shop Drawings
 - .1 Submit shop drawings in accordance with Division 01 and Section 20 05 05 Documentation and Submittals.
 - .2 Submit shop drawings for all equipment and materials
 - .3 Submit shop drawings of all restraining devices, including details of attachment to the structure, either tested in an independent testing laboratory or approved by the Contractor's Supporting Professional Seismic Engineer (Delegated Design).
 - .4 Submit calculations for each piece of restrained equipment, piping, ductwork, and conduit, including seismic forces, restraint selection, and selection data.
 - .1 Allow for worst case combination of tension and shear loads at each snubber and restraint location.

- .2 Calculations shall be sealed by the Contractor's Supporting Professional Seismic Engineer (Delegated Design).
- .3 Include anchor bolt diameters, embedment depth, full welding details including type and length for field welds and required housekeeping base dimensions.
- .4 Proposed inserts or connections to structure to follow directions of project structural consultant.
- .5 Provide a calculation analysis summary (spreadsheet is acceptable) for each piece of equipment, including the following information:
 - .1 Equipment ID
 - .2 Floor level
 - .3 Horizontal seismic force factor
 - .4 Equipment weight
 - .5 Horizontal seismic force
 - .6 Vertical uplift seismic force (where applicable)
 - .7 Equipment centre of gravity in three directions
 - .8 Design condition (worst case) overturning moment
 - .9 Number of restraint fastenings
 - .10 Pull-out tension per fastener
 - .11 Horizontal shear per fastener
 - .12 Pull-out tension load rating per fastener
 - .13 Horizontal shear rating per fastener.
- .6 Maintenance Manuals
 - .1 Submit Maintenance Data in accordance with Division 01 and Section 20 05 05 Documentation and Submittals.
 - .2 Submit operating and maintenance data for inclusion into the manuals.
 - .3 Submit manufacturer's recommended maintenance tasks for a one-year period. Include maintenance schedules and lubrication products.

1.6 SEISMIC RESTRAINT DESIGN AND INSPECTION

- .1 Arrange and pay for the services of the Contractor's Supporting Professional Seismic Engineer (Delegated Design).
 - .1 The Contractor's Supporting Professional Seismic Engineer (Delegated Design) shall provide all required engineering services related to seismic restraints of non-vibration isolated equipment, ductwork and piping as indicated below.
 - .2 The Contractor's Supporting Professional Seismic Engineer (Delegated Design) shall assist the Contractor as necessary during the course of restraint of equipment, ductwork, and piping.
 - .3 The Contractor's Supporting Professional Seismic Engineer (Delegated Design) shall certify that the installation fully meets the stipulated Post Disaster requirements.
 - .4 The Contractor's Supporting Professional Seismic Engineer (Delegated Design) shall inspect the completed seismic installation and shall submit a statutory declaration to the Consultant stating that the complete seismic installation is installed in accordance with their drawings and instructions, and it complies with the regulatory requirements.
 - .1 The sign-off form in Section 20 99 60 should be used for this purpose.
 - .2 Prior to substantial performance, the Seismic Engineer shall provide letters of assurance for all mechanical, plumbing and fire protection systems.

1.7 DESIGN CRITERIA

- .1 Restraint systems as indicated in SMACNA "Seismic Restraint Manual Guidelines for Mechanical Systems", Seismic Hazard Level SHL A.
 - .1 If lesser restraint than recommended by SMACNA SHL A is proposed to meet local Code seismic requirements, provide shop drawings of details certified by the Contractor's Supporting Professional Seismic Engineer (Delegated Design).
- .2 Design seismic restraint systems to conform to the Provincial Building Code for the project location:
- .3 For all pipework and duct systems, the vertical uplift force is restrained by the systems as defined in the SMACNA standard.

Part 2 Products

2.1 SPECIAL REQUIREMENTS FOR SUPPORTS

- .1 In some locations in the project there may be large pipes that are required to be suspended from the slab above.
 - .1 The Contractor shall install the anchors and supports in an approved manner to ensure the entire installation (seismic, gravity and lateral forces) will comply with the Provincial Building Code.
- .2 Cast-In-Place Anchors:
 - .1 Anchors, Bolts, Nuts, and Washers: Bolts and studs, nuts, and washers shall conform to ASTM A307, Grade A, and ASTM A449, ASTM A563, and ASTM F436, as applicable.
 - .1 Hot-dip galvanized bolts and studs including associated nuts and washers in accordance with ASTM A153.

2.2 SEISMIC SNUBBER RESTRAINTS

- .1 Single-Axis Limit Stop Snubber Assemblies:
 - .1 Steel construction, attached to equipment structure and equipment, maximum of 6 mm [$\frac{1}{4}$ "] seismic movement.
 - .2 Designed to restrict movement in one axis.
 - .3 Minimum 6 mm [$\frac{1}{4}$ "] thick resilient neoprene pads to prevent metal-to-metal impact.
 - .4 Minimum four (4) snubbers for each piece of equipment.
- .2 Multi-Axis Limit Stop Snubber Assemblies:
 - .1 Interlocking steel construction, attached to equipment structure and equipment, maximum of 6 mm [$\frac{1}{4}$ "] seismic movement.
 - .2 Designed to restrict movement in two (2) or three (3) axis.
 - .3 Minimum 6 mm [$\frac{1}{4}$ "] thick resilient neoprene pads to prevent metal-to-metal impact.
 - .4 Minimum two (2) snubbers for each piece of equipment.

2.3 SEISMIC VIBRATION ISOLATORS

- .1 All Direction Neoprene Isolator:
 - .1 Molded, oil resistant neoprene compound, with encapsulated cast-in-place top steel load plate, and steel base plate with anchor holes designed for seismic loads in all directions with no metal-to-metal contact.

- .2 Restrained Spring Isolator – Constant Load:
 - .1 Colour coded seismic-controlled spring isolator, single or multiple spring coils, with minimum 6 mm [$\frac{1}{4}$ "] neoprene pad.
 - .2 Removable coil spring element without having to disturb supported equipment.
 - .3 Lateral stiffness greater than 1.2 times rated vertical stiffness.
 - .4 Minimum 50% overload capacity
 - .5 Non-welded spring elements: epoxy coated, with a minimum 1,000-hour rating when tested in accordance with ASTM B-117.
 - .6 Steel housing design to limit lateral and vertical movement of the supported equipment.
 - .7 Neoprene snubber, to limit maximum equipment movement in any direction to 6 mm [$\frac{1}{4}$ "].
 - .8 Adaptor base suitable sized for larger anchors, when required to suit anchorage capacity.

2.4 PIPING AND DUCTWORK RESTRAINT

- .1 Cable Restraints for suspended piping and ductwork:
 - .1 Manufactured system consisting of cable, building attachment, and vertical rod reinforcement assembly,
 - .2 Field-built assemblies are not acceptable,
 - .3 Steel wire strand cables:
 - .1 Galvanized steel aircraft cable
 - .2 Sized for seismic load with a safety factor of 2,
 - .3 Arranged for restraint in both longitudinal and transverse directions.
 - .4 Rope connections: overlap wire “U” clips or tool-less wedge insert lock connectors.
 - .5 Connector strength rating equal to 90% of cable breaking strength rating.
 - .4 Building and equipment attachment brackets: designed to permit free cable movement in all directions up to a 45-degree misalignment:
 - .1 Protective thimbles at sharp corners to protect against cable wear, selected to exceed the cable working design load by 50%,
 - .2 Single sided “C” beam clamps are not acceptable.
 - .5 Vertical suspension rods:
 - .1 Braced to avoid potential for buckling due to vertical up-lift forces,
 - .2 Structural steel angle or formed channel brace selected to prevent support rod buckling,
 - .3 Brace attached to support rod with a series of adjustable clips, without the use of hand-tools.
- .2 Steel angles or channels:
 - .1 Sized for seismic load with a safety factor of 2,
 - .2 Arranged for restraint in both longitudinal and transverse directions.
- .3 Rigidly Mounted Equipment Restraint
 - .1 Undercut or Heavy-Duty Sleeve type, for post concrete-cure installation:
 - .1 Carbon steel bolt, nut, and sleeve,

- .2 Selected for concurrent shear and tension loads with a safety factor not less than 2.0 x estimated load.

Part 3 Execution

3.1 GENERAL

- .1 Seismically restrain the following equipment and systems:
 - .1 Piping:
 - .1 Natural gas 25mm [1"] pipe and larger,
 - .2 Piping located inside of mechanical equipment and service rooms, 30mm [1¼"] pipe and larger,
 - .3 All other piping 65mm [2½"] pipe and larger.
 - .2 All Ductwork and Piping:
 - .1 Rectangular and oval ductwork with cross sectional area 0.55 sq.m [6 sq.ft] and greater,
 - .2 Round ducts with diameters 710 mm [28"] and larger.
 - .3 Equipment:
 - .1 Vibration isolated equipment,
 - .2 Rigidly or gravity supported equipment.

3.2 DESIGN

- .1 Design seismic restraints to;
 - .1 Keep equipment in place during and after seismic events in accordance with local building code,
 - .2 Resist vertical loading simultaneously with transverse or longitudinal seismic loading
- .2 It is the responsibility of the contractor to ascertain that an appropriate size device be selected for each individual piece of equipment.
- .3 Give special consideration to design for adjacent connections, insulation treatment, thermal movement, vibration isolation, and relation to building seismic joints.
- .4 Building structure attachments;
 - .1 Concrete construction:
 - .1 Cast in place anchor or drill-in wedge anchor
 - .2 Steel construction:
 - .1 Double-sided beam clamp loaded perpendicular to beam or Specifically designed welded or bolted connection.
 - .3 Single sided "C" type beam clamps for support rods for piping, ductwork, conduit, bus duct, cable trays or other equipment are unacceptable as seismic restraint anchor points.
 - .4 Brace installation;
 - .1 Install cable restraints snug,
 - .2 Install solid braces only in rigidly supported situations
 - .3 Brace hanger rods forming a part of seismic restraint to accept resulting compressive loads

- .4 Transverse and longitudinal braces to be no more than 45° above or below centerline of pipe, duct, or tray.
- .5 Equipment:
 - .1 Equipment secured rigidly to wall, floor, or housekeeping pad to have resilient neoprene bushings and washers between equipment and anchor bolts.

3.3 SELECTION OF BRACING DETAILS

- .1 Select application type;
 - .1 Single hanger or Trapeze support
- .2 Determine required force level, based on weight of equipment and specified factors.
- .3 With required force level, develop transverse and longitudinal brace spacing for single or trapeze hanger in accordance with;
 - .1 Break length into separate straight runs, which are considered to be single straight section between any bends except where bend is at an offset of less than 610mm [24"],
 - .2 Brace each straight run-in transverse direction at both ends.
 - .1 Check required spacing for transverse bracing and compare it to the length of straight run.
 - .2 If length of straight run is greater than allowable distance for transverse bracing add transverse braces until spacing does not exceed allowable transverse brace distance,
 - .3 Each straight run must have at least one longitudinal brace.
 - .1 Add longitudinal braces so that the spacing does not exceed allowable longitudinal brace spacing.
 - .2 Transverse brace may act as longitudinal brace for an adjacent run when it is located within 610mm [24"] of adjacent straight run,
 - .4 Where several short runs occur one after other, each straight run requires longitudinal brace when adjacent short runs exceed offset length of 610mm [24"].
 - .1 When adjacent short runs do not exceed maximum offset length the longitudinal braces can act as transverse braces as long as allowable transverse brace spacing is not exceeded.
 - .2 Multiple offsets can be treated as single run when the total offset is less than maximum offset length,
- .4 Select brace anchorage detail.
- .5 Calculate hanger rod load and select rod attachment to structure to suit.
- .6 Check if rod stiffeners are required to prevent hanger rod from buckling under compressive load.

3.4 INSTALLATION

- .1 Install seismic restraint devices in accordance with manufacturer's instructions.
- .2 Install snubber devices only after equipment is installed and operating, to ensure no metal-to-metal contact.
- .3 Seismic restraint manufacturer to provide training to the installation contractor on installation methods.
- .4 Anchors on piping systems used for thermal expansion may be used as both a lateral and longitudinal restraint where they are designed for concurrent thermal and seismic loadings.

- .5 Racked piping systems may have the rack braced (laterally, longitudinally, or combination thereof), provided each pipe supported by the rack is restrained to the rack.
- .6 Each lateral or longitudinal brace must be secured to the building structure, and not any other building service.
- .7 Pipe and duct penetrations through masonry and poured concrete wall partitions are acceptable as a lateral restraint, provided sleeves and fire stopping materials are installed correctly.
 - .1 Drywall partitions, including demountable partitions, are not to be used for lateral restraint.

3.5 EQUIPMENT RESTRAINTS

- .1 Floor Mounted Vibration Isolated Equipment
 - .1 Select basic vibration isolator as per Section 20 05 48.
 - .2 Select seismic restraint for each piece of equipment either:
 - .1 Integrated seismic vibration restraint, or
 - .2 Vibration isolator as per 23 05 48 combined with seismic snubbers.
 - .3 Do not mix type of restraint on the same piece of equipment.
- .2 Suspended Vibration Isolated Equipment
 - .1 Provide restraint in accordance with the SMACNA guideline and manufacturers' instructions.
 - .2 Do not mix cable restraints and rigid bar restraints on the same piping or duct system, except:
 - .1 On piping or ductwork which is suspended on vibration isolators, use cable type SCR restraints, and provide a small amount of slack in the cable to prevent vibration short-circuiting.
 - .3 Select basic vibration isolator as per Section 20 05 48.
 - .4 Provide cable restraints in longitudinal and lateral directions.
 - .5 Connect slack cable restraints to ceiling hung equipment in such a way that the axial projection of the wires passes through the centre of gravity of the equipment.
 - .6 Provide hanger rod reinforcement.
 - .7 Do not use ductwork or piping restraints to restrain equipment.
 - .8 Orient restraint wires on ceiling hung equipment at approximately 90 degrees to each other (in plan), and tie back to the ceiling slab at an angle not exceeding 45 degrees to the slab.
 - .9 On piping systems, provide transverse slack cable restraints at a maximum spacing of 12 m [40 ft] and longitudinal restraints at 24 m [80 ft] maximum spacing, or as limited by anchor/slack cable performance.
 - .10 Transverse bracing for one pipe section may also act as longitudinal bracing for the pipe connected perpendicular to it, provided the bracing is installed within 600 mm [24"] of the elbow or T, and if the connected pipe is the same or smaller in size.
 - .1 Do not use branch lines to restrain main lines.
 - .11 Provide flexibility in piping joints or sleeves where pipes pass through building seismic or expansion joints.
 - .12 Vary adjacent spacing of restraints on a piping run by 10% to 30% to avoid coincident resonances.

- .13 Install restraints at least 50 mm [2"] clear of all other equipment and services.
- .14 Adjust restraint cables such that they are not visibly slack, or such that the flexibility is approximately 40 mm [1-1/2"] under thumb pressure for a 1.5 m [5 ft] cable length (equivalent ratio for other cable lengths).
 - .1 Adjust the clearance at cable strap/spacer piece restraints to not exceed 6 mm [1/4"].
- .15 Provide transverse and axial restraints as close as practical to a vertical bend.
- .16 At steel trusses, connect to top chords and follow truss manufacturer's instructions.
- .3 Rigidly Floor Mounted Equipment
 - .1 Anchor all floor mounted equipment with anchor bolts, minimum four bolts for rectangular equipment bases, and three bolts for circular equipment bases.
 - .2 Provide resilient neoprene bushings and washers between equipment and anchor bolt.
- .4 Surface wall-mounted Equipment and Panels
 - .1 Select bolts for concurrent shear dead-weight without deduction for uplift load, and tension restraint load.
 - .2 In block wall;
 - .1 Up to three bolts, each bolt rated for 2.0 times estimated restraint load, or
 - .2 For four bolts or more, each bolt is rated for 1.0 times estimated concurrent load.
 - .3 In drywall;
 - .1 Minimum of four self-tapping screws drilled into the studs, with each screw rated for 1.0 times estimated restraint load.
- .5 Recessed wall-mounted Equipment and Panels
 - .1 Same as for surface mounted equipment, except fasten through top bottom and sides of panels to adjacent block wall or wall studs.

3.6 AIR TERMINALS

- .1 Where air terminals are installed in mechanical grid ceilings, provide at least two 12 ASWG galvanized steel wire seismic security bridles per air terminal tied either to the building structure or to ceiling hanger wires.
- .2 Attach security bridles at opposite corners of each air terminal and in such a manner that the air terminal cannot fall.
- .3 Provide all necessary brackets for attachment of security bridles to the air terminals.

3.7 RADIANT CEILING PANELS.

- .1 Provide 12 ASWG galvanized steel wire seismic security bridles from radiant ceiling panel cross brace to building structure or to ceiling hanger wires at maximum 1200 mm [48"] O.C.

3.8 FIELD QUALITY CONTROL

- .1 Testing - Anchors:
 - .1 Adhesive anchors and capsule anchors shall not be torque tested unless otherwise directed by the Contractor's Supporting Professional Seismic Engineer (Delegated Design).

- .2 If any of the tested anchors fail to achieve the specified torque or proof load all anchors shall be tested, unless otherwise instructed by the Contractor's Supporting Professional Seismic Engineer (Delegated Design).
- .3 Tension testing shall be performed in accordance with ASTM E488.
- .4 Torque shall be applied with a calibrated torque wrench.
- .5 Proof loads shall be applied with a calibrated hydraulic ram.
- .1 Displacement of adhesive and capsule anchors at proof load shall not exceed $D/10$, where D is the nominal anchor diameter.

3.9

MANUFACTURER'S SERVICES

- .1 Review design drawings and specifications, and shop drawings.
- .2 Provide design and selection of seismic restraints, and preparation of shop and installation drawings.
- .3 Provide training of contractor personnel for the installation of seismic restraints.
- .4 Conduct site inspections of the Work in progress, and to conduct a final inspection of the work.
- .5 Provide a copy of the final inspection report to the Consultant for review, including photographs of representative installations of each type of restraint used in the Work.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section provides General, Product, and Execution Requirements for Mechanical Systems Identification.
- .2 Provide painting, labelling, tagging and identification, for all mechanical systems and equipment as follows,
 - .1 General Requirements - Division 01
 - .2 Common Work for Mechanical Systems – Division 20
 - .3 Fire Suppression Systems - Division 21
 - .4 Plumbing Systems - Division 22
 - .5 Heating, Ventilation and Air Conditioning Systems - Division 23
 - .6 Controls and Instrumentation - Division 25

1.2 RELATED REQUIREMENTS

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.
- .2 In conjunction with Division 01, this Section is intended to apply to all work in Division 20, 21, 22, 23 and 25.
- .3 Refer to and comply with the following sections:
 - .1 General Requirements - Division 01
 - .2 Common Work for Mechanical Systems – Division 20
 - .3 Fire Suppression Systems - Division 21
 - .4 Plumbing Systems - Division 22
 - .5 Heating, Ventilation and Air Conditioning Systems - Division 23
 - .6 Controls and Instrumentation - Division 25
 - .7 Electrical - Division 26/27

1.3 APPLICABLE CODES AND STANDARDS

- .1 Refer to Section 20 05 01, Codes, Bylaws and Standards.
- .2 All equipment, materials, installation, and testing shall conform to the following standards as a minimum:
 - .1 Provincial Building Code
 - .2 Local Building By-Laws
 - .3 Provincial Safety Authority
 - .4 ASME A13.1, Scheme for the Identification of Piping Systems.
 - .5 CAN/CGSB-24.3, Identification of Piping Systems
 - .6 CAN/CGSB 1-GP-2, WHMIS Pictograms
 - .7 CAN/CSA-B149.1, Natural Gas & Propane Installation Code
 - .8 CAN/CGSB-1.60-M89 Interior Alkyd Gloss Enamel Paint
 - .9 Federal Standard 595C Paint Colors

1.4 **QUALITY ASSURANCE**

- .1 Refer to Section 20 05 00 General Mechanical Provisions, Quality Assurance for additional details.
- .2 Coordinate painting of piping and equipment with work of Division 09.

1.5 **SUBMITTALS**

- .1 Comply with Division 01 and Section 20 05 05 Documentation and Submittals.
- .2 Comply with Section 23 05 00 Common Work for HVAC Systems, Submittals
- .3 Comply with Section 22 05 00 Common Work for Plumbing Systems, Submittals
- .4 Refer to Section 20 99 60 Mechanical Forms and submit all documentation therein that is applicable to this Specification Section.
- .5 Shop Drawings
 - .1 Submit shop drawings in accordance with Division 01 and Section 20 05 05 Documentation and Submittals.
 - .2 Submit shop drawings for all equipment and materials
 - .3 Submit a schedule of pipe and equipment identification methods, materials, and colours to the Consultant's representative for review.
- .6 Identification Schedules
 - .1 Submit schedules of the following for review, prior to framing:
 - .1 Pipe Identification Colours.
 - .2 Valves.
 - .3 Ceiling Access Identification Colours.
 - .4 Duct Access Identification Colours.
- .7 Submit list of nameplates, with proposed wording, prior to engraving.

Part 2 Products

2.1 **GENERAL**

- .1 Manufactured identification systems:
 - .1 Laminated vinyl or polyester,
 - .2 Resistant to chemical, ultraviolet,
 - .3 Operating temperature: -25oC to 121oC [-12oF to 250oF]

2.2 **MANUFACTURER'S NAMEPLATES**

- .1 Each piece of manufactured equipment shall have a metal nameplate, with raised or recessed letters.
 - .1 Mechanically fasten plate to equipment.
- .2 Manufacturer's nameplates shall indicate manufacturer's name, equipment model, size, serial number and electrical characteristics and pertinent information for any other services connections.
- .3 Include ULC, (Underwriters' Laboratories Canada) or CSA, (Canadian Standards Association) registration logos and those of other agencies, as required by the respective agencies.

2.3 EQUIPMENT IDENTIFICATION NAMEPLATES

- .1 Identification plates are in addition to manufacturers plates.
- .2 Identification plates:
 - .1 Provided for equipment identified with number designations in schedules and equipment selection sheets.
 - .2 Marked with equipment ID, service and power source using wording and numbering used in contract documents, e.g. Supply Fan SF-1, Cooling Coil CC-1, Pump P-1
 - .3 Apply nameplates securely in conspicuous places, on cool surfaces.
 - .4 Identify systems, and areas or zones of building being serviced.
 - .5 Coordinate with any existing facility nameplates, as applicable.
- .3 Fabrication:
 - .1 Self-adhesive composite, laminated plastic,
 - .2 Black lettering on white background for "Normal" power equipment
 - .3 White lettering on red background for "Emergency" power equipment
 - .4 Minimum size 90mm x 40mm x 2.5mm [3" x 1½" x 1/8"],
 - .5 Engraving size:
 - .1 Use 25 mm [1"] high lettering for,
 - .1 All Major Equipment
 - .2 Air Terminal Boxes
 - .3 Magnetic Contactors and VFDs
 - .2 Use 10 mm [7/16"] high lettering for all other locations.

2.4 PIPING IDENTIFICATION

- .1 General
 - .1 Each piping system shall be colour coded for identification and labelled with:
 - .1 System identification code letters
 - .2 Directional flow arrows
 - .3 50mm [2"] wide identification colour bands for primary and secondary colours to indicate the type and degree of hazard in accordance with the pipe identification colour schedule.
 - .1 See diagram for sizes of lettering and bands.
 - .4 WHMIS Pictogram (as applicable), same colour as legend letters.
 - .5 50 mm wide black tape at each end of the label, wrapped around the entire circumference of pipe/insulation to secure the Identification Labels.
 - .2 Identification Labels may be accomplished by paint, stenciling and/or factory fabricated labels.
 - .1 Labels shall cover full circumference of pipe or insulation.
 - .3 Flexible coil-wrap manufactured markers:
 - .1 Plastic coated markers with integral printing, or plastic cover with field applied self-adhesive markers,
 - .4 Self-adhesive manufactured pipe markers, flow arrows and colour bands:
 - .1 Standard of Acceptance:

- .1 Brady vinyl cloth tape bands or Brady vinyl tape bands, with adhesive compatible with the surface temperature.
- .5 Colour band tape with flow direction arrows,
 - .1 Waterproof and heat resistant plastic marker tags for pipes and tubing 20mm [$\frac{3}{4}$ "] nominal and smaller.
- .6 Stenciled pipe markers:
 - .1 Stenciled letters and numbers:
 - .1 12 mm [$\frac{1}{2}$ "] high lettering on pipes 50mm [2"] and smaller
 - .2 25mm [1"] high for pipes 65mm [2.5"] and larger
 - .3 Indicating pipe service, pipe size and arrows showing direction of flow.
 - .2 Direction arrows:
 - .1 150mm [6"] long by 50mm [2"] wide for piping 75mm [3"] nominal or larger outside diameter including insulation,
 - .2 100mm [4"] long by 20mm [$\frac{3}{4}$ "] wide for smaller diameters.
 - .3 Applicable WHIMS pictogram for identification of material hazard
 - .3 Paint shall conform to CGSB-1.60-M89 Interior Alkyd Gloss Enamel.

2.5 VALVE IDENTIFICATION

- .1 Provide every valve job with a numbered tag showing valve type and size, attached to valve stem or wheel handle with nonferrous chain or S-hook.
 - .1 Valve identification is not required at the following valves:
 - .1 Fixture stops,
 - .2 Within sight of equipment or apparatus they control provided there is no branch piping between valve and equipment served.
 - .2 Tags shall be:
 - .1 Brass, aluminum, metal photo, Lamicoid or fiberglass
 - .2 Stamped or engraved
 - .3 40 mm [1.5"] minimum diameter, with 20 mm [$\frac{3}{4}$ "] lettering
 - .4 Attach to stem or wheel handle with nonferrous chain or S-hook
 - .3 Identification information:
 - .1 Indicating service, sequential valve number by service or specific equipment ID for control valves, location identifier, purpose of valve, valve type and size.
 - .2 Valve type designation:
 - .1 B (ball valve), GT (gate valve), GL (globe valve), CBV (circuit balancing valve), BF (butterfly valve).
 - .3 Valve size:
 - .1 For valve size, use NPS designation.
 - .4 Valve Directories:
 - .1 Laminated sheets plus digital "pdf" copy. Include the following information for each tagged valve:
 - .2 Valve identifier (valve number or logical point mnemonic)
 - .3 Location
 - .4 Service

- .5 Function
- .6 Size
- .7 Normal position
- .5 Submit three laminated copies of valve tag schedules, encased in clear plastic, bound in vinyl covered, hardbacked 210mm x 297mm [8½" x 11"] three ring binders.
- .6 Submit digital "pdf" copy of valve tag schedules.

2.6 DUCTWORK IDENTIFICATION

- .1 Paint stenciled letters 25mm [1"] high identifying,
 - .1 Duct service,
 - .2 Fan number, and
 - .3 Arrows showing direction of flow,

Part 3 Execution

3.1 PIPING IDENTIFICATION - GENERAL

- .1 Install markers on cleaned and prepared surfaces free of dirt and oil.
- .2 Provide manufactured tape markers:
 - .1 Self-adhesive type:
 - .1 Indoor uninsulated piping,
 - .2 Indoor insulated piping with PVC or smooth metal jackets,
 - .2 Flexible coil-wrap:
 - .1 Outdoor piping,
 - .2 Indoor insulated piping with canvas or embossed metal jackets.
- .3 Provide stencil markers:
 - .1 Paint stenciled letters and numbers, identification marks showing pipe service, pipe size and showing direction of flow.
 - .2 Paint flow direction arrows adjacent to each identification mark.
 - .3 Paint colour bands adjacent to each identification mark.
- .4 Locations:
 - .1 Identify piping (pipe markers and direction arrows) at the following locations:
 - .1 Adjacent to major valves and where valves are in series at no more than 2 m [6.5 ft] intervals.
 - .2 At least once in each room and at 15 m [50 ft.] maximum spacing in open areas.
 - .3 Maximum every 15 m [50 ft] along length of pipe, except for natural gas.
 - .4 Adjacent to all major changes in direction.
 - .5 At point of entry and leaving each pipe chase and/or confined space and piping accessible at each access opening.
 - .6 At the beginning and end points of each run; and, at each piece of equipment in each run.
 - .7 Maximum every 6 m [20 ft] along length of pipe for natural gas.
 - .8 Within 1 m [3 ft] of each side of barriers, floors, and walls,

- .9 Within 1 m [3 ft] of and behind access doors,
- .10 Within 1 m [3ft] of piping termination point.
- .5 Provide schedules in each major mechanical room and at least one schedule will be required on each floor having a minor mechanical room.
 - .1 Frame schedules under glass in matching frames and hang where directed.
 - .2 Include one copy of schedules in each operating and maintenance manual.

3.2 VALVE IDENTIFICATION

- .1 Provide valves with a numbered tag showing valve type and size, attached to valve stem or wheel handle with nonferrous chain or S-hook.
- .2 Valves to be tagged include:
 - .1 Valves on all main piping circuits.
 - .2 Valves on all major branch lines.
 - .3 Valves on minor branch lines in horizontal service spaces, vertical service spaces and mechanical equipment rooms.
 - .4 Drain valves and hose bibbs on systems containing glycol.
- .3 Prepare flow diagrams for each system showing pumps, heat transfer equipment, schematic piping and tagged valves.
- .4 Provide a tag schedule for each system, designating number, service, function, size, and location of each tagged item and normal operating position of each valve.
- .5 Schedule the valve numbers using a sequential numbering system indicating location, service, and normal position (open or closed).
 - .1 Numbers shall be prefixed by the letter "P" or the letter "H" indicating that the valve is on plumbing or heating service.
- .6 Submit two copies of valve tag schedules, encased in clear plastic, bound in vinyl covered, hardbacked 210mm x 297mm [8½" x 11" in] three ring binders.

3.3 DUCTWORK IDENTIFICATION

- .1 Identify plenum access doors as to accessed items, e.g., Filter F-1, Supply Fan SF-1, Cooling Coil CC-1.
- .2 Stencil on all plenum doors, downstream from air filter bank, "Do Not Open When Fan Operating".
- .3 Identify automatic control dampers concealed in ductwork.
 - .1 Identify the "open" and "closed" position of the operator arm on the outside of the duct or duct insulation.

3.4 CEILING ACCESS IDENTIFICATION

- .1 Secure 6 mm [1/4"] self-adhesive coloured dots, (Brady Quik Dots or Avery Data Dots), to the ceiling, to identify the location of access to equipment concealed above the ceiling according to the following schedule:
 - .1 Concealed equipment and cleaning access – Yellow
 - .2 Control equipment, including control valves, dampers, and sensors – Black
 - .3 Fire and smoke dampers – Red
 - .4 Fire protection including sprinkler equipment including drains – Red
 - .5 DCW, DHW isolation valves – Green

- .6 Pipe mounted equipment, other than fire, smoke, and sprinkler equipment - Green
- .2 When T-bar ceilings are installed adhere coloured dots to T-bar framing, adjacent to panel to be removed.

3.5 DUCT ACCESS PANEL IDENTIFICATION

- .1 Provide identification for all duct access panels.
 - .1 Paint access panels.
 - .2 Stencil paint lettering, minimum 50mm [2"] high.
 - .3 Conform to the following schedule for background colour / text colour / text tag:
 - .1 Cleaning and service access – yellow / black / CA
 - .2 Controls, including sensors – black / white / C
 - .3 Dampers (backdraft, balance, and control) - blue / white / D
 - .4 Fire dampers – red / white / FD
 - .5 Smoke dampers – red / white / SD
 - .6 Combination Fire/Smoke dampers – red / white / FSD
 - .7 Smoke detectors - red / white / SMD

3.6 EQUIPMENT IDENTIFICATION

- .1 Secure engraved laminated plastic identification tags (black face and white text) on the following items:
 - .1 Temperature control instruments, gauges, and panels, coordinated with control diagrams identification.
 - .2 Electrical switchgear, VSD's, harmonic filters, load/line reactors, etc., supplied under Divisions 20, 21, 22, 23, and 25.
 - .3 Refer also to Division 25 Controls and Instrumentation.

3.7 IDENTIFICATION SCHEDULES

- .1 Submit schedules of the following for review, prior to framing:
 - .1 Pipe Identification Colours.
 - .2 Valves.
 - .3 Ceiling Access Identification Colours.
 - .4 Duct Access Identification Colours.
- .2 Schedules will be required in each major mechanical room and at least one schedule will be required on each floor having a minor mechanical room.
 - .1 Frame schedules under glass in matching frames and hang where directed.
 - .2 Include one copy of schedules in each operating and maintenance manual.

3.8 PIPE IDENTIFICATION COLOURS

- .1 Colour numbers for Identification Labels on piping systems, valves and equipment are defined in Federal Standard 595C Colours for colour code identification.
 - .1 Safety Yellow - 13591
 - .2 Safety Red - 11120
 - .3 Safety Orange - 12300
 - .4 Safety Blue - 15102

- .5 Safety Green - 14120
- .6 Safety Purple - 17155
- .7 Black - 17038
- .8 White - 17860
- .9 Brown - 10115
- .10 Aluminum - 16515
- .11 Gray - 16293
- .12 Light Blue - 15450
- .2 Pipe Identification Label - Background Colour/Lettering Colour/Symbol/Legend Schedule:
 - .1 Flammables and Oxidizers:
 - .1 Yellow label with Black lettering, with applicable WHMIS Pictogram, flow direction arrow, and applicable temperature/pressure.
 - .1 Natural Gas and Propane
 - .2 High Temperature Fluids and Gases:
 - .1 Yellow label with Black lettering, with applicable WHMIS Pictogram, flow direction arrow, and applicable temperature/pressure.
 - .1 Domestic Hot Water and Recirculation
 - .3 Low Temperature Fluids:
 - .1 Green label with White lettering, with flow direction arrow and applicable temperature.
 - .1 Domestic Cold Water
 - .4 Compressed Air, Non-Hazardous Gases:
 - .1 Blue label with White lettering, with flow direction arrow and applicable pressure.
 - .5 Fire Suppression Systems:
 - .1 Red label with White lettering, with flow direction arrow and applicable pressure.
- .3 Ductwork:
 - .1 Identify all ductwork with identification labels services as follows, complete with directional arrows:
 - .2 Return Air
 - .1 Background / Lettering Colour: blue / white, WHMIS Symbol: n/a, Legend: RETURN AIR
 - .3 Supply Air
 - .1 Background / Lettering Colour: blue / white, WHMIS Symbol: n/a, Legend: SUPPLY AIR
 - .4 General Exhaust Air
 - .1 Background / Lettering Colour: blue / white, WHMIS Symbol: n/a, Legend: GENERAL EXHAUST AIR
 - .5 Washroom Exhaust
 - .1 Background / Lettering Colour: blue / white, WHMIS Symbol: n/a, Legend: W.R. EXHAUST AIR

3.9 LOCATION OF LABELS

- .1 Orient labels on piping systems in visual sight lines while standing at floor levels.
- .2 Locate labels as follows:
 - .1 Upstream of valves.
 - .2 Adjacent to changes in direction.
 - .3 Branches.
 - .4 Where pipes pass through walls or floors.
 - .5 On straight pipe runs at 6 m [20'] intervals.
 - .6 For natural gas piping systems, at 6 m [20'] intervals on straight pipe runs.
 - .7 Where system is installed in pipe chases, ceiling spaces, shafts, or similar confined spaces, at entry and exit points and at access openings.
 - .8 At beginning and end points of each run and at each piece of equipment.
- .3 Adhere labels to piping/insulation.
 - .1 Labels to cover entire pipe circumference.
 - .2 Secure both ends of labels with 50 mm [2"] wide black tape around the entire pipe circumference.

3.10 VISIBLE (EXPOSED) DUCTWORK

- .1 Paint visible ductwork as directed by Architect.
 - .1 Refer to Division 09.
- .2 Paint ductwork/flexible connectors that are visible behind grilles/diffusers, matt black.
 - .1 Refer to Division 09.

3.11 ABANDONED PIPING:

- .1 Piping that has been abandoned in place shall be identified.
- .2 The recommended color scheme is safety white background with black letters.
- .3 A black border shall be added to the identification.
- .4 When the abandoned piping is protected from corrosion by the addition of a pressurized fluid or contains residual hazardous material, the legend should indicate that.

3.12 MECHANICAL CONTROLS IDENTIFICATION:

- .1 Refer to Section 25 05 00, Common Work for Control Systems

3.13 RECORD PROVISIONS

- .1 Mark valve numbers on Red Line system schematic drawings for transfer onto record drawings. Include copies in O&M Manuals.

3.14 VALVE TAGS

- .1 Tag pneumatic/electric controls, instruments, and relays. Key to control schematics on which instruments are numbered in sequence.
- .2 Tag all valves in mechanical rooms.
- .3 Tag all circuit balancing and isolating valves external to mechanical rooms except valves at terminal heating and cooling equipment.

3.15 VALVE DIRECTORIES

- .1 Include laminated directories in operation and maintenance manuals.
 - .1 Provide electronic copy in PDF, as well as spreadsheet user editable format.
- .2 Provide the following information on the valve schedule:
 - .1 Valve number
 - .2 Service
 - .3 Equipment that valve is servicing
 - .4 Size
 - .5 Reference drawing number
 - .6 Location of the valve on the drawing, referencing grid line locations

3.16 NAMEPLATES

- .1 Identify the following with engraved plastic nameplates:
 - .1 All mechanical equipment.
 - .2 Electric starting switches, electric disconnects, remote push buttons and control panels.
- .2 Nameplates shall be located so that they are easily read. Do not insulate or paint over nameplates.
- .3 All nameplates to be mechanically fastened, easily visible without need to use ladder or extraordinary body position.
 - .1 Affix additional nameplates if necessary.
- .4 Provide the Consultant with an example of the contents of each type of nameplate.
 - .1 Obtain approval prior to engraving.
- .5 Identification plates are in addition to manufacturers plates.
- .6 Apply nameplates securely in conspicuous places, on cool surfaces.
- .7 Identify systems, and areas or zones of building being serviced.
- .8 Coordinate with any existing facility nameplates, as applicable.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section provides guidance and requirements for testing, balancing, and adjusting of mechanical systems as described herein.
- .2 Balance, adjust, and test air, liquid, and equipment systems, and submit reports using identical units to those shown on contract documents.
- .3 Employ an approved independent testing and balancing agency to test and balance the following systems.
 - .1 Air Systems
 - .1 Supply air systems
 - .2 Return air systems
 - .3 Exhaust air systems
 - .2 Plumbing Systems
 - .1 Domestic hot water recirculation systems

1.2 RELATED REQUIREMENTS

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.
- .2 In conjunction with Division 01, this Section is intended to apply to all work in Division 20, 21, 22, 23 and 25.
- .3 Refer to and comply with the following sections:
 - .1 General Requirements - Division 01
 - .2 Common Work for Mechanical Systems – Division 20
 - .3 Fire Suppression Systems - Division 21
 - .4 Plumbing Systems - Division 22
 - .5 Heating, Ventilation and Air Conditioning Systems - Division 23
 - .6 Controls and Instrumentation - Division 25

1.3 APPLICABLE CODES AND STANDARDS

- .1 Refer to Section 20 05 01, Codes, Bylaws and Standards.
- .2 All installation, execution, and testing shall conform to the following standards as a minimum:
 - .1 Procedures shall be in accordance with AABC'S National Standards for Field Measurement and Instrumentation.
 - .2 Balancing procedures shall be in accordance with SMACNA and ASHRAE Standards.

1.4 QUALITY ASSURANCE

- .1 Refer to Section 20 05 00 General Mechanical Provisions, Quality Assurance for additional details.
- .2 The Agency shall be responsible to the Contractor but report jointly to the Consultant and the Contractor.
 - .1 Report in writing to the Consultant any lack of cooperation and any discrepancies or items not installed in accordance with the contract documents.

- .3 Work specified in this section shall be performed by an Independent Agency specializing in this type of work.
- .4 Balancing (of both air and liquid systems) and sound level readings shall be performed by the same agency.
- .5 The Testing, Balancing and Adjusting (TAB) Contractor must be a member in good standing with the National Environmental Balancing Bureau (NEBB) or the Associated Air Balance Council.
- .6 Prior to finalizing contractual arrangements with the balancing agency, submit the names, qualifications and years of direct field testing and balancing experience in the testing and balancing field for all members of the balancing team that is scheduled to carry out the balancing work.
 - .1 The senior site technologist must have a minimum of five years testing and balancing experience of similar projects.
 - .2 Provide a list of a minimum of ten comparable projects successfully completed by all key members of the balancing team.
- .7 During the one-year warranty period, the Owner may request re-check or re-setting of outlets or fans as listed in the test report. Provide technicians and equipment required during visits for seasonal adjustments.

1.5 SUBMITTALS

- .1 Comply with Division 01 and Section 20 05 05 Documentation and Submittals.
- .2 Balance Report - Preliminary
 - .1 Submit a draft outline for the balancing report (less field data) sixty (60) days after award of contract.
 - .2 Submit report in digital format.
 - .3 Submit a draft copy of rough balancing report sixty (60) days prior to final acceptance of project.
- .3 Balancing Agenda
 - .1 Submit balancing agenda to the Consultant and Commissioning Agency for review at least sixty (60) days prior to the start of balancing work.
- .4 Balance Report - Final
 - .1 Submit a copy of the final balancing report to the consultant for review prior to the date of Substantial Performance/Substantial Completion for review and comment.
 - .2 Provide a PDF format file and four (4) hard copies of final reports to the Contractor for inserting in the Owner's Operating and Maintenance Manuals as described in Section 20 05 05, Documentation and Submittals.
- .5 Occupancy Documentation Requirements
 - .1 Refer to Division 01 and Section 20 05 05 Documentation and Submittals.

1.6 PRE-APPROVED BALANCING AGENCIES

- .1 Refer to Section 20 99 66 for approved Balancing Agencies.
- .2 Other Balancing Agencies must be pre-approved via Addendum prior to RFP close.
 - .1 For options or alternatives, refer to Section 20 05 00, Addition of Acceptable Sub-trades.

1.7 SITE VISITS

- .1 Prior to the Testing and Balancing (TAB) Contractor executing his work, a minimum of six (6) site visits shall be made to correspond with the general monthly site meetings held by the Contractor.
 - .1 After each site visit, a written report shall be submitted to the Contractor and the Consultant.
 - .2 Site visits shall commence after the start of air and liquid distribution system work and shall be spread over the construction period to the start of the balancing work.
 - .3 The written reports shall include a review of the installation.
 - .4 Access to all valves, dampers, and equipment shall be made at the specified site visits
 - .5 Any additional dampers or valves required for proper balancing shall be forwarded in writing to be reviewed by the Consultant.
- .2 Begin balancing after equipment start-up and testing, and after systems have been completed and are in full working order.
 - .1 Place systems and equipment into full operation and continue operation during each working day of balancing.
- .3 Allow for a minimum of six (6) visits of two (2) days to site to adjust systems for seasonal changes during the warranty period.
 - .1 Coordinate time of visits with the Owner.
 - .2 Submit reports to the Consultant.

Part 2 Products

2.1 INSTRUMENTS

- .1 Provide all required tools, equipment, and instruments.
- .2 Provide calibration histories for each instrument.
 - .1 Recalibration or use of other instruments may be requested when accuracy of readings is questionable.

Part 3 Execution

3.1 TESTING AND BALANCING - GENERAL

- .1 The Balancing Agency shall be responsible to the Contractor but report jointly to the Consultant and the Contractor.
 - .1 The Balancing Agency shall report in writing to the Consultant any lack of cooperation and any discrepancies or items not installed in accordance with the Contract Documents.
- .2 The Balancing Agency shall agree to perform spot checks, where requested, in the presence of the Consultant's designated representative.
- .3 The Contractor shall work with the Balancing Agency to:
 - .1 Ensure all mechanical systems are complete and ready to be balanced and provide enough time for testing and balancing prior to Substantial Performance.

- .2 Make corrections to achieve system balance without delay, include all corrections made during the balancing procedure on "As Built" Drawings.
 - .1 Mechanical Contractor shall provide "As Built" information to the Balancing Agency before balancing commences.
- .3 Adjust fan drives, change blade pitch angles, and change sheaves and belts as directed by the agency.
- .4 Maintain all systems in full operation during the complete testing and balancing period.
- .5 Employ control technicians to adjust the control systems as required to facilitate the balancing process.
- .6 Employ the journeyman millwright to check the alignment of any V-belt drives and/or shaft coupling drives if they have been adjusted during the balancing process.
 - .1 Belt tension correctness to be verified.
- .4 Consult with the Consultant to clarify the design intent where necessary or if there are any problems foreseen as the balancing processes.
- .5 Accuracy:
 - .1 Balance to maximum flow deviation of 10% at terminal device and to 5% at equipment.
 - .2 Measurements to be accurate to within plus or minus 5% of actual values.
- .6 The Balancing Agency shall remove and re-install ceiling tile to provide access to ductwork and piping.
 - .1 The Balancing Agency will make good any damage or soiling caused by his forces.
- .7 Instrument calibration:
 - .1 At the Consultants request, the Balancing Agency shall submit a dated calibration chart for all instruments.
- .8 Permanently mark final settings on valves, dampers, and other adjustment devices. Set and lock all memory stop balancing devices.
- .9 Seal all holes with snap plugs or approved alternate method, used for flow and pressure measurements.
- .10 The Controls Contractor and Balancing Agency are to allow for checking and adjusting during the 12-month warranty period, when weather conditions provide natural loads and in cases where complaints arise.
- .11 Submit a draft balance report to the Consultant for approval and submit approved copies to the Balancing Agency preparing the O & M manuals for inclusion in each operating and maintenance manual.
 - .1 Provide field notes in the balancing report to clearly identify unusual conditions, problem areas and report on any cases where the specified flow rates or conditions could not be achieved by adjustment.
 - .2 Identify outstanding problems that cannot be corrected by the balancing team or that will not be corrected by the installing trades (e.g., in cases where additional balancing dampers are required).
- .12 Submit a statutory declaration to the Consultant, certifying that the testing and balancing 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.
 - .1 Follow-up testing, after correction of faults and omissions has been completed and recorded.

- .2 Form MF170 in Section 20 99 60 should be used for this purpose.
- .3 Reports shall be signed by the senior member of the balancing team.

3.2 TESTS - FIRE DAMPER / FIRE STOP FLAPS

- .1 Employ the Balancing Agency to test all fire dampers as follows:
 - .1 Inspect all fire damper blades and tracks prior to test firing. Sheet metal trade to clean all dirty dampers and tracks to satisfaction of balancer.
 - .2 Test all fire dampers (including combination smoke/fire dampers). The test shall be made by releasing the fusible link and witnessing closure of the damper.
 - .1 All fire dampers shall be left in the open position.
 - .3 A set of prints shall be marked up to show that each damper has checked for closure, accessibility and installation or provide schematic mechanical drawing showing all fire damper locations, label all fire dampers on drawing and reference to form MF172 in Section 20 99 60.
 - .1 The prints shall be certified correct by the agency and submitted to the consultant with completed test certificate MF172.
- .2 Visually inspect all fire dampers and fire stop flaps:
 - .1 Installation is straight
 - .2 Wall angles properly installed
 - .3 Duct has breakaway connection
 - .4 Fire stopping material where used is properly installed
 - .5 Adequate access
 - .6 Clearance between sleeve and wall
- .3 Manually remove each fusible link to ensure damper blade drops properly, then reset damper. Mark dropped fire damper with black felt marker.
- .4 Testing of 10% of the fusible links shall be performed with a suitable heat source capable of generating sufficient heat to detonate fusible link without burning or generating carbon deposits on the blades, frame, or adjacent ductwork.
 - .1 Selection of links to be test dropped to be as directed by Consultant.
 - .2 Retesting and resetting shall be witnessed by the Consultant.
- .5 If fire damper does not close properly, sheet metal trade to repair installation and Balancing Agency to retest.
- .6 Submit written confirmation that all fire damper tests are certified by the Contractor and witnessed by the Commissioning Agent.

3.3 BALANCING - GENERAL

- .1 Permanently mark, by stick-on labels and/or fluorescent paint, settings on valves, splitters, dampers, and other adjustment devices.
- .2 After correctional work, take measurements to verify balance has not been disrupted or that any such disruption has been rectified.
- .3 Where vane anemometer is used to measure supply, return, or exhaust air grilles, AK factors shall be determined as follows:
 - .1 Determine and tabulate similar sized grilles being balanced for AK schedule.
 - .2 Traverse all ducts serving grilles (outlined in AK schedule) to verify AK factors.

- .3 AK factor from schedule, must be approved by the Consultant during initial review with balancer on site. (Balancing Agency shall include written procedure for determination of AK factors.)
- .4 No-flow hoods are to be used for measurement of exhaust or return air grilles.
- .4 Balancing shall be performed to the following accuracies:
 - .1 Air - terminal outlets: $\pm 10\%$ (outlets less than 200 L/s [425 cfm])
 - .2 Air - terminal outlets: $\pm 5\%$ (outlets greater than 200 L/s [425 cfm])
 - .3 Air - central equipment: $\pm 5\%$
- .5 Balancing Agency shall advise Mechanical Contractor of required revised pulleys, sheaves, and impeller shavings to allow proper balancing of systems (Refer to Section 20 05 12, Coordination with Balancing Agency.)

3.4 BALANCING AGENDA

- .1 General: Submit balancing agenda to the Consultant and Commissioning Agency for review at least [sixty (60) days] prior to the start of balancing work.
 - .1 Start balancing work only after agenda has been approved.
 - .2 Include descriptive data, procedure data and sample forms in agenda.
- .2 Descriptive Data: General description of each system including associated equipment and different operation cycles, listing of flow and terminal measurements to be performed [and selection points for proposed sound measurements].
- .3 Procedure Data: Procedures for converting test measurements to establish compliance with requirements, specify type of instrument to be used, method of instrument application (by sketch) and correction factors.
- .4 Sample Forms: Form showing application of procedures to typical systems.

3.5 BALANCING - AIR SYSTEMS

- .1 All Areas:
 - .1 Perform balancing, adjusting, and testing with building doors and windows in their normal operation position.
 - .2 The following procedure shall be adopted for central systems:
 - .1 Ensure dampers or volume control devices are in fully open position.
 - .2 Balance central apparatus to $\pm 5\%$ air flow.
 - .3 Balance branches and mains in accordance with 3.1.4.
 - .4 Recheck central apparatus.
 - .5 Balance all terminal air outlets in accordance with 3.1.4.
 - .6 Re-balance central apparatus to $\pm 5\%$.
 - .7 Re-check all air outlets.
 - .8 Perform acoustical measurements.
 - .3 When balancing air outlets:
 - .1 Rough balance furthest outlets and then balance sequentially back to source.
 - .2 Fine balance furthest outlet back to source.
 - .4 Make air quantity measurements in ducts by "Pitot Tube" traverse of entire cross-sectional area.
 - .1 Take minimum of 16 for rectangular ducts, and 10 on each vertical and horizontal axis for round ducts, traverse readings.

- .2 If readings are inconsistent across duct obtain straight run of six (6) diameters widths upstream and redo traverse.
- .5 Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels.
 - .1 Effect volume control only by duct mounted balancing dampers.
- .6 Vary total system air quantities by adjustment of fan speeds. Vary branch air quantities by balancing damper regulation.
- .7 Complete balancing to achieve positive building pressure unless otherwise instructed.
 - .1 A positive pressure relative to outside of 10 Pa [0.04"wc] minimum and 20 Pa [0.08"wc] maximum shall be achieved, measured with negligible outside wind velocity.

3.6 BALANCING AND ADJUSTING OF DOMESTIC WATER SYSTEMS

- .1 Balance domestic hot water recirculating system piping to ensure flow from all points in the system. Ensure all hot and cold supply shutoff valves are fully open.

3.7 BALANCE REPORT

- .1 Refer to "Submittals" above.
- .2 Report shall be indexed as follows:
 - .1 Air:
 - .1 Summary
 - .2 Procedure
 - .3 Instrumentation
 - .4 Drawings
 - .5 Equipment Summary
 - .6 Fan Sheets
 - .7 Traverse Data and Schedule
 - .8 Outlet Data Summary and Schematics (per system)
 - .9 Building Schematic
 - .10 Weather Conditions at Time of Test
 - .11 Diagnostic
 - .2 Liquid:
 - .1 Summary
 - .2 Procedure
 - .3 Instrumentation
 - .4 Drawings

3.8 SYSTEM DATA

- .1 Refer to Section 20 05 08 Equipment Testing and Start-up.
- .2 Air Handling Equipment:
 - .1 Design Data:
 - .1 Total air flow rate
 - .2 Fan total static pressure
 - .3 External static pressure

- .4 System static pressure
- .5 Motor kW [HP], r/min, amps, volts, phase
- .6 Outside air flow rate L/s [cfm]
- .7 Inlet and outlet, dry and wet bulb temperatures
- .2 Installation Data:
 - .1 Manufacturer, model, and size.
 - .2 Arrangement discharge and class
 - .3 Motor type, kW [HP], r/min, voltage, phase, cycles, and load amperage
 - .4 Location and local identification data
- .3 Air Inlet and Outlets
 - .1 Outlet identification location and designation
 - .2 Design and recorded velocities
 - .3 Design and recorded air flow rates
 - .4 Deflector vane or diffuser cone settings

END OF SECTION

Part 1 Mechanical Forms

NOTES

- .1 The Mechanical Forms in this section are suggestions for content and structure.
- .2 The Contractor shall create their own Mechanical Forms on Company Letterhead, and complete and sign-off as applicable.
- .3 Submit as required in this Section and as indicated in other sections of the Specification.

MF 100 CHECK LIST - SUBMISSIONS TO CONSULTANT

ITEM	CHECKED BY	DATE
10 WORKING DAYS BEFORE CLOSE OF SUBTRADE TENDER – Request for addition of acceptable manufacturers		
10 DAYS AFTER AWARD OF THE CONTRACT – List of equipment suppliers and subtrades – Detailed price breakdown (MF 120, 121, 122)		
A.S.A.P. – Product & Fabrication samples (MF 131) – Shop Drawings		
WITH EACH APPLICATION FOR PROGRESS PAYMENT – Price breakdown (MF 120, 121, 122)		
PRIOR TO CLOSING IN CEILINGS & SHAFTS – Duct and pipe test data – Piping Test Data (MF 141)		
PRIOR TO STARTING SYSTEMS – Checklists for start-up (MF 151, 152, 153)		
PRIOR TO COMMISSIONING SYSTEMS – Checklists for operation (MF 151, 152, 153) – Commissioning schedule		
PRIOR TO DEMONSTRATION OF SYSTEMS – Demonstration agenda		
10 DAYS PRIOR TO SUBSTANTIAL PERFORMANCE INSPECTION – Submission of items listed on Form MF-188		
WHEN REQUESTING INSPECTION OF OUTSTANDING WORK – Certificate of total completion (MF 192) – Checklist of work remaining (MF 191) – Checklists of Demonstrations (MF 181, 182, 183)		

MF 120 PROGRESS CLAIM SUMMARY - MECHANICAL SUMMARY

	CLAIM NO:
	FOR MONTH OF:

ITEM	PRICE		WORK TO DATE		PREVIOUS WORK		THIS MONTH	
	\$	%	\$	%	\$	%	\$	
Base Contract Summary								
- Div. 21 Fire Protection								
- Div. 22 Plumbing								
- Div. 23 HVAC								
- Div. 25 Controls								
- Cash Allowances								
Total Base Contract								
Change Order Summary								
Total Change Orders								
Total Contract:								
Amount due less 10% lien holdback								

NOTES:
 Submit this form as called for on MF 100 for tender price breakdown and for each progress claim.

MF 121 DETAILED PRICE BREAKDOWN - DIV. 21

		CLAIM NO:	
		FOR MONTH OF:	

ITEM		PRICE		WORK TO DATE		PREVIOUS WORK		THIS MONTH	
		\$	%	\$	%	\$	%	\$	%
Plumbing									
Fire Pumps	Matl. Lab.								
Clean Agent Systems	Matl. Lab.								
Pipe & Fittings Rough-in	Matl. Lab.								
Fittings & Heads - finishing	Matl. Lab.								
TOTAL									

NOTES:

- .1 Submit this form as called for on MF 100 for tender price breakdown and with each progress claim.
- .2 Submit a separate form for each item listed on MF 120.

MF 122 DETAILED PRICE BREAKDOWN - DIV. 22

		CLAIM NO:			
		FOR MONTH OF:			

ITEM		PRICE		WORK TO DATE		PREVIOUS WORK		THIS MONTH	
		\$	%	\$	%	\$	%	\$	
Plumbing									
Sanitary & Storm Drainage	Matl. Lab.								
Domestic Water	Matl. Lab.								
Fixtures & Equipment	Matl. Lab.								
Plumbing Insulation	Matl. Lab.								
Medical Gas	Matl. Lab.								
Outside Services	Matl. Lab.								
TOTAL									

NOTES:

- .1 Submit this form as called for on MF 100 for tender price breakdown and with each progress claim.
- .2 Submit a separate form for each item listed on MF 120.

MF 123 DETAILED PRICE BREAKDOWN - DIV. 23

	CLAIM NO:
	FOR MONTH OF:

ITEM		PRICE		WORK TO DATE		PREVIOUS WORK		THIS MONTH	
		\$	%	\$	%	\$	%	\$	%
Mechanical									
Mobilization & Permits									
Air Handling Equipment	Matl. Lab.								
HVAC Piping & Equipment:	Matl. Lab.								
Insulation – Piping & Equipment	Matl. Lab.								
SUBTOTAL									
Sheet Metal									
Air Terminal & Access.	Matl. Lab.								
Ductwork	Matl. Lab.								
Insulation – Ductwork	Matl. Lab.								
SUBTOTAL									
Refrigeration									
SUBTOTAL									
Finishing									
Duct Cleaning:	Lab.								
Testing & Balancing	Lab.								
Comm. & Demonstration Maintenance Manuals									
SUBTOTAL									
TOTAL									

NOTES:

- .1 Submit this form as called for on MF 100 for tender price breakdown and with each progress claim.
- .2 Submit a separate form for each item listed on MF 120.

MF 125 DETAILED PRICE BREAKDOWN - DIV. 25

		CLAIM NO:	
		FOR MONTH OF:	

ITEM		PRICE		WORK TO DATE		PREVIOUS WORK		THIS MONTH	
		\$	%	\$	%	\$	%	\$	
Panels, Devices & Controllers	Matl. Lab.								
Conduit, Cabling & Wiring	Matl. Lab.								
Control Dampers	Matl. Lab.								
Control Valves	Matl. Lab.								
Software & Graphics									
TOTAL									

NOTES:

- .1 Submit this form as called for on MF 100 for tender price breakdown and with each progress claim.
- .2 Submit a separate form for each item listed on MF 120.

MF 141 - PIPING TEST DATA

System: _____		
(e.g. Heat pump loop water piping, Heating water piping, Chilled water piping, Condenser water piping, Steam piping, Boiler and boiler room piping, Domestic water piping main, Fire protection piping)		
Date: _____	Time: _____	AM/PM: _____
Section of System Tested: _____		
Pressure at start of Test: _____ kPa [psig]	TEST: Length: _____ hrs Medium: water /air / nitrogen	Pressure at end of Test: _____ kPa [psig]
Test Performed by:		
Name: _____	Signature: _____	Company: _____
Test witnessed at start:		
Name: _____	Signature: _____	Company: _____
Test witnessed at end:		
Name: _____	Signature: _____	Company: _____
Remedial Work / Comments:		

MF 151 CHECK LIST - START-UP OF AIR SYSTEMS

System: _____

ITEM	CHECKED BY	DATE
<u>Prior To Start-Up</u> Safety Controls Installed & Operational Control And Smoke Dampers Operational Permanent Electrical Connections Made Fan Drives Aligned By Millwright Fan Rooms & Plenums Vacuum Cleaned Equipment Lubricated Building Swept & Clear Of Dust All Filters Installed Operating & Maintenance Data Available		
<u>During Start-Up</u> Qualified Operator In Charge Supply Ducts Blown Out Using Fans R.A. & Exhaust Ducts Blown Out Using Fans		
<u>During Subsequent Operation</u> Qualified Operator In Charge Ensure That The Building Has Remained Clean Equipment Maintained Lubrication Maintained & Logged		

NOTES:

- .1 This is a brief checklist and does not cover all procedures, which may be advisable in a particular case. Additional information is available from equipment suppliers.
- .2 Prior to starting or operating each system complete the appropriate section of this form and submit it to the Consultant.
- .3 Submit completed copies of this form for each system with the certificate of substantial performance.

MF 170 CERTIFICATE OF TESTING AND BALANCING

I hereby declare that I _____

I am an employee/a principal of _____

And certify that the testing and balancing procedures specified under Division 21, 22, 23 and 25 have been satisfactorily completed and I hereby certify that complete factual reports have been distributed.

SIGNED _____ DATE _____

NOTES:

- .1 This certificate must be submitted prior to substantial performance.

MF 171 CERTIFICATE OF DUCT CLEANLINESS

I hereby certify that I _____

I am an employee/a principal of _____

And have personally witnessed that the following duct systems have been vacuumed as necessary, are now clean and have been resealed with access panels in place at all cleaning openings in the ductwork.

FAN NO. SYSTEM DESCRIPTION

SIGNED _____ DATE _____

NOTES:

- .1 This certificate must be submitted prior to substantial performance.

MF 172 CERTIFICATE OF FIRE DAMPER INSPECTION

I hereby certify that I _____
am an employee/a principal of _____

And that all fire dampers have been tested by removing the fusible link and witnessing closure of the damper.

SIGNED _____ DATE _____

- Contract drawings supplied by: _____
- Latest addendum number or date of plans used: _____

NOTES:

1. This certificate must be submitted prior to substantial performance.

MF 173 CERTIFICATE OF FIRE STOPPING

I hereby certify that I _____
am an employee of _____

And have personally witnessed that all mechanical (HVAC & Plumbing) service penetrations through fire separations (rated & non-rated) and sound separations in the following areas have been properly sealed in accordance with the specified requirements.

AREA	SIGNED	DATE
Level:		
Level:		
Level:		
Level:		
Level:		
Level:		
Level:		
Level:		
Level:		

NOTES:

- .1 This certificate must be submitted prior to substantial performance.

MF 174 CERTIFICATE OF SEISMIC RESTRAINTS

I hereby declare that I _____
am an employee/a principal of _____

And certify that the seismic restraint of all mechanical equipment, piping and ductwork specified under Division 21, 22, 23 and 25 has been satisfactorily completed and that the installation meets the requirements of the Ontario Building Code as it relates to seismic restraint.

SIGNED _____ DATE _____

NOTES:

- .1 This certificate must be submitted prior to substantial performance.

MF 175 CERTIFICATE OF VIBRATION ISOLATION

I hereby declare that I _____
am an employee/a principal of _____

And certify that the vibration isolation installation specified under Division 20, 21, 22, 23 and 25 has been satisfactorily completed.

SIGNED _____ DATE _____

NOTES:

- .1 This certificate must be submitted prior to substantial performance.

MF 180 CHECK LIST - ITEMS TO BE HANDED TO OWNER

ITEM	RECEIVED	DATE
C.O. System Portable Calibration Kit		
Chemical Test Kit		
Control Drawings (Framed/Plasticized)		
Fan Belts – Spare Sets		
Filters - Spare Sets (Panel and Final)		
Glycol (enough to fill mixing tank when mixed)		
Hydrometer & Specific Gravity Chart		
Identification Schedule (Framed)		
Maintenance Program (Schedules & Cards)		
Rated Access Door Keys		
Salvaged Materials (Attach List)		
Spare Chemicals		
Sprinkler Heads & Cabinet		
Test Thermometer		
Thermostat Keys		
Valve List (Framed)		
Water Cooler Spare Filters		
Water flow meter for liquid flow measuring devices		
Differential Pressure Meter for Circuit Setting Balance Valves		
P/T Plug Master Test Kit		

NOTES:

- 1 Copies of this form to be submitted to the Consultant and the Contracting Authority with all items signed off prior to substantial performance.

MF 181 CHECK LIST - DEMONSTRATION OF AIR HANDLING SYSTEMS

System: _____

ITEM	Contractor		Contracting Authority	
	SIGNED	DATE	SIGNED	DATE
Review of System Concept				
Review of Maintenance Manual				
Review of System Balance				
Troubleshooting				
Points of required Maintenance				
Access to Equipment				
Location of Control Devices				
All Electric Interlocks				
All Alarms				
Temperature Control				
Humidity Control				
Air Pressure Control				
Air Volume Control				

NOTES:

- .1 Contractor to submit copies of this form with each appropriate item signed and dated by the person having overall charge of commissioning prior to substantial performance. (See MF 190).
- .2 Contracting Authority's representative to sign off each item during the demonstration.
- .3 Contractor to strike out items where they do not apply to the systems being demonstrated.
- .4 Interlocks and controls to be demonstrated by following the descriptions and diagrams in the contract documents and proving that all controls function as required.
- .5 Where multiple identical controls are installed (thermostats) the Contracting Authority's representative may elect to only witness sample items, but the person having charge of commissioning is expected to have checked all of them.

MF 186 CHECK LIST - SUBSTANTIAL COMPLETION SUBMISSIONS - DIV 21

ITEM	CHECKED
Operating & Maintenance Manuals	
Record Drawings	
Pipe test reports	
Fire protection system test certificate	
Backflow prevention test certificate	

NOTES:

- .1 This list is provided as a checklist and may not include all substantial completion requirements.

MF 187 CHECK LIST - SUBSTANTIAL COMPLETION SUBMISSIONS - DIV 22

ITEM	CHECKED
Operating & Maintenance Manuals	
Record Drawings	
Plumbing Inspection certificate	
Buried drainage piping. Pipe leakage and bedding tests	
Buried gas pipe covering report.	
Water mains chlorination report.	
Backflow prevention station test certificate	
Hose Bibb operating keys. Signed receipt from Contracting Authority	
Pipe test reports	
Spare Water filters.	
Backflow prevention (RPPD) test certificate	

NOTES:

- .1 This list is provided as a checklist and may not include all substantial completion requirements.

MF 188 CHECK LIST - SUBSTANTIAL COMPLETION SUBMISSIONS - DIV 23

ITEM	CHECKED
Boiler Inspection Certificate	
Gas Inspection Certificate	
Equipment Extended Warranties Certificates	
Millwright Setting and Alignment Certificate	
Lubrication of Equipment Checklist	
Penetrations through Separations Certificate (MF-173)	
Air and Liquid Balancing Report	
Testing & Balancing Certificate (MF 170)	
Fire Damper Inspection Certificate (MF 172) and Checked Drawings	
Commissioning Report and Checklists	
Operating & Maintenance Manuals	
Record Drawings	
Demonstration to Operating Staff agenda	
Identification Schedules	
Vibration Isolation Installation Certificate. (MF-175)	
Seismic Restraint Installation Certificate. (MF-174)	
Chemical Treatment and Cleaning Report for Piping Systems	
Fuel Oil Tank and Piping Pressure Test Report	
Boiler Start-up Test Reports	
Refrigeration System Start-up Test Reports	
Chiller Capacity and Efficiency Test Reports	
Duct Leakage Test Reports	
Duct Cleanliness Certificate (MF 171)	
Demonstrations Checklists (MF 181, 182, 183)	
Items handed to Contracting Authority Checklist (MF 180)	
Substantial Performance Certificate (MF(190)	
Checklist of work remaining after Substantial (MF 191).	

NOTES:

- .1 This list is provided as a checklist and may not include all substantial completion requirements.

MF 190 CERTIFICATE OF SUBSTANTIAL PERFORMANCE

I hereby certify that I _____
am an employee / a principal / an agent

of _____

and have personally witnessed the following with regard to the mechanical systems work specified on the above project and that to the best of my knowledge except as noted on MF 191 (attached);

- The installation is complete and as specified.
- The systems have been commissioned and operate satisfactorily.
- Every control sequence and every control performs as specified.
- The systems are clean.
- All of the required submissions have been made to the consultant.

SIGNED _____ DATE _____

NOTES:

- 1 This certificate must be completed and submitted to the consultant prior to substantial performance.
- 2 If it is apparent during this inspection that the systems or their operation are seriously deficient then all reasonable costs of any subsequent inspections shall be deducted from the contract sum.

MF 191 WORK REMAINING AFTER SUBSTANTIAL PERFORMANCE

ITEM NO.	DESCRIPTION	COMPLETION		
		CLAIMED BY	DATE	VERIFIED DATE

NOTES:

- .1 This form must be filled in and submitted to the Consultant prior to substantial performance.
- .2 Items arising out of this inspection will be added to the list by the Consultant. Copies of the complete list will be circulated to the Contracting Authority, the Architect and the Contractor.
- .3 The Contractor may include estimated values against the outstanding work but determination of the actual amounts to be held will be made by the Consultant.
- .4 The Contractor shall sign off each item as it is completed and submit the list monthly to the Consultant. When all items are signed off the completed list shall be submitted with the certificate of total performance MF 192.

MF 192 CERTIFICATE OF TOTAL PERFORMANCE

I hereby certify that I _____
am an employee / a principal / an agent

of _____

and have personally witnessed that each item of outstanding work on the checklist and record of work remaining after substantial completion MF 191 (attached) has been satisfactorily completed and I hereby certify that the Mechanical systems work specified on the above project is complete.

SIGNED _____ DATE _____

NOTES:

- 1 This certificate must be completed and submitted to the Consultant prior to substantial performance.
- 2 If it is apparent during this inspection that the systems or their operation are seriously deficient then all reasonable costs of any subsequent inspections shall be deducted from the contract sum.

END OF SECTION

Part 1 General**1.1 WORK INCLUDED**

- .1 This section provides guidance and requirements to indicate manufactures that are generally acceptable for proposing for the project.
- .2 The named manufacturers shall comply with all specific requirements of the Project, as well as details and performance as indicated by the Standard of Acceptance named in the individual specification sections and the equipment schedules.
- .3 Where a manufacturer's name below is underlined>, that manufacturer is generally used as the Basis of Design.
- .4 Refer to Specification Section 20 05 00 General Mechanical Provisions for details regarding Standard of Acceptance, Addition of Acceptable Manufacturers, and Alternate Materials and Equipment.
- .5 Shop Drawings are required to be submitted for all equipment.
- .6 This section refers to Division 20 only. Each Mechanical Division (21, 22, 23, and 25) contains a similar section for equipment that falls under that division.
 - .1 For Fire Suppression Systems refer to section 21 99 65
 - .2 For Plumbing Systems refer to section 22 99 65
 - .3 For HVAC items refer to section 23 99 65
 - .4 For Instrumentation and Controls items refer to section 25 99 65

Part 2 Products**2.1 ACCESS DOORS – BUILDING SURFACES**

- .1 Specification Section 20 05 33
- .2 Acudor, Maxam Metal, Milcor, Cendrex, Elmdoor

2.2 ACCESS DOORS – WITH BACK BOX

- .1 Specification Section 20 05 33
- .2 Acudor, Milcor, Cendrex, Elmdor

2.3 ACCESS PANELS/DOORS – DUCTS AND PLENUMS

- .1 Refer to Specification Section 23 33 00

2.4 FLEXIBLE DUCT CONNECTORS

- .1 Refer to Specification Section 23 99 65

2.5 PIPE GUIDES AND ANCHORS

- .1 Specification Section 20 05 29
- .2 Grinnell

2.6 FIRE STOPPING

- .1 Specification Section 20 05 31
- .2 Hilti; 3M

2.7 PRESSURE GAUGES

- .1 Pressure Differential Gauges – Duct or Filters - Dial
 - .1 Specification Section 20 05 19
 - .2 Dwyer Magnehelic, Winters PFD, Greystone, Honeywell
 - .3 Dwyer Photohelic (Where pressure drop is monitored by the BMS)
- .2 Pressure Differential Gauges – Duct or Filters - Digital
 - .1 Specification Section 20 05 19
 - .2 Dwyer DigiMag, Winters, Greystone, Honeywell
- .3 Air Pressure, Piping - Dial
 - .1 Specification Section 20 05 19
 - .2 Marsh, Weksler, Terice, Ashcroft
- .4 Air Pressure, Piping - Digital
 - .1 Specification Section 20 05 19
 - .2 Winters, Omega
- .5 Liquid, Steam Pressure - Dial
 - .1 Specification Section 20 05 19
 - .2 Marsh, Weksler, Terice, Ashcroft
- .6 Liquid, low temp, Pressure - Digital
 - .1 Specification Section 20 05 19
 - .2 Ashcroft, Greystone

2.8 TEMPERATURE GAUGES AND THERMOMETERS

- .1 Thermometers – Pipe Mounted Stem
 - .1 Specification Section 20 05 19
 - .2 Marsh, Weksler, Terice, Ashcroft
- .2 Thermometers - Pipe Mounted (Dial)
 - .1 Specification Section 20 05 19
 - .2 Marsh, Weksler, Terice, Ashcroft
- .3 Thermometers – Pipe Mounted (Digital, Light Powered)
 - .1 Specification Section 20 05 19
 - .2 Terice SX9
- .4 Temperature Gauge - Panel or wall Mounted (Dial)
 - .1 Specification Section 20 05 19
 - .2 Marsh, Weksler, Terice, Ashcroft
- .5 Temperature Gauge – Panel or Bracket Mounted (Digital, Powered)
 - .1 Specification Section 20 05 19

.2 Trerice TDD/TMD with TRD16, Marsh, Weksler, Ashcroft

2.9 VIBRATION ISOLATORS

- .1 Specification Section 20 05 48
- .2 Vibro-Acoustics, Kinetics, Mason

2.10 SEISMIC RESTRAINTS

- .1 Specification Section 20 20 49

Part 3 Execution

3.1 NOT APPLICABLE.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section provides guidance and requirements to indicate Acceptable Mechanical Sub-Trade Agencies
- .2 The named Sub-trade shall comply with all specific requirements of the Project.
- .3 Refer to Specification Section 20 05 00 General Mechanical Provisions for details regarding the Addition of Acceptable Sub-trades.
- .4 This section refers to Division 20 only. Each of the other Mechanical Divisions (21, 22, 23, and 25) contain a similar section for sub-trades that falls under that division.

Part 2 Products

2.1 NOT APPLICABLE

Part 3 Execution

3.1 BALANCING

- .1 .
- .2 .
- .3 .

3.2 MECHANICAL COMMISSIONING

- .1 .
- .2 .
- .3 .

3.3 COMMISSIONING AUTHORITY

- .1 .
- .2 .
- .3 .

3.4 OPERATING & MAINTENANCE MANUALS

- .1 .
- .2 .
- .3 .

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section provides General, Product, and Execution Requirements for Common Work for Fire Suppression Systems.
- .2 Provide all fire suppression systems throughout the buildings as indicated, including, but not limited to:
 - .1 Wet sprinkler systems
 - .2 Dry sprinklers systems
 - .3 Portable fire extinguishers
- .3 The Fire Suppression Contractor shall retain the services of a Contractor's Supporting Professional Fire Protection Engineer (Delegated Design) registered in the province where the project is located
 - .1 The Contractor's Supporting Professional Fire Protection Engineer (Delegated Design) shall provide complete engineering design and field review services including signed and sealed CAD fire suppression drawings and hydraulic calculations.
 - .2 Refer to "Document Submittals" for additional information.
- .4 The Fire Suppression Contractor shall retain the services of a Contractor's Supporting Professional Seismic Engineer (Delegated Design) registered in the province where the project is located
 - .1 This Seismic Engineer shall provide complete engineering design and field review services for all seismic restraints.
 - .1 Refer to "Document Submittals" for additional information.
- .5 The Contractor's Supporting Professional Fire Protection Engineer (Delegated Design) shall provide field reviews of the work on site as the work progresses and submit signed copies of the reports to the Consultant.
- .6 Arrange for, pay for, and obtain static and residual water supply pressure information from the utility or municipality in writing and submit a copy of this information with the Shop Drawings.
 - .1 If this information is not available, arrange for, pay for, and perform a hydrant flow test.
- .7 Provide all Testing, Adjusting, Commissioning; Identification; Insulation; and Heat Tracing for all fire suppression systems.
- .8 Submit all documentation to the Authorities Having Jurisdiction, arrange for, pay for, and obtain trade permits prior to commencing installation work on site.
- .9 Connect to the combined fire suppression / potable water supply main or dedicated fire suppression water main located as shown on the drawings.
- .10 Provide hard copy and digital files of "as-built" record drawings for inclusion in the maintenance manuals.
- .11 Fire Suppression drawings are diagrammatic and approximately to scale.
 - .1 They establish the scope of the work and the general location and orientation of the fire suppression systems.
 - .2 The systems shall be installed generally in the locations and generally along the routings shown, close to the building structure and coordinated with other services.

- .3 Piping shall be concealed within walls, ceilings or other spaces and shall be routed to maximize head room and the intended use of the space through which they pass, unless specifically noted otherwise.
- .12 Provide hard copy and digital files (AutoCAD and pdf formats) of all “as-built” record drawings for inclusion in the maintenance manuals.

1.2 RELATED REQUIREMENTS

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.
- .2 In conjunction with Division 01, Division 20 General Mechanical Provisions shall govern all Division 21 Sections of the work.
- .3 Refer to Section 20 99 60 Mechanical Forms and submit all documentation therein that is applicable to Division 21.
- .4 Refer to and comply with the following sections:
 - .1 General Requirements - Division 01
 - .2 Common Work for Mechanical Systems – Division 20
 - .3 Fire Suppression Systems - Division 21
 - .4 Plumbing Systems - Division 22
 - .5 Heating, Ventilation and Air Conditioning Systems - Division 23
 - .6 Controls and Instrumentation - Division 25
 - .7 Electrical - Division 26/27/28

1.3 APPLICABLE CODES AND STANDARDS

- .1 Refer to Section 20 05 01, Codes, Bylaws and Standards.
- .2 All installation, workmanship, and testing shall conform to the following standards as a minimum:
 - .1 Provincial Building Code
 - .2 Local building by-Laws
 - .3 Fire protection equipment and installation shall be approved by local Fire Commissioner.
 - .4 National Fire Protection Association NFPA 10 - Standard for Portable Fire Extinguishers.
 - .5 National Fire Protection Association NFPA 13 - Standard for the Installation of Sprinkler Systems.
- .3 Installation shall be subject to design approval, inspection, and test of the Authority Having Jurisdiction.
- .4 All system components shall be of one manufacturer. Normally, materials and devices listed by nationally recognized fire test laboratories will be acceptable.

1.4 QUALITY ASSURANCE

- .1 Refer to Section 20 05 00 General Mechanical Provisions, Quality Assurance for additional details.
- .2 Manufacturers shall specialize in development and production of the products specified in this Division.

- .3 Employ only Tradespeople holding valid Provincial Trade Qualification Certificates.
 - .1 Tradespeople shall perform only work that their certificate permits.
 - .2 Certificates shall be available for inspection by the Consultant.
- .4 Fire Suppression systems shall be installed by qualified contractors licensed and regularly engaged in installation of fire suppression systems.
- .5 The Fire Suppression Contractor shall retain the services of a Supporting Professional Fire Protection Engineer (Delegated Design) to provide complete engineering design and field review services including signed and sealed CAD fire suppression drawings and hydraulic calculations.
- .6 The Fire Suppression Contractor's Supporting Professional Fire Protection Engineer (Delegated Design) shall provide signed and sealed Letters of Assurance for the project as required by Provincial Building Code and Local Building By-Laws.
- .7 The Fire Suppression Contractor shall retain the services of a Contractor's Supporting Professional Seismic Engineer (Delegated Design)
 - .1 This Seismic Engineer shall provide complete engineering design and field review services for all seismic restraints.
 - .1 Refer to "Document Submittals" for additional information.
- .8 Any drawings prepared by the Consultant are provided only to show the general features of the systems, and general concepts of the arrangement and locations of the sprinklers.

1.5 SUBMITTALS

- .1 Comply with Section 21 05 00 Common Work for Fire Suppression Systems.
- .2 Refer to Section 20 99 60 Mechanical Forms and submit all documentation therein that is applicable to Division 21 Fire Suppression.
- .3 Shop Drawings
 - .1 Submit shop drawings in accordance with Division 01 and Division 20 05 05 Documentation and Submittals.
 - .2 Shop drawings are required for all materials and equipment.
 - .3 Submit static and residual water supply pressure information.
 - .4 Submit hydraulic calculations for all water-based fire suppression sprinkler systems.
 - .5 Submit additional signed and sealed sets of shop drawings as requested by the Owner for their use and for review by their insurer, and incorporate all requirements made during that review process.
 - .6 Submit to the Authority Having Jurisdiction for their review and/or approval, complete sets of shop drawings and hydraulic calculations for each area.
 - .7 Arrange for, pay for, and obtain a fire suppression system / sprinkler permit prior to commencing the fire suppression system installation.
 - .8 Only those shop drawings that have been reviewed, signed, and sealed by the Contractor's Supporting Professional Fire Protection Engineer (Delegated Design) shall be submitted to the Consultant for review.
- .9 Drawings
 - .1 Any drawings prepared by the Consultant are provided only to show the general features of the systems, and general concepts of the arrangement and locations of the sprinklers.

- .2 Submit detailed CAD based drawings of all fire suppression sprinkler systems.
 - .1 Shop drawings shall be signed and sealed by the Contractor's Supporting Professional Fire Protection Engineer (Delegated Design), including hydraulic calculations.
 - .3 Submit CAD drawings of all fire suppression sprinkler systems for both shop drawings and record drawings.
 - .4 Sprinklers shall be referred to on drawings, submittals, and other documentation, by the sprinkler identification or model number as specifically published in the appropriate agency listing or approval.
 - .5 The Fire Suppression Contractor's Supporting Professional Fire Protection Engineer (Delegated Design) shall include for all sprinklers as required to fully comply with NFPA-13, local by-laws and the Provincial Building Code and Local Building By-Laws, whether or not they are indicated on the Consultant's, Architect's, or any other drawings.
 - .6 Indicate on the drawings all information required by the Authority Having Jurisdiction including features of the building construction, direction and size of beams, ceiling configurations, partition locations, as well as light fixtures (noting the depths of surface mounted light fixtures where these occur) and diffuser locations.
 - .7 Indicate the positions and elevations of the sprinklers with respect to the floor elevations; the temperature rating all sprinklers; the spacing and types of hangers; drains and low point drains; test and flushing connections; types of sprinkler alarms; locations and types of sprinkler control valves; backflow preventers and all other essential features of the piping systems.
 - .8 Sprinklers shall be referred to on drawings, submittals, and other documentation, by the sprinkler identification or model number as specifically published in the appropriate agency listing or approval.
- .4 Product Options and Substitutions
 - .1 Refer to Section 20 0 00, for requirements pertaining to product options and substitutions.
 - .5 Maintenance Data
 - .1 Refer to Division 01 and Section 20 05 05 Documentation and Submittals.
 - .2 Submit pdf format digital files of all equipment data sheets, approved shop drawings, and maintenance data for inclusion in the maintenance manual.
 - .3 Include a copy of National Fire Protection Association NFPA-25, Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems.
 - .4 Information provided must be suitable for incorporation into the local Fire Department's operation manual.
 - .5 Shop drawings for all components as listed in the Shop Drawings clauses above.
 - .6 Record Drawings
 - .1 Refer to Division 1 and Section 20 05 05 Documentation and Submittals.
 - .2 Provide project "As-Built" Record Drawings for all Fire Suppression systems.
 - .3 Record drawings shall be signed and sealed by the Contractor's Supporting Professional Fire Protection Engineer (Delegated Design), including hydraulic calculations.

- .4 In addition, as a minimum, during the construction period,
 - .1 Keep on site a clean set of drawings marked up, IN COLOUR, to reflect the 'As-Built' state, for examination by the Consultant on a regular basis.
 - .2 Include elevations, rough-in details, and detailed locations of all hidden services, including locations of maintenance items and their associated identification code (ie. valves).
 - .3 All concealed (above grade and below grade) services shall be dimensionally located and noted, (use gridlines or structure as the reference).
- .5 At the time of 'Substantial Performance', submit to the Consultant one complete full-sized COLOUR hard copy of all Record Drawing information produced as per the above section.
- .6 The Record Drawings produced shall be based on the IFC drawings and any updates (addendums, change orders, site instructions, field directives, etc) that have been issued.
- .7 Submit signed and sealed copies of Record Drawings, Final Design Drawings and As-built Drawings as requested by the project Architect, Certified Professional (C.P.), Authority Having Jurisdiction and the Consultant.
- .8 Submit hard copies of all As-Built record drawings for inclusion in the hard copy maintenance manual.
- .9 Provide digital files in PDF format for inclusion in the digital format manuals and submit files directly to the consultant.
 - .1 Provide one PDF file for each drawing file produced.
- .10 The Owner will make arrangements to have the contractor provided as-built drawings (red-lines) incorporated into CAD.
- .7 Occupancy Documentation Requirements
 - .1 Refer to Division 1 and Section 20 05 05 Documentation and Submittals.
 - .2 The Contractor shall submit the following documentation to the Consultant a minimum of 5 working days prior to the project occupancy site walk-through or occupancy date, whichever is scheduled first.
 - .3 The site walk-through or occupancy dates will be established by the project architect, project manager or Certified Professional.
 - .4 It is the contractor's responsibility to provide all documentation to the Consultant in a timely manner.
 - .5 If all documentation is not received, the Consultant may not be able to issue their associated Letters of Assurance in support of the building occupancy application and any associated consequences shall become the responsibility of the contractor.
 - .6 Fire Suppression System Letters of Assurance from the Fire Suppression Contractor's Supporting Professional Fire Protection Engineer (Delegated Design).
 - .7 Seismic restraint system Letters of Assurance from the Fire Suppression Contractor's Supporting Professional Seismic Engineer (Delegated Design).
 - .8 Backflow Prevention Assembly Test Reports for each backflow prevention device, signed by the tester.
 - .9 Letter confirming that all penetrations of rated assemblies have been firestopped in conformance with CAN4-S115, on the firestopping installing agencies letterhead.
 - .10 Fire Suppression system Contractor's Material and Test Certificates for Aboveground Piping and for Underground Piping systems per NFPA-13.

- .11 A copy of the Fire Alarm Verification Certificate for components related to the fire suppression system devices.
- .12 Copies of pressure test reports for all piping systems on contractor's letterhead.
- .13 Submit a "Contractor's Material and Test Certificate" for each Underground and each Aboveground section of the work in accordance with the Authority Having Jurisdiction test procedure requirements, to the Consultant and to the local Authority Having Jurisdiction a minimum of 10 working days prior to Occupancy.
- .14 Submit a Backflow Prevention Test Certificate for all backflow prevention devices.
- .15 Submit a signed letter from the fire stopping installation firm on their company letterhead certifying that all penetrations of fire suppression piping through vertical and horizontal rated separations have been fire stopped in accordance with CAN4-S115.
- .16 Obtain from the Division 26/27/28 Electrical contractor and submit a copy of the Fire Alarm Verification Certificate.
- .17 Submit maintenance data for all systems and arrange for inclusion in the project Mechanical Maintenance and Operations Manuals as outlined below.
- .18 Submit signed and sealed copies of Record Drawings, Final Design Drawings and As-built Drawings as requested by the project Architect, Certified Professional (C.P.), Authority Having Jurisdiction and the Consultant.

Part 2 Products

2.1 GENERAL

- .1 All materials shall be ULC Listed for the intended service and shall be supplied in original factory packaging.

2.2 PIPE, FITTINGS AND COUPLINGS

- .1 The responsibility for including for all pipe, fittings, couplings, valves, nipples, drains, test connections and all accessory pipe work for a complete installation is to be included in this Section of the work within the base Proposal price.
- .2 Where system working pressures exceed 1035 kPa [150 psig] provide valves with a minimum listed working pressure of 2060 kPa [300 psig] or as required.
- .3 No extra cost will be considered based on failure of the contractor to allow for extra pipe, fittings and pipe work as required during construction to provide offsets to avoid structural components, and to coordinate with other piping services, ductwork, cable trays, conduits or other obstacles whether shown on the drawings or not.
- .4 All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer.
 - .1 Grooving tools shall be of the same manufacturer as the grooved components.
- .5 All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.

2.3 BACKFLOW PREVENTION STATIONS

- .1 Provide a ULC Listed double check valve assembly (DCVA) complete with O.S. & Y. inlet and outlet shut-off valves.

- .2 Backflow prevention stations shall be in complete accordance with the manual "Cross Connection Control Manual" published by the Pacific Northwest Section of the American Water Works Association.
- .3 Isolation valves shall be provided with supervisory switches connected to supervisory signals at the fire alarm system.

2.4 ISOLATION VALVES:

- .1 Install isolation valves whether shown on the drawings or not at the following locations:
 - .1 At the point where the water service first enters the building.
 - .2 At each sprinkler zone.
 - .3 At all points as indicated on the drawings.
 - .4 At all points where required by the Building Codes, By-Laws or NFPA.

2.5 HANGERS AND SUPPORTS

- .1 Refer to Section 20 05 29 Hangers, Supports and Anchors.
- .2 All hangers and supports including seismic restraints shall be ULC Listed and shall conform to the Provincial Building Code and to the appropriate NFPA standards.
- .3 Toggle hangers or strap hangers are unacceptable.

2.6 SWAY BRACES

- .1 Supply and install sway-bracing hangers on fire suppression piping systems in accordance with NFPA 13 requirements.
 - .1 Generally, this shall apply to all crossmains 50 mm [2"] and larger and shall apply to all feed mains including all standpipe risers.
 - .2 Horizontal piping shall be 2-way bracing and vertical piping shall include 4-way bracing at the tops of all risers.
 - .3 On floor loops, sway-braces are also required at the corners of all loops.
- .2 Power actuated or drop-in fasteners shall not be used to resist tension forces for the support or restraint of the fire suppression systems or their components.
- .3 All fasteners shall be reviewed and approved by the Contractor's Supporting Professional Seismic Engineer (Delegated Design) prior to installation.

2.7 MISCELLANEOUS METAL RELATED TO FIRE PROTECTION SYSTEM

- .1 Refer to Division 20.
- .2 All miscellaneous metal related to the fire suppression systems including all metal back up plates, stands, brackets, and supports for all roof, floor or wall supported equipment and piping systems is part of this Section of the work.
- .3 Provide two coats of heavy red oxide primer to all steel components after fabrication and touch up on site after installation.

Part 3 Execution

3.1 PIPE ROUTING

- .1 Install piping to maximize headroom in all areas, including areas without ceilings where the piping is exposed, without interfering with other systems.

- .2 Do not route piping through electrical or communications rooms or closets, elevator machine rooms, or other similar locations without express permission from the electrical consultant.
 - .1 Limit the piping to branch lines that serve those specific rooms where such rooms are required to be sprinklered.

3.2 GRADING AND DRAINAGE OF PIPING

- .1 Grade all fire suppression piping so that it can be drained through drain cocks.
- .2 Pipe all sprinkler system drains to floor drains in mechanical service rooms.

3.3 BUILDING MOVEMENT

- .1 Install all piping systems, including all take-offs installed within the building such that the piping and connected equipment will not be distorted by expansion, contraction or building settlement.
- .2 Provide offsets and / or piping expansion components at all building expansion joints, all building seismic joints and all firewalls.
- .3 Provide anchors where necessary to control pipe expansion and pipe movement.

3.4 PIPE SLEEVES AND ESCUTCHEONS

- .1 The supply and installation of pipe sleeves and escutcheons for fire suppression system piping is included in this Section of the work.
- .2 Do not cast piping into concrete walls, slabs, or masonry walls.
- .3 Install pipe concentric within the sleeves.
- .4 Remove plastic sleeves, where they are used, prior to installation of the pipe penetration.
 - .1 The resulting hole shall be then classified as the sleeve except in wet areas.
- .5 Provide minimum Schedule 10 steel pipe sleeves where piping penetrates masonry walls.
- .6 Install chrome plated escutcheons on exposed piping passing through walls, floors and ceilings in finished areas.
- .7 Risers for fire suppression systems with horizontal branch takeoffs passing through sleeves that are set rigidly in the structure adjacent to the risers shall be set to accommodate long term structural movement to avoid imposing stress on these systems.

3.5 FIRE STOPPING

- .1 Provide fire stopping to CAN4-S115 at all pipes penetrating horizontal and vertical rated separations.
- .2 Smooth the finished surface in a neat and workman like appearance.

3.6 CORE DRILLING

- .1 The fire suppression contractor shall be on site and coordinate sleeves and block out requirements in accordance with the project construction schedule to minimize coring.
- .2 Arrange and pay for all costs of all core drilling required for fire suppression systems in this Section of the Work.
- .3 X-ray all concrete walls, partitions, shafts, slabs and other concrete or concrete block assemblies prior to coring.
 - .1 The cost of x-raying shall be included in the cost of the Work.

- .4 Verify the location of existing service runs and structural reinforcement within existing concrete floors and walls prior to core drilling and cutting.
 - .1 Core drilling and cutting of structural building components shall only take place upon the receipt of specific written approval of the structural consultant.
 - .2 Repairs that may be required to existing services damaged as a result of core drilling is included in this Section of the work.
- .5 Penetrations up to 150 mm [6"] nominal pipe size in precast concrete may be cored on site per the fire suppression contractor.
 - .1 Larger penetrations shall be located and arranged for in precast work with the precast manufacturer prior to shipping to the construction site.

3.7 BACKFLOW PREVENTION STATIONS

- .1 Install backflow prevention stations in complete accordance with the "Cross Connection Control Manual" published by the Pacific Northwest Section of the American Water Works Association.
 - .1 Mount backflow preventers a maximum of 1.5 meters [5 feet] above the adjacent floor level for servicing.
- .2 Complete testing of all backflow prevention devices shall be carried out under this Section of the work prior to final acceptance of fire suppression systems.
 - .1 Submit a certificate duly signed and witnessed that testing was satisfactorily completed and include a copy in the project Mechanical Operation and Maintenance Manual.

3.8 HANGERS AND SUPPORTS

- .1 Provide all hangers and supports as outlined in NFPA including supports to adequately secure the piping to restrict movement upon activation of the fire suppression systems including the activation of fire pumps and charging of the systems through the fire department connections.

3.9 SEISMIC RESTRAINTS

- .1 Provide seismic restraints as outlined in NFPA and to the seismic zone listed in the applicable building code or bylaw.
- .2 Anchorage and seismic restraints of the fire suppression systems is included in this Section of the work.

3.10 PRESSURE GAUGES

- .1 Provide pressure gauges at the following locations and additional gauges as required by NFPA, the Authority Having Jurisdiction and the system configuration:
 - .1 Water entry valve station both upstream and downstream of the backflow preventer.

3.11 TESTS AND INSPECTION

- .1 Furnish all labour, materials, equipment, and instruments necessary for all required tests.
- .2 All work shall be subject to review by the Consultant, Owner's representative, and local Authority Having Jurisdiction.
- .3 Provide at least one hundred and twenty (120) business hours' notice in advance of making the required tests.

- .4 Tests on fire suppression systems shall include pressure tests and shall conform to the standards of the Authority Having Jurisdiction.
- .5 Fire department connections and fire pump test header lines shall be hydrostatically tested.

3.12 CLEAN UP

- .1 Leave systems operating with work areas clean to satisfaction of the Consultant, Architect, or the Owner's representative. Refer to Division 20 General Mechanical Provisions

3.13 SYSTEM DEMONSTRATIONS

- .1 Refer to Section 20 05 06 Commissioning and Demonstration.
- .2 The Fire Suppression Contractor's Supporting Professional Fire Protection Engineer (Delegated Design) and their licensed journeyman sprinkler fitter shall attend all demonstrations of the fire suppression systems to the Municipal officials, the Fire Department, and the Consultant.
 - .1 This may require multiple site visits and multiple demonstrations depending on the scheduling and sequence of demonstrations as may be established by the Architect, Project Manager or General Contractor.
- .3 The Fire Suppression Contractor's Supporting Professional Fire Protection Engineer (Delegated Design) and their licensed journeyman sprinkler fitter shall demonstrate all devices to the Consultant, including all tamper switches, all flow switches, all test and drain assemblies, all dry pipe valves, all pre-action system devices including detection and activation devices.
- .4 Demonstrations to Municipal officials and / or the Fire Department shall not alleviate the requirement to provide an additional demonstration of all devices and components to the Consultant partial demonstrations in lieu of full demonstrations shall be at the sole discretion of the Consultant.
- .5 The Fire Suppression Contractor's Supporting Professional Fire Protection Engineer (Delegated Design) and their licensed journeyman sprinkler fitter shall coordinate to have the Electrical Contractor and / or their fire alarm system contractor present and to provide all necessary walkie-talkies, ladders, smoke canisters etc. to provide complete system demonstrations.
- .6 The Fire Suppression Contractor's licensed journeyman sprinkler fitter shall rectify any deficiencies and subsequently drain all dry system piping, reset all devices, and leave the systems in a fully operating condition.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section provides General, Product, and Execution Requirements for Fire Suppression Sprinkler Systems.
- .2 Provide all required Fire Suppression Sprinkler Systems as indicated, including, but not limited to:
 - .1 Wet sprinkler systems throughout the renovated area.
 - .2 Dry sprinkler systems at designated areas subject to freezing.
- .3 The Fire Suppression Contractor shall retain the services of a Contractor's Supporting Professional Fire Protection Engineer (Delegated Design).
- .4 The Fire Suppression Contractor shall retain the services of a Contractor's Supporting Professional Seismic Engineer (Delegated Design).
- .5 Obtain flow and pressure test data from municipal utility service for use in system design.
- .6 Obtain a copy of the Code Consultant's report and include all equivalency requirements, glazing system requirements and all other works described therein that pertain to the fire suppression sprinkler systems.
- .7 Supply and install seismic restraints for all fire suppression sprinkler piping systems in accordance with National Fire Protection Association NFPA-13, the provincial Building Code, and local Building By-Laws.
- .8 Provide all fire suppression sprinkler system piping as depicted on the drawings to and including all fire department connections, risers, sprinklers, sprinkler zone valves, and all other inlets and outlets that require piping connections for water based wet or dry fire suppression sprinkler systems.
- .9 The responsibility for allowing for all sprinklers for a complete installation is to be included in this Section of the work within the base Proposal price.
 - .1 The layout on the drawings shows the general intention of the work and sprinkler locations with respect to other ceiling elements such as ceiling tiles, lights, and diffusers.
 - .2 The Contractor shall provide all additional sprinklers as may be required.
 - .3 No request for extra cost will be considered based on failure of the Contractor to allow for extra sprinklers as required during construction to conform to all National Fire Protection Association requirements and the Authority Having Jurisdiction, whether shown on the drawings or not.
 - .4 Include sprinklers in concealed spaces containing exposed combustible construction including exposed wood beams, exposed wood framing and exposed wood ceiling materials.
- .10 Connect the fire suppression sprinkler system piping to receive water supply from the water service main as indicated on the drawings.

1.2 RELATED REQUIREMENTS

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.
- .2 In conjunction with Division 01, Division 20 General Mechanical Provisions shall govern all Division 21 Sections of the work.

- .3 Refer to Section 20 99 60 Mechanical Forms and submit all documentation therein that is applicable to Division 21.
- .4 Refer to and comply with the following sections:
 - .1 General Requirements - Division 01
 - .2 Common Work for Mechanical Systems – Division 20
 - .3 Fire Suppression Systems - Division 21
 - .4 Plumbing Systems - Division 22
 - .5 Heating, Ventilation and Air Conditioning Systems - Division 23
 - .6 Controls and Instrumentation - Division 25
 - .7 Electrical - Division 26/27/28
- .5 Coordinate with Division 26/27/28 Electrical for connection of all supervised isolation valves to supervisory signals, flow switches to alarm signals, and supervisory switches to supervisory signals on the fire alarm system.
- .6 Coordinate the work of this Section with the HVAC trades, plumbing trades, electrical trades, and ceiling trades.

1.3 APPLICABLE CODES AND STANDARDS

- .1 Refer to Section 20 05 01, Codes, Bylaws and Standards.
- .2 All installation, execution, and testing shall conform to the following standards as a minimum:
 - .1 Provincial Building Code
 - .2 Local building by-Laws
 - .3 Fire protection equipment and installation shall be approved by local Fire Commissioner.
 - .4 National Fire Protection Association NFPA-13 Standard for the Installation of Sprinkler Systems.

1.4 QUALITY ASSURANCE

- .1 Refer to Section 21 05 00 Common Works, Quality Assurance, for additional details.
- .2 Refer to Section 21 05 00 Common Works, Quality Assurance, for requirements related to retaining the services of a Contractor's Supporting Professional Fire Protection Engineer (Delegated Design)
- .3 Any drawings prepared by the Consultant are provided only to show the general features of the systems, and general concepts of the arrangement and locations of the sprinklers and distribution system.
- .4 The Fire Suppression Contractor shall retain the services of a Contractor's Supporting Professional Seismic Engineer (Delegated Design)
- .5 Fire protection equipment and installation shall be approved by local Fire Commissioner.

1.5 SUBMITTALS

- .1 Comply with Section 21 05 00 Common Work for Fire Suppression Systems.
- .2 Refer to Section 20 99 60 Mechanical Forms and submit all documentation therein that is applicable to Division 21 Fire Suppression.
- .3 Product Options and Substitutions
 - .1 Refer to Section 20 05 00, for requirements pertaining to product options and substitutions.

- .4 Shop Drawings
 - .1 Refer to Section 20 05 00, for requirements pertaining to product options and substitutions.
 - .2 Submit shop drawings in accordance with Division 1 and Section 20 05 05 Documentation and Submittals.
 - .3 Refer to Section 21 05 00 Common Works, Quality Assurance, for detailed requirements related to retaining the services of a Contractor's Supporting Professional Fire Protection Engineer (Delegated Design).
 - .4 The Fire Suppression Contractor and their Supporting Professional Fire Protection Engineer (Delegated Design) shall include for all sprinklers as required to fully comply with NFPA-13, local by-laws and the provincial Building Code and Local Building By-Laws, whether or not they are indicated on the Consultant's, Architect's, or any other drawings.
 - .5 Indicate on the drawings all information required by the Authority Having Jurisdiction including features of the building construction, direction and size of beams, ceiling configurations, partition locations, as well as light fixtures (noting the depths of surface mounted light fixtures where these occur) and diffuser locations.
 - .6 Stipulate the positions and elevations of the sprinklers with respect to the floor elevations; the temperature rating all sprinklers; the spacing and types of hangers; drains and low point drains; test and flushing connections; types of sprinkler alarms; locations and types of sprinkler control valves; backflow preventers and all other essential features of the piping systems.
 - .7 Sprinklers shall be referred to on drawings, submittals, and other documentation, by the sprinkler identification or model number as specifically published in the appropriate agency listing or approval. Shop drawings are required for all materials and equipment.
- .5 Maintenance Data
 - .1 Refer to Division 1 and Section 20 05 05 Documentation and Submittals.
 - .2 Submit manufacturer's recommended maintenance tasks for a one-year period. Include maintenance schedules and lubrication products.
- .6 Record Drawings
 - .1 Refer to Division 1 and Section 20 05 05 Documentation and Submittals.
- .7 Occupancy Documentation Requirements
 - .1 Refer to Division 1 and Section 20 05 05 Documentation and Submittals.

Part 2 Products

2.1 GENERAL

- .1 All pipe, fittings, couplings, valves, devices, and materials used in the fire suppression standpipe system shall be of an approved type.
 - .1 All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
 - .2 All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.
- .2 System components shall be rated for working pressures not less than the maximum pressure to be developed at their corresponding locations within the system under any

condition, including the pressure that occurs when a permanently installed fire pump is operating at shutoff pressure.

2.2 SPRINKLER PIPING AND FITTINGS - ABOVE GROUND

- .1 Where system working pressures exceed 1035 kPa [150 psig] provide valves with a minimum listed working pressure of 2060 kPa [300 psig] or as required.
- .2 Combined potable water and fire suppression sprinkler system portion of the piping upstream of the approved double check valve assembly backflow prevention device shall comply with Section 22 11 00 Domestic Water Distribution.
- .3 Sprinkler system piping:
 - .1 Steel pipe, black or hot dipped galvanized, standard weight or lightwall, material and IPS dimensions conforming to NFPA 13 and ASTM A53, ASTM A135 or ASTM A795.
 - .2 Ductile iron pipe or copper pipe for the portion of the combined potable water and fire suppression system upstream of a ULC listed backflow prevention device, as per Section 21 12 00.
 - .3 CPVC plastic piping is not acceptable for this project.
- .4 Sprinkler system fittings:
 - .1 Compatible with the piping material and suitable for the maximum pressures in the system but not less than 1210 kPa [175 psig] working pressure.
 - .2 Welded fittings shall conform to ANSI B16.5, B16.9, B16.11 and B16.25 and ASTM A234.
 - .3 Threaded fittings conforming to ANSI B16.1, B16.3 and B16.4 are acceptable on minimum Schedule 40 steel pipe up to 150 mm [6"] diameter and minimum Schedule 30 steel pipe for 200 mm [8"] diameter and larger and shall have a ULC corrosion resistance ratio of 1.00 or greater.
 - .4 Grooved end fittings shall be ductile iron conforming to ASTM A536, and shall provide full flow design, short pattern, with flow equal to standard pattern fittings.
 - .1 Fittings, couplings, and gaskets shall be of one manufacturer and shall provide a rigid joint. Grooving tools shall be of the same manufacturer as the grooved components.
 - .2 Standard of Acceptance: Victaulic FireLock™.
 - .5 Branch connections may be provided by bolted mechanical branch connections complete with synthetic rubber gaskets approved for line service.
 - .1 Standard of Acceptance: Victaulic Style 920920N and 922.
 - .6 Victaulic 922 outlet tees shall have cast upper and lower housings and may be used for up to 25 mm [1"] branch outlets and individual sprinklers.
 - .7 Victaulic "Pressfit System" of pipe and cold drawn carbon steel fittings with integral synthetic O-ring is not acceptable for this project.
 - .8 Victaulic "Vicflex™ Dry Sprinkler heads are acceptable for locations that require dry sprinkler protection (soffits etc.).
 - .9 Grooved joint couplings shall consist of two ductile iron housing segments conforming to ASTM A536, pressure responsive gasket to ASTM D2000, and zinc electroplated steel bolts and nuts.
 - .1 Rigid Type:
 - .1 Housings shall be cast with offsetting angle pattern bolt pads to provide rigidity and system support and hanging in accordance with NFPA-13. Couplings shall be fully installed at visual pad-to-pad offset contact.

- .2 Tongue and recess type couplings, or any coupling that requires exact gapping of bolt pads on each side of the coupling at specified torque ratings, are not allowed.
- .3 32 mm [1-1/4"] through 100 mm [4"]: Installation Ready, for direct stab installation without field disassembly.
- .4 Standard of Acceptance: Victaulic Style 107, Victaulic FireLock™ Style 005H or Victaulic Zero-Flex Style 07
- .2 Flexible Type:
 - .1 For use only in locations where vibration attenuation and stress relief are required, and for seismic applications.
 - .2 Standard of Acceptance: Victaulic Installation Ready Style 177 and Style 75 / 77.
- .3 For dry pipe systems, use a FlushSeal® coupling gasket in rigid and flexible couplings where required by NFPA 13.
 - .1 Standard of Acceptance: Victaulic Style 005 Firelock and Style 75
- .10 Submit requests for consideration of other products or systems in accordance with the submittal procedures, prior to the closing of this subtrade tender.
- .5 The Victaulic Vic-Flex multiple use flexible stainless steel drop system may be used to properly locate sprinkler heads.
 - .1 The drop system shall be supplied with required supporting members and bracing.

2.3

SYSTEM VALVES

- .1 Where system working pressures exceed 1035 kPa [150 psig] provide valves with a minimum listed working pressure of 2060 kPa [300 psig].
- .2 Gate - 1210 kPa [175 psig] - ULC listed:
 - .1 12 mm - 50 mm [1/2" - 2"]: Standard of Acceptance: Jenkins 305-U, Crane 459, Nibco T-104-0, Kennedy.
 - .2 64 mm [2½"] and larger: Standard of Acceptance: Jenkins 825, Crane 467, Nibco F-607-0TS, Kennedy; Grooved end valves shall be Victaulic Series 771.
- .3 Butterfly - 2065 kPa [300 psig] - ULC listed, or UL and FM approved, with handwheel and weatherproof actuator housing:
 - .1 12 mm - 50 mm [1/2" - 2"]: Butterball slow close butterfly valve with indicator and integral supervisory switch,
 - .1 Standard of Acceptance: Nibco KT-505-8, Victaulic 728 Firelock ball valve.
 - .2 50 mm - 300 mm [2" - 12"]: Standard of Acceptance: Demco Series NE-H with tapped lug end design, -Nibco L-002-N6 complete with gear operator and indicator, and pressure responsive seat. The valve stem shall be offset from the disc centerline to provide full 360-degree circumferential seating.
 - .1 Standard of Acceptance: Victaulic 705 Firelock butterfly valve.
- .4 Check - 1210 kPa [175 psig] - ULC listed:
 - .1 64 mm [2½"] and larger:
 - .1 Standard of Acceptance: Jenkins 477, Crane 375, Nibco F-908-W, Kennedy, Victaulic Style 717.
 - .2 Provide a spool piece to ensure full check valve opening where adjacent to an alarm valve or gate valve.

- .5 Pressure Reducing - ULC listed:
 - .1 64 mm [2½"] in-line valve: modulating piston type pressure reducing valve.
 - .1 Standard of Acceptance: Zurn Z-3005IL, Watts 500.
 - .2 100 mm - 200 mm [4" - 8"] in-line valve: Pilot operated type pressure reducing valve,
 - .1 Standard of Acceptance: Clayton 90-21.
 - .3 If pressure reducing valve is left in the "normally open" position it shall be provided with either an integral or separate supervisory switch.
 - .4 Outlet pressures on all pressure reducing valves shall be set at 690 kPa [100 psig] unless otherwise indicated, at a discharge rate of 6.3 L/s [100 USgpm] for 38 mm [1½"] size and 15.8 L/s [250 USgpm] for 64 mm [2½"] size.
 - .5 All pressure reducing valves providing reduced pressure water to two or more outlet connections shall be the modulating piston type pressure reducing valve.
- .6 Pressure regulating sprinkler zone control valve - 2750 kPa [400 psig] - ULC listed:
 - .1 64 mm [2 ½"]: cast brass, straight pattern valve, rough brass finish with red wheel handle, female threaded outlet, 2760 kPa [400 psig] rated. Capable of field adjustment of the pressure.
 - .2 Standard of Acceptance: NFE model A203NB
- .7 Test and Drain Valves - 1210 kPa [175 psig] - ULC listed
 - .1 25 mm and 50 mm [1" through 2"]: Forged brass or cast bronze construction, tapped 6 mm [¼"] gauge outlet, and integral sight glass.
 - .2 Standard of Acceptance: Victaulic TestMaster II or NFE model A61
- .8 Alarm, Dry Pipe Valves:
 - .1 ULC listed for automatic fire suppression sprinkler systems.
 - .2 Standard of Acceptance: FireFlex, Grinnell, Victaulic NXT Series, Viking. -
- .9 All valves shall be ULC listed for fire suppression systems.
- .10 Required air pressure for dry valves shall be 90 kPa [13 psig].
- .11 All grooved end valves shall be of one manufacturer. Acceptable products: Victaulic.
- .12 Valves shall be externally resettable.
- .13 Valve internal components shall be replaceable without removing the valve from the installed position.
- .14 All drain valves shall be provided with hose end adaptors complete with caps and chains, and auxiliary drains shall be provided with a drum drip.

2.4 SPRINKLERS - GENERAL

- .1 The responsibility for allowing for all sprinklers for a complete installation is to be included in this Section of the work within the base Proposal price.
- .2 The layout on the drawings shows the general intention of the work and sprinkler locations with respect to other ceiling elements such as ceiling tiles, lights, and diffusers. The Contractor shall provide all additional sprinklers as may be required.
- .3 No extra cost will be considered based on failure of the Contractor to allow for extra sprinklers as required during construction to conform to all NFPA requirements and the Authority Having Jurisdiction, whether shown on the drawings or not.
- .4 Include sprinklers in concealed spaces containing exposed combustible construction including exposed wood beams, exposed wood framing and exposed wood ceiling materials.

2.5 SPRINKLERS - SPECIFIC

- .1 Standard of Acceptance: Viking
- .2 The sprinkler head body shall be die-cast with a glass bulb type activator.
- .3 The body shall be integrally cast with a hex-shaped wrench boss to reduce the risk of damage during installation.
 - .1 Wrenches shall be provided by the sprinkler manufacturer that directly engage the hex-shaped wrench boss in the sprinkler body.
- .4 Sprinklers with rubber O-rings are not permitted,
- .5 All sprinklers shall be ULC listed for use in the occupancies in which they are to be installed.
- .6 All sprinklers shall be quick response unless stated otherwise.
- .7 All sprinklers shall be for commercial applications unless stated otherwise.
- .8 Sprinkler Head Types:
 - .1 Upright, brass:
 - .1 plain brass, quick response, glass bulb in unfinished mechanical and service rooms without ceilings.
 - .2 Upright chrome:
 - .1 chrome plated, quick response, glass bulb in finished rooms and spaces without ceilings such as atriums, skylights and sprinklered exterior covered areas.
 - .3 Pendent, recessed:
 - .1 quick response, glass bulb, chrome plated finish on sprinklers and escutcheons in all finished areas with ceilings except noted below.
 - .4 Pendant, concealed:
 - .1 quick response, chrome plated flat cover plate, at locations as noted on the drawings including main entrances, foyers, boardrooms, and other similar high-profile locations.
 - .5 Horizontal Sidewall, recessed:
 - .1 recessed, quick response, glass bulb, chrome plated finish on sprinklers and escutcheons
 - .6 Horizontal Sidewall, extended throw:
 - .1 recessed, glass bulb, quick response, chrome plated finish on sprinklers and escutcheons
 - .7 Horizontal Sidewall, dry:
 - .1 recessed, glass bulb, quick response, chrome finish on sprinklers and escutcheons
 - .8 Intermediate and high temperature
 - .1 provide at top of each elevator shaft, elevator machine rooms and electrical rooms and other required locations as per NFPA 13, complete with wire guards.
 - .9 Dry Sprinklers
 - .1 provide dry pendant or dry sidewall sprinklers where serving an exterior area or an area subject to freezing from wet sprinkler system piping
- .9 All sprinklers in exposed areas subject to viewing by the occupants of the building shall be in chrome plated finish with chrome plated escutcheons.

- .10 All sprinklers in service spaces, mechanical and electrical rooms, and other spaces subject to view by the maintenance staff of the building only may be in natural plain brass finish.
- .11 Escutcheon plates shall allow accessible (T-bar) ceilings to be removed without removing sprinklers.
 - .1 Construction shall consist of a cup and skirt, the cup being the portion retaining the sprinkler and the skirt being the removable portion around the exterior perimeter of the cup that covers the tile hole.
 - .2 The finished escutcheon installation shall not project more than 4 mm [1/4"] below the finish ceiling surface.
 - .3 Recessed two-piece escutcheons and single piece escutcheons that are specifically manufactured with sprinklers to permit escutcheon and ceiling tile removable without sprinkler removal are acceptable.
 - .4 The escutcheons shall match the sprinkler finish, be of the same manufacturer as the sprinkler and shall coordinate with architectural features of the building.
- .12 Provide wire sprinkler guards in areas such as mechanical rooms, service rooms, exterior locations, where heads are located less than 2.1m [7'] from floor, etc. where sprinklers are susceptible to mechanical damage or vandalism.
- .13 Escutcheons and guards shall be listed, supplied, and approved for use with the sprinkler by the sprinkler manufacturer.

2.6 FLOW SWITCHES

- .1 ULC listed flow switches suitable for 24 VDC, each with one set of normally open and one set of normally closed contacts, time delay feature and paddle indicator specifically chosen and ULC listed for the size of pipe in which the flow switch is mounted.
- .2 Flow switch test and drain assembly immediately downstream of each flow switch in addition to normal inspector's test connections required by NFPA-13 requirements.
- .3 Flow switches shall be manufactured specifically for use in sprinkler systems rated a minimum 1210 kPa [175 psig], and higher pressure where required.

2.7 PRESSURE SWITCHES

- .1 ULC listed pressure switches where shown on drawings. Pressure switches shall be suitable for 24-VDC contact rating unless otherwise specified, rated a minimum 1210 kPa [175 psig], and higher pressure where required.

2.8 SUPERVISORY SWITCHES

- .1 ULC listed supervisory switches, Potter complete with "J" hooks (on gate valves of OS&Y type) Potter PIVS-C (on NRS valves) or "Potter" BF (on butterfly valves) complete with 1 set of normally open contacts and 1 set of normally closed contacts, or 2 sets of SPDT contacts.
- .2 Switches shall be suitable for 24-volt DC contact rating unless otherwise specified, rated a minimum 1210 kPa [175 psig], and higher pressure where required.
- .3 Looped cable devices are not acceptable.
- .4 Approved valves with integral and/or factory installed indicators and supervisory controls are acceptable products.

2.9 AIR COMPRESSORS

- .1 Provide air compressors for the capacity as determined by the hydraulic calculation design of the dry sprinkler systems.

2.10 SPARE SPRINKLERS

- .1 Provide a red baked enamel steel cabinet containing a minimum of 2 spare sprinklers of each pattern, but in addition, not less than the following of all types:
 - .1 Systems less than 300 heads: 6 spare heads minimum

2.11 FIRE DEPARTMENT CONNECTIONS (FDC)

- .1 Flush mounted fire department inlet connections:
 - .1 Flush mounted fire department inlet connection with cast brass body, double 64 mm [2½"] clapper valves, two 64 mm [2½"] inlet ports with brass plugs and chains, 100 mm [4"] outlet, integral ball drip.
 - .1 Threads shall be as per local Fire Department.
 - .2 Wall escutcheon plate 380 mm x 229 mm [15" x 9"] marked with 25 mm [1"] high raised letters "COMBINED AUTO SPKR STANDPIPE" or as applicable.
 - .3 Standard of Acceptance: National Fire Equipment model 229
- .2 Provide polished chrome plated finish on all exposed parts including the bodies, swivels, plugs and chains, escutcheon plates and the vertical pipe on sidewalk connections.
- .3 At the low point near each fire department connection, install a 90-degree elbow with drain connection to allow for system drainage to prevent freezing. Elbow shall be Victaulic #10-DR.

Part 3 Execution

3.1 WATER SUPPLY CONNECTIONS

- .1 If the water supply connections are in place prior to the commencement of this scope of work, connect to and adapt to the water supply connections and provide all required material and size adapters, offsets, fittings, tie rods, thrust blocks, seismic restraints, and other provisions for a complete installation.

3.2 FIRE SUPPRESSION SPRINKLER SYSTEMS

- .1 Refer to Section 21 05 00 Common Works, Quality Assurance, for requirements related to retaining the services of a Supporting Professional Fire Protection Engineer.
- .2 Supply and install fire suppression sprinkler systems throughout the area of work, in accordance with the listed codes, bylaws, standards and approvals including NFPA-13 and the provincial Building Code and Local Building By-Laws.
- .3 Fire suppression sprinkler system piping within the area of work shall generally be concealed except where specifically noted to be exposed.
- .4 Test sprinkler systems to listed requirements and furnish a certificate stating that such testing has been carried out and approved.
- .5 Provide inspector's test valves and drains at all remote points in the system to NFPA - 13 requirements.
- .6 Install piping to maximize headroom in all areas, including areas without ceilings where the piping is exposed, without interfering with other systems.
- .7 All sprinkler heads shall be new prior to being installed. The use of previously used sprinkler heads is prohibited.
- .8 Do not install sprinklers that have been dropped, damaged, or show a visible loss of fluid. Never install sprinklers with cracked bulbs.

- .9 Locate sprinklers in general conformance with the locations shown on the sprinkler design drawings.
 - .1 For exact locations refer to the architectural reflected ceiling plans. In the absence of reflected ceiling plans sprinklers shall be installed at the centre point, quarter point and/or third point in the long dimension of ceiling tiles, and in the center point of the short dimension of ceiling tiles, and/or in line with other ceiling elements, light fixtures, diffusers, audio devices and other fittings, in a symmetrical and aesthetic pattern acceptable to the Architect.
 - .2 Coordinate the sprinkler layout with architectural, structural, electrical, and mechanical HVAC ceiling elements.
 - .3 The Victaulic Vic-Flex multiple use flexible stainless steel drop system may be used to properly locate sprinkler heads.
 - .1 The drop system shall be supplied with required supporting members and bracing.
- .10 Sprinkler bulb protector shall be removed by hand after installation. Do not use tools or any other device(s) to remove the protector that could damage the bulb in any way.
- .11 At substantial completion, and a minimum of 10 working days prior to the scheduled Occupancy date, submit Letters of Assurance: Assurance of Professional Field Review and Compliance' to the Consultant and to the local Authority Having Jurisdiction in accordance with the provincial Building Code and Local Building By-Laws.
- .12 Submit to the Consultant a completed Contractor's Material and Test Certificate for all fire suppression systems, and a provide copy in the project Mechanical Operation and Maintenance Manuals.
 - .1 All sections of the forms must be filled in completely and accurately and signed by the applicable persons.
 - .2 In addition to their signatures, their names must be legibly printed on each form.

3.3

PIPE AND FITTINGS

- .1 All welding shall be done in the shop using welding fittings. Field welding is not permitted.
- .2 Flanged pattern fittings shall be used for piping 200 mm [8"] diameter and larger, and at valve stations and fire department connections.
- .3 Provide ULC listed expansion joints or flexible joint fitting assemblies at building expansion joints, building earthquake joints, building firewalls and all other locations as necessary.
- .4 All grooved end components including valves, fittings, gaskets, and couplings shall be of one manufacturer and shall be installed in accordance with the manufacturer's instructions.
- .5 The grooved coupling manufacturer's factory trained representative shall provide on-site training for the Contractor's field personnel in the use of grooving tools and installation of grooved joint products.
 - .1 The representative shall periodically visit the jobsite and review that the Contractor is following their recommended practices in grooved product installation.
 - .2 Roll and cut grooves shall be made in conformance with the fitting manufacturer's written Standard Groove Specifications and within the listed dimensional tolerances.
 - .3 The Contractor shall measure the groove dimensions and adjust the grooving machine rollers and cutters on a regular basis to ensure all grooves are within the manufacturer's written dimensional tolerances.
- .6 Tie rods shall only be used in conjunction with fittings possessing integral tie lugs.

- .7 Tie rods complete with their associated nuts and bolts shall be coated with two coats of asphaltic paint after installation.

3.4 FLUSHING OF SPRINKLER SYSTEMS

- .1 Flush piping with water until effluent is clear and free of debris.
- .2 Rate of flushing flows shall be as indicated in NFPA-13.
- .3 Provide proper drainage for this flushing operation.

3.5 FLOW SWITCHES

- .1 Provide tight pipe drain connections from test valves to open discharge at floor drains, service sinks, or other discharge points acceptable to the Owner or the Consultant.
- .2 Conduct tests in conjunction with Division 26/27/28 Electrical on each device to ensure the indication of an "alarm" signal and the correct location and labeling thereof on the fire alarm system.

3.6 SUPERVISORY SWITCHES

- .1 Install supervisory switches on all valves supplying the fire suppression sprinkler systems inside the building perimeter.
- .2 Conduct tests in conjunction with Division 26/27/28 Electrical on each device to ensure the indication of a "supervisory" signal and the correct location and labeling thereof on the fire alarm system.

3.7 SYSTEM DEMONSTRATIONS

- .1 Refer to Section 20 05 06 re system demonstration requirements.

3.8 ELECTRICAL EQUIPMENT PROTECTION FROM WATER

- .1 Sprinkler piping and sprinklers are to be installed in various areas containing electrical equipment as shown on the drawings.
- .2 Responsibility for water damage to electrical equipment in these areas from the sprinkler system installation whether due to testing or leakage prior to the Owner's acceptance of the building shall be the responsibility of this Section.
- .3 Provide and install in this Section of the work minimum 20-gauge sheet metal protective hoods individually located over all electrical equipment susceptible to water damage upon release of sprinklers in electrical areas.
 - .1 Such electrical equipment shall include all transformers, all equipment with ventilation grilles and all other switchgear with openings that will allow water entry into the electrical equipment.
 - .2 Protective hoods shall be sloped to allow shedding of water and shall project horizontally beyond the equipment perimeter and shall not be integrally mounted on the equipment unless prior approval has been obtained from the electrical authorities.
 - .3 Holes through protective hoods that cannot be avoided as in the case of traversing electrical conduit shall be sealed with an appropriate waterproof sealing compound.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section provides General, Product, and Execution Requirements for Fire Extinguishers.
- .2 Provide all required Fire Extinguishers as indicated, including, but not limited to:
 - .1 Multipurpose Dry Chemical Fire Extinguishers
 - .2 Special K Fire Extinguishers
 - .3 Fire Extinguishers cabinets

1.2 RELATED REQUIREMENTS

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.
- .2 In conjunction with Division 01, Division 20 General Mechanical Provisions shall govern all Division 21 Sections of the work.
- .3 Refer to Section 20 99 60 Mechanical Forms and submit all documentation therein that is applicable to Division 21.
- .4 Refer to and comply with the following sections:
 - .1 General Requirements - Division 01
 - .2 Common Work for Mechanical Systems – Division 20
 - .3 Fire Suppression Systems - Division 21
- .5 Coordinate the work of this Section with the HVAC trades, plumbing trades, electrical trades, and ceiling trades.

1.3 APPLICABLE CODES AND STANDARDS

- .1 Refer to Section 20 05 01, Codes, Bylaws and Standards.
- .2 Installation, execution, and testing shall conform to the following standards:
 - .1 Provincial Building Code
 - .2 Local building by-Laws
 - .3 Fire protection equipment and installation shall be approved by local Fire Commissioner.
 - .4 National Fire Protection Association NFPA 10 - Standard for Portable Fire Extinguishers.

1.4 QUALITY ASSURANCE

- .1 Refer to Section 20 05 00 General Mechanical Provisions, Quality Assurance for additional details.
- .2 Fire protection equipment and installation shall be approved by local Fire Commissioner.

1.5 SUBMITTALS

- .1 Comply with Section 21 05 00 Common Work for Fire Suppression Systems, Submittals
- .2 Refer to Section 20 99 60 Mechanical Forms and submit all documentation therein that is applicable to Division 21 Fire Suppression.

- .3 Shop Drawings
 - .1 Submit shop drawings in accordance with Division 1 and Section 20 05 05 Documentation and Submittals.
 - .2 Shop drawings are required for all materials and equipment.
 - .3 Submit shop drawings for the following items, including but not limited to:
 - .1 Fire Extinguishers
 - .2 Fire Extinguisher Cabinets
- .4 Record Drawings
 - .1 Refer to Division 1 and Section 20 05 05 Documentation and Submittals.
- .5 Occupancy Documentation Requirements
 - .1 Refer to Division 1 and Section 20 05 05 Documentation and Submittals.

Part 2 Products

2.1 STANDARD OF ACCEPTANCE:

- .1 Refer to Section 21 99 65 for Acceptable Manufacturers.

2.2 FIRE EXTINGUISHERS GENERAL:

- .1 All fire extinguisher assemblies shall be as per the following:
 - .1 Cabinets as indicated in the following clauses.
 - .2 Fully rechargeable
 - .3 Steel cylinder with bottom skirt
 - .4 Polyester powder coat finish
 - .5 Waterproof gauge
 - .6 Stainless steel or aluminum valve body and rivets, and gauge
 - .7 Handles with polyester powder coat finish,
 - .8 Steel pull pin
 - .9 Service info tag, hose strap, hose, and nozzle
 - .10 As applicable, meet or exceed requirements of
 - .1 CAN/ULC-S504 Multipurpose Dry Chemical Extinguishers
 - .2 CAN/ULC-S 508-02-R13 Standard for The Rating and Fire Testing of Fire Extinguishers
 - .3 NFPA 10 Standard for Portable Fire Extinguishers
 - .4 NFPA 17 Standard for Dry Chemical Extinguishing Systems

2.3 FIRE EXTINGUISHER FE-1

- .1 Cabinet, fully recessed:
 - .1 203 mm [8"] wide x 432 mm [17"] high x 127 mm [5"] deep fully recessed cabinet with 6mm [1/4"] turnback frame for minimum 127 mm [5"] wall thickness
 - .2 22-gauge steel tub, 16-gauge steel door and trim with 5 mm [3/16"] clear tempered glass.
 - .3 Full length semi-concealed piano hinge for 180-degree swing and flush stainless-steel door latch with no exposed fasteners

- .4 Gray baked enamel finish that can be used for either prime coat for field painting, or final finish.
- .2 Extinguisher:
 - .1 kg [5 lb.] dry chemical, multipurpose 2-A:10-B:C

2.4 FIRE EXTINGUISHER FE-2

- .1 Fully recessed cabinet with 2.3 kg [5 lb.] Type K liquid agent fire extinguisher specifically designed for use on fires that involve combustible cooking vegetable or animal fats in commercial cooking equipment multipurpose dry chemical fire extinguisher
- .2 Cabinet:
 - .1 203 mm [8"] wide x 432 mm [17"] high x 127 mm [5"] deep fully recessed cabinet with 6mm [1/4"] turnback frame for minimum 127 mm [5"] wall thickness
 - .2 22-gauge steel tub, 16-gauge steel door and trim with 5 mm [3/16"] clear tempered glass.
 - .3 Full length semi-concealed piano hinge for 180-degree swing and flush stainless-steel door latch with no exposed fasteners
 - .4 Gray baked enamel finish that can be used for either prime coat for field painting, or final finish.
- .3 Extinguisher:
 - .1 kg [5 lb.] Purple K
 - .2 Rating: 30B:C
 - .3 Exposed wall hung, Type K portable handheld fire extinguishers specifically designed for use on fires that involve combustible cooking vegetable or animal fats in commercial cooking equipment
 - .4 Type K contains potassium carbonate, potassium acetate, or potassium citrate
 - .5 Wide angle, soft discharge spray pattern, stainless-steel bourdon tube gauge, stainless steel pick-up tube and strainer, heavy chrome plated.

Part 3 Execution

3.1 INSTALLATION

- .1 Install fire extinguishers in cabinets at locations as indicated on the drawings.
- .2 Coordinate locations of fire extinguisher cabinets with the framing trades in order to facilitate recessed and semi-recessed installations.
- .3 Mount fire extinguishers and cabinets such that the top of the extinguisher is at 1,220 mm [4 feet] above the floor.
- .4 Install fire extinguisher cabinet doors, glazing panels and fire extinguishers in the cabinets prior to the project substantial completion review by the Consultant.

3.2 IDENTIFICATION

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

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section provides Product Requirements to indicate manufactures that are generally acceptable for proposing for the project.
- .2 The named manufacturers shall comply with all specific requirements of the Project, as well as details and performance as indicated by the Standard of Acceptance named in the individual specification sections and the equipment schedules.
- .3 Where a manufacturer's name below is underlined>, that manufacturer is generally used as the Basis of Design.
- .4 Refer to Specification Section 20 05 00 General Mechanical Provisions for details regarding Standard of Acceptance, Addition of Acceptable Manufacturers, and Alternate Materials and Equipment.
- .5 Shop Drawings are required to be submitted for all equipment.
- .6 This section refers to Division 21 only. Each Mechanical Division (20, 21, 22, 23, and 25) contains a similar section for equipment that falls under that division.
 - .1 For General Mechanical refer to section 20 99 65
 - .2 For Plumbing and Medical Gas Systems refer to section 22 99 65
 - .3 For HVAC items refer to section 23 99 65
 - .4 For Instrumentation and Controls items refer to section 25 99 65

Part 2 Products

2.1 ACCESS DOORS – BUILDING SURFACES

- .1 Specification Section 20 05 33
- .2 Acudor, Maxam Metal, Milcor, Cendrex, Elmdoor

2.2 CABINETS, HOSE & HOSE VALVES

- .1 Specification Section 21 12 00
- .2 NFE, Larsons, Wilson & Cousins

2.3 FIRE EXTINGUISHERS

- .1 Specification Section 21 25 00
- .2 NFE, Larsons, Wilson & Cousins, Flag

2.4 FIRE EXTINGUISHER CABINETS

- .1 Specification Section 21 25 00
- .2 NFE, Larsons, Wilson & Cousins

2.5 CLEAN AGENT EXTINGUISHING SYSTEMS

- .1 Specification Section 21 22 00
- .2 FM200, Inergen, Novec

- 2.6 CO2 EXTINGUISHING SYSTEMS**
 - .1 Kidde
- 2.7 FIRE SUPPRESSION SPRINKLERS**
 - .1 Specification Section 21 13 00
 - .2 Reliable, Grinnell, Viking, Victaulic
- 2.8 INSULATION – FIRE WRAP**
 - .1 Specification Section 21 07 13
 - .2 3M
- 2.9 PIPE FITTINGS & COUPLINGS – GROOVED END**
 - .1 Specification Section 20 12 00 and 21 13 00
 - .2 Victaulic
- 2.10 PRE-ACTION & DELUGE PACKAGES**
 - .1 Specification Section 20 13 00
 - .2 Fire Flex [Viking], Fire Pac [Victaulic]
- 2.11 FIRE PUMPS**
 - .1 Specification Section 20 30 00
 - .2 Armstrong, Aurora, Bell & Gossett
- 2.12 SEISMIC RESTRAINTS**
 - .1 Refer To Division 20
- 2.13 EXPANSION FITTINGS AND JOINTS**
 - .1 Specification Section 20 20 40
 - .2 Mason, Flexonics
- 2.14 FLEXIBLE PIPE CONNECTORS**
 - .1 Specification Section 20 20 40
 - .2 Mason, Victaulic
- 2.15 FLEXIBLE DUCT CONNECTORS**
 - .1 Refer to Specification Section 23 99 65
- 2.16 PIPE GUIDES AND ANCHORS**
 - .1 Specification Section 20 05 29
 - .2 Grinnell
- 2.17 FIRE STOPPING**
 - .1 Specification Section 20 05 31
 - .2 Hilti; 3M

2.18 PRESSURE GAUGES

- .1 Liquid - Dial
 - .1 Specification Section 20 05 19
 - .2 Marsh, Weksler, Terice, Ashcroft

2.19 HEAT TRACING

- .1 Specification Section 20 20 33
- .2 Raychem Chemelex Auto Trace

Part 3 Execution

3.1 NOT APPLICABLE.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section provides General, Product, and Execution Requirements for Common Work for Plumbing Systems (Division 22).
- .2 The Plumbing Contractor shall retain the services of a Contractor's Supporting Professional Seismic Engineer (Delegated Design) registered in the province where the project is located
 - .1 This Seismic Engineer shall provide complete engineering design and field review services for all seismic restraints.
 - .1 Refer to "Document Submittals" for additional information.
- .3 Provide all Plumbing Systems throughout the buildings as indicated, including, but not limited to the following:
 - .1 Domestic cold, hot and recirc water systems.
 - .2 Sanitary and storm sewer systems
 - .3 Natural gas and propane LPG systems
 - .4 Plumbing fixtures and trim

1.2 RELATED REQUIREMENTS

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.
- .2 In conjunction with Division 01, Division 20 General Mechanical Provisions shall govern all Division 22 Sections of the work.
- .3 Refer to Section 20 99 60 Mechanical Forms and submit all documentation therein that is applicable to Division 22.
- .4 Refer to and comply with the following sections:
 - .1 General Requirements - Division 01
 - .2 Common Work for Mechanical Systems – Division 20
 - .3 Plumbing Systems - Division 22
 - .4 Controls and Instrumentation - Division 25
 - .5 Electrical - Division 26/27

1.3 SEISMIC PROTECTION

- .1 Refer to Section 20 05 49 Seismic Restraints.

1.4 APPLICABLE CODES AND STANDARDS

- .1 Refer to Section 20 05 01, Codes, Bylaws and Standards.
- .2 All equipment, installation, and testing shall conform to the following standards as a minimum:
 - .1 Provincial Building Code
 - .2 Local Building By-Laws
 - .3 National Building Code of Canada
 - .4 ASME/ANSI B31.9 Building Services Piping

.5 CSA B149.1, Natural Gas and Propane Installation Code

.6 Provincial Gas and Safety Branch Bulletins

1.5 LEAD-FREE COMPLIANCE

- .1 All pipe, pipe fittings, valves, faucets, accessories, or any other system components that contact drinking water shall be certified as "lead-free" as required by NSF-372, and NSF 61 Annex G Section 9.

1.6 QUALITY ASSURANCE

- .1 Refer to Section 20 05 00 General Mechanical Provisions, Quality Assurance for additional details.
- .2 Follow manufacturer's recommended installation details and procedures for equipment, supplemented by requirements of Contract Documents.
- .3 Installation shall be in accordance with well-established practice and standards accepted and recognized by the Consultant and the Trade.
- .4 The Consultant 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.
- .5 Employ only Tradespeople holding valid Provincial Trade Qualification Certificates.
- .6 Temporary Usage of Plumbing Equipment
- .1 Plumbing equipment and systems shall not be used without the written permission of the Design Authority and in no circumstances shall be used prior to testing and inspection.

1.7 COORDINATION

- .1 Systems indicated in Division 22 sections, located inside and/or buried beneath and/or on the roof of the building shall extend to a point 900 mm [36"] beyond the exterior face of the building.
- .2 Plumbing drawings are diagrammatic and approximately to scale.
- .1 They establish the scope of the work and the general location and orientation of the plumbing systems.
- .2 The systems shall be installed generally in the locations and generally along the routings shown, close to the building structure and coordinated with other services.
- .3 Piping shall be concealed within walls, ceilings or other spaces and shall be routed to maximize head room and the intended use of the space through which they pass, unless specifically noted otherwise.

1.8 SUBMITTALS

- .1 Comply with Division 01 and Section 20 05 05 Documentation and Submittals.
- .2 Refer to Section 20 99 60 Mechanical Forms and submit all documentation therein that is applicable to Division 22.
- .3 Shop Drawings
- .1 Submit shop drawings in accordance with Division 01 and Division 20 05 05 Documentation and Submittals.
- .2 Shop drawings are required for all materials and equipment.

- .4 Product Options and Substitutions
 - .1 Refer to Section 20 05 00, for requirements pertaining to product options and substitutions.
- .5 Samples
 - .1 Refer to Division 01 and Section 20 05 05 Documentation and Submittals.
 - .2 Provide samples as indicated.
- .6 Maintenance Data
 - .1 Refer to Division 01 and Division 20 05 05 Documentation and Submittals.
 - .2 Submit manufacturer's recommended maintenance tasks for a one-year period. Include maintenance schedules and lubrication products.
 - .3 Refer to the following clause "Record Drawing" for additional information.
- .7 Record Drawings
 - .1 Refer to Division 01 and Division 20 05 05 Documentation and Submittals.
 - .2 Provide project "As-Built" Record Drawings for all plumbing systems.
 - .3 In addition, as a minimum, during the construction period,
 - .1 Keep on site a clean set of drawings marked up, IN COLOUR, to reflect the 'As-Built' state, for examination by the Consultant on a regular basis.
 - .2 Include elevations, rough-in details, and detailed locations of all hidden services, including locations of maintenance items and their associated identification code (ie. valves).
 - .3 All concealed (above grade and below grade) services shall be dimensionally located and noted, (use gridlines or structure as the reference).
 - .4 Provide invert elevations for all below grade services.
 - .4 At the time of 'Substantial Performance', submit to the Consultant one complete full-sized COLOUR hard copy of all Record Drawing information produced as per the above section.
 - .5 The Record Drawings produced shall be based on the IFC drawings and any updates (addendums, change orders, site instructions, field directives, etc) that have been issued.
 - .6 Submit signed and sealed copies of Record Drawings, Final Design Drawings and As-built Drawings as requested by the project Architect, Certified Professional (C.P.), Authority Having Jurisdiction and the Consultant.
 - .7 Submit hard copies of all As-Built record drawings for inclusion in the hard copy maintenance manual.
 - .8 Provide digital files in PDF format for inclusion in the digital format manuals and submit files directly to the consultant.
 - .1 Provide one PDF file for each drawing file produced.
 - .9 Transfer the Record Drawing mark-ups digitally using AutoCAD and by creating As-Built record drawings "DWG" files.
- .8 Occupancy Documentation Requirements
 - .1 Refer to Division 01 and Section 20 05 05 Documentation and Submittals.

1.9 SITE UTILITY SERVICES

- .1 Required connections are:
 - .1 Water connection for the domestic water system. (See Division 21 if combined with a fire service).
 - .2 Sanitary sewer connection.
 - .3 Storm sewer connection.
 - .4 Natural gas connection.
- .2 Refer to the drawings for the general arrangement of connections to the municipal or utility service systems.
- .3 Arrange and pay for all applicable fees and/or charges including connection fees and inspection fees levied by the municipal or utility authority for the right of connecting to their systems.
- .4 Determine the extent of work provided by the municipality or utility for the above referenced fees and provide all necessary additional work to effect complete and fully functional connections to their systems.

1.10 PENETRATING WATERTIGHT STRUCTURE

- .1 Provide water stops, link seals, and anchor flanges for all piping penetrating lower-level floors, exterior walls, etc., where water penetration may occur.

1.11 BUILDING OPERATION DURING CONSTRUCTION

- .1 To minimize operational difficulties for the building's staff, the Contractor shall cooperate with the Owner throughout the entire construction period and particularly ensure that noise and dust is minimized.
 - .1 Provide hoarding as deemed necessary and instructed.
- .2 Convenient access for the staff and public to the building must always be maintained.
 - .1 Minor inconvenience and interruption of services will be tolerated, provided advance notice is given to the Owner.
 - .2 The Contractor is expected to coordinate his work, in consultation with the Owner, so the operation of the facility can be maintained as nearly normal as possible.

1.12 EXISTING SERVICES

- .1 Protect all existing services encountered.
 - .1 Every effort has been made to show the known existing services. However, the removal of concealing surfaces may reveal other existing services.
 - .2 Work with the Owner's staff to trace the originating source and points served.
 - .3 Obtain instructions from the Consultant when existing services require relocation or modifications, other than those already indicated in the Contract Documents.
- .2 Arrange work to avoid shutdowns of existing services.
 - .1 Where shutdowns are unavoidable, obtain the Owner's approval of the timing, and work to minimize any interruptions.
- .3 In order to maintain existing services in operation, temporary relocations and/or bypasses of piping may be required.
- .4 Be responsible for any damages to existing system by this work.

- .5 The Owner reserves the right to withhold permission for a reasonable period with respect to any shutdown, if shutting off a service will interfere with important operations.

1.13

EXISTING PIPING AND EQUIPMENT TO BE REMOVED

- .1 All existing plumbing equipment and piping systems that become obsolete because of the work depicted on the drawings, or as indicated for abandonment, shall be removed, and disposed of if the Owner declines to retain, in the following situations:
 - .1 Where specifically noted on the drawings for removal.
 - .2 Where plumbing piping systems are exposed.
 - .3 Where ceilings are opened-up for any reason that would permit such removal to be implemented.
 - .1 In such a case only those portions of the plumbing equipment and systems that can be removed without taking down more ceiling shall be removed.
 - .4 If the Owner wants to retain the equipment or piping, move to a location as identified by the Owner.

1.14

ACOUSTICAL TREATMENT

- .1 The contractor shall consider equipment selection and pay close attention to detail during the rough-in stage to assure maximum acoustical provisions have been made.
- .2 The insulation for wall, ceilings and pipe chases as outlined herein is to be provided and installed under another division of work.
 - .1 This section is responsible for ensuring that all special requirement for plumbing systems have been met before the wall or ceilings have been closed in.
- .3 General Scope of Work
 - .1 All plumbing systems located in any walls or within 2 metres [6½'] in any direction of the enclosing walls of the following areas (or of similar areas not specifically named) shall be especially protected against noise transmission as defined herein:
 - .1 AV/TV studio.
 - .2 Classrooms (including laboratories).
 - .3 Conference rooms.
 - .4 Library.
 - .5 Private offices.
 - .6 Residence.
 - .7 Quiet Rooms.
 - .8 Sleeping Rooms.
 - .9 Study/testing rooms.
 - .10 Theatre.
- .4 Summary of Requirements
 - .1 Drain, Waste and Vent Stacks and Rainwater Leaders:
 - .1 Cast iron pipe and mechanical or neoprene compression gasket hub fittings shall be used.
 - .1 Plastic and copper piping are unacceptable.
 - .2 Waste piping over sound sensitive areas shall be insulated with pre-formed glass fiber insulation.

- .2 Stubs from appliances in the kitchens or lounge areas may be copper, but a minimum length should be used.
- .3 Waste connections from appliances and fixtures may be copper to the waste stack.
- .4 All copper dry vent pipes in walls, chases and ceiling plenums shall be lagged with 25 mm [1"] preformed glass fiber pipe insulation, canvas wrapped and sealed airtight and with one or more coats of heavy enamel paint.
- .5 Rainwater leader chases shall be airtight and contain non-compressed RSI 2.11 [R-12] glass fibre insulation in the stud cavities.
- .2 Domestic Water Operating Parameters:
 - .1 The maximum pressure at any faucet or outlet shall be 275 kPa [40 psig] with at least 10% of maximum rated flow through any pressure reducing valve in the system.
- .3 Pipe Sizes:
 - .1 The minimum pipe size to faucets or mixing valves of each fixture shall be 12 mm [$\frac{1}{2}$ "].
 - .1 The use of 9 mm [$\frac{3}{8}$ "] pipes is prohibited.
- .4 Plumbing Fixtures and Trim:
 - .1 Bathtubs:
 - .1 A layer of RSI 1.76 [R-10] insulation shall be placed under bathtubs.
 - .2 Mixing Valves and Faucets:
 - .1 Quiet cartridge shall be used at mixing faucets and shower valves.
 - .2 Any which subsequently become noisy during the warranty period shall be replaced at no extra charge to the owner.
 - .3 Back-to-back Fixtures:
 - .1 Drain line and water supply lines shall be divided at the riser.
 - .2 Tee takeoffs serving back-to-back fixtures are not permitted.
 - .4 Quick Acting Valves:
 - .1 All solenoid operated, or other quick acting valves shall be equipped with water hammer arresters located as close to the valves as possible.
 - .5 Waste Disposal Units:
 - .1 Waste disposal units shall be resiliently isolated from the sink and waste piping and a limp loop of flexible conduit shall be installed for all electrical connections.
 - .2 Compliance with local codes per installation of flexible connectors shall be checked.
- .5 Fastening to the structure:
 - .1 Piping shall not contact any framing stud or wall surface; or any other conduit, electrical or ventilation fixture that is connected to any wall or ceiling surface.
 - .2 Piping shall not be fastened to a partition which forms part of an adjacent room not served by the pipe in question.
 - .1 Do not secure piping to gypsum wallboard or its supporting frame.

- .3 Riser clamps shall be isolated from the structure using an approved resilient material between the support collar and the floor structure (Vibro-Acoustics type SN, 30 durometer, 57.15 mm [2¼"] x 57.15 mm [2¼"] in size, or an approved equal).
 - .1 An alternate method is to wrap the pipe with neoprene prior to clamping.
- .4 Pipe hangers shall be oversized to suit the insulation and shall have a protection shield between the insulation and the hanger.
- .5 Pipe hangers shall contain 50 durometer, 3.2 mm [1/8"] thick neoprene pads inserted between the hanger saddle and pipe.
- .6 Clearance Around Pipes:
 - .1 All pipe (bare or insulated) shall be clear of contact with studs or gypsum wallboard.
 - .2 Pipes in acoustically critical walls shall be wrapped with a minimum thickness of 6 mm [¼"] of Armaflex or Rubatex sleeving and secured by use of oversized clamps.
 - .1 This is not necessary where the piping is insulated if pipe clamps are mounted around the exterior of the insulation.
 - .2 Hard plastic pipe sleeves shall not be used.
- .7 Wall and Slab Penetration by Pipes:
 - .1 Slab penetrating pipes shall be glass fiber wrapped prior to grouting. The grout shall not contact pipes.
 - .2 Gypsum wallboard or plaster wall pipe penetrations shall be 3 mm [⅛"] to 6 mm [¼"] oversized with the pipe centred in the hole and the gap caulked with silicone or other non-hardening sealant.
 - .3 Pipe expansion joints shall be for noise free operation.
- .8 Ceiling, Wall and Other Plumbing Pipe Chases:
 - .1 The interior spaces shall be insulated with non-compressed RSI 2.11 [R-12] batt insulation in the following proportions:
 - .1 Ceiling plenum - 80% of area.
 - .2 Chases - 100% of all four vertical surfaces.
 - .3 Walls - 50% of space containing pipe, and 100% of adjacent stud space.

1.15 DIRECT DIGITAL CONTROL (DDC/BMS/BAS)

- .1 Refer to Division 25 Controls for further detail.
 - .1 Connection from plumbing systems equipment to the BMS network shall be by Division 25.
- .2 The following equipment and systems shall include contacts and/or electronic relays as required as an integral part of the equipment supplied and installed in the Plumbing Section of the work to allow connection from such equipment to a BMS network.
- .3 The plumbing systems and each condition to be monitored and/or controlled within each plumbing system for remote readout on the BMS network is as follows:
 - .1 Heat tracing
 - .2 BACnet interface for the connection to the BMS network.

1.16 MISCELLANEOUS METAL RELATED TO PLUMBING SYSTEMS

- .1 Refer to Section 20 05 00 General Mechanical Provisions.

1.17 CUTTING, PATCHING, DIGGING, CANNING, AND CORING

- .1 Refer to Section 20 05 00 General Mechanical Provisions.

1.18 MISCELLANEOUS METALS

- .1 Refer to Section 20 05 00 General Mechanical Provisions.

Part 2 Products

2.1 PRODUCT CONSISTENCY

- .1 All products utilized on the project shall be as per the shop drawing submissions.
- .2 All products of a similar nature used in a similar system or application shall be of the same manufacturer throughout the project.

2.2 HANGERS AND SUPPORTS

- .1 Refer to section 20 05 29 for Hangers, Supports, and Anchors.

2.3 PIPE SLEEVES AND ESCUTCHEONS

- .1 Refer to Section 20 05 31 Penetrations, Flashings, and Seals.

2.4 CLEANOUTS

- .1 Refer to section 22 13 00 Sanitary and Storm Drainage.

2.5 ACCESS DOORS

- .1 Refer to Section 20 05 33 Access Doors.

2.6 SERVICE PENETRATIONS IN RATED FIRE SEPARATIONS

- .1 Refer to Section 20 05 31 Penetrations, Flashings, and Seals.

2.7 SERVICE PENETRATIONS IN NON-RATED FIRE SEPARATIONS

- .1 Refer to Section 20 05 31 Penetrations, Flashings, and Seals.

2.8 FIRE STOPPING AND SMOKE SEAL MATERIALS

- .1 Refer to Section 20 05 31 Penetrations, Flashings, and Seals.

Part 3 Execution

3.1 PIPING INSTALLATION

- .1 General:
 - .1 Install piping straight, parallel, and close to walls and ceilings, with a downward slope of not less than 1:100 for gravity piping and with a slope to drain cocks, fixtures or equipment for all pressure piping unless otherwise indicated on drawings.
 - .1 Use industry standard fittings for direction changes.
 - .2 Provide drain cocks as required.

- .2 Install groups of piping parallel to each other; spaced to permit application of insulation, identification, and service access, on trapeze hangers.
- .3 Where pipe size differs from connection size to equipment, install reducing fitting close to equipment.
 - .1 Reducing bushings are not permitted.
- .4 Brass and copper pipe and tubing shall be free from surface damage.
 - .1 Replace damaged pipe or tubing.
- .5 Ream ends of pipe and tubes before installation.
- .6 Lay copper pipe so that it is not in contact with dissimilar metal and will not be crimped or collapsed.
 - .1 All joints on cast or ductile iron pressure service piping shall be made electrically conductive.
- .7 Install flanges or unions to permit removal of equipment without disturbing piping systems.
- .8 Clean ends of pipes or tubing and recesses of fittings to be jointed.
 - .1 Assemble joints without binding.
- .9 Install piping to connections at fixtures, equipment, outlets, and all other appurtenances requiring service.
- .10 Grade all vents to drain back to waste piping.
- .11 Plug or cap pipe and fittings to keep out debris during construction.
- .12 Jointing of pipe shall be compatible with type of pipe used.
- .13 Non-corrosive lubricant or Teflon tape shall be applied to the male thread of threaded joints.
- .14 Flush and clean out piping systems after testing.
- .2 Equipment Drainage:
 - .1 Install drain valves with caps and chains at low points.
 - .2 Extend equipment drain piping to discharge into floor or hub drain.
- .3 Expansion and Contraction and Building Seismic Joints:
 - .1 Support piping to prevent any stress or strain.
- .4 Install pressure piping with loops and offsets which will permit expansion and contraction to occur without damaging the pressure piping system.
- .5 Buried Piping:
 - .1 Lay pipe on compacted bedding of clean, coarse sand free from clay, snow or ice, organic matter, or stones.
 - .2 Do not lay pipe in water or when conditions are unsuitable.

3.2

ACCESS DOORS

- .1 Refer to Section 20 05 33 Access Doors.
- .2 Install access doors at all concealed cleanouts, traps, unions, expansion joints, valves, control valves, air vents, water hammer arrestors, special equipment, trap primers, vacuum breakers, and any other equipment for which subsequent periodic access will be required.
- .3 Locate access doors so that all concealed items are readily accessible for adjustment, operation, maintenance, and replacement.

- .4 Do not locate access doors in feature walls or ceilings without the prior approval of the Consultant.
 - .1 Locate in service areas and storage rooms wherever possible.

3.3 PIPING EXPANSION

- .1 Refer to Section 20 20 40 Expansion Fittings and Loops
- .2 Install piping with all necessary changes of direction, expansion loops, anchors, and guides so that expansion and contraction will not overstress the piping and equipment piping connections.
- .3 Expansion loops shall be of all welded construction with long radius elbows; cold sprung 50% and located between anchors.
- .4 Anchors shall be fabricated from mild steel plate and structural steel angle and channel sections, in accordance with ANSI B.31.

3.4 TESTING AND INSPECTION

- .1 Refer to Section 20 05 07 Materials Testing.
- .2 Refer to Section 20 05 08 Equipment Testing.
- .3 Furnish all labour, materials, instruments, etc. necessary for all required tests.
 - .1 All work shall be subject to inspection by local plumbing inspector and review by the Consultant.
 - .2 At least forty-eight (48) business hours (2 business days) notice shall be given in advance of making the required tests for projects within 40 km of the Consultant's Project Office.
- .4 All leaks shall be corrected by remaking the joints.
 - .1 The systems shall be retested until no leaks are observed.
- .5 No plumbing system or part thereof shall be covered until it has been inspected and approved by the Consultant and the Plumbing Inspector.
- .6 If any plumbing system or part thereof is covered before being inspected or approved, it shall be uncovered upon the direction of the Plumbing Inspector or Consultant.

3.5 PROJECT PHOTOGRAPHS

- .1 The Contractor shall provide digital photographs in "jpg" format to the Consultant complete with a text description or each photograph including the date, system type, materials used, and location/direction for all sections of underground piping prior to backfilling.
 - .1 Submit the photographs via email and/or disc as requested by the Consultant.
- .2 Provide additional digital photographs of the work as requested by the Consultant to assist in the resolution of RFIs, prior to covering the work.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section provides General, Product, and Execution Requirements for insulation on plumbing piping, valves, and tubing
- .2 Provide piping insulation on all plumbing piping systems as indicated, including, but not limited to
 - .1 Domestic cold water.
 - .2 Domestic hot water and recirculation.
 - .3 Domestic tempered water and recirculation.
 - .4 Storm drainage piping for the full length of the systems located within the building and the underside of roof drain bodies.
 - .5 Sanitary waste and p-traps, and storm drainage systems in exterior and unheated areas (after heat tracing is complete and commissioned).
 - .6 Sanitary vent stacks for the last 3 meters [10 feet] prior to penetrating the roof or penetrating a cold attic or similar space.
 - .7 Offset waste piping, p-traps and supplies under all wheelchair accessible lavatories and sinks.
 - .8 Provide anti-sweat coating where required.
- .3 Include:
 - .1 Insulation
 - .2 Adhesives, tie wires, tapes.
 - .3 Finishing and recovering.

1.2 RELATED REQUIREMENTS

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.
- .2 In conjunction with Division 01, Division 20 General Mechanical Provisions shall govern all Division 22 Sections of the work.
- .3 Refer to Section 20 99 60 Mechanical Forms and submit all documentation therein that is applicable to Division 22.
- .4 Refer to and comply with the following sections:
 - .1 General Requirements - Division 01
 - .2 Common Work for Mechanical Systems – Division 20
 - .3 Plumbing Systems - Division 22

1.3 APPLICABLE CODES AND STANDARDS

- .1 Refer to Section 20 05 01, Codes, Bylaws and Standards.
- .2 All installation, execution, and testing shall conform to the following standards as a minimum:
- .3 Insulation thickness and insulating values shall be in accordance with the most stringent of the National Energy Code of Canada for Buildings (NECB), and ASHRAE 90.1.
 - .1 The more stringent insulation value (between the two codes) will be the minimum level required for this project.

- .4 Flame spread ratings and smoke developed classifications shall be as required by the Provincial Building Code and NFPA 90A.
 - .1 Flame Spread / Smoke Development
 - .1 The flame spread/smoke developed index throughout the material shall not exceed the following:
 - .1 Flame Spread Index: 25
 - .2 Smoke Developed Index: 50
- .5 Insulating materials and accessories shall withstand service temperatures without smoldering, glowing, smoking, or flaming when tested in accordance with ASTM C411.
- .6 In addition to Section 20 05 01, Division 23 work shall conform to the following codes, regulations and standards, and all other codes in effect at the time °F award °F Contract, and any others having jurisdiction.
 - .1 National Energy Code °F Canada for Buildings (NECB).
 - .2 ASHRAE Standard 90.1 - Energy Standard for Buildings except Low Rise Residential Buildings
 - .3 ASTM C335 - Steady State Heat Transfer Properties °F Pipe Insulation.
 - .4 ASTM C411 - Hot-Surface Performance °F High Temperature Thermal Insulation
 - .5 ASTM C449 – Mineral Fiber Hydraulic Setting Thermal Insulating and Finishing Cement
 - .6 ASTM C533 - Calcium Silicate Bl°ck and Pipe Thermal Insulation
 - .7 ASTM C547 - Mineral Fiber Pipe Insulation
 - .8 ASTM C552 Standard Specification for Cellular Glass Thermal Insulation
 - .9 ASTM C553 - Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
 - .10 ASTM C612 - Mineral Fiber Bl°ck and Board Thermal Insulation
 - .11 ASTM C1126 (Gr.1) Standard Specification for Faced and Unfaced Rigid Cellular Phenolic Thermal Insulation
 - .12 CGSB 51-GP-11M Thermal Insulation, Mineral Fiber, Blanket for Piping, Ducting, Machinery and Boilers.
 - .13 CAN/CGSB-51.2 Thermal Insulation, Calcium Silicate, for Piping, Machinery and Boilers.
 - .14 CAN/CGSB-51.12 Cement, Thermal Insulating and Finishing.
 - .15 CAN/CGSB-51.40 Thermal Insulation, Flexible, Elastomeric, Unicellular, Sheet and Pipe Covering.
 - .16 CGSB 51-GP-52MA - Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation
 - .17 CAN/CGSB- 51.53 - Poly (Vinyl Chloride) Jacketing Sheet for Insulated Pipes, Vessels, and Round Ducts
 - .18 CAN/ULC- S102 - Surface Burning Characteristics °F Building Materials and Assemblies

1.4 **QUALITY ASSURANCE**

- .1 Refer to Section 20 05 00 General Mechanical Provisions, Quality Assurance for additional details.
- .2 Employ only Tradespeople holding valid Provincial Trade Qualification Certificates.

- .3 Be responsible for ensuring that enough space is always provided to allow proper installation °F insulation materials.
- .4 Material and method °F application to comply with or be tested in accordance with the latest version °F the following Insulation Standards Manuals,
 - .1 Provincial Building Code and I°Cal by-laws
 - .2 Master Insulators Ass°Ciation Standards Manual.
 - .3 Insulation Contractors Ass°Ciation Standards Manual.
 - .1 Use the latest edition °F the Insulation Standards Manual as the base reference standard if insufficient detail/information is contained herein, or if the Insulation Standards Manual Standard is more stringent.
 - .4 Thermal Insulation Ass°Ciation °F Canada (TIAC) National Insulation Standard.
- .5 Work shall be inspected by certified mechanical insulation inspectors who maintain current certification by the National Insulation Ass°Ciation, or other certified mechanical insulation certification ass°Ciation.
 - .1 Provide the Owner with a Quality Assurance Certificate for the mechanical insulation work at Substantial Completion °F the Work.

1.5 SUBMITTALS

- .1 Comply with Division 01 and Section 20 05 05 D°Cumentation and Submittals.
- .2 Comply with Section 22 05 00 Common Work for Plumbing Systems, Submittals
- .3 Refer to Section 20 99 60 Mechanical Forms and submit all d°Cumentation therein that is applicable to Division 22 Plumbing.
- .4 Shop Drawings
 - .1 Submit shop drawings in accordance with Division 01 and Division 20 05 05 D°Cumentation and Submittals.
 - .2 Shop drawings are required for all materials and equipment.
 - .3 Submit, for approval, substantiating manufacturer's d°Cumentation when requested for all materials, applications and finishing methods to establish that all will satisfy this specification and meet all applicable code requirements, before commencing work.
 - .4 Submit product data and test reports indicating that insulation and recovery assemblies meet flame/smoke development indices and performance requirements.
 - .5 Submit, for approval, samples °F each type °F firestopping, smoke seal and accessory.
 - .6 Submissions (Shop Drawings) and other d°Cumentation shall include all Adhesives and Sealants Material Safety Data Sheets (MSDS) highlighting the materials Volatile Organic Compound (V°C) levels.
 - .7 For each application submit an insulation schedule to include the following information:
 - .1 Materials
 - .2 Flame/Smoke rating
 - .3 "k" Value: Thermal conductivity °F insulating material per unit °F thickness (W/m.°C).
 - .4 Thickness
 - .5 Density
 - .6 Finish

- .7 Jacketing
- .8 Submit information showing installed insulation and membrane products meet the requirements of the Model National Energy Code of Canada for Buildings (MNECB) and ASHRAE 90.1.
- .5 Product Options and Substitutions
 - .1 Refer to Section 20 05 00, for requirements pertaining to product options and substitutions.
- .6 Samples
 - .1 Refer to Division 01 and Section 20 05 05 Documentation and Submittals.
 - .2 Submit, for approval, samples of all materials, applications and finishing methods to establish that all will satisfy this specification and meet all applicable code requirements, before commencing work.
- .7 Maintenance Data
 - .1 Refer to Division 01 and Division 20 05 05 Documentation and Submittals.
- .8 Occupancy Documentation Requirements
 - .1 Refer to Division 01 and Section 20 05 05 Documentation and Submittals.

Part 2 Products

2.1 ASBESTOS

- .1 All material / products installed shall be free of asbestos.

2.2 FLAME SPREAD RATINGS AND SMOKE DEVELOPED CLASSIFICATIONS

- .1 All material / products installed shall meet the 25/50 indices.

2.3 FIRE STOPPING AND SMOKE SEAL MATERIALS

- .1 Refer to Section 20 05 31 Penetrations, Flashings, and Seals.

2.4 HOT PIPE INSULATION - MINERAL FIBER:

- .1 Standard of Acceptance:
 - .1 Manson Alley K-ASJ
- .2 Service Temperature: 27°C to 150°C.
- .3 Material: Formed rigid mineral fiber insulation sleeving to ASTM C547.
- .4 Jacket: Factory applied general purpose jacket with pressure sensitive self-sealing longitudinal lap.
- .5 Thermal conductivity at 24°C [75°F] – 0.033 W/sq.m/°C [0.23 btu/h/sq.ft/°F]
- .6 Thermal conductivity at 93°C [200°F] – 0.04 W/sq.m/°C [0.28 btu/h/sq.ft/°F]

2.5 HOT PIPE INSULATION - HIGH TEMPERATURE

- .1 Use this type where there is a chance of insulation getting wet.
- .2 Standard of Acceptance:
 - .1 Johns Manville Thermo-12
- .3 Service Temperature: up to 750°C.

- .4 Material: Formed rigid hydrous calcium silicate for piping to ASTM C533.
- .5 Water resistant
- .6 Thermal conductivity at 93°C [200°F] – 0.058 W/m°C

2.6 CALCIUM SILICATE INSULATION - SPRAY GRADE

- .1 Standard °F Acceptance:
 - .1 Thermolite SG
- .2 Product for high temperature thermal insulation with super calcium silicate plastic.
- .3 This method is designed especially for large surfaces and irregular shapes such as turbines, boilers, storage tanks and others.

2.7 COLD PIPE INSULATION: - MINERAL FIBER:

- .1 Service Temperature: below 15°C.
- .2 Material: Formed mineral fibre rigid insulation sleeving to ASTM C547.
- .3 Thermal conductivity at 24°C [75°F] – 0.035 W/m°C [0.245 btu/h/sq.ft/°F]
- .4 Jacket: factory applied vapor barrier jacket to CGSB 51-GP-52Ma, Type 1, with longitudinal lap seal.

2.8 ACCESSORIES

- .1 For mineral fibre insulation materials:
 - .1 FSK Tape: Vapor barrier tape consisting °F laminated aluminum foil, glass fiber scrim and paper, with pressure sensitive self-adhesive.
 - .2 ASJ Tape: Vapor resistant tape consisting °F all-service jacket material with pressure sensitive self-adhesive.
 - .3 Adhesive: Quick setting adhesive for joints and lap sealing.
- .2 Thermal Insulating and Finishing Cement:
- .3 To ASTM C449 mineral fiber hydraulic setting thermal insulating and finishing cement for use up to 650°C.

2.9 RECOVERY JACKETS, FASTENERS, ADHESIVES, AND COATINGS

- .1 Canvas Jacket
 - .1 Fire rated, 6-ounce fire retardant canvas jacket
 - .2 Flame spread and smoke density does not exceed 25/50 per ASTM E84
 - .3 Standard °F Acceptance:
 - .1 Robson Flamex FR
- .2 Metal Jacket
 - .1 mm [22 ga] aluminum, smooth finish
 - .2 longitudinal slip joints and 50 mm [2"] end laps
 - .3 factory applied protective liner on interior surface
 - .4 mm [22 ga.] thick, die shaped fitting covers
 - .5 Stainless-steel bands
 - .6 Standard °F Acceptance:
 - .1 Johns Manville Metal Jacketing System

- .3 PVC Finishing Jacket
 - .1 minimum 0.50 mm [0.02"] thick, white
 - .2 minimum 0.50 mm [0.020"] thick premoulded one-piece fitting covers.
 - .3 Standard °F Acceptance:
 - .1 Proto PVC, Speedline PVC, Zeston PVC.

2.10 FASTENERS, ADHESIVES, AND COATINGS

- .1 General
 - .1 Tape shall be shelf adhesive 100 mm [4"] wide.
 - .2 Contact adhesive shall be quick setting.
 - .3 Lap seal adhesive shall be quick setting for joints and lap sealing for vapor barriers.
 - .4 Adhesive for canvas shall be washable, for cementing canvas to equipment insulation.
 - .5 Steel wire shall be 1.3 mm diameter galvanized anneal.
 - .6 Stainless steel wire shall be 1.3 mm diameter, type 304.
 - .7 Steel brands shall be 19 x 0.4 mm stainless steel.
- .2 Jacket Fastenings:
 - .1 Therm°Canvas and All Service:
 - .1 Stainless-steel staples (flare type)
 - .2 Compatible jacket finishing tape and contact adhesives as recommended by the jacket manufacturer.
 - .2 PVC Jacket and Fitting Covers:
 - .1 PVC self-adhesive tape, plastic pop rivets, bonding cement.
- .3 Adhesives:
 - .1 As recommended by the insulation or jacket manufacturer.
 - .2 Vapour barrier jacket adhesive:
 - .1 Standard °F Acceptance:
 - .1 Bakelite 230-39, Childers CP-82, Epolux Cadoprene 400, Foster 85-20.
 - .3 Fabric adhesive, to insulation pipe covering:
 - .1 Standard °F Acceptance:
 - .1 Bakelite 120-18, Childers CP-52, Epolux Cadalag 336, Foster 30-36, Robson White Lag.
- .4 Coatings:
 - .1 Vapour barrier coating on reinforcing membrane or on insulating cement:
 - .1 Standard °F Acceptance:
 - .1 Bakelite 120-09, Childers CP-50, Epolux Cadalag 336, Foster 30-36.
 - .2 Childers CP-30 (refrigeration suction lines only).
- .5 Reinforcing Membrane:
 - .1 Glass reinforcing membrane as commercially available.
- .6 Insulating Cement:
 - .1 Standard °F Acceptance:
 - .1 Fibrex Superkote, Partek No. 1, Ryder Thermokote MW high temperature.

- .7 Finishing Cement:
 - .1 Standard °F Acceptance:
 - .1 Ryder Thermokote 1 FW.
- .8 Preformed Insulation fittings:
 - .1 Standard °F Acceptance:
 - .1 Shur-Fit, Moulded Acoustic Products or from insulation fabricators.

Part 3 Execution

3.1 DEFINITIONS

- .1 For the purposes °F this section, the following definitions apply:
 - .1 Concealed: Piping systems and equipment in trenches, shafts, furring, and suspended ceilings.
 - .2 Exposed: Piping systems and equipment in mechanical rooms or otherwise not "concealed".
 - .1 For greater certainty, the following l°Cations are considered exposed:
 - .1 Services in all mechanical and electrical rooms.
 - .2 Services in tunnels,
 - .3 Services in space beneath raised floors.
 - .4 Trenches l°Cated in boiler rooms.

3.2 INSTALLATION GENERAL

- .1 Apply insulation after required piping system tests have been completed, witnessed, and certified.
- .2 Ensure piping surface is clean and dry before insulating.
- .3 Install in accordance with TIAC National Standards, or Provincial Standards.
- .4 Install in accordance with manufacturers recommendations.
- .5 Insulation and vapour barrier shall be continuous through all non-rated separations.
- .6 L°Cate cover seams in least visible l°Cations.
- .7 Stagger butt joints where multi-layered insulation is used.
- .8 On vertical piping with diameters 25 mm and larger, use insulation supports welded or bolted to pipe directly above lowest pipe fitting.
 - .1 Repeat supports on 4.5 m centers and at each valve and flange.
- .9 Tightly fit insulation sections to pipe to make smooth and even surfaces. Cut insulation for proper fit where weld beads protrude.
 - .1 Bevel away from studs and nuts to allow their removal without damage to insulation.
 - .2 Trim closely and neatly around extending parts °F pipe saddles, supports, hangers, clamp guides and seal with insulating/finishing cement.
- .10 Apply insulation and insulation finish in a workmanlike manner so that the finished product is uniform in diameter, smooth in finish, pleasing to the eye and with the longitudinal seams positioned to be concealed from view.
 - .1 Apply piping insulation materials, accessories and finishes in accordance with manufacturer's recommendations.

- .11 On piping 65mm [2-1/2"] and larger with insulation and vapour barrier, install high density insulation above hanger shield. Insert to be slightly longer than the length °F shield.
 - .1 Maintain integrity °F vapour barrier over full length °F pipe without interruption at sleeves, fittings and supports.
 - .2 Pro-pipe supports by Shur-Fit or equivalent products are acceptable.

3.3 INSULATION TERMINATION POINTS

- .1 Terminate insulation 75 mm [3"] back from all uninsulated fittings to provide working clearance and terminate insulation at 90o and finish with reinforced scrim cloth and vapour barrier mastic system.
 - .1 Cover onto pipe and over the insulation vapour barrier.
 - .2 On concealed hot services terminate insulation 75mm [3"] back from all uninsulated fittings, cut °Ff at 90o and apply reinforced scrim cloth and breather mastic system.
- .2 Cut back insulation at 45o and finish with a silicone caulking sealant around the base °F thermometer wells, pressure gauges, flow switches and pressure and control sensors.

3.4 VERTICAL RISERS

- .1 On vertical pipe over 75 mm [3"] provide insulation supports welded or bolted to pipe, directly above lowest pipe fitting. Thereafter, l°Cate on 4.5 m [15 ft.] centres.

3.5 HOT APPLICATION 26°C [80°F] TO 200°C [400°F]

- .1 Piping:
 - .1 Install medium temperature pipe insulation with integral jacket to pipe and hold in place by stapling the flap, with spreading staples at 75 mm [3"] centres.
 - .1 Pipe insulation with integral self-sealing jacket will not require additional fastening.
 - .2 Install strips °F vapour barrier jacket over butt joints and secure with spreading staples.
- .2 Fittings:
 - .1 Insulate fittings, to thickness °F adjacent pipe insulation, with oversize sections °F the pipe insulation mitred to fit tightly, or with preformed insulation fittings (Shur-Fit or equivalent) or from insulation fabricator.
- .3 Valves, Strainers:
 - .1 Insulate valve bodies and strainers with fitted pipe insulation, or mitred bl°Cks all to thickness °F adjacent pipe insulation or insulate with preformed insulation fittings (Shur-Fit or equivalent) or from insulation fabricator.
 - .1 Drains, blow°Ff plugs and caps shall be left uncovered.
- .4 Flanges and Victaulic Fittings:
 - .1 Insulate flanges with oversized pipe insulation or mitred bl°Cks to the thickness °F the adjacent pipe insulation.
 - .1 Insulation to overlap adjoining insulation at least 75 mm [3"].
 - .2 Alternatively, use preformed insulation fittings (Shur-Fit or equivalent).

3.6 COLD APPLICATION 10°C [50°F] AND LESS

- .1 Piping:
 - .1 Install low/medium temperature pipe insulation with integral vapour barrier jacket to pipe and hold in place by securing the jacket flap.
 - .1 Seal all flaps with vapour barrier adhesive.
 - .2 Pipe insulation with integral self-sealing vapour barrier jackets will not require additional fastening.
 - .2 Install strips °F vapour barrier jacket over butt joints with vapour barrier adhesive.
 - .1 Over wrap butt strips by 50 percent for insulation O.D. 300 mm [12"] and above apply strips on 250 mm [10"] centres for additional securement.
- .2 Fittings:
 - .1 Insulate fittings to thickness °F adjacent pipe insulation with sections °F the pipe insulation mitred to fit tightly, or preformed insulation fittings (Shur-Fit or equivalent), then apply reinforcing membrane embedded barrier coating and apply finish vapour barrier coating.
 - .2 Alternatively, insulate fittings with tightly placed flexible insulation and apply premoulded 25/50 rated PVC fitting covers.
 - .1 Apply vapour-barrier adhesive and tape on all joints and overlaps. Demonstrate continuity °F vapour barrier.
- .3 Valves, Strainers:
 - .1 Insulate valve bodies, bonnets and strainers with fitted pipe insulation, or mitred bl°cks all to thickness °F adjacent pipe insulation, then apply reinforcing membrane embedded in barrier coating.
 - .2 Alternately, insulate with preformed insulation fittings (Shur-Fit or equivalent) covered with reinforcing membrane, secured in place with a continuous barrier. Drains, blow-°Ff plugs and caps shall be left uncovered.
- .4 Unions, Flange and Victaulic Fittings:
 - .1 Insulate cold unions and flanges with oversized pipe insulation or mitred bl°cks to the thickness °F the adjacent pipe covering, then apply reinforcing membrane embedded in barrier coating and final coating °F vapour barrier mastic.
 - .2 Alternately, insulate with preformed insulation fittings (Shur-Fit or equivalent) covered with reinforcing membrane, secured in place and with continuous vapour barrier.

3.7 ANTI-SWEAT COATING

- .1 Coat with an anti-sweat coating - "No Sweat" by Robson Thermal Mfg. Ltd. or approved alternate the following uninsulated cold surfaces:
 - .1 Connecting surfaces °F thermometers, pressure gauges, flow switches, controllers, etc.
- .2 The coating thickness shall be as recommended by the coating manufacturer for the system operation conditions.

3.8 PIPE INSULATION FINISHES

- .1 "Concealed" insulation in horizontal and vertical service spaces will require no further finish.
- .2 "Concealed" pipe insulation in damp l°cations, e.g. pipe trenches shall have a vapour barrier jacket, vapour sealed.

- .3 "Exposed" flexible insulation shall be painted with a heavy brush coating °F foam plastic white insulation coating.
- .4 "Exposed" insulation inside the building shall be finished as follows:
- .5 Basic Finish:
 - .1 Apply pipe insulation with an integral all-service type jacket.
 - .2 Cover longitudinal and circumferential joints with jacket finishing tape neatly applied.
 - .1 Alternately secure jacketing longitudinal joint using integral self-sealing lap.
 - .3 Cover circumferential joints with jacket finishing butt strips. Over wrap strips by 50 percent.
 - .4 For insulation O.D. 300 mm [12"] apply strips on 250 mm [10"] centres for additional securement.
 - .5 PVC jacketing is not acceptable a substitute for a vapour barrier. Use ASJ or mastic system under it.
 - .6 Over insulation on short pipe runs and piping adjacent to fittings, valves, etc., jacket to be field applied.
 - .7 Over insulated fittings apply tack coat °F vapour barrier mastic and embed reinforcing membrane and cover with same mastic.
 - .8 Over insulated valve bodies, valve bonnets, strainers, and flanges, apply all-service jacketing using necessary fastenings and jacket finishing tape and with the reinforced mastic system on irregular surfaces.
- .6 PVC Jacket Finish:
 - .1 Over a factory applied integral all-service type jacket on the pipe insulation, apply PVC jacket.
 - .2 Over insulated fittings apply PVC fitting covers.
 - .1 Over insulated valve bodies, valve bonnets, strainers and flanges apply purchased PVC covers or field fabricate from PVC sheeting secured with solvent bonding cement.
 - .3 Finish fabric with one (1) coat °F fabric coating.
- .7 Canvas Finish:
 - .1 Over a factory applied integral all-service type jacket on the pipe insulation, apply canvas jacket.
 - .2 Over insulated fittings apply PVC fitting covers and canvas jacket.
 - .3 Over insulated valve bodies, valve bonnets, strainers and flanges apply purchased PVC covers or field fabricate from PVC sheeting secured with solvent bonding cement and apply canvas jacket.
 - .4 Finish fabric with one (1) coat °F fabric coating.
- .8 Aluminum Finish:
 - .1 Use in areas subject to traffic or mechanical damage, and all insulation outdoors, and were specifically called for on mechanical dwg's or equipment schedules.
- .9 "Exposed" outdoor insulation, including in the parking garage, shall be finished as follows:
 - .1 Insulation shall have a vapour sealed vapour barrier jacket.
 - .2 Over the pipe insulation jacket apply aluminum protective jacket.
 - .1 The longitudinal seam shall be l°Cated to shed water.

- .3 Secure the jacket using necessary metal banding on approximately 250 mm (10") centres and at the overlaps.
 - .1 Screws are not permitted on cold operating systems since they will penetrate the vapour barrier.
- .4 Over insulated fittings, valve bodies, valve bonnets, strainers and flanges apply metal jacket or preformed metal fittings to provide a complete jacket system. Secure with necessary fastenings.
- .5 Seal all outdoor jacketing watertight.

3.9 INSULATION PACKING °F PIPE SLEEVES

- .1 Tightly pack the space between all pipe sleeves and pipe or between pipe sleeve and pipe insulation with mineral wool insulation.
- .2 Apply fire stop compound to prevent transmission °F sound and/or passage °F fire/smoke.

3.10 CONNECTIONS TO EXISTING PIPING

- .1 Make good all existing insulation disturbed or removed to facilitate alterations and additions to existing piping.

3.11 HEAT TRACED PIPE INSULATION

- .1 Insulation shall completely cover heat tracing.
- .2 Oversize insulation as necessary.
- .3 Provide suitable identification for those pipe systems provided with heat tracing.
 - .1 At intervals °F 6 m [20 ft], provide on outside surface °F insulation an adhesive backed nameplate "Caution - Heat Tracing."

3.12 SCOPE °F INSULATION WORK

- .1 Insulate the following systems, unless otherwise noted:
 - .1 Domestic cold water system including meter body
 - .2 Domestic hot water supply and recirculation piping.
 - .3 Water valves, flanges, PRV's, strainers, check valves.
 - .4 Traps on handicapped lavatories.
 - .5 Sprinkler / standpipe system from domestic water connection point to 5 metres [16 ft] downstream there °F or to the inlet °F the alarm valve, whichever is less.
- .2 DO NOT insulate the following, unless otherwise noted:
 - .1 Piping used exclusively for fire protection (unless in unheated spaces).
 - .2 Soil stacks, vents, etc.,
 - .3 All special service piping, e.g. gas, compressed air, etc.
 - .4 Unions.
 - .5 Flexible connections or expansion joints (unless noted on the drawings).
 - .6 Check valve covers.
 - .7 Strainer leg and basket covers.
 - .8 Flexible fixture connections.

3.13 HOT PIPE INSULATION APPLICATION

- .1 Apply mineral fibre insulation when pipe surface temperatures are 25°C to 120°C.
- .2 Apply insulation and recovery over full length °F pipe without penetration °F hangers, interruption at sleeves and fittings.
 - .1 Seal butt joints with 100 mm wide ASJ tape.
- .3 Terminate insulation at each end °F valves, unions, and flanges. Cut to a 45o bevel to allow room for tools. Trowel finishing cement into bevel.
- .4 Cover fittings and valves with equivalent thickness °F finishing cement.
- .5 Apply finishing cement over exposed fittings and valves before applying canvas recovering.
- .6 Insulate with tightly placed flexible insulation and apply PVC fitting covers.
- .7 Cut insulation layers straight on 10 m centers with 25 mm gap to allow for expansion between terminations.
 - .1 Pack voids tightly with insulation and protect joints with aluminum sleeves.
- .8 Recover exposed insulated piping as indicated.
- .9 Recover insulated piping exposed to outdoors with waterpro°F aluminum jacket system.
- .10 Do not insulate the following piping system components:
 - .1 Hot water heating piping in radiation cabinets.
 - .2 Unions, flanges, strainers, expansion joints, flexible piping connectors.
 - .3 Condensate trap assemblies and drip legs.
 - .4 Chrome plated.
 - .5 Valve bonnets on domestic water systems.
 - .6 Drains, plugs, and caps.

3.14 COLD PIPE INSULATION APPLICATION

- .1 Insulate 2.5 m [8'] portion °F plumbing vents measured from ro°F outlet back. Do not insulate remaining vent piping.
- .2 Insulate storm sewer piping throughout. Insulate final 2.5 m [8'] portion from outlet drain back with 25 mm [1"] insulation.
- .3 Apply vapor retardant insulation and recovery over full length °F pipe without penetration °F hangers, interruption at sleeves and fittings.
- .4 Apply adhesive to ends °F butt joints and seal joint seams with 100 mm [4"] wide strips °F joint tape.
- .5 Terminate insulation at each end °F valves, unions, and flanges. Cut to a 45o bevel to allow room for tools. Trowel finishing cement into bevel.
- .6 Insulate complete system including valves, unions, flanges, strainers, drains, caps, and fittings.
 - .1 Cover fittings and valves with equivalent thickness °F finishing cement.
 - .2 Cover finishing cement with open mesh glass cloth and vapor retardant adhesive.
- .7 Seal lap joints with 100% coverage °F joint tape and seal the assembly with vapor retardant adhesive.
- .8 Alternatively, insulate with tightly placed flexible insulation and apply reinforcing membrane embedded in vapor retardant coating and apply PVC fitting covers.
- .9 Recover exposed insulated piping as indicated.

- .10 Recover insulated piping exposed to outdoors with aluminum jacketing system.

3.15

INSULATION TYPE AND THICKNESS SCHEDULE

- .1 Evaporator Drip Pan Drains
 - .1 Design Operating Temperature 11°C [51°F] and above
 - .2 Pipe Size / Insulation Thickness: not required
- .2 Evaporator Drip Pan Drains
 - .1 Design Operating Temperature 10°C [50°F] and lower
 - .2 Pipe Size / Insulation Thickness:
 - .1 All Pipe Sizes: 25 [1"]
- .3 Domestic Cold Water
 - .1 Design Operating Temperature less than 4.9°C [41°F]
 - .2 Pipe Size / Insulation Thickness:
 - .1 25mm [1"] and less: 25 [1"]
 - .2 30mm [1-1/4"] and larger: 40 [1.5"]
- .4 Domestic Hot & Tempered Water Supply and Recirculation
 - .1 Design Operating Temperature 50-90°C [120-200°F]
 - .2 Pipe Size / Insulation Thickness:
 - .1 25mm [1"] and less: 40 [1.5"]
 - .2 30mm [1-1/4"] and larger: 50 [2"]
- .5 Buried & Exterior Rainwater Storm Drainage
 - .1 Design Operating Temperature 5°C [40°F]
 - .2 Pipe Size / Insulation Thickness: not required
- .6 Above Grade Interior Rainwater Storm Drainage including drain bodies
 - .1 Design Operating Temperature, 5°C [40°F]
 - .2 Pipe Size / Insulation Thickness:
 - .1 All sizes: 40 [1.5"]

END °F SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section provides General, Product, and Execution Requirements for Domestic Water Distribution Systems.
- .2 Provide all interior domestic water distribution systems as called for and as scheduled.
- .3 Provide Domestic Water distribution as indicated, including, but not limited to:
 - .1 Domestic cold water.
 - .2 Domestic hot water and recirculation.
- .4 Interior domestic water piping shall be provided as depicted on the drawings to all plumbing fixtures, appliances and equipment that require domestic water service.
- .5 New interior domestic water piping shall be connected to receive domestic water supply from the existing domestic water piping as depicted on the drawings.
- .6 Non-functioning existing interior domestic water piping shall be removed where access is readily available or capped off and abandoned in place as referenced on the drawings.
- .7 All equipment, pipe, pipe fittings, valves, accessories, or any other system components that contact drinking water shall be certified as "lead-free" as required by NSF-372, and NSF 61 Annex G Section 9.

1.2 RELATED REQUIREMENTS

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.
- .2 In conjunction with Division 01, Division 20 General Mechanical Provisions shall govern all Division 22 Sections of the work.
- .3 Refer to Section 20 99 60 Mechanical Forms and submit all documentation therein that is applicable to Division 22.
- .4 Refer to and comply with the following sections:
 - .1 General Requirements - Division 01
 - .2 Common Work for Mechanical Systems – Division 20
 - .3 Plumbing Systems - Division 22
 - .4 Electrical - Division 26/27

1.3 LEAD-FREE COMPLIANCE

- .1 All pipe, pipe fittings, valves, faucets, accessories, or any other system components that contact drinking water shall be certified as "lead-free" as required by NSF-372, and NSF 61 Annex G Section 9.
- .2 All solder joints shall comply with ASTM B828 2002. Flux shall comply with ASTM B813 2010.
- .3 No paints containing lead or cadmium.
- .4 Contractor shall submit documentation for all applicable products to prove compliance with the above.

1.4 APPLICABLE CODES AND STANDARDS

- .1 Refer to Section 20 05 01, Codes, Bylaws and Standards.

- .2 All equipment, materials, installation, and testing shall conform to the following standards as a minimum:
 - .1 Provincial Building Code
 - .2 Local Building By-Laws

1.5 QUALITY ASSURANCE

- .1 Refer to Section 20 05 00 General Mechanical Provisions, Quality Assurance for additional details.
- .2 Employ only Tradespeople holding valid Provincial Trade Qualification Certificates.
- .3 Follow manufacturer's recommended installation details and procedures for equipment, supplemented by requirements of Contract Documents.
- .4 Installation shall be in accordance with well-established practice and standards accepted and recognized by the Consultant and the Trade.
- .5 The Consultant 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.

1.6 TEMPORARY USAGE OF DOMESTIC WATER SYSTEMS

- .1 Plumbing equipment and systems shall not be used without the written permission of the Consultant and in no circumstances shall be used prior to testing and inspection.

1.7 SUBMITTALS

- .1 Comply with Division 01 and Section 20 05 05 Documentation and Submittals.
- .2 Comply with Section 22 05 00 Common Work for Plumbing Systems, Submittals
- .3 Refer to Section 20 99 60 Mechanical Forms and submit all documentation therein that is applicable to Division 22 Plumbing.
- .4 Shop Drawings
 - .1 Submit shop drawings in accordance with Division 01 and Section 20 05 05 Documentation and Submittals.
 - .2 Shop drawings are required for all materials and equipment.
- .5 Product Options and Substitutions
 - .1 Refer to Section 20 05 00, for requirements pertaining to product options and substitutions.
- .6 Record Drawings
 - .1 Refer to Division 01 and Division 20 05 05 Documentation and Submittals.
- .7 Maintenance Data
 - .1 Refer to Division 01 and Section 20 05 05 Documentation and Submittals.
 - .2 Submit manufacturer's recommended maintenance tasks for a one-year period. Include maintenance schedules and lubrication products.
 - .3 Submit operating and maintenance data for inclusion into the manuals.
- .8 Occupancy Documentation Requirements
 - .1 Refer to Division 01 and Section 20 05 05 Documentation and Submittals.

Part 2 Products

2.1 PIPE AND FITTINGS

- .1 Low Lead Content
 - .1 All pipe, pipe fittings, valves, faucets, accessories, or any other system components that contact drinking water shall be certified as "lead-free" as required by NSF-372, and NSF 61 Annex G Section 9.
 - .2 All solder joints shall comply with ASTM B828 2002. Flux shall comply with ASTM B813 2010.
 - .3 No paints containing lead or cadmium.
 - .4 Contractor shall submit documentation for all applicable products to prove compliance with the above.
- .2 Buried water pipe and fittings inside the building:
 - .1 75 mm and smaller.
 - .1 Polyethylene (PE) water pipe series 160 to CSA B137.1-M
 - .2 Polyvinyl chloride (PVC) Schedule 40 pressure pipe to CSA B137.3 with socket fittings to ASTM D2466/D2467.
 - .3 Chlorinated polyvinyl chloride (CPVC) water pipe, fittings, and solvent cement to CSA B137.6-M
 - .4 Type 'K' seamless soft copper tubing to ASTM B88 or copper pipe to ASTM B42 with cast brass or wrought copper fittings and silver soldered joints all encased in a polyethylene piping system.
 - .2 100 mm and larger.
 - .1 All fittings shall be provided with integral tie lugs where thrust blocks are unable to be used. Weld on lugs are not acceptable.
 - .2 Polyvinyl chloride (PVC) AWWA C-905 pressure water pipe to CSA B137.3 with C905 PVC Pressure Fittings.
 - .3 Centrifugally spun cement lined cast iron pipe with rubber ring type joints for 1380 kPa [200 psig] working pressure.
 - .4 Ductile iron pipe to ANSI/AWWA C150 and C151, minimum thickness Special Class 54 for use with cut grooved fittings, cement mortar lining to ANSI/AWWA C104 with NSF-61 epoxy lining on top of the cement lining. Confirm temperature limitations.
 - .1 Pipe to be ULC Listed.
 - .2 Standard of Acceptance: Canada Pipe Company Limited.
 - .3 Ductile iron pressure couplings to ANSI/AWWA C-606 for grooved end AWWA fittings and cut grooved AWWA ductile iron pressure pipe with synthetic gasket, plated carbon steel bolts, alkyd phenolic primer and protective enamel finish.
 - .1 Standard of Acceptance:
 - .1 Victaulic Style 31 Couplings,
 - .2 Victaulic Style 307 Transition Couplings
 - .3 Victaulic Style 31 Grade M FlushSeal gasket.
 - .4 Ductile iron pressure fittings to ANSI/AWWA C-606, cement mortar lined, black asphalt coated, NSF 61 Annex G and Section 9 compliant.
 - .1 Bolts, nuts, hex head with washers: to ASTM A307, heavy series

- .2 Tie rods, bolts and nuts shall conform to the requirements of ASTM specifications for steel bridges and buildings, serial designation A-7.
 - .1 All bolts shall have American Standard coarse screw threads with a Class 2 free fit. Rolled threads are unacceptable.
- .3 Above ground water pipe and fittings inside the building:
 - .1 Copper:
 - .1 Pipe
 - .1 Type "K" hard drawn seamless copper tubing to ASTM B88 or copper pipe to ASTM B42.
 - .2 All copper water tubing shall be certified by the Canadian Standards Association or Warnock Hersey Professional Services Ltd. to ASTM B88.
 - .2 Fittings
 - .1 Use of the 'T-Drill' system of joining copper piping is not permitted.
 - .2 Saddle type fittings (mechanical tees) shall not be installed in drainage, venting or water systems.
 - .3 Compression fittings, Vic-Press, SharkBite, and similar fittings are not acceptable.
 - .4 Above ground copper water pipe fittings inside the building:
 - .1 Cast brass or wrought copper solder joint pressure fittings with 95/5 Sn/Sb or Silvacbrite 100 solder joints; or
 - .2 Grooved and shoulder-type mechanical couplings for pressure applications shall conform to CSA B242, "Groove- and Shoulder-Type Mechanical Pipe Couplings."
 - .3 Cast bronze or wrought copper roll grooved pressure fittings with grooved mechanical pipe connector couplings with angle bolt pad and Victaulic style of 'flush seal' gaskets.
 - .1 Standard of Acceptance: Victaulic 'The Copper Connection System for Copper Tubing (CTS)'. - .2 Saddle connectors are not permitted.
 - .2 PEX
 - .1 Up to 40mm, unless noted otherwise:
 - .1 Crosslinked polyethylene PEX-A-PEX
 - .2 Flame/smoke ratings not to exceed 25/50, product shall be plenum rated.
 - .3 Rated for 180°F (82°C) at 100 psig (689 kPa)
 - .4 Uponor PEX-a with ProPEX couplings and Uponor PEXa pipe support.
 - .3 Stainless-steel
 - .1 50mm and larger, unless noted otherwise:
 - .1 Stainless-steel Pipe: ASTM A312, Schedule 10S, Type 304/304L Unified Alloy YC-INOX, or greater, stainless-steel with plain ends, all conforming to CSA-B242
 - .2 All products shall be UL classified in accordance with ANSI / NSF-61 for potable water service and shall be certified to the low lead requirements of NSF-372.
 - .3 65mm [2.5"] unless otherwise noted, and larger pipe shall be grooved using a grooving tool, specifically designed for stainless steel pipe.

- .4 Fittings 65 mm [2.5"] and larger: ASTM A403 stainless steel, or factory-fabricated from ASTM A312 stainless steel pipe, meeting ASME B16.9 and certified to NSF/ANSI 61 & NFS/ANSI372. (Schedule to match adjoining system.)
- .5 Grooved joint couplings: rigid style couplings consisting of two ductile iron ASTM A-536 housing segments, pressure responsive elastomer flush seal gasket, and electroplated steel bolts and nuts, certified to NSF/ANSI 372 & ANSI/NSF 61.
- .6 Each grooved joint shall be verified as being installed in accordance with manufacture's standards and identified (with blue paint) as such.
 - .1 Prior to installation, coordinate with local equipment representatives to ensure training of installers is adequate and up to date.
 - .2 Prior to installation, coordinate with local equipment representatives to ensure that the equipment used is calibrated.

2.2 VALVES (LEAD-FREE)

- .1 Low Lead Content
 - .1 All potable water pipes, pipe fittings, plumbing fittings, faucets, solder, and flux to connect plumbing pipe to be NSF 61, Annex G, Section 9, or NSF 372 compliant.
 - .2 All solder joints shall comply with ASTM B828 2002. Flux shall comply with ASTM B813 2010.
 - .3 No paints containing lead or cadmium.
 - .4 Contractor shall submit documentation for all applicable products to prove compliance with the above.
- .2 Gate: (for shut-off and isolation), bronze body, inside screw, rising stem, Class 125, ASME rated
 - .1 50mm and smaller:
 - .1 Standard of Acceptance:
 - .1 Soldered - Kitz 807, Toyo 207ALF
 - .2 Threaded - Kitz 808, Toyo 206ALF
- .3 Ball: (in lieu of gate valves or as specified)
 - .1 50mm and smaller: forged brass body, stainless steel vented ball and stem, PTFE seat and seal, 325 psig at 212oF, ASME rated
 - .1 Standard of Acceptance:
 - .1 Soldered. - Kitz 869M
 - .2 Threaded - Kitz 868M
- .4 Butterfly: (in lieu of gate valves or as specified,)
 - .1 65 mm and larger: flanged, full lug body, NSF-372 compliant, suitable for bi-directional dead-end service, extended neck, stainless steel stem and disc, ductile iron body, low operating torque lever lock handle operators on 100 mm diameter and smaller, handwheel worm gear operator on 150 mm diameter and larger.
 - .1 ANSI 125/150 temperature and pressure rating and suitable for working pressures up to 1720 kPa [250 psig] at 100°C [212°F].
 - .2 Standard of Acceptance
 - .1 Kitz 6133 (B/E) L

- .5 Globe: (for throttling, bypass and make-up applications), bronze body, inside screw, rising stem, Class 125, ASME rated
 - .1 50mm and smaller:
 - .1 Standard of Acceptance:
 - .1 Soldered. Kitz 812
 - .2 Threaded Kitz 811
- .6 Swing Check Valves: (for horizontal installation only) Y-pattern, horizontal swing type, bronze body and disc, screwed cap, integral seat, Class 125, ASME rated
 - .1 50mm and smaller:
 - .1 Standard of Acceptance:
 - .1 Soldered. Kitz 823
 - .2 Threaded Kitz 822
 - .2 65 mm and larger: flanged,
- .7 Balancing Valves (for domestic hot water recirculation):
 - .1 Thermostatic Variable Flow Type
 - .1 Standard of Acceptance:
 - .1 Victaulic TA Series 7TZ Therm Zero Valve
 - .2 For potable water applications, lead-free and compliant with NSF 61 and NSF 372 for cold and hot potable water service.
 - .3 Lead-free brass valve body, corrosion-resistant acetal material valve plug, corrosion-resistant polysulphone material valve seat, EPDM rubber O-rings, fiberglass reinforced polyamide plastic handwheel.
 - .4 1,600 kPa maximum working pressure
 - .5 Adjustable temperature setting with integral dial thermometer
 - .2 Non-thermostatic Cartridge Type
 - .1 Standard of Acceptance:
 - .1 Nexus UltraMatic UMNL
 - .2 25mm and smaller
 - .3 Lead-free brass construction, automatic flow limiting valve with test ports
 - .4 Removable pre-calibrated flow control cartridge
 - .5 Specifically designed for domestic potable water applications, threaded ends, 0.03 LPS to 0.38 LPS.
 - .3 Manual Circuit Setter Type
 - .1 Standard of Acceptance:
 - .1 Watts LFCSM-61-S
 - .2 50mm and smaller
 - .3 Lead-free brass construction, ball-type design balancing valve, extended throttling range, indicator plate
 - .4 Accurate flow measurement even in low flow ranges
 - .5 Viton packing, PTFE seats, specifically designed for domestic potable water applications, solder ends.
- .8 Pressure Reducing Valves
 - .1 65 mm [2½"] and larger, 860 kPa [125 psig] rating, NSF-61 compliant epoxy coating, integral external pilot operated for accurate downstream pressure maintenance,

maintenance and repairs shall be possible without removing the main valve body from the line.

- .1 Standard of Acceptance:
 - .1 Singer 106PR.

.9 Strainers:

- .1 75mm and smaller: wye-pattern lead free cast copper silicon alloy
- .2 Standard of Acceptance:
 - .1 Watts LF777

.10 Vacuum relief: (for DHW tanks)

- .1 Water service vacuum relief valves, lead free brass body, low profile, protective cap,
- .2 Standard of Acceptance:
 - .1 Watts LFN36

.11 Solenoid Valves:

- .1 Two-way solenoid valve, lead-free brass or stainless-steel body.
- .2 Standard of Acceptance:
 - .1 ASCO

.12 Drain Valves:

- .1 50mm and smaller: forged brass body, stainless steel vented ball and stem, PTFE seat and seal, [325 psig at 212oF], ASME rated, complete with cap and chain.
- .2 Standard of Acceptance:
 - .1 Threaded - Kitz 868M

2.3 BACKFLOW PREVENTION STATIONS

.1 Reduced pressure principle backflow prevention device (RPBP)

- .1 65 mm [2½"] to 250 mm [10"], 1206 kPa [175 psig] pressure rating
 - .1 Suitable for up to 60oC [140oF] water temperature, ductile iron body with NSF-61 epoxy lining, fusion epoxy finish exterior, lead-free, with inlet and outlet shut-off valves, double check valve assembly with differential relief port
 - .2 Standard of Acceptance:
 - .1 Zurn 375

2.4 STRAINERS

.1 50 mm and smaller, wye-pattern, threaded ends, NSF-61 compliant cast bronze body and plug, stainless-steel screen, blow down outlet, epoxy coated removeable cover, 2068 kPa [300 psig] rating.

- .1 Standard of Acceptance:
 - .1 Zurn SXL, Watts 77F-SS.

.2 65 mm and larger, wye-pattern, flanged ends, lead-free, stainless-steel body, stainless-steel screen, blow down outlet, epoxy coated removeable cover, 1378 kPa [200 psig] rating.

- .1 Standard of Acceptance:
 - .1 Watts 77F-SS.

2.5 WATER HAMMER ARRESTORS

- .1 Bellows style with stainless steel casing and welded stainless steel nesting bellows, nitrogen and helium charged chambers are not acceptable.
 - .1 Standard of Acceptance:
 - .1 MiFab WHB

2.6 PIPE JOINTS

- .1 Solders and fluxes having a lead content and self-cleaning acid type fluxes are not acceptable.
- .2 All copper to steel or iron and flanged adaptors shall be brass, not copper.
- .3 All unions or similar interconnections between dissimilar metals shall be dielectric couplings.
 - .1 Standard of Acceptance:
 - .1 Epco Dielectric Pipe Fittings, Victaulic dielectric waterway

2.7 TRAP SEAL PRIMERS

- .1 Time clock controlled electronic trap primer:
 - .1 Provide trap priming assembly to maintain a constant water seal in multiple floor drain traps.
 - .2 Assembly shall include
 - .1 16-gauge galvanized steel metal cabinet, suitable for recessed mounting, stainless steel access door with screwdriver latch
 - .2 Manual shut off valve
 - .3 Anti-syphon atmospheric vacuum breaker
 - .4 Calibrated manifold header for equal distribution to suit number of drains
 - .5 Time clock timer to activate once per day.
 - .6 24V Solenoid Valve
 - .7 20mm [3/4"] type L copper tubing
 - .8 Lead-free (<0.2%) soldered joints
 - .9 Select unit model/size to suit number of connected drains.
 - .3 Standard of Acceptance:
 - .1 Precision Plumbing Products Prime-Time Electronic Trap Priming Assembly

2.8 LINK SEALS

- .1 Fit each pipe passing through floor slab in contact with ground or basement walls below grade with link seal between sleeve and bare pipe.
- .2 Submit manufacturer's literature and schedule showing location, service, inside diameter of wall opening, sleeve length and pipe outside diameter.
- .3 Link seal:
 - .1 Manufactured from modular synthetic rubber links with stainless steel hardware.
 - .2 Loosely assembled with bolts to form continuous rubber belt around pipe, with pressure plate under each bolt head and nut.
 - .3 Constructed to provide electrical insulation between pipe and sleeve.
- .4 Installation
 - .1 Determine inside diameter of each wall opening or sleeve before ordering seal.

- .5 Position seal in sleeve around pipe and tighten bolts to expand rubber links until watertight seal is obtained.

Part 3 Execution

3.1 CONCEALED SUPPLY PIPING

- .1 Concealed water supply piping to plumbing fixtures, trim items, equipment, hose bibbs, etc. shall be installed using cast brass 90 degree drop ear elbow or drop ear tees as the piping design dictates.
- .2 Blocking shall be provided within the concealed space and the elbows and tees shall be secured to the blocking using brass screws to provide a rigid installation.

3.2 VALVE INSTALLATION

- .1 Combined domestic and fire suppression systems:
 - .1 Coordinate with the fire suppression contractor regarding all valves in piping systems that serve both domestic and fire suppression systems.
 - .1 These valves shall be ULC and / or FM labeled for use in fire suppression systems and shall be provided with supervisory switches for monitoring their valve position by the fire alarm system.
 - .2 Where possible, disassemble solder end joint valves before soldering.
 - .3 Where disassembly and the subsequent reassembly is not possible, the contractor shall give special regard to solder jointing in order not to damage, melt or deform and valve parts.
 - .4 Shut Off Valves:
 - .1 Install shut-off or isolation valves whether shown on the drawings or not at the following locations:
 - .1 At the point where the water service first enters the building.
 - .2 At the base of each building riser.
 - .3 At each main branch supply point; provide a valve on each outlet leg from the tee or cross.
 - .4 At each single plumbing fixture (i.e. normally this requirement is satisfied by the provision of the angle valve specified with the specific fixture).
 - .5 At each single piece of equipment.
 - .6 At all points as indicated on the drawings.
 - .7 At all points where the plumbing code requires the same.
 - .5 Balancing Valves:
 - .1 Install circuit balancing valves in hot water recirculating branch mains and branch connections to return mains whether indicated on drawings or not.
 - .6 Drain Valves:
 - .1 Install drain valves 18 mm minimum, or line size where the piping is smaller than 18 mm.
 - .2 Install a hose-end adaptor, cap and chain on the discharge side of each drain valve or pipe to drain where indicated.

3.3 VACUUM BREAKER INSTALLATION

- .1 Install at each fixture or item of equipment where contamination of the domestic water system can occur.
- .2 All atmospheric type vacuum breakers shall be installed at least 300mm [12"] above flood level rim of fixture.
- .3 Provide drain pan with water deflecting enclosure on concealed pressure type vacuum breakers with drain line to appropriate drain.
- .4 Complete testing of all vacuum breakers shall be carried out under this section of the work prior to final acceptance of plumbing systems.
 - .1 Submit a certificate for each device signed and witnessed that testing was successfully completed.

3.4 BACKFLOW PREVENTION STATION INSTALLATION

- .1 Install at each fixture or item of equipment where contamination of the water system can occur.
- .2 Pipe differential relief outlet to drain.
- .3 Backflow prevention stations shall be in complete accordance with CAN/CSA-B64.10 and CAN/CSA-B64.10.1 Manual for the Selection and Installation of Backflow Prevention Devices/Manual for the Maintenance and Field Testing of Backflow Prevention Devices.
- .4 Complete testing of all double check valve assemblies and reduced pressure principle backflow prevention devices shall be carried out by a certified tester under this section of the work prior to final acceptance of plumbing systems.
 - .1 Submit a certificate for each device signed and witnessed that testing was successfully completed.

3.5 STRAINER INSTALLATION

- .1 Install strainer blow-off connections.
- .2 Blow-off connections shall be full drain connection size and shall include:
 - .1 Up to 50 mm [2"] - nipple and cap (hot services).
 - .2 65 mm [2½"] and larger - nipple, globe valve and nipple (hot services).
 - .3 All sizes (cold services) - plug the blow-off connection only.

3.6 FLANGES AND UNIONS

- .1 Provide on all connections to pumps, reducing valves, control valves, fixtures, and equipment.
- .2 Connections up to and including 50 mm [2"] size shall be all bronze union, 1,035 kPa [150 psig] rating with ground seat; larger connections shall be flanged.

3.7 WATER HAMMER ARRESTORS

- .1 Size in accordance with the Plumbing and Drainage Institute PD1-WH-201 sizing procedures.
- .2 Install on branch lines to flush valves, solenoid valves, self-closing faucets, quick closing valves and on refrigeration, kitchen and laundry equipment incorporating solenoid valves.

3.8 PIPE JOINTS

- .1 Install dielectric type couplings where copper piping and accessories connect to plumbing equipment such as steel storage tanks, pressure reducing stations and ductile iron pipe.
- .2 Where the water service enters the building terminate at the edge of the building and excavation with a Smith Blair standard sleeve coupling having stainless steel nuts and bolts. Bridge the excavation with ductile iron pipe.
- .3 Tie rods shall only be used in conjunction with fittings possessing integral tie lugs.
- .4 Tie rods complete with their associated nuts and bolts shall be coated with two coats of asphaltic paint after installation.

3.9 AIR VENTS

- .1 Install at all high points in domestic hot water recirculation system.
- .2 Install on tees and not on horizontal piping or radiused elbows.
- .3 Install 12 mm [$\frac{1}{2}$ "] minimum isolating gate valve ahead of each air vent.
- .4 Pipe all air vent discharge connections separately to nearest building drain using 6 mm [$\frac{1}{4}$ "] hard drawn copper.

3.10 TRAP SEAL PRIMERS VALVES

- .1 Provide floor drain trap primers in watercloset rooms and other areas connected to the sanitary sewer in accordance with the plumbing code and as designated on the drawings.
- .2 Locate at locations that are readily accessible by the building maintenance staff.

3.11 TESTING AND INSPECTION

- .1 Testing shall consist of hydraulic pressure testing at 1,400 kPa [200 psig] for 8 hours.
- .2 Submit signed and dated pressure test reports for all sections of the water distribution systems.

3.12 CLEANING AND CHLORINATION OF POTABLE WATER PIPING

- .1 Standard of Acceptance:
 - .1 PACE Chemicals Ltd. (Pace Solutions)
- .2 All domestic water piping shall be thoroughly flushed so that it is free from scale, sediment, construction debris, etc.
- .3 The piping shall be chlorinated so that a chlorine residual of not less than 10 ppm remains in the water after standing for 24 hours.
 - .1 Hypochlorite and water is recommended as a disinfectant. AWWA C-601 recommends the amount of chlorine required.
 - .2 Thoroughly flush again until flush water meets AWWA standards.
- .4 Retain an independent inspection firm to supervise and inspect the chlorination and flushing procedures and perform chemical tests as required.
- .5 Submit to the Consultant, a certificate from the testing firm, stating that the chlorination and flushing have been successfully carried out.

- .6 On projects with water piping being connected to the existing water distribution system including system piping modifications, piping extensions, flushing and chlorination of all new piping remains a requirement.
 - .1 Provide all required isolation, fill, and drain valves required to flush and chlorinate the new piping without impacting the existing system piping.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section provides General, Product, and Execution Requirements for Sanitary and Storm Drainage Systems.
- .2 Provide all sanitary and storm drainage systems, including venting systems, as indicated, including, but not limited to:
 - .1 Sanitary sewer and venting systems
 - .2 Storm sewer drainage systems
 - .3 Cleanouts
 - .4 Floor drains
- .3 Connect plumbing fixtures and drains to discharge sanitary waste to the existing sanitary waste piping as depicted on the drawings.
- .4 Connect all roof drains to discharge storm drainage to the existing storm drainage piping as depicted on the drawings.
- .5 Connect all roof drains, area drains, planter drains, etc. to discharge storm drainage or clear unpolluted wastewater to the exterior storm building service as depicted in the Civil drawings and specifications.
- .6 Some portions of the work involved renovations in existing buildings.
 - .1 Non-functioning existing interior sanitary waste piping shall be removed where access is readily available or capped off and abandoned in place as referenced on the drawings.

1.2 RELATED REQUIREMENTS

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.
- .2 In conjunction with Division 01, Division 20 General Mechanical Provisions shall govern all Division 22 Sections of the work.
- .3 Refer to Section 20 99 60 Mechanical Forms and submit all documentation therein that is applicable to Division 22.
- .4 Refer to and comply with the following sections:
 - .1 General Requirements - Division 01
 - .2 Common Work for Mechanical Systems – Division 20
 - .3 Plumbing Systems - Division 22
 - .4 Electrical - Division 26/27

1.3 APPLICABLE CODES AND STANDARDS

- .1 Refer to Section 20 05 01, Codes, Bylaws and Standards.
- .2 All installation, execution, and testing shall conform to the following standards as a minimum:
 - .1 Provincial Building Code
 - .2 Local Building By-Laws

1.4 QUALITY ASSURANCE

- .1 Refer to Section 20 05 00 General Mechanical Provisions, Quality Assurance for additional details.
- .2 Employ only Tradespeople holding valid Provincial Trade Qualification Certificates.
- .3 Follow manufacturer's recommended installation details and procedures for equipment, supplemented by requirements of Contract Documents.
- .4 Installation shall be in accordance with well-established practice and standards accepted and recognized by the Consultant and the Trade.
- .5 The Consultant 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.

1.5 SUBMITTALS

- .1 Comply with Division 01 and Section 20 05 05 Documentation and Submittals.
- .2 Comply with Section 22 05 00 Common Work for Plumbing Systems, Submittals
- .3 Refer to Section 20 99 60 Mechanical Forms and submit all documentation therein that is applicable to Division 22 Plumbing.
- .4 Shop Drawings
 - .1 Submit shop drawings in accordance with Division 01 and Section 20 05 05 Documentation and Submittals.
 - .2 Shop drawings are required for all materials and equipment.
- .5 Product Options and Substitutions
 - .1 Refer to Section 20 05 00, for requirements pertaining to product options and substitutions.
- .6 Maintenance Data
 - .1 Refer to Division 01 and Division 20 05 05 Documentation and Submittals.
- .7 Record Drawings
 - .1 Refer to Division 01 and Division 20 05 05 Documentation and Submittals.
- .8 Occupancy Documentation Requirements
 - .1 Refer to Division 01 and Section 20 05 05 Documentation and Submittals.

Part 2 Products

2.1 INTERIOR DRAIN, WASTE AND VENT PIPE AND FITTINGS

- .1 Buried pipe and fittings:
 - .1 Acrylonitrile-Butadiene-Styrene (ABS) Drain Waste and Vent Pipe Fittings conforming to CSA CAN 3-B181.1
- .2 Above Ground Pipe and Fittings – Combustible Buildings:
 - .1 DWV copper drainage pipe with cast brass or wrought copper drainage pattern fittings with recessed solder joints.
 - .2 Acrylonitrile-Butadiene-Styrene (ABS) Drain Waste and Vent Pipe Fittings conforming to CSA CAN 3-B181.1
 - .3 Polyvinyl Chloride (PVC) Drain Waste and Vent Pipe and Pipe Fittings conforming to CSA B181.2

.3 Additional Requirements

- .1 Pressure waste piping from pumping stations and other equipment shall be pressure piping and fittings as specified for domestic water.
- .2 Plastic (PVC or ABS) piping where used underground shall adapt to approved non-plastic material prior to penetration above the building slab.
- .3 Combustible pipes penetrating fire rated floor and ceiling assemblies shall be fitted with approved fire stop devices and materials.
- .4 Class 4000 mechanical joint cast iron soil pipe, fittings and mechanical joint couplings shall be of one manufacturer.
- .5 Copper to cast iron joints shall be male brass adaptors to tapped fittings.
- .6 Nipples shall be cast iron or heavy brass.
- .7 Vent terminals shall be complete with 180o return bends.

2.2

CLEANOUTS

.1 Cleanouts – General

- .1 Standard of Acceptance: Zurn Z1400-BP
- .2 Coated cast iron adjustable floor cleanout
- .3 Gas and watertight bronze threaded plug
- .4 Round scoriated cast iron extra heavy-duty secured top comes
- .5 Foam thread protector to keep threads clean prior to and during final concrete pour.

.2 Sheet Flooring area cleanouts:

- .1 Centre portion of cover recessed 3mm [1/8"] to receive a piece of Lino that matches the adjoining tile.
- .2 Standard of Acceptance: Zurn ZN 1400-BP-X (round) or ZN 1400-BP-TX (square)

.3 Terrazzo tile floor area cleanouts:

- .1 Centre portion of cover recessed 32mm [1.25"] receive terrazzo that matches the adjoining terrazzo finish.
- .2 Standard of Acceptance: Zurn ZN 1400-Z

.4 Carpet area cleanouts:

- .1 Complete with carpet flange and carpet marker
- .2 Standard of Acceptance: Zurn ZN 1400-CF-CM

2.3

FLOOR DRAINS

- .1 Floor drains connected to the sanitary system shall include trap primer connections and BMS controlled trap primer solenoid valves.
- .2 Refer to equipment schedules on drawings for additional details.
- .3 Floor Drain FD-1:
 - .1 Standard of Acceptance: Watts
 - .2 Outlet size shall be as per the pipe size noted on the drainage plans.

Part 3 Execution

3.1 CLEANOUTS

- .1 Cleanouts shall be full size for pipe sizes up to 100 mm and not less than 100 mm on larger sizes. Cleanouts in inside finished areas shall all be of the same shape either round or square.
- .2 Cleanouts passing through a waterproofed floor or a slab on grade subject to hydrostatic pressure shall possess a clamping collar which shall be clamped to the floor membrane or lead flashing.
- .3 Pipe manufacturers' cleanouts are acceptable for vertical installation at the base of soil and waste stacks or rainwater leaders only.
- .4 Make cleanouts with Barrett type fitting that has a bolted cover plate and gasket, fitting that has a threaded plug, or a cleanout ferrule that is installed in a wye or extended wye.
- .5 Cleanouts which are located low on walls shall be located 75 mm minimum above the top of the baseboard or minimum 200 mm above finished floor level where there is no baseboard.
- .6 Cleanouts shall be coordinated with all millwork and with all other obstructions, shall be placed in readily accessible locations and shall have enough clearance for rodding and cleaning.
- .7 Extend cleanouts to the finished floor or wall unless exposed in a basement room, pipe tunnel or accessible crawlspace.
- .8 Install cleanouts at the following locations:
 - .1 Building drain leaving building on the upstream side of exterior wall.
 - .2 Changes of direction of more than 45 degrees in drainage piping.
 - .3 Nominally horizontal branch or building drain at intervals of not more than 7.5 metres for pipe sizes 65 mm and less, 15 metres for 75 mm and 100 mm pipe sizes, and 26 metres for pipe sizes larger than 100 mm.
 - .4 Base of soil or waste stacks and rainwater leaders.
 - .5 As called for by the applicable codes.

3.2 FLOOR DRAINS

- .1 Install floor drains set low to provide proper drainage.
- .2 Generally, do not locate floor drains in the center of mechanical rooms.
 - .1 Locate floor drains near the equipment and / or devices that will be discharging water to them, such that drain connections from the equipment and / or devices can be piped to the floor drains without creating a tripping hazard.
- .3 Do not locate floor drains in front of doors.
- .4 Water piping from trap primer to floor drain to be PEX tubing where cast into concrete and protected in a polyethylene sleeve where buried below slab. Provide Type L copper where exposed within the building.

3.3 PIPING

- .1 Do not install ABS, PVC, or other plastic piping upstream of any oil interceptors.
- .2 Do not install piping with glued joints at temperatures below those recommended by the solvent manufacture.

- .3 Testing and Inspection
 - .1 Tests on the sanitary waste and storm drainage systems shall consist of hydraulic pressure testing of 3000 mm for 8 hours.
 - .2 An air test in accordance with the Plumbing Code may be used during freezing conditions.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section provides General, Product, and Execution Requirements for interior Natural Gas Systems.
- .2 Provide all required Natural Gas distribution piping, valves, and accessories for the facility as indicated, including, but not limited to:
 - .1 Submit to the Provincial Gas Inspection Department documentation and detailed drawings as required, pay for, and obtain a permit and approval for the natural gas installation prior to commencing work.
 - .2 Provide all natural gas piping, fittings, valves, pressure regulators, unions, hangers and supports, and all other components as required for a complete installation generally as depicted on the drawings.
 - .3 Distribute natural gas to all natural gas outlets, appliances and equipment that require natural gas service including boilers, domestic water heaters, natural gas fired air handling units, kitchen equipment, laboratory equipment and plant equipment.
 - .4 Connect natural gas piping to existing natural gas piping at locations indicated on the drawings.
 - .5 Remove all unused or redundant natural gas piping throughout the renovated or demolished areas of the project where access is readily available or cap off and abandon in place as referenced on the drawings.

1.2 RELATED REQUIREMENTS

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.
- .2 In conjunction with Division 01, Division 20 General Mechanical Provisions shall govern all Division 22 Sections of the work.
- .3 Refer to Section 20 99 60 Mechanical Forms and submit all documentation therein that is applicable to Division 22.
- .4 Refer to and comply with the following sections:
 - .1 General Requirements - Division 01
 - .2 Common Work for Mechanical Systems – Division 20
 - .3 Plumbing Systems - Division 22
 - .4 Electrical - Division 26/27
- .5 Also refer to Division 33 Utilities, Natural Gas Distribution for site underground natural gas piping where required.

1.3 APPLICABLE CODES AND STANDARDS

- .1 Where multiple versions of the same code are published, the most recent version shall be applied, unless noted otherwise by provincial building codes and local by-laws.
- .2 All installation, execution, and testing shall conform to the following standards as a minimum:
 - .1 Provincial Building Code
 - .2 Local Building By-Laws
 - .3 CSA B149.1 Natural Gas and Propane Installation Code

- .4 Provincial Gas Code Amendments
- .5 ASTM A53, Standard Specification for pipe, Steel, Black and Hot Dipped, Zinc-Coated Welded and Seamless
- .6 CSA-B137.4.1-M89 Electrofusion Type Polyethylene Fittings for Gas Services
- .7 B149.3-00 Code for the Field Approval of Fuel Related Components on Appliances and Equipment.
- .8 Z662-99 Oil and Gas Pipeline Systems

1.4 QUALITY ASSURANCE

- .1 Refer to Section 20 05 00 General Mechanical Provisions, Quality Assurance for additional details.
- .2 Installation shall be in accordance with well-established practice and standards accepted and recognized by the Consultant and the Trade.
- .3 Submit to the Provincial Gas Inspection Department documentation and detailed drawings as required, pay for, and obtain a permit and approval for the natural gas installation prior to commencing work.

1.5 SUBMITTALS

- .1 Comply with Division 01 and Section 20 05 05 Documentation and Submittals.
- .2 Refer to Section 20 99 60 Mechanical Forms and submit all documentation therein that is applicable to this Specification Section.
- .3 Comply with Section 22 05 00 Common Work for Plumbing Systems, Submittals
- .4 Submit to the Provincial Gas Inspection Department documentation and detailed drawings as required, pay for, and obtain a permit and approval for the natural gas installation prior to commencing work.
- .5 Shop Drawings
 - .1 Submit shop drawings in accordance with Division 01 and Division 20 05 05 Documentation and Submittals.
 - .2 Shop drawings are required for all materials.
- .6 Product Options and Substitutions
 - .1 Refer to Division 01 and Section 20 05 00, for requirements pertaining to product options and substitutions.
- .7 Record Drawings
 - .1 Refer to Division 01 and Division 20 05 05 Documentation and Submittals.
- .8 Maintenance Data
 - .1 Refer to Division 01 and Section 20 05 05 Documentation and Submittals.
 - .2 Submit manufacturer's recommended maintenance tasks for a one-year period. Include maintenance schedules and lubrication products.
 - .3 Submit operating and maintenance data for inclusion into the manuals.
 - .4 Submit WHMIS MSDS in accordance with Division 01.
- .9 Occupancy Documentation Requirements
 - .1 Refer to Division 01 and Section 20 05 05 Documentation and Submittals.

Part 2 Products

2.1 BELOW GROUND PIPING

- .1 Gas piping shall not be installed below the building.
- .2 Polyethylene pipe to CSA B137.4
- .3 Standard of Acceptance: Performance Pipe
- .4 Refer to Section 33 51 00 Site Work Natural Gas Distribution for any required below grade exterior piping.
- .5 Tracer Wire
 - .1 No. 14 gauge stranded copper wire.
- .6 Warning Tape
 - .1 Underground warning tape (plain tape only). - Acceptable Products: Brady Idenoline
- .7 Transition Risers
 - .1 Epoxy coated (4 mil) transition steel risers with one-pound anodes shall be used.
- .8 Below Ground Valves
 - .1 High pressure isolation valves shall be of the plug, ball, or eccentric type.
 - .2 Pressure regulator valves sized for required flow at the extremes of inlet pressures.
 - .3 All valves to the Canadian Gas Association, CGA B149, Natural Gas Installation Code.

2.2 ABOVE GROUND

- .1 Piping
 - .1 Schedule 40 seamless carbon steel to ASTM A53 and CSA B-63.
- .2 Fittings
 - .1 Screwed fittings up to 50 mm diameter shall be malleable iron with beaded ends, Class 150 to ANSI B16.3.
 - .2 Welded fittings 65 mm and larger shall be forged steel of the same weight as the connecting pipe.
 - .1 Steel butt weld fittings to ANSI B16.9a. Steel pipe flanges and flanged fittings to ANSI B16.5.
 - .3 Unions shall be malleable iron with ground joints to ANSI B16.3.
 - .4 Thredolets or Weldolets: - Acceptable Products: Grinnell, Anvil, CCTF, Bonny Forge.
 - .5 Provide dielectric fittings where a buried service enters and connects to the building piping.

2.3 JOINT MATERIALS

- .1 Screwed: Thread lubricant or Teflon paste.
- .2 Teflon tape is unacceptable.
- .3 Flanged: Full faced gasket materials to ANSI B16.20, ANSI B16.21 or ANSI B21.11, flanged steel weld neck, raised face type, carbon steel (ASTM A307) square headed bolts with hexagon nuts to ANSI B18.2.1 and ANSI B18.2.2. Bolts shall be full diameter of bolt holes.

2.4 MANUAL ISOLATION VALVES

- .1 Provincial Gas Department approved and suitable for the temperature to which they are exposed.
- .2 Screwed end valves up to 50 mm and flanged end valves 65 mm and larger.
- .3 Standard of Acceptance: Homestead 601

Part 3 Execution

3.1 BELOW GROUND PIPE INSTALLATION

- .1 Install all piping in accordance with CSA B149.1 Natural Gas and Propane Installation Code.
- .2 Join polyethylene pipe in accordance with manufacturer's recommendations.
- .3 Align pipes carefully before jointing.
 - .1 Maintain a minimum of 900 mm separation between natural gas line and any adjacent buried services.
- .4 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes or as otherwise approved by the Consultant.
- .5 Upon completion of pipe laying and after the Consultant has inspected work in place, surround and cover pipes between joints with approved granular material placed to dimensions indicated or directed.
- .6 Hand place granular material in uniform layers not exceeding 150 mm thick to minimum 600 mm over top of pipe.
 - .1 Dumping of material directly on top of pipe is not permitted.
 - .2 Bury a plastic tracer tape marked "Natural Gas" 150 mm [6"] above the natural gas line.
- .7 Place layers uniformly and simultaneously on each side of pipe to prevent lateral displacement of pipe.
- .8 Compact each layer to at least 95% maximum density ASTM D698-78.
- .9 Backfill of piping shall not be commenced until tests have been accepted by the Consultant.
- .10 Do not paint dielectric isolating couplings used for cathodic protection.

3.2 ABOVE GROUND PIPE INSTALLATION

- .1 Install all piping in accordance with CSA B149.1, Natural Gas and Propane Installation Code.
- .2 Cut pipe ends square utilizing proper pipe cutting tools.
 - .1 Ream pipe ends and clean scale and dirt from inside and outside the pipe before and after assembly.
- .3 Protect all openings in piping and equipment, by capping or plugging to prevent the entry of dirt or debris during construction.
- .4 Slope piping down in the direction of flow to low points and provide dirt legs with capped ends.
- .5 Interior gas piping - screw or weld up to 50 mm; weld 65 mm and larger.
- .6 Interior gas piping located in unvented spaces, in supply or return air ceiling plenums, or operating at 35 kPa pressure or higher - weld all sizes.

- .7 Exterior gas piping - weld all sizes except for polyethylene pipe which shall have no joints other than those allowed in CSA B149.1 Natural Gas and Propane Installation Code.
- .8 Use welding tees to make all branch connections, except those less than half the diameter of the main.
 - .1 Branch connections less than half the diameter of main may be made with weldolets or threadolets.
- .9 Use eccentric reducers at changes in pipe size, to provide for positive drainage.
- .10 Remake all leaking joints.
- .11 Do not paint dielectric isolating couplings.
- .12 Provide pressure regulators and lockable shut-off valves at the discharge of the gas meter before entry into the building.

3.3 ABOVE GROUND EXTERIOR PIPING

- .1 Allow for expansion with suitable anchors, guides, and expansion loops to prevent undue stress on any part of the system.
- .2 All piping shall be welded with approved flexible connectors at the point of connection to gas fired equipment.
- .3 Paint exterior piping as noted above.

3.4 SEISMIC ACTUATED SHUT-OFF VALVES

- .1 Install natural gas seismic actuated automatic shut-off valves at the service entry point to each building immediately prior to entry.

3.5 PRESSURE REGULATING VALVES

- .1 Install pressure regulating valves in each equipment room or at each piece of equipment where the natural gas supply pressure exceeds the maximum operating pressure of the equipment.
- .2 Pipe the relief vent ports full diameter to atmosphere in accordance with the requirements of CSA B149.1 Natural Gas and Propane Installation Code.

3.6 TESTING

- .1 Pressure test all piping in accordance with CSA B149.1 Natural Gas and Propane Installation Code.
- .2 Examine all joints for leaks and remake all leaking joints with new materials.
- .3 Purge all piping after pressure tests in accordance with CSA B149.1 Natural Gas and Propane Installation Code.
- .4 Submit copies of pressure test reports for all sections of piping.

3.7 PAINTING AND COLOR CODING

- .1 Refer to Section 20 05 53 Mechanical Identification.
- .2 Paint all exterior piping including the section of piping from the gas meter to the building entry.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section provides General, Product, and Execution Requirements for Plumbing Fixtures and trim.
- .2 Provide all required Plumbing Fixtures and Trim as indicated, including, but not limited to:
 - .1 Plumbing fixtures
 - .2 Faucets and valves, including mixing valves

1.2 RELATED REQUIREMENTS

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.
- .2 In conjunction with Division 01, Division 20 General Mechanical Provisions shall govern all Division 22 Sections of the work.
- .3 Refer to Section 20 99 60 Mechanical Forms and submit all documentation therein that is applicable to Division 22.
- .4 Refer to and comply with the following sections:
 - .1 General Requirements - Division 01
 - .2 Common Work for Mechanical Systems – Division 20
 - .3 Plumbing Systems - Division 22
 - .4 Controls and Instrumentation - Division 25
 - .5 Electrical - Division 26/27

1.3 SUSTAINABILITY

- .1 Refer to Section 20 50 00

1.4 APPLICABLE CODES AND STANDARDS

- .1 Refer to Section 20 05 01, Codes, Bylaws and Standards.
- .2 All equipment, materials, installation, and testing shall conform to the following standards as a minimum:
 - .1 Provincial Building Code
 - .2 Local Building By-Laws
 - .3 Provincial Safety Authority
 - .4 All pipe, pipe fittings, valves and accessories that come in contact with drinking water shall be lead-free and compliant with NSF 61 Annex G and Section 9.
 - .5 All fixtures shall display CSA (Canadian Standards Association) approval where a CSA standard is available and in effect.
 - .6 Plumbing fittings shall be to CAN/CSA B125, Plumbing Fittings.
 - .7 Plumbing fixtures shall be to CAN/CSA B45, 'General Requirements for Plumbing Fixtures',
 - .8 Vitreous China plumbing fixtures shall be to CAN/CSA B45.1, 'Ceramic Plumbing Fixtures',

- .9 Stainless steel plumbing fixtures shall be to CAN/CSA B45.4, 'Stainless Steel Plumbing Fixtures'.

1.5 QUALITY ASSURANCE

- .1 Refer to Section 20 05 00 General Mechanical Provisions, Quality Assurance for additional details.
- .2 Follow manufacturer's recommended installation details and procedures for equipment, supplemented by requirements of Contract Documents.
- .3 Installation shall be in accordance with well-established practice and standards accepted and recognized by the Consultant and the Trade.
- .4 Similar plumbing fixtures shall be of one manufacturer.
- .5 Plumbing fixture supply brass shall be of one manufacturer unless indicated otherwise.
- .6 Fixtures shall be free from flaws or blemishes. Surfaces shall be clear, smooth and bright and have dimensional stability.
- .7 Plumbing fixtures and trim shall be new and unused unless indicated otherwise.
- .8 All visible or exposed parts, trim, supplies, traps, tubing, nipples escutcheons, check valves on diverter supply lines and valves to sanitary and/or kitchen fixtures shall be chrome plated finish unless otherwise noted.
- .9 All fittings shall have heavy duty stems.
- .10 Colour and Finish
 - .1 Vitreous China fixtures shall be white unless otherwise noted.
 - .2 Stainless steel fixtures shall be satin and/or mirror finish or a combination thereof.
 - .3 Exposed plumbing brass and metal work shall be heavy triple chromium plated.

1.6 SUBMITTALS

- .1 Comply with Division 01 and Section 20 05 05 Documentation and Submittals.
- .2 Comply with Section 22 05 00 Common Work for Plumbing Systems, Submittals
- .3 Refer to Section 20 99 60 Mechanical Forms and submit all documentation therein that is applicable to this Specification Section.
- .4 Shop Drawings
 - .1 Submit shop drawings in accordance with Division 01 and Division 20 05 05 Documentation and Submittals.
 - .2 Shop drawings are required for all materials and equipment.
- .5 Product Options and Substitutions
 - .1 Refer to Division 01 and Section 20 05 00, for requirements pertaining to product options and substitutions.
- .6 Record Drawings
 - .1 Refer to Division 01 and Division 20 05 05 Documentation and Submittals.
- .7 Maintenance Data
 - .1 Refer to Division 01 and Section 20 05 05 Documentation and Submittals.
 - .2 Submit manufacturer's recommended maintenance tasks for a one-year period. Include maintenance schedules and lubrication products.
 - .3 Submit operating and maintenance data for inclusion into the manuals.

- .8 Occupancy Documentation Requirements
 - .1 Refer to Division 01 and Section 20 05 05 Documentation and Submittals.

Part 2 Products

2.1 REFER TO DRAWINGS

Part 3 Execution

3.1 FIXTURE INSTALLATION

- .1 Connect fixtures complete with specified trim, supplies, drains accessory piping, vented traps, stops or valves, reducers, escutcheons, and fittings for the proper installation of all fixtures and their respective supply fittings.
- .2 Provide necessary hangers, supports, brackets, reinforcement, steel back-up plates and floor flanges to set fixtures level and square.
 - .1 Mount fixtures so that 90 kilogram mass will not loosen or distort mounting.
- .3 Provide minimum 18-gauge circular stainless-steel shrouds for concealing all services dropping to island or bench fixtures from ceiling spaces complete with all necessary ceiling and counter flanges.
 - .1 Diameter shall be as necessary to accommodate services; however, all shrouds shall be of the same diameter in any one room or area.
- .4 Provide chrome plated quarter turn mini ball valves for all lavatories, sinks and tank type water closets.
- .5 ABS p-traps and waste arms are not permitted.
- .6 Waterclosets
 - .1 Water closets shall be connected to waste utilizing brass or cast-iron floor flanges with lead stub or mechanical joint connections and wax seals.
 - .2 Provide braided stainless-steel flexible supplies for tank type water closets.
 - .1 Supply shall incorporate 12 mm [$\frac{1}{2}$ "] chrome plated quarter turn mini ball valve stop.
 - .2 Plastic handles are not acceptable.
 - .3 PEX or other plastic supplies are not acceptable.
- .7 Lavatories and Sinks
 - .1 Provide braided stainless-steel flexible supplies for sinks, drinking fountains and lavatories.
 - .1 Supplies for drinking fountains and lavatories shall incorporate 9 mm [$\frac{3}{8}$ "] chrome plated lead-free quarter turn mini ball valve stop.
 - .2 Supplies for sinks shall incorporate 12 mm [$\frac{1}{2}$ "] chrome plated quarter turn mini ball valve stop.
 - .3 Plastic handles are not acceptable.
 - .2 PEX or other plastic supplies are not acceptable.
 - .3 Double waste fittings for lavatories and sinks shall be a double sanitary tee.

- .4 Control handles for all two handle mixing faucets shall be positioned with the cold control on the right and the hot control on the left.
 - .1 Activation shall be accomplished by rotating the cold control handle clockwise and the hot control handle counterclockwise.
- .5 Faucets shall be complete with nuts and tailpieces.
- .6 Provide appropriate gaskets and/or sealing washers that will prevent the entry of water into fixture trim or faucet holes or punchings in millwork.
- .7 Gooseneck spouts shall have a clearance of 200 mm from nozzle tip to countertop, unless otherwise specified.
- .8 Plastic control handles and spouts are unacceptable.
- .9 Lavatory and sink P-traps shall be cast brass or tubular brass complete with either a cleanout or possess slip joint connections.
 - .1 Assembly shall be chrome plated where not concealed in millwork. Plastic drain and trap assemblies are not acceptable.
- .10 Lavatory and sink P-traps shall be complete with either a cleanout or possess slip joint connections.
- .8 Urinals
 - .1 Piping, fittings, and P-traps from urinals shall not be copper; vents above the urinal rim may be copper.
 - .2 Urinals shall have individual wastes; double waste fittings are unacceptable.

3.2 ACOUSTICAL REQUIREMENTS

- .1 The minimum pipe size to faucets or mixing valves of each fixture shall be 12 mm. The use of 9 mm pipes is prohibited.
- .2 All pipes (bare or insulated) shall be clear of contact with studs or gypsum wallboard.
- .3 Mixing Valves and Faucets:
 - .1 Quiet cartridge shall be used at mixing faucets and shower valves.
 - .2 Any which subsequently become noisy during the warranty period shall be replaced at no extra charge to the owner.
- .4 Back-to-back Fixtures:
 - .1 Drain line and water supply lines shall be divided at the riser.
 - .2 Tee takeoffs serving back-to-back fixtures are not permitted.
- .5 Piping shall not contact any framing stud or wall surface; or any other conduit, electrical or ventilation fixture that is connected to any wall or ceiling surface.
- .6 Piping shall not be fastened to a partition which forms part of an adjacent room not served by the pipe in question.
 - .1 Do not secure piping to gypsum wallboard or its supporting frame.
- .7 Riser clamps shall be isolated from the structure using an approved resilient material between the support collar and the floor structure (Vibro-Acoustics type SN, 30 durometer, 57.15 mm x 57.15 mm in size, or an approved equal).
 - .1 An alternate method is to wrap the pipe with neoprene prior to clamping.
- .8 Pipe hangers shall be oversized to suit the insulation and shall have a protection shield between the insulation and the hanger.
- .9 Pipe hangers shall contain 50 durometer, 3.2 mm thick neoprene pads inserted between the hanger saddle and pipe.

3.3 FIXTURE TRIM HOLES OR PUNCHINGS

- .1 Fixture punchings for faucets or other trim shall not contain more punchings than necessary for the specified trim.
- .2 Provide fixture and templates to the applicable trades for holes and cut outs required in all countertops.

3.4 WALLS AND FLOORS

- .1 Fixtures mounted on glazed tile surfaces shall have ground faces to finished surface.
- .2 Where plumbing fixtures come in contact with walls and floors, joints shall be sealed with Dow Corning anti-mildew 786 building sealant, made watertight and beaded smooth in a neat and workmanlike manner.

3.5 WATER HAMMER ARRESTORS

- .1 Provide water hammer arrestors on fixtures with flush valves and/or quick closing valves.

3.6 BARRIER-FREE FIXTURES

- .1 Water Closets
 - .1 Install all wall hung water closets designated for barrier-free use such that the top of the seat is 400 mm to 460 mm above the finished floor level.
 - .2 For flush tank water closets install the flush tank trip lever such that the handle is on the transfer or non-grab bar side of the water closet.
- .2 Lavatories and Sinks
 - .1 Install offset P-traps with the run of the P-trap parallel to and close to wall.
 - .2 Supplies on barrier-free lavatories shall be offset to accommodate the offset P-trap.
 - .3 Insulate P-traps and waste arms at all barrier-free lavatories and sinks with a manufactured insulation kit or 12 mm of fiberglass insulation and finished with a polyvinyl chloride jacket in a neat and workmanlike manner.
 - .4 Acceptable Manufactured Products: Truebro 'Handi Lav-Guard', Brocar Products Inc. 'Trap Wrap', Sexauer 'Handi Lav-Guard' Plumberex 'Handy Shield'.
- .3 Urinals
 - .1 Mount handicap designated urinals at mounting heights in accordance with the applicable code or bylaw.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section provides Product Requirements to indicate Plumbing Equipment manufacturers that are generally acceptable for proposing for the project.
- .2 The named manufacturers shall comply with all specific requirements of the Project, as well as details and performance as indicated by the Standard of Acceptance named in the individual specification sections and the equipment schedules.
- .3 Where a manufacturer's name below is underlined, that manufacturer is generally used as the Basis of Design.
- .4 Refer to Specification Section 20 05 00 General Mechanical Provisions for details regarding Standard of Acceptance, Addition of Acceptable Manufacturers, and Alternate Materials and Equipment.
- .5 Shop Drawings are required to be submitted for all equipment.
- .6 This section refers to Division 22 only. Each of the other Mechanical Divisions (20, 21, 23, and 25) contain a similar section for equipment that falls under that division.
 - .1 For General Mechanical refer to section 20 99 65
 - .2 For Fire Suppression Systems refer to section 21 99 65
 - .3 For HVAC items refer to section 23 99 65
 - .4 For Instrumentation and Controls items refer to section 25 99 65

Part 2 Products

2.1 ACCESS DOORS – BUILDING SURFACES

- .1 Refer to Specification Section 20 05 33

2.2 ACCESS DOORS – WITH BACK BOX

- .1 Refer to Specification Section 20 05 33

2.3 BACKFLOW PREVENTERS

- .1 Zurn, Ames, Apollo, Febco, Watts
- .2 Refer to Specification Section 22 11 00

2.4 DRAINAGE PRODUCTS - CLEANOUTS, DRAINS, HOSE BIBS, WATER HAMMER ARRESTORS

- .1 Mifab, Jay R.Smith, Watts, Zurn, Wade
- .2 Refer to Specification Section 22 13 00

2.5 DRINKING FOUNTAINS & WATER COOLERS

- .1 Acorn Aqua, Elkay, Haws, Halsey Taylor, Oasis, Sunroc
- .2 Refer to Specification Section 22 40 00

- 2.6 ELECTRIC MOTORS**
 - .1 Specification Section 20 05 03
- 2.7 FAUCETS**
 - .1 Delta, American Standard, Chicago, Grohe, Kohler
 - .2 Refer to Specification Section 22 40 00
- 2.8 FIRE STOPPING**
 - .1 Specification Section 20 05 31
- 2.9 FIXTURES**
 - .1 Refer to Specification Section 22 40 00
 - .2 Acrylic, Composite
 - .1 Fiat, Hytec, Swan, Valley, Williams
 - .3 Stainless Steel
 - .1 Acorn, AMI, Bradley, Franke, KIL, Kindred, Steel Queen
 - .4 Vitreous China
 - .1 American Standard, Crane, Kohler, TOTO
- 2.10 FLEXIBLE PIPE CONNECTORS**
 - .1 Refer to Specification Section 20 20 40
- 2.11 HANGERS AND SUPPORTS**
 - .1 Refer to Specification Section 20 05 29
- 2.12 INSULATION**
 - .1 Piping & Equipment – Manson, Johns Manville, Certainteed, Owens Corning
 - .2 Below Lavatories - Prowrap, Trubro
- 2.13 PIPE GUIDES AND ANCHORS**
 - .1 Specification Section 20 05 29
 - .2 Grinnell
- 2.14 PIPE & FITTINGS – DWV**
 - .1 Refer to Specification Section 22 08 31
 - .2 Acid Waste: Polyvinylidene Fluoride PVDF, Flame Retardant - Pegas, IpeX, Watts, Orion
 - .3 Cast Iron - Bibby St Croix, Charlotte Pipe, Tyler Pipe
 - .4 Copper - Great Lakes Copper Ltd., Wolverine
 - .5 PVC - Canplas, IPEX, Royal
- 2.15 PIPE & FITTINGS – WATER**
 - .1 Refer to Specification Section 22 11 00
 - .2 Copper - Great Lakes Copper Ltd., Wolverine

- .3 Ductile Iron - Canada Pipe, Charlotte Pipe
- .4 PEX above grade – IPEX, Rehau, Vanguard, Wirsbo
- .5 PEX in-slab - Wirsbo only
- .6 High Purity Water - GF Piping Systems, IPEX, Chemtrol, stainless steel welded
- .7 Stainless Steel for Potable Water - Type 304

2.16 PIPE FITTINGS & COUPLINGS - GROOVED END

- .1 Victaulic only
- .2 Refer to Specification Section 22 11 00

2.17 PRESSURE RELIEF VALVES

- .1 Watts, Mifab, Jay R.Smith, Zurn
- .2 Refer to Specification Section 22 11 00

2.18 SEISMIC RESTRAINTS

- .1 Specification Section 20 20 49

2.19 VALVES

- .1 brass, butterfly, cast iron - Crane, Apollo, Jenkins, Kitz, Nibco, Red & White/Toyo
- .2 fixture shut off - Brass Craft, Dahl
- .3 flush valves, urinal & water closet - Delta
- .4 pressure reducing, air - DeVilbiss, Fischer, Watts
- .5 pressure reducing, gas - Fisher, Rockwell
- .6 pressure reducing, water - Watts, Apollo, Clayton, Conbraco, Singer, Wilkins, Zurn
- .7 pressure & temperature relief - Watts
- .8 PVC - Chemtrol
- .9 thermostatic or pressure mixing - Guardian, Bradley, Lawler, Leonard, Powers, Symmons

2.20 VIBRATION ISOLATORS

- .1 Specification Section 20 05 48

Part 3 Execution

3.1 NOT APPLICABLE.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section provides General, Product, and Execution Requirements for Common Work for HVAC Systems.
- .2 Division 20 General Mechanical Provisions shall govern the Division 23 HVAC sections of the work, read in conjunction with Division 01.
- .3 This section covers items common to Division 23 series sections and is intended only to supplement the requirements of Division 1 and 20.
- .4 Refer to Section 20 99 60 Mechanical Forms and submit all documentation therein that is applicable to Division 23 HVAC Systems.
- .5 Provide all HVAC systems throughout the buildings as noted on the drawings and including:
 - .1 Supply air, return air, and exhaust air systems
 - .2 Unit heaters and cabinet unit heaters
 - .3 HVAC duct cleaning
 - .4 Air filtration
 - .5 Custom air handling units
- .6 The HVAC Contractor shall retain the services of a Contractor's Supporting Professional Seismic Engineer (Delegated Design) registered in the province where the project is located
 - .1 This Seismic Engineer shall provide complete engineering design and field review services for all seismic restraints.
- .7 Provide all Testing, Adjusting, Commissioning; Identification; and Insulation and for all HVAC systems.
- .8 Submit all documentation to the Authorities Having Jurisdiction, arrange for, pay for, and obtain trade permits prior to commencing installation work on site.
- .9 Provide hard copy and digital files of all documentation. Refer to Section 20 05 05 Documentation and Submittals for details.

1.2 RELATED REQUIREMENTS

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.
- .2 Connect to equipment specified in other sections and to equipment supplied and installed by other Contractors or by the Owner.
 - .1 Uncrate equipment, move in place and install complete, start-up and test. Include all field assembly of loosely/separately packaged accessories
- .3 Refer to and comply with the following sections:
 - .1 General Requirements - Division 01
 - .2 Common Work for Mechanical Systems – Division 20
 - .3 Plumbing Systems - Division 22
 - .4 Heating, Ventilation and Air Conditioning Systems - Division 23
 - .5 Controls and Instrumentation - Division 25
 - .6 Electrical - Division 26/27

1.3 APPLICABLE CODES AND STANDARDS

- .1 Refer to Section 20 05 01, Codes, Bylaws and Standards.
- .2 Where multiple versions of the same code are published, the most recent version shall be applied, unless noted otherwise by building codes and local by-laws.
- .3 In addition to Section 20 05 01, Division 23 work shall conform to the following codes, regulations and standards, and all other codes in effect at the time of award of Contract, and any others having jurisdiction.
- .4 All equipment, materials, installation, and testing shall conform to the following standards as a minimum:
 - .1 Provincial Building Code
 - .2 Local Building By-Laws
 - .3 Provincial Safety Authority
 - .4 ASME/ANSI B31.9 Building Services Piping
 - .5 SMACNA 001 Guidelines for seismic restraints of mechanical systems
 - .6 SMACNA 006 HVAC Duct Construction Standards, Metal and Flexible
 - .7 SMACNA Fire, Smoke, and Radiation Damper Installation Guide

1.4 QUALITY ASSURANCE

- .1 Refer to Section 20 05 00 General Mechanical Provisions, Quality Assurance for additional details.
- .2 Employ only Tradespeople holding valid Provincial Trade Qualification Certificates.
 - .1 Tradespeople shall perform only work that their certificate permits.
 - .2 Certificates shall be available for inspection by the Consultant.
- .3 Follow manufacturer's recommended installation details and procedures for equipment, supplemented by requirements of Contract Documents.
- .4 Installation shall be done in accordance with well-established practice and standards accepted and recognized by the Consultant and the Trade.
- .5 The Consultant 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.
- .6 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards

1.5 PERFORMANCE VERIFICATION OF INSTALLED EQUIPMENT

- .1 Installed mechanical equipment whose performance is questioned by the Consultant, may be subject to performance verification as specified herein.
- .2 When performance verification is requested, equipment shall be tested to determine compliance with specified performance requirements.
- .3 The Consultant will determine by whom testing shall be carried out.
 - .1 When requested, the Contractor shall arrange for services of an independent testing agency.
- .4 Testing procedures shall be reviewed by the Consultant.
- .5 Maintain building comfort conditions when equipment is removed from service for testing purposes.

- .6 Promptly provide the Consultant with all test reports.
- .7 Should test results reveal that originally installed equipment meets specified performance requirements, Owner will pay all costs resulting from performance verification procedure.
- .8 Should test results reveal that equipment does not meet specified performance requirements, equipment will be rejected, and the following shall apply:
 - .1 Remove rejected equipment. Replace with equipment, which meets requirements of Contract Documents including specified performance requirements.
 - .2 Replacement equipment will be subject to performance verification as well; using the same testing procedures on originally installed equipment.
 - .3 Contractor shall pay all costs resulting from performance verification procedure.

1.6 COORDINATION

- .1 Drawings are diagrammatic and approximately to scale.
 - .1 They establish the scope of the work and the general location and orientation of the HVAC systems.
 - .2 The systems shall be installed generally in the locations and generally along the routings shown, close to the building structure and coordinated with other services.
 - .3 Piping shall be concealed within walls, ceilings or other spaces and shall be routed to maximize head room and the intended use of the space through which they pass, unless specifically noted otherwise.

1.7 SUBMITTALS

- .1 Comply with Division 01 and Section 20 05 05 Documentation and Submittals.
- .2 Comply with Section 21 05 00 Common Work for Fire Suppression Systems, Submittals
- .3 Comply with Section 22 05 00 Common Work for Plumbing Systems, Submittals
- .4 Comply with Section 23 05 00 Common Work for HVAC Systems, Submittals
- .5 Refer to Section 20 99 60 Mechanical Forms and submit all documentation therein that is applicable to this Specification Section.
- .6 All products utilized on the project shall be as per the shop drawing submissions.
- .7 All products of a similar nature used in a similar system or application shall be of the same manufacturer throughout the project.
- .8 Shop Drawings
 - .1 Submit shop drawings in accordance with Division 01 and Section 20 05 05 Documentation and Submittals.
 - .2 Shop drawings are required for all materials and equipment.
- .9 Product Options and Substitutions
 - .1 Refer to Division 01 and Section 20 05 00, for requirements pertaining to product options and substitutions.
- .10 Samples
 - .1 Refer to Division 01 and Section 20 05 05 Documentation and Submittals.
- .11 Record Drawings
 - .1 Refer to Division 01 and Section 20 05 05 Documentation and Submittals.
 - .2 Provide project "As-Built" Record Drawings for all HVAC systems.
 - .3 In addition, as a minimum, during the construction period,

- .1 Keep on site a clean set of drawings marked up, IN COLOUR, to reflect the 'As-Built' state, for examination by the Consultant on a regular basis.
- .2 Include elevations, rough-in details, and detailed locations of all hidden services, including locations of maintenance items and their associated identification code (ie. valves).
- .3 All concealed (above grade and below grade) services shall be dimensionally located and noted, (use gridlines or structure as the reference).
- .4 Provide invert elevations for all below grade services.
- .4 At the time of 'Substantial Performance', submit to the Consultant one complete full-sized COLOUR hard copy of all Record Drawing information produced as per the above section.
- .5 The Record Drawings produced shall be based on the IFC drawings and any updates (addendums, change orders, site instructions, field directives, etc) that have been issued.
- .6 Submit signed and sealed copies of Record Drawings, Final Design Drawings and As-built Drawings as requested by the project Architect, Certified Professional (C.P.), Authority Having Jurisdiction and the Consultant.
- .7 Submit hard copies of all As-Built record drawings for inclusion in the hard copy maintenance manual.
- .8 Provide digital files in PDF format for inclusion in the digital format manuals and submit files directly to the consultant.
 - .1 Provide one PDF file for each drawing file produced.
- .9 Transfer the Record Drawing mark-ups digitally using AutoCAD onto, and by creating, As-Built record drawings "DWG"
- .10 Submit to the Consultant, at the time of 'Substantial Performance', on a USB drive, all produced Record Drawings PDF and AutoCAD DWG, including external reference files (XRefs, fonts, shapes, line type, plot/print profiles). Consider using the E-Transmit function.
 - .1 Provide one PDF file for each drawing file produced.
 - .2 Provide digital files in AutoCAD formats for inclusion in the digital format manuals and submit files directly to the consultant.
- .12 Maintenance Data
 - .1 Refer to Division 01 and Section 20 05 05 Documentation and Submittals.
 - .2 Submit manufacturer's recommended maintenance tasks for a one-year period. Include maintenance schedules and lubrication products.
 - .3 Submit operating and maintenance data for inclusion into the manuals.
- .13 Occupancy Documentation Requirements
 - .1 Refer to Division 01 and Section 20 05 05 Documentation and Submittals.

1.8 ACCESS DOORS

- .1 Refer to Section 20 05 33 Access Doors.
- .2 Install access doors at all concealed unions, expansion joints, valves, control valves, air vents, special equipment, vacuum breakers, and any other equipment for which subsequent periodic access will be required.
- .3 Locate access doors so that all concealed items are readily accessible for adjustment, operation, maintenance, and replacement.

- .4 Do not locate access doors in feature walls or ceilings without the prior approval of the Consultant.
 - .1 Locate in service areas and storage rooms wherever possible.

1.9 MISCELLANEOUS METAL RELATED TO HVAC

- .1 Refer to Section 20 05 00.

1.10 CONCEALMENT

- .1 Conceal all piping, ductwork and conduit in partitions, walls, crawlspaces, and ceiling spaces, unless otherwise noted.
- .2 Do not install piping and conduit in outside walls or roof slabs unless specifically directed, in which case, install them with the building insulation between them and the outside face of the building.

1.11 ACCESSIBILITY

- .1 Install all work so as to be readily accessible for adjustment, operation, and maintenance. Furnish access doors where required in building surfaces for installation by building trades. Refer to Section 20 05 33 Access Doors.

1.12 PIPING EXPANSION

- .1 Refer to Section 20 20 40 Expansion Fittings and Loops
- .2 Install piping with all necessary changes of direction, expansion loops, anchors, and guides so that expansion and contraction will not overstress the piping and equipment piping connections.
- .3 Expansion loops shall be of all welded construction with long radius elbows; cold sprung 50% and located between anchors.
- .4 Anchors shall be fabricated from mild steel plate and structural steel angle and channel sections, in accordance with ANSI B.31.

1.13 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 piping, ductwork, and conduits, as installation work progresses.
- .3 Equipment having operating parts, bearings, or machined surfaces, showing signs of rusting, pitting or physical damage will be rejected.
- .4 Refinish damaged or marred factory finish.
- .5 Air systems to have air filters installed before fans are operated. Install new air filters before system acceptance.

1.14 EQUIPMENT RESTRAINT

- .1 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.

1.15 EQUIPMENT INSTALLATION

- .1 Provide unions and flanges to permit equipment maintenance and disassembly and to minimize disturbance to piping and duct systems and without interfering with building structure or other equipment.
- .2 Provide means of access for servicing equipment including permanently lubricated bearings.
- .3 Pipe equipment drains to floor drains.
- .4 Line up equipment, rectangular cleanouts, and similar items with building walls wherever possible.

1.16 TESTING AND INSPECTION

- .1 Refer to Section 20 05 07 Materials Testing.
- .2 Refer to Section 20 05 08 Equipment Testing.
- .3 Furnish all labour, materials, instruments, etc. necessary for all required tests.
 - .1 All work shall be subject to review by the Consultant.
 - .2 At least forty-eight (48) business hours [2 business days] notice shall be given in advance of making the required tests for projects within 40 km of the Consultant's Project Office.
- .4 All leaks shall be corrected by remaking the joints.
 - .1 The systems shall be retested until no leaks are observed.
- .5 No system or part thereof shall be covered until it has been inspected and approved by the Consultant.
- .6 If any system or part thereof is covered before being inspected or approved, it shall be uncovered upon the direction of the Consultant.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section provides General, Product, and Execution Requirements for HVAC Duct Insulation.
- .2 Provide external thermal insulation for plenums and ductwork as called for and as scheduled.
- .3 Provide internal acoustical insulation for plenums and ductwork, as called for and as scheduled.
- .4 Do not externally insulate any ductwork that is specified to be internally insulated, unless indicated otherwise.
- .5 Provide all duct insulation and accessories as indicated, including, but not limited to, the following:
 - .1 Supply air ducts and plenums
 - .2 Outside air ducts and plenums
 - .3 Return air ducts and plenums.
 - .4 Exhaust ducts and plenums.
 - .5 Exterior mounted ducts and plenums
- .6 Include:
 - .1 Insulation
 - .2 Adhesives, tie wires, tapes.
 - .3 Finishing and recovering.

1.2 RELATED REQUIREMENTS

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.
- .2 In conjunction with Division 01, Division 20 General Mechanical Provisions shall govern all Division 23 Sections of the work.
- .3 Refer to Section 20 99 60 Mechanical Forms and submit all documentation therein that is applicable to Division 23.
- .4 Refer to and comply with the following sections:
 - .1 General Requirements - Division 01
 - .2 Common Work for Mechanical Systems – Division 20
 - .3 Plumbing Systems - Division 22
 - .4 Heating, Ventilation and Air Conditioning Systems - Division 23
 - .5 Controls and Instrumentation - Division 25
 - .6 Electrical - Division 26/27

1.3 APPLICABLE CODES AND STANDARDS

- .1 Refer to Section 20 05 01, Codes, Bylaws and Standards.
- .2 Insulation thickness and insulating values shall be in accordance with the most stringent of the National Energy Code of Canada for Buildings (NECB), and ASHRAE 90.1.

- .1 The more stringent insulation value (between the two codes) will be the minimum level required for this project.
- .3 Flame spread ratings and smoke developed classifications shall be as required by the Provincial Building Code and NFPA 90A.
 - .1 Flame Spread / Smoke Development
 - .1 The flame spread/smoke developed index throughout the material shall not exceed the following:
 - .1 Flame Spread Index: 25
 - .2 Smoke Developed Index: 50
- .4 Insulating materials and accessories shall withstand service temperatures without smoldering, glowing, smoking, or flaming when tested in accordance with ASTM C411.
- .5 In addition to Section 20 05 01, Division 23 work shall conform to the following codes, regulations and standards, and all other codes in effect at the time of award of Contract, and any others having jurisdiction.
- .6 All equipment, materials, installation, and testing shall conform to the following standards as a minimum:
 - .1 Provincial Building Code
 - .2 Local Building By-Laws
 - .3 Provincial Safety Authority
 - .4 National Energy Code of Canada for Buildings (NECB).
 - .5 ASHRAE Standard 90.1 - Energy Standard for Buildings except Low Rise Residential Buildings
 - .6 NFPA 90A Air Conditioning and Ventilating Systems and Installation.
 - .7 NFPA 90B Warm Air Heating and Air Conditioning Systems.
 - .8 ASTM C533 - Calcium Silicate Block and Pipe Thermal Insulation
 - .9 ASTM C553 - Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
 - .10 ASTM C1126 (Gr.1) Standard Specification for Faced and Unfaced Rigid Cellular Phenolic Thermal Insulation
 - .11 CGSB 51-GP-11M Thermal Insulation, Mineral Fiber, Blanket for Piping, Ducting, Machinery and Boilers.
 - .12 CAN/CGSB-51.12 Cement, Thermal Insulating and Finishing.
 - .13 CGSB 51-GP-52MA - Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation

1.4 QUALITY ASSURANCE

- .1 Refer to Section 20 05 00 General Mechanical Provisions, Quality Assurance for additional details.
- .2 Employ only Tradespeople holding valid Provincial Trade Qualification Certificates.
- .3 Be responsible for ensuring that enough space is always provided to allow proper installation of insulation materials.
- .4 Follow manufacturer's recommended installation details and procedures for equipment, supplemented by requirements of Contract Documents.
- .5 Installation shall be done in accordance with well-established practice and standards accepted and recognized by the Consultant and the Trade.

- .6 Material and method of application to comply with or be tested in accordance with the latest version of the following Insulation Standards Manuals,
 - .1 Provincial Building Code and local by-laws
 - .2 Master Insulators Association Standards Manual.
 - .3 Insulation Contractors Association Standards Manual.
 - .1 Use the latest edition of the Insulation Standards Manual as the base reference standard if insufficient detail/information is contained herein, or if the Insulation Standards Manual Standard is more stringent.
 - .4 Thermal Insulation Association of Canada (TIAC) National Insulation Standard.
- .7 Work shall be inspected by certified mechanical insulation inspectors who maintain current certification by the National Insulation Association, or other certified mechanical insulation certification association.
 - .1 Provide the Owner with a Quality Assurance Certificate for the mechanical insulation work at Substantial Completion of the Work.

1.5 SUBMITTALS

- .1 Comply with Division 01 and Section 20 05 05 Documentation and Submittals.
- .2 Comply with Section 23 05 00 Common Work for HVAC Systems, Submittals
- .3 Refer to Section 20 99 60 Mechanical Forms and submit all documentation therein that is applicable to Division 23 HVAC.
- .4 Shop Drawings
 - .1 Submit shop drawings in accordance with Division 01 and Division 20 05 05 Documentation and Submittals.
 - .2 Shop drawings are required for all materials and equipment.
 - .3 Submit, for approval, substantiating manufacturer's documentation when requested for all materials, applications and finishing methods to establish that all will satisfy this specification and meet all applicable code requirements, before commencing work.
 - .4 Submit product data and test reports indicating that insulation and recovery assemblies meet flame/smoke development indices and performance requirements.
 - .5 Submit, for approval, samples of each type of firestopping, smoke seal and accessory.
 - .6 Submissions (Shop Drawings) and other documentation shall include all Adhesives and Sealants Material Safety Data Sheets (MSDS) highlighting the materials Volatile Organic Compound (VOC) levels.
 - .7 For each application submit an insulation schedule to include the following information:
 - .1 Materials
 - .2 Flame/Smoke rating
 - .3 "k" Value: Thermal conductivity of insulating material per unit of thickness (W/m°C).
 - .4 Thickness
 - .5 Density
 - .6 Finish
 - .7 Jacketing

- .8 Submit information showing installed insulation and membrane products meet the requirements of the Model National Energy Code of Canada for Buildings (MNECB) and ASHRAE 90.1.
- .5 Product Options and Substitutions
 - .1 Refer to Section 20 05 00, for requirements pertaining to product options and substitutions.
- .6 Maintenance Data
 - .1 Refer to Division 01 and Division 20 05 05 Documentation and Submittals.
- .7 Occupancy Documentation Requirements
 - .1 Refer to Division 01 and Section 20 05 05 Documentation and Submittals.

Part 2 Products

2.1 FLAME SPREAD RATINGS AND SMOKE DEVELOPED CLASSIFICATIONS SHALL BE AS REQUIRED BY THE PROVINCIAL BUILDING CODE AND NFPA 90A.

- .1 Flame Spread / Smoke Development
 - .1 The flame spread/smoke developed index throughout the material shall not exceed the following:
 - .1 Flame Spread Index: 25
 - .2 Smoke Developed Index: 50
 - .2 Insulating materials and accessories shall withstand service temperatures without smoldering, glowing, smoking, or flaming when tested in accordance with ASTM C411.

2.2 ASBESTOS

- .1 All material / products installed shall be free of asbestos.

2.3 FIRE STOPPING AND SMOKE SEAL MATERIALS

- .1 Refer to Section 20 05 31 Penetrations, Flashings, and Seals.

2.4 DUCT INSULATION - EXTERNAL

- .1 External flexible glass fibre insulation with integral vapour barrier.
 - .1 Standard of Acceptance:
 - .1 Certainteed SoftTouch Duct Wrap 75
 - .2 Minimum density - 12 kg/cu.m. [0.75 lbs/cu. ft.].
 - .3 Thermal Conductivity (uncompressed) at 24oC [75oF] - 0.042 W/sq.m/oC [0.29 btu/h/sq.ft/oF]
 - .4 Flame Spread/Smoke Developed rating throughout the material shall not exceed 25/50.

2.5 DUCT INSULATION - INTERNAL

- .1 Flexible Duct Liner – Glass Fibre
 - .1 Glass fibre is not permitted inside supply air ducts or plenums, return air ducts or plenums, or outside air intake systems.
 - .2 Standard of Acceptance:

- .1 Certainteed Toughgard-R
- .3 Yellow or light coloured internal flexible, glass fibre acoustical insulation with a non-woven fiberglass mat facing on one side.
- .4 Mat shall be complete with an EPA-registered antimicrobial agent on the airstream side.
- .5 Flame Spread/Smoke Developed rating throughout the material shall not exceed 25/50.
- .6 Minimum density - 24 kg/cu.m. [1.5 lbs/cu. ft.].
- .7 Minimum sound absorption (NRC) of 0.70 as tested per ASTM C423 using type "A" mounting.
- .8 Thermal Conductivity at 24oC [75oF]- 0.033 W/sq.m/oC [0.24 btu/h/sq.ft/oF]
- .2 Rigid Duct Liner – Glass Fibre
 - .1 Glass fibre is not permitted inside supply air ducts or plenums, return air ducts or plenums, or outside air intake systems.
 - .2 Standard of Acceptance:
 - .1 Certainteed Rigid Liner Board with Toughgard Facing
 - .3 Yellow or light coloured internal rigid resin bonded glass fibre acoustical insulation with a non-woven fiberglass mat facing on one side.
 - .4 Mat shall be complete with an EPA-registered antimicrobial agent on the airstream side.
 - .5 Flame Spread/Smoke Developed rating throughout the material shall not exceed 25/50.
 - .6 Minimum sound absorption (NRC) of 0.70 as tested per ASTM C423 using type "A" mounting.
 - .7 Thermal Conductivity at 24oC [75oF]- 0.033 W/sq.m/oC [0.24 btu/h/sq.ft/oF]

2.6 ACCESSORIES

- .1 Finish Jacket
 - .1 Metal Jacket
 - .1 Standard of Acceptance:
 - .1 Johns Manville Metal Jacketing System
 - .2 mm [22 ga] aluminum, smooth finish
 - .3 Preformed elbows
 - .4 Stainless-steel bands
 - .2 Canvas Jacket
 - .1 Standard of Acceptance:
 - .1 Robson Flamex FR Canvas
 - .2 Fire rated, 6-ounce fire retardant canvas jacket
 - .3 Flame spread and smoke density does not exceed 25/50 per ASTM E84

2.7 JACKET FASTENINGS:

- .1 All Service:
 - .1 Stainless-steel staples (flare type)

- .2 Compatible jacket finishing tape and contact adhesives as recommended by the jacket manufacturer.
- .2 Lagging Adhesive (Canvas Jackets): Childers' CP-50A, Epolux's Cadalag 336, Foster's 30-36.
- .3 Vapor Seal Adhesive (Fibrous Glass Insulation): Childers' CP-82, Epolux's Cadoprene 400, Foster's 85-75 or 85-20.
- .4 Vapor Barrier Mastic/Joint Sealer (Fibrous Glass Insulation): Childers' CP-30, Epolux's Cadalar 670, Foster's 95-44 or 30-35.
- .5 Adhesive (Flexible Elastomeric Foam): Armstrong's 520, Childers' CP-80, Epolux's Cadoprene 488, Foster's 82-40.
- .6 Adhesive (Reinforcing Membrane): Childers' Chil-Spray WB CP-56.
- .7 Mastic (Reinforcing Membrane): Childers' AK-CRYL CP-9.

2.8 FIRE STOPPING AND SMOKE SEAL MATERIALS

- .1 Refer to Section 20 05 31 Penetrations, Flashings, and Seals.

Part 3 Execution

3.1 APPLICATION

- .1 Apply external insulation to ductwork only after all tests have been made and systems accepted by the Consultant as airtight.
- .2 Apply insulation and insulation finish in a workmanlike manner so that the finished product is uniform, smooth in finish, pleasing to the eye and with longitudinal seams concealed from view. Apply ductwork insulation materials, accessories and finishes in accordance with manufacturer's recommendations.
- .3 Insulation and vapour barrier shall be continuous through all non-rated separations.

3.2 INSULATION TERMINATION

- .1 Terminate insulation short of all control, smoke, and fire dampers so as not to interfere with their operation.
- .2 Terminate insulation 900 mm [36"] short of duct mounted electric heating coils.

3.3 EXTERNAL FLEXIBLE INSULATION

- .1 Round ducts and rectangular ducts/plenums under 610mm [24"] in diameter/width,
 - .1 Apply insulation adhesive in 100 mm [4"] wide strips on 300 mm [12"] centres on lower half and bottom of ducts.
 - .2 Cut insulation to required size allowing for 50 mm [2"] overlap at each joint and apply to exterior of duct. Secure insulation with wire fastening on approximately 500 mm [20"] centres.
 - .3 Adhesive coverage of one hundred percent (100%) prior to applying duct wrap is an acceptable alternative to wire fastenings.
- .2 Rectangular ducts/plenums over 610mm [24"] in width,
 - .1 Spot-weld pins 6mm [1/4"] longer than the insulation thickness, one per 0.1 sq.m [1 sq ft] of duct minimum. If pins are installed in the field, a capacitor gun shall be used.
 - .2 Cut insulation to required size allowing for 50 mm [2"] overlap at each joint and apply to exterior of duct.

- .3 Impale the insulation over the pins and hold in place using metal clips.
 - .1 Alternatively, use an assembly consisting of a welded pin with integral head washer welded in place over the insulation.
 - .2 Clinched pins not acceptable.
- .3 Adhere foil faced vapour barrier tape over all butt joints, raw edges, holding washers and other points of penetration of the insulation vapour barrier jacket on all exposed hot and cold ducts and all concealed cold ducts.

3.4 ACOUSTIC NOISE BARRIER

- .1 Product shall be easily removeable and replaceable where access is required for underlying serviceable items, e.g., using tie wires, eyelets with wire lacing, and fitted with external angles for support where more than 0.6m [24"] wide.

3.5 DEFINITIONS

- .1 "EXPOSED" will mean not concealed. For greater certainty, the following locations are considered exposed:

3.6 DUCTWORK INSULATION FINISHES

- .1 "CONCEALED" means insulated mechanical services in chases, furred spaces, shafts and hung ceilings.
 - .1 Concealed ductwork insulation, in horizontal and vertical service spaces, will require no further finish.
- .2 "EXPOSED" will mean not concealed. For greater certainty, the following locations are considered exposed:
 - .1 Services in all mechanical and electrical rooms.
- .3 Exposed insulated ductwork outside of the building shall be recovered all around with an aluminum jacketing system
 - .1 Exterior application shall be a vapour sealed installation.
 - .2 Over the insulation, moisture barrier and then apply 0.53 mm [22 ga] thick stucco embossed aluminum.
 - .3 The moisture barrier shall be continuous.
 - .4 The longitudinal seams of the jacketing shall be located to shed water.
 - .5 Attach with holding straps at 150 mm [6"] on centres.
 - .6 Provide a complete aluminum jacket system using all of the parts, accessories, and installation procedures of the manufacturer.
 - .7 Seal all outdoor jacketing watertight with an exterior grade flexible waterproof caulking.

3.7 MINIMUM STANDARDS

- .1 All ductwork shall be insulated to meet or exceed the minimum requirements of the National Energy Code of Canada.
 - .1 Refer to NECB Insulation of Ducts for additional information:
 - .2 In addition, the requirements of ASHRAE 90.1 are also applicable to this project.
 - .3 The more stringent insulation value (between the two codes) will be the level required for this project.

- .2 ASHRAE 90.1 specifies that where duct or plenum insulation forms part of an exterior wall or roof, duct or plenum R values shall match that wall or roof.
 - .1 Provide shop drawings to demonstrate compliance.
- .3 Where the Temperature Difference between interior of duct or plenum, and surrounding air is less than 5oC
 - .1 Min. Thermal Resistance (RSI) for Ducts and Plenums $m^2 \cdot oC/W - 0$
 - .2 Min. Thermal Resistance (RSI) for Runouts $m^2 \cdot oC/W - 0$
- .4 Where the Temperature Difference between interior of duct or plenum, and surrounding air is between 5oC to 22oC
 - .1 Min. Thermal Resistance (RSI) for Ducts and Plenums $m^2 \cdot oC/W - 0.58$
 - .2 Min. Thermal Resistance (RSI) for Runouts $m^2 \cdot oC/W - 0.88$
 - .3 Where the Temperature Difference between interior of duct or plenum, and surrounding air is greater than 22oC
 - .1 Min. Thermal Resistance (RSI) for Ducts and Plenums $m^2 \cdot oC/W - 0.58$
 - .2 Min. Thermal Resistance (RSI) for Runouts $m^2 \cdot oC/W - 0.58$
- .5 Temperature Difference refers to the temperature difference at design conditions between the space within which the duct is located and the design air temperature of the air carried by the duct.
- .6 Where duct is used for both heating and cooling purposes the larger temperature difference shall be used.

3.8 INSULATION SCOPE TYPES

- .1 Scope Type 1: External Flexible Insulation with vapour barrier.
 - .1 Exposed ducts within a room, which is being served by the exposed ducts, do not require external insulation unless there is a chance for condensation to occur.
 - .2 Service: All cooling and heating supply ducts where the temperature difference between the space within which the duct is located and the design air temperature in the duct, is less than or equal to 22.2°C [40°F] – minimum RSI-0.3522 [R-2]
 - .1 Thickness: 40mm [1.5"]
 - .3 Service: All cooling and heating supply ducts where the temperature difference between the space within which the duct is located and the design air temperature in the duct, is greater than 22.2°C [40°F] – minimum RSI-1.0566 [R-6]
 - .1 Thickness: 50mm [2"]
 - .4 Service: Outdoor air ductwork and plenums (from intake to mixing plenum).
 - .1 Thickness: 50mm [2"]
 - .5 Service: Combustion intake / relief air
 - .1 Thickness: 50mm [2"]
 - .6 Service: Exhaust air discharge through roof (including sides and bottom of plenum).
 - .1 Thickness: 50mm [2"]
 - .7 Service: Exhaust air ductwork outside the building.
 - .1 Thickness: 50mm [2"]
 - .8 Service: All exhaust air ductwork from outside wall or roof to 1.5 m [5 ft.] inside building.
 - .1 Thickness: 25mm [1"]

- .2 Scope Type 2: Internal Flexible Duct Liner
 - .1 Service: All ductwork where indicated by single hatching, unless noted otherwise – minimum RSI-1.0566 [R-6]
 - .1 Thickness: 25mm [1”]
 - .2 Service: All exposed supply ductwork in the mechanical room (from A.H.U. discharge to duct shaft), outdoors, or where indicated with double hatching – minimum RSI-1.0566 [R-6]
 - .1 Thickness: 50mm [2”]
- .3 Scope Type 3: Internal Rigid Duct Liner
 - .1 Service: Built-up site fabricated air handling unit(s). Line sheet metal walls and tops from inlet dampers to discharge dampers. Do not line transverse walls containing coils, filters, or fan discharge.
 - .1 Thickness: 25mm [1”]
 - .2 Service: Built-up site fabricated heat recovery exhaust unit(s). Line sheet metal walls and tops – minimum RSI-1.0566 [R-6]
 - .1 Thickness: 50mm [2”]
 - .3 Service: Cold and hot supply air plenums. Line walls, tops, and bottoms from discharge dampers to supply duct connections – minimum RSI-1.0566 [R-6]
 - .1 Thickness: 50mm [2”]
 - .4 Service: All outdoor air plenums. Line sheet metal walls and top – minimum RSI-1.0566 [R-6]
 - .1 Thickness: 50mm [2”]

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section provides General, Product, and Execution Requirements for HVAC Ducts and Casings.
- .2 Provide all ducts, casings and plenums as indicated, including but not limited to the following,
- .3 Supply air systems
- .4 Return air systems
- .5 Outside air systems
- .6 General exhaust systems
- .7 Wet exhaust systems
- .8 Duct Accessories, HVAC Equipment, Duct Insulation, Air Inlets/Outlets, are specified elsewhere. Refer to Related Requirements.

1.2 RELATED REQUIREMENTS

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.
- .2 In conjunction with Division 01, Division 20 General Mechanical Provisions shall govern all Division 23 Sections of the work.
- .3 Refer to Section 20 99 60 Mechanical Forms and submit all documentation therein that is applicable to Division 23.
- .4 Refer to and comply with the following sections:
 - .1 General Requirements - Division 01
 - .2 Common Work for Mechanical Systems – Division 20
 - .3 Plumbing Systems - Division 22
 - .4 Heating, Ventilation and Air Conditioning Systems - Division 23
 - .5 Controls and Instrumentation - Division 25
 - .6 Electrical - Division 26/27

1.3 APPLICABLE CODES AND STANDARDS

- .1 Refer to Section 20 05 01, Codes, Bylaws and Standards.
- .2 Where multiple versions of the same code are published, the most recent version shall be applied, unless noted otherwise by provincial building codes and local by-laws.
- .3 The construction and installation of ductwork and plenums shall be in accordance with the latest edition of the following referenced SMACNA manuals and ASHRAE handbooks.
- .4 All equipment, materials, installation, and testing shall conform to the following standards as a minimum:
 - .1 Provincial Building Code
 - .2 Local Building By-Laws
 - .3 SMACNA - H.V.A.C. Duct Construction Standards.
 - .4 SMACNA - H.V.A.C. Air Duct Leakage Test Manual.

.5 ASHRAE - Handbook - Equipment Volume.

1.4 **QUALITY ASSURANCE**

- .1 Manufacturer shall specialize in development and production of the products specified in this Section.
- .2 Follow manufacturer's recommended installation details and procedures for equipment, supplemented by requirements of Contract Documents.
- .3 Installation shall be in accordance with well-established practice and standards accepted and recognized by the Consultant and the Trade.
- .4 The Consultant 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.
- .5 Employ only Tradespeople holding valid Provincial Trade Qualification Certificates.
 - .1 Tradespeople shall perform only work that their certificate permits.
 - .2 Certificates shall be available for inspection by the Consultant.

1.5 **SUBMITTALS**

- .1 Comply with Section 23 05 00 Common Work for HVAC Systems, Submittals
- .2 Refer to Section 20 99 60 Mechanical Forms and submit all documentation therein that is applicable to Division 23 HVAC.
- .3 Shop Drawings
 - .1 Submit shop drawings in accordance with Division 01 and Section 20 05 05 Documentation and Submittals.
 - .2 Shop drawings are required for all equipment and materials.
- .4 Product Options and Substitutions
 - .1 Refer to Section 20 05 00, for requirements pertaining to product options and substitutions.
- .5 Maintenance Data
 - .1 Refer to Division 01 and Division 20 05 05 Documentation and Submittals.
- .6 Record Drawings
 - .1 Refer to Division 01 and Division 20 05 05 Documentation and Submittals.
- .7 Occupancy Documentation Requirements
 - .1 Refer to Division 01 and Section 20 05 05 Documentation and Submittals.

Part 2 Products

2.1 **GALVANIZED STEEL**

- .1 Galvanized steel shall have a 380 g/sq.m. [1-1/4 oz/sq.ft] galvanizing coat both sides to ASTM A525 G90.

2.2 **DUCTWORK AND PLENUM PRESSURES**

- .1 Provide ductwork and plenums fabricated from galvanized steel for the static pressure categories listed below.
 - .1 500 Pa [2" W.G.] static pressure

- .1 All supply ductwork downstream from mixing boxes/air valves to terminal air outlets.
- .2 All supply ductwork and plenums on systems without mixing boxes/air valves.
- .3 All return air ductwork and plenums, except where otherwise specified.
- .4 All exhaust and relief air ductwork and plenums, except where otherwise specified (welding/sawdust exhaust).
- .5 All outdoor air ductwork and plenums, except as otherwise specified.

2.3 DUCTWORK - 500 PA [2" W.G.] STATIC PRESSURE

- .1 Provide galvanized iron ductwork for system operating pressures 500 Pa [2" W.G.] and less.
 - .1 Ductwork shall be constructed, reinforced, sealed, and installed to withstand 1-1/2 times the working static pressure.
- .2 Construct rectangular ductwork in accordance with Section I including Tables 1-5, 1-10, 1-11, 1-12, 1-13 and Figs. 1-4 through 1-18 of the SMACNA Duct Standards.
- .3 Nomasco "Ductmate System, Lockformer TDC" or Exanno "Nexus System" may be used for rectangular duct joints.
- .4 At least two opposite faces of all rectangular ductwork must be joined together using a type of joint, which cannot pull apart.
- .5 Construct rectangular duct fittings in accordance with Section II including Figs. 2-1 to 2-11 and Figs. 2-16 to 2-18 of the SMACNA Duct Standards.
- .6 Construct round ductwork in accordance with Section III including Table 3-2 and Figs. 3-1 and 3-2 of the SMACNA Duct Standards but excluding beaded crimp joints and snaplock seams.
- .7 Construct flat oval ductwork in accordance with Section III including Table 3-4 and Fig. 3-6 of the SMACNA Duct Standards.
 - .1 Joints and seams shall be similar to those indicated for round ducts.
 - .2 Flat oval duct to be used for positive pressure application only.
- .8 Construct round and flat oval duct fittings in accordance with Section III including Table 3-1 and Figs. 3-3 through 3-6 of the SMACNA Duct Standards.
 - .1 Round elbows shall have a centreline radius of 1.5 times duct diameter.
 - .2 Sheet metal gauge of fittings and elbows shall be not less than the thickness of that specified for longitudinal seam straight duct.
 - .3 Adjustable elbows are not permitted.

2.4 PLENUMS - 500 PA [2"] STATIC PRESSURE

- .1 Provide galvanized steel low pressure plenums suitable for 500 Pa [2" W.G.] positive or negative pressure, for central plant ventilating and air conditioning equipment.
- .2 Construct plenums in accordance with Section VI including Figs. 6-1 through 6-3 of the SMACNA Duct Standards.
- .3 Where the building structure does not form the bottom surface of a walk-in plenum, fabricate plenum floor panels of 1.78 mm (14 ga.) galvanized steel, with angle iron reinforcing such as to limit deflection of the floor panels to a maximum of 6.4 mm [1/4"] under a concentrated load of 115 kg [250 lbs] at mid span.
- .4 Where plenum floors are internally lined, install a 1.47 mm [16 ga.] thick galvanized steel panel on top of the insulation.

- .5 Apply silicone sealant CGE Silpruf 2000 series or Dow Corning 781/732 between plenum base angles and concrete or curbs before bolting together.
- .6 Reinforce all openings in plenum walls with 40 mm x 40 mm x 4.8 mm [1-1/2" x 1-1/2" x 3/16"] angle iron, secured to the main vertical and horizontal reinforcing angles.
- .7 Construct access door and casing around door as per SMACNA, casing access doors, Fig. 6-12. Section C-C with angle iron frame sized to suit plenum wall.
 - .1 Doors constructed of 16-gauge metal.
- .8 Arrange access doors so that they open against the airflow and static pressure.
- .9 Weld all joints on condensate drain pans.
 - .1 Construct the pans from 1.45 mm [16 ga.] thick stainless-steel type #302 or #304.
 - .2 Install a minimum of 32 mm [1-1/4"] piping connection, complete with water seal at least 100 mm [4"] deep, from the pan drain connection to the nearest building drain.
 - .3 Install drain connections so that they shall completely drain the pans.
- .10 Seal piping penetrations through plenum walls, with gland seals as detailed in Fig. 6-10 of the SMACNA Duct Standards.
- .11 Bulkheads mounting air filters and air coils shall be airtight to prevent air bypass around filters and/or coils.

2.5 DUCTWORK AND PLENUM SEALERS

- .1 Provide duct sealing compounds for use in fabrication of all ductwork and plenum joints.
- .2 All ductwork shall be sealed to SMACNA Seal Classification A.
- .3 For further details refer to Section 23 33 00, Duct Accessories.

2.6 DUCT CONSTRUCTION - ACOUSTICALLY LINED

- .1 Where rectangular ductwork is indicated to be acoustically insulated with flexible acoustic duct liner, liner shall be installed in accordance with instructions and Figures 2-22 through 2-25, SMACNA Duct Standards.
 - .1 Duct sizes shown are inside the duct liner.
- .2 Where round ductwork is indicated to be acoustically insulated, it shall consist of two concentric round ducts with 25 mm [1"] thick flexible fibrous glass duct liner between the two ducts.
 - .1 The inner duct shall be perforated and correspond to the duct diameter noted on the drawings.
 - .2 The outer duct shall be suitable for the static pressure and shall be sealed airtight where it joins the adjacent ductwork.

2.7 DUCT CONSTRUCTION – OUTDOORS

- .1 The internally or externally insulated supply, return and exhaust ducts (downstream of heat recovery coils) including silencers, located outdoors on the roof, shall be constructed watertight.
- .2 All joints shall be caulked with a water impervious sealant. TDC clips should be continuous on the top and sides of the ducts.
- .3 The top of the finished product (waterproof membrane) should be pitched to avoid pooling of water.
- .4 After pressure testing, the exterior of the ducts and the duct silencers shall be wrapped with a waterproof membrane.

- .1 The details of this membrane need to be researched but could be as follows:
- .2 Membrane consisting of a SBS rubberized asphalt compound, integrally laminated to a reinforced aluminum foil, providing a waterproof membrane.
- .5 Standard of Acceptance:
 - .1 Bakor Foilskin

2.8 COUNTER FLASHINGS

- .1 Counter flashings - galvanized sheet steel of 0.8 mm [22 gauge] minimum thickness.
- .2 Counter flashings are attached to mechanical equipment and lap the base flashings on the roof curbs.
- .3 All joints in counter flashings shall be flattened and solder double seam.
 - .1 Storm collars shall be adjustable to draw tight to pipe with bolts.
 - .2 Caulk around the top edge.
 - .3 Storm collars shall be used above all roof jacks.
- .4 Vertical flange section of roof jacks shall be screwed to face of curb.

Part 3 Execution

3.1 GENERAL

- .1 Duct sizes on drawings indicate clear inside dimensions.
 - .1 For acoustically lined or internally insulated ducts, maintain inside duct dimensions.
- .2 Where duct sizes are shown in nominal metric sizes, round and oval duct sizes may be supplied in the nearest available sizes in equivalent imperial units.
- .3 Proper sized openings shall be arranged for in the correct locations through all slabs and walls.
 - .1 Openings shall be planned to include for the installation of fire dampers at all rated fire separations.
- .4 Where ducts penetrate roofs, provide roof curbs with flashing and counterflashing.
- .5 Arrange for 100 mm [4"] high by 100 mm [4"] wide concrete curbs around all duct penetrations through floor slabs outside of duct shafts.
- .6 The project drawings are diagrammatic and although efforts have been made to provide information regarding the number of offsets and transitions, not all are necessarily shown.
 - .1 Changes may be required in duct routings, elevation, and duct shape to eliminate interference with structure and other services.
 - .2 All required adjustments shall be established when coordinating and field measuring the work prior to fabrication and must be provided as part of the contract and all associated costs must be considered and included.
- .7 Ductwork used on this project shall be clean and free from scale, corrosion, and deposits.
 - .1 All ductwork shall be degreased and wiped clean of all oil and other surface films with appropriate solvents prior to installation.
- .8 All ductwork shall be delivered clean to the site and maintained in clean condition.
 - .1 Dirty ductwork shall be removed from site.
- .9 Provide seismic restraints for ductwork in accordance with SMACNA "Guidelines for seismic restraints of mechanical systems and plumbing piping systems".

3.2 DUCTWORK & PLENUM INSTALLATION

- .1 Where a duct contains a fire or smoke damper, construct the duct so that the free area of the duct is maintained through the fire or smoke damper.
- .2 Where a duct is to be internally insulated, enlarge the duct so as not to reduce the duct free area.
- .3 Make the taper of diverging transitions less than 20 deg. and the taper of converging transitions less than 30 deg., in accordance with Fig. 2-9 of the SMACNA Duct Standards.
 - .1 Maximum divergence upstream of equipment to be 30 deg. and 45 deg. convergence downstream.
- .4 Make the inside radius of any rectangular duct elbow at least equal to the duct width, measured in the direction of the radius.
 - .1 If space conditions do not permit a full radius elbow to be installed, use square elbows with multi-blade turning vanes.
- .5 Turning vanes shall be single wall type.
 - .1 Vanes in galvanized sheet metal ducts shall be constructed from galvanized steel, minimum thickness 0.76 mm [22 ga].
 - .2 Vanes shall be spaced at 40 mm [1-1/2"] centres and shall turn through 90 deg., with a radius of 50 mm [2"].
 - .3 Vanes shall not include a straight trailing edge. Refer to Figs. 2-3 and 2-4 of the SMACNA Duct Standards.
 - .4 Vanes and runners in aluminum ducts shall be constructed from aluminum.
 - .5 Aluminum vanes shall be 0.86 mm thick [18 ga].
- .6 For 500 Pa [2"] pressure systems, install tie rods to limit the maximum unsupported vane length to 914 mm [36"]. Refer to Fig. 2-4 of the SMACNA Duct Standards.
- .7 Install duct necks before grilles, registers and diffusers and cushion heads after diffuser take-offs as required to suit site conditions.
- .8 Where indicated, install adjustable air turning devices, where full radius take-off fittings cannot be installed, in accordance with Fig. 2-16 of the SMACNA Duct Standards.
 - .1 Adjustment shall be accessible outside the duct with lockable quadrant operator or through the grille or register with key-operated worm gear mechanism.
- .9 Cross-break or bead all metal duct panels unless otherwise noted.
- .10 Roof mounted ducts shall have standing seams and shall be sealed weather tight.
- .11 Provide moisture collection sections inside all louvres for outside air and exhaust air.
- .12 Support ductwork using galvanized steel straps, cadmium plated threaded rods, flat bar, or angle hangers.
 - .1 Attachments to the structure shall be compatible with the structure and selected for the load of the ductwork.
 - .2 Install ductwork hangers in accordance with Section IV including Tables 4-1 through 4-3 and Figs. 4-1 through 4-9 of the SMACNA Duct Standards.
- .13 Support duct risers at their base and at each floor and at not greater than 3.7 m [12 ft] intervals.
- .14 Prior to the fabrication of ductwork, co-ordinate and field measure all ductwork to ensure a complete installation respecting all other services.
 - .1 Provide all necessary fittings, offsets, and alternate construction methods to facilitate the installation.

- .15 Arrange ductwork and plenums so that duct and plenum mounted equipment can be easily removed.
- .16 Arrange access doors so that they open against the airflow and static pressure.
- .17 Ducts passing through non-rated fire separations, sound insulated walls and through non-rated walls and floors shall be tightly fitted and sealed on both sides of the separation with silicon sealant to prevent passage of smoke and/or transmission of sound. (U.L.C. approved fire stop sealant is not a requirement).
 - .1 Where ducts are insulated provide a 0.61 mm [24 ga] thick galvanized steel band tightly fitted around insulation and then caulk to band.
- .18 During construction, protect openings in ductwork, from dust infiltration, by covering with polyethylene, and protect floor outlet duct openings with metal caps.
- .19 Where ductwork is required to pass through open web steel joists, coordinate with the joist fabricator before fabricating ductwork.
- .20 Where ducts penetrate roofs, install sleeves and roof curb c/w flashing and counterflashing.
 - .1 Pack sleeves in roof with fibreglass insulation.
- .21 Provide drip pans under piping and shields for protection of electrical panels and equipment.
- .22 Unless noted otherwise, line all builder's shafts and air plenums used as ducts and plenums with sheet metal.

3.3 DUCTWORK AND PLENUM CLEANING

- .1 Refer to Section 23 33 05 - Duct Cleaning.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section provides General, Product, and Execution Requirements for Air Duct Accessories.
- .2 Provide all required Air Duct Accessories as indicated, including, but not limited to:
 - .1 Backdraft dampers
 - .2 Balancing Dampers
 - .3 Duct connectors
 - .4 Fire, smoke, and combination Fire/Smoke Dampers
 - .5 Access Doors

1.2 RELATED REQUIREMENTS

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.
- .2 In conjunction with Division 01, Division 20 General Mechanical Provisions shall govern all Division 23 Sections of the work.
- .3 Refer to Section 20 99 60 Mechanical Forms and submit all documentation therein that is applicable to Division 23.
- .4 Refer to and comply with the following sections:
 - .1 General Requirements - Division 01
 - .2 Common Work for Mechanical Systems – Division 20
 - .3 Plumbing Systems - Division 22
 - .4 Heating, Ventilation and Air Conditioning Systems - Division 23
 - .5 Controls and Instrumentation - Division 25
 - .6 Electrical - Division 26/27

1.3 APPLICABLE CODES AND STANDARDS

- .1 Refer to Section 20 05 01, Codes, Bylaws and Standards.
- .2 All equipment, materials, installation, and testing shall conform to the following standards as a minimum:
 - .1 Provincial Building Code
 - .2 Local Building By-Laws
 - .3 Provincial Safety Authority

1.4 QUALITY ASSURANCE

- .1 Refer to Section 20 05 00 General Mechanical Provisions, Quality Assurance for additional details.
- .2 Employ only Tradespeople holding valid Provincial Trade Qualification Certificates.
- .3 Follow manufacturer's recommended installation details and procedures for equipment, supplemented by requirements of Contract Documents.

- .4 Installation shall be in accordance with well-established practice and standards accepted and recognized by the Consultant and the Trade.

1.5 SUBMITTALS

- .1 Comply with Division 01 and Section 20 05 05 Documentation and Submittals.
- .2 Comply with Section 23 05 00 Common Work for HVAC Systems, Submittals
- .3 Refer to Section 20 99 60 Mechanical Forms and submit all documentation therein that is applicable to Division 23 HVAC.
- .4 Shop Drawings
 - .1 Submit shop drawings in accordance with Division 01 and Division 20 05 05 Documentation and Submittals.
 - .2 Shop drawings are required for all materials and equipment.
- .5 Product Options and Substitutions
 - .1 Refer to Division 01 and Section 20 05 00, for requirements pertaining to product options and substitutions.
- .6 Samples
 - .1 Refer to Division 01 and Section 20 05 05 Documentation and Submittals.
- .7 Maintenance Data
 - .1 Refer to Division 01 and Section 20 05 05 Documentation and Submittals.
- .8 Occupancy Documentation Requirements
 - .1 Refer to Division 01 and Section 20 05 05 Documentation and Submittals.

Part 2 Products

2.1 BACKDRAFT DAMPERS - LIGHT DUTY

- .1 Minimum Requirements:
 - .1 mm thick [16 ga] galvanized steel or aluminum channel frame.
 - .2 mm thick [24 ga] embossed aluminum blades.
 - .3 Full blade length shafts, brass bearings.
 - .4 Felt or neoprene anti-chatter blade strips.
 - .5 Maximum blade height per section, 610 mm [24"], use multiples for larger dimensions.
 - .6 Maximum blade length of 460 mm [18"], use multiples for larger dimensions.
 - .7 Manufacturer's label.
 - .8 Where a balanced backdraft damper (BDD) is indicated the damper shall incorporate an adjustable counterbalance weight and lever.
 - .9 Maximum pressure drop across damper at 4.06 m/s [800 FPM] shall be 35 Pa [0.14" w.g.]
- .2 Standard of Acceptance:
 - .1 E.H. Price BDD

2.2 BALANCING DAMPERS

- .1 Construction in accordance with SMACNA Duct Standards - Figs. 2-14 and 2-15.
- .2 Rectangular ducts:

- .1 Up to 300 mm [12"] deep - single blade (butterfly type).
- .2 330 mm [13"] to 400 mm [16"] deep - two opposed blades, mechanically interlocked with pivots at quarter points.
- .3 430 mm [17"] deep and over - multiple opposed blades, mechanically interlocked with blades not greater than 200 mm [8"] deep and pivots equally spaced.
- .3 Round Ducts:
 - .1 Single blade (butterfly type).
- .4 Material:
 - .1 Minimum 1.47 mm [16 ga] thick galvanized steel blade on all butterfly dampers.
 - .2 Minimum 1.47 mm [16 ga] thick galvanized steel blades on multi-blade dampers with rigidly constructed galvanized steel frame (no frame required on single blade dampers).
 - .3 Minimum 1.14 mm [18 ga] thick stainless-steel blades for fume exhaust ducts.
- .5 Bearings:
 - .1 End bearings on all low-pressure single blade dampers above 300 mm [12"] dia.
 - .2 Bearings on multiple blade dampers shall be bronze oilite type.
- .6 Operating Mechanism:
 - .1 Lockable quadrant type with end bearing on accessible rectangular ducts up to 400 mm [16"] deep and on accessible round ducts.
 - .2 Wide pitch screw mechanism type with crank operator on accessible rectangular ducts 430 mm [17"] and over in depth and on inaccessible rectangular and round ducts.
 - .3 Override limiting stops.
 - .4 No blade movement in set position.
- .7 Concealed Regulators:
 - .1 Drawing designation: D (CR).
 - .2 For all drywall ceilings which do not have access panels provide concealed balancing damper regulators embedded in the finished ceiling, mounted behind grilles, on or inside plenum slot diffusers and various types of diffusers.
 - .3 Concealed damper regulator to be connected to balancing damper by means of flexible Bowden cable and to be installed flush with ceiling.
 - .4 Coverplate to be held in place with 2 screws and to be easily removed for damper adjustment.
 - .5 Refer to Mechanical Details.
 - .6 Standard of Acceptance:
 - .1 Young Regulator Co. Model No. 270-301.
 - .2 Provide all necessary hardware including Young Regulator balance damper model 5020-CC, Bowden cable and Young Regulator Model 030-12 wrench.

2.3 DUCT AND PLENUM ACCESS

- .1 Locations: Refer to Part 3 (Execution).
- .2 Dimensions:
 - .1 Doors:
 - .1 500 mm [20"] wide x 1370 mm [54"] high.

- .2 Head of door 1780 mm [70"] above floor.
- .2 Panels:
 - .1 380 mm x 500 mm [15"x20"].
 - .2 Where the far corners of the duct are closer than 500 mm [20"] and the equipment within the duct is closer than 300 mm [12"] the size may be reduced to 400 mm x 300 mm [16"x12"] or 450 mm x 250 mm [18"x10"] elliptical.
 - .3 Where space will not permit the above dimensions to be attained, they should be matched as closely as possible and where necessary additional access be provided.
- .3 Products:
 - .1 Doors - construct in accordance with SMACNA Duct Standards Fig. 6-12 except for latch type. 40 mm [1-1/2"] thick insulation.
 - .2 Panels - Nailor Hart, Ventlok, 25 mm [1"] thick insulation.
 - .3 Gaskets - neoprene or foam rubber.
- .4 Hardware:
 - .1 Panels up to 400 mm x 300 mm [16 "x 12"] - 2 sash locks.
 - .2 Panels - 380 mm x 500 mm [15 "x 20"] - 4 sash locks.
 - .3 Doors - piano hinge and Ventlok 310 latches c/w front and inside handles and front door pull.

2.4 DUCT CONNECTORS - VIBRATION ISOLATION

- .1 Provide flexible duct connections to provide vibration isolation at all duct and plenum connections to fan and air handling units.
 - .1 See Figure 2-19 SMACNA Duct Standards.
- .2 Minimum Requirements:
 - .1 Pre-assembled 75 mm [3"] minimum long flexible connection with 75 mm [3"] long 0.62 mm [24 ga] galvanized steel duct connectors on each side of the flexible connection.
 - .1 Flexible connector - fiber glass fabric with elastomer coating.
- .3 Centrifugal fans with 900 mm [36"] diameter and larger fan wheels, use 150 mm [6"] long flexible connection.
- .4 Do not install connectors on perchloric acid fume exhaust systems.
- .5 Standard of Acceptance: Duro Dyne "Durolon", Dynair "Hypalon", Ventfabrics "Ventlon".

2.5 DUCTWORK - FLEXIBLE - PLAIN

- .1 Provide factory fabricated plain, flexible air ductwork for the following applications:
 - .1 Connections to air terminals.
 - .2 Connections to downstream side of mixing boxes / air valves.
 - .3 Connections to round fire dampers (up to 300 mm [12"] diameter).
- .2 Minimum Requirements:
 - .1 Non-corrosive spiral wire reinforcing with flexible vinyl coated fiberglass cloth membrane.
 - .2 Suitable for up to 2500 Pa [10" w.g.] positive static pressure and 250 Pa [1" w.g.] negative static pressure.

- .3 U.L. or U.L.C. labelled, Class 1, duct connector.
- .4 Flame spread rating not to exceed 25. Smoke developed rating not to exceed 50.
- .3 Standard of Acceptance: Flexmaster FAB4, Thermaflex SLP10,

2.6 DUCTWORK SEALERS

- .1 Provide duct sealing compounds for use in fabrication of all ductwork and plenum joints.
- .2 All ductwork shall be sealed to SMACNA Seal Classification A.
- .3 Standard of Acceptance:
 - .1 Foster 32-14, Hardcast Versa Grip, Hardcast Foil Grip 1402, Robson's Duct Seal-WB, United Duct Sealer, Trans Continental Multi-Purpose.
- .4 Where accessible, apply sealer to inside of joints on ducts and plenums under positive pressure - e.g., on the discharge side of fans.
- .5 Apply sealer to outside of joints on ducts and plenums under negative pressure - e.g., on the suction side of fans.

Part 3 Execution

3.1 BALANCING DAMPERS

- .1 Provide balancing dampers at points on low pressure supply, return and exhaust systems where branches are taken from larger duct as required for proper air balancing.
- .2 Provide balancing dampers at each run out to a grille or diffuser.
- .3 Identify the airflow direction and blade rotation and open and closed position.
- .4 On all round ductwork larger than 300 mm [12"] diameter and on externally insulated rectangular ductwork, provide sheet metal bridge to raise quadrant type operators above the insulation thickness (coordinate with Section 23 07 13). Provide an open end bearing where bridges are used.
 - .1 Bridges on uninsulated round ducts shall be at least 25 mm [1"] high.
- .5 Where quadrant type operators are used, the lever shall be arranged parallel with the damper blade.

3.2 BACKDRAFT DAMPERS

- .1 Install backdraft dampers on all exhaust and relief openings through the building walls and roof on all exhaust fans where control dampers are not called for or indicated.

3.3 DUCT AND PLENUM ACCESS

- .1 Locations: Provide access doors and panels as follows:
 - .1 Doors: where shown on the drawings.
 - .2 Panels:
 - .1 Minimum, every 12 m [40 ft] on all ductwork.
 - .1 Refer to Section 23 33 05 Duct Cleaning for additional requirements.
 - .2 At the base of each duct riser.
 - .3 Both sides of equipment blocking the duct e.g.
 - .1 air flow measuring stations
 - .2 coils

- .4 At or to one side of other equipment in duct e.g.
 - .1 backdraft dampers (counterweight side)
 - .2 balance dampers serving multiple outlets/inlets
 - .3 bearings (fans/motors)
 - .4 control dampers
 - .5 control sensors
 - .6 fire dampers (rectangular ducts and round ducts 330 mm [13"] dia. and larger - latch side)
 - .7 heat detectors (upstream from device)
 - .8 smoke dampers (operator side)
 - .9 smoke detectors (upstream from device)
- .5 Panels need not be provided where access is available through a door or a register mounted on the side of the duct.
- .6 Kitchen exhaust access requirement specified under "Ductwork - Kitchen Exhaust".
- .3 Patches:
 - .1 Where required for cleaning and where access panels are not specified, e.g. on both sides of turning vanes.
 - .4 Flexible duct - on round duct and round fire dampers up to 300 mm [12"] dia.
- .2 Seal frames airtight.
- .3 Install so as not to interfere with airflow.
- .4 Install to provide easiest possible access for service and cleaning.
- .5 Do not use sheet metal screws for attaching access panels to ductwork.
- .6 Round ducts 330 mm [13"] dia. and larger shall include a short collar for the installation of access panels.
- .7 Small rectangular ducts shall be transitioned to a minimum dimension across the duct of 330 mm [13"] for the installation of access panels.
- .8 SPEC. NOTE: Include the following clause for Telus projects.
- .9 Provide retaining chains on panels 2.1 m [7 ft] above floor, and higher.

3.4 DUCT CONNECTORS - VIBRATION ISOLATION

- .1 Ensure flexible duct connectors do not reduce duct free area on suction side of fans.

3.5 DUCTWORK – FLEXIBLE

- .1 Installed lengths shall be limited to 6 times duct diameter but not longer than 1200 mm [4 ft].
- .2 Connect to ductwork and diffusers with stainless steel worm drive clamps or Panduit adjustable clamps or Thermaflex duct strap applied over two wraps of duct tape.
 - .1 Use stainless steel clamps on connections to fire dampers.
- .3 Minimum centreline radius of flexible ductwork bends shall be 1.5 times the duct diameter.
 - .1 Alternatively, sheet metal elbows may be used at branch takeoffs and boot/diffuser connections.
- .4 Support with 25 mm x 0.76 mm [1" x 22 ga] galvanized steel straps at a maximum of 600mm [24"]. Straps shall completely encircle duct.

- .5 Support clear of ceiling assembly, light fixtures, and hot surfaces.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section provides General, Product, and Execution Requirements for Air Duct Cleaning.
- .2 Provide all required Air Duct Cleaning Services as indicated, including, but not limited to:
 - .1 When the duct systems are completed and before any fan systems are operated, all supply air ductwork, return air ductwork, plenums, coils, and air handling equipment shall be cleaned by compressed air and mechanical equipment, or compressed air and high-power suction equipment.
 - .2 Clean all supply/exhaust/return duct systems, equipment, and plenums.
 - .3 Clean all terminal boxes and reheat coils.
 - .4 Clean air handling unit and all interior components, including fans, silencers, heating/cooling coils, motors.
 - .5 All duct systems, plenums, and equipment shall be cleaned to a minimum of Level 1 Clean.
 - .6 General exhaust ductwork systems that always convey air directly to the outside without recirculation require Level 1 cleaning.
 - .7 All supply air systems, return air systems, and related equipment require Level 2 cleaning.
 - .8 Refer to Part 3 Execution for definitions and additional details.
 - .9 A letter shall be submitted by the cleaning company certifying that all systems have been completely cleaned, and all access doors, access ports and covers are in place.

1.2 RELATED REQUIREMENTS

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.
- .2 In conjunction with Division 01, Division 20 General Mechanical Provisions shall govern all Division 23 Sections of the work.
- .3 Refer to Section 20 99 60 Mechanical Forms and submit all documentation therein that is applicable to Division 23.
- .4 Refer to and comply with the following sections:
 - .1 SPEC NOTE: Modify the following list as applicable to the project.
 - .2 General Requirements - Division 01
 - .3 Common Work for Mechanical Systems – Division 20
 - .4 Plumbing Systems - Division 22
 - .5 Heating, Ventilation and Air Conditioning Systems - Division 23
 - .6 Controls and Instrumentation - Division 25
 - .7 Electrical - Division 26/27

1.3 APPLICABLE CODES AND STANDARDS

- .1 Refer to Section 20 05 01, Codes, Bylaws and Standards.
- .2 All components, products and fabrication techniques shall be provided in compliance with the Regulations and Requirements of the Local Authority Having Jurisdiction.

- .3 All equipment, materials, installation, and testing shall conform to the following standards as a minimum:
 - .1 SPEC NOTE: Modify the following list as applicable to the project.
 - .2 Provincial Building Code
 - .3 Local Building By-Laws

1.4 QUALITY ASSURANCE

- .1 Refer to Section 20 05 00 General Mechanical Provisions, Quality Assurance for additional details.
- .2 The HVAC system cleaning sub-trade shall be a certified member of the National Air Duct Cleaners Association (NADCA) or equivalent.
- .3 Firms to be specialists in this field.
 - .1 Submit list of equipment, capacities, method, and sequence of cleaning to the Consultant for approval prior to beginning work.
- .4 Execution shall be in accordance with well-established practice and standards accepted and recognized by the Consultant and the Trade.
- .5 Any ductwork delivered to the site which in the Consultant's opinion is dirty, shall be removed from the site and cleaned by the sheet metal contractor.
- .6 The Owner may hire an independent agency to review duct cleaning procedures prior to starting work and perform spot-checks to confirm that duct system cleaning has been effectively executed.
- .7 The Consultant shall have the right to reject any item of work that does not conform to the Contract Documents and accepted standards of performance, finish, and appearance.
- .8 Submit a letter certifying that all systems have been completely cleaned and are ready for inspection.

1.5 SUBMITTALS

- .1 Comply with Division 01 and Section 20 05 05 Documentation and Submittals.
- .2 Comply with Section 23 05 00 Common Work for HVAC Systems, Submittals
- .3 Refer to Section 20 99 60 Mechanical Forms and submit all documentation therein that is applicable to this Specification Section.
- .4 Submit certification of NADCA membership.
- .5 Submit list of five (5) recent projects of similar magnitude.
- .6 Submit the name of the superintendent-in-charge of the work and list his project experience.
- .7 Submit an outline of the work scope for each ductwork system, lighting procedures, equipment, materials, and schedule, prior to starting work.
- .8 Submit a certificate of completion for each ductwork system that cleaning has been completed as defined in the specifications.

Part 2 Products

2.1 ACCESS DOORS

- .1 The sheet metal subtrade shall provide all necessary access doors to facilitate efficient ductwork cleaning as listed under installation.

- .2 Access Doors: Minimum 450 mm x 350 mm [18" x 14"] door, hinge and frame type, positive latching / locking mechanism. Refer to Section 23 33 00, Air Duct Accessories.

2.2 CLEANING EQUIPMENT

- .1 Capable of 5.0 kPa [20 in WG] suction capacity and 12,000 L/s [25,425 cfm] minimum flow capacity.
- .2 Provide approved filters to protect equipment during cleaning operation. Submit shop drawings indicating which type of filters are to be utilized to protect equipment during construction and cleaning operation.
- .3 Temporary Filters: 3-ply filter element with 35% ASHRAE 52-76 dust spot efficiency of 2.64 m/s face velocity to protect equipment during cleaning operation.

2.3 CLEANING AGENT:

- .1 Safeguard
- .2 Microban

Part 3 Execution

3.1 DUCT CLEANING GENERAL

- .1 Perform HVAC system cleaning in accordance with the current published standards of NADCA.
- .2 Definitions
 - .1 Level 1 Clean: No visible particulates or deposition after vacuum techniques have been completed.
 - .2 Air System: Includes central equipment; supply, return, exhaust fans, coils, dampers, turning vanes, grilles, diffusers, high, medium, and low-pressure ductwork (supply, return and exhaust) that is associated with an air handling system.
- .3 Commence Level 1 Standard cleaning after completion of duct system installation and before air handling system are started.
- .4 When the duct systems are completed and before any fan systems are operated, clean all ductwork, plenums, coils and air handling equipment by compressed air and mechanical equipment or compressed air and high-power suction equipment.
- .5 Do not use mechanical brushes on acoustic lined ductwork.
- .6 Remove all filters within five (5) days after vacuum procedures is completed. Ensure the number of filters removed is equal to the number of filters installed.
- .7 Seal all ductwork outlets and plenum openings with polyethylene sheet cover after ductwork has been cleaned.

3.2 PREPARATION

- .1 Isolate items to be cleaned so as not to contaminate unprotected work.
- .2 Equip vacuum equipment with filters.
- .3 Prior to any work being started on the system, filter media shall be installed behind every supply grille or diffuser and on inlet side of duct or box reheat coils. This will act as a safety net for contamination which may be disturbed during cleaning. After a settling down period of two (2) to (5) five days, the filter media will be removed.

- .4 Each aspect of a system shall be cleaned regardless of the size, type or configuration. Dirt clinging to the sides or top of ducting must be removed and left as clean as the bottom. Spiral ducting should be as clean as flat.
- .5 The cleaning contractor shall mark damper positions before cleaning and return them to their original position when cleaning is completed unless the system is still to be balanced.
- .6 One (1) sample air system shall be cleaned first prior to commencement of overall work, to determine standard of acceptance. The Consultant and all representatives, mechanical and general contractors, having jurisdiction to inspect and accept completed work shall be present during this pre-quality acceptance inspection.

3.3 INSTALLING ACCESS DOORS

- .1 Access doors shall be as specified in Section 23 33 00, Air Duct Accessories.
- .2 Access port system shall be reusable to allow for future inspection or cleaning.
- .3 All ductwork outlets shall be sealed with suitable cover after ductwork has been cleaned. All plenums to be sealed after plenums have been cleaned.
- .4 Locate access doors and install as follows:
 - .1 At 10 m [30'] intervals in vertical ducts.
 - .2 Horizontal ducts at intervals of 6 m [20'].
 - .3 At the base of all duct risers.
 - .4 Both sides of turning vanes in all ducts.
 - .5 At each fire damper location.
 - .6 At each side of all coils except where an access is provided.
 - .7 At all locations of internally duct mounted equipment or devices including balancing dampers, automatic dampers, damper motors, duct mounted smoke detectors and heat detectors, and controls, except where access is provided.
 - .8 Where required to facilitate duct cleaning.
 - .9 For duct cleaning system utilizing compressed air and mechanical brush, suitably sized access ports with positive locking cover and zero flame spread rating, shall be installed at 3 m [10'] intervals in the ductwork and on both sides of dampers, coils, turning vanes, etc.
- .5 The duct cleaning agent shall supply a minimum of 5% or 50 (whichever is less) replacement access port caps to the Owner.

3.4 COMPLETION

- .1 Any ductwork found to be dirty shall be recleaned through its entire length.
- .2 Once an air system is started after final cleanliness inspection and acceptance, for testing purposes, balancing and/or fine tuning, the maintaining of cleanliness is the responsibility of the Mechanical Contractor.
- .3 Prior to semi-final, the cleanliness of all ventilation systems shall be re-inspected.
 - .1 If the cleanliness is not acceptable, the Mechanical Contractor shall be responsible for re-cleaning.
- .4 If the cleanliness of ventilation systems can be jeopardized due to unclean and dusty conditions, the cleaning and start-up of ventilation system shall not be allowed.
- .5 The cleaning contractor shall be responsible for removing and replacing filter media in the pre-filter.

- .6 The cleaning contractor shall mark damper positions before cleaning and return them to their original position when cleaning is completed unless the system is still to be balanced.
- .7 The contractor shall sample and analyze the contamination in the ductwork as requested by the Consultant.
 - .1 The results will be verified by an independent laboratory, paid for by the Contractor, specializing in this type of work.

3.5 DUCTWORK AND PLENUM CLEANING

- .1 All ductwork and equipment installed shall be free of scale, debris and dirt.
- .2 Maintain all duct and equipment openings covered with poly or equivalent to prevent the entry of dirt.
- .3 Clean all plenums and buried supply ductwork with an industrial vacuum cleaner on completion of the duct and plenum installation.
- .4 Install air filters of the specified performance.
- .5 Blow out all supply ductwork, (by means of the supply fan) on completion of the duct and plenum installation and prior to installation of air terminals.
- .6 Ductwork shall be considered clean when all foreign material visible to the naked eye has been removed.
 - .1 A random sampling review by the Consultant will be conducted to check for cleanliness.

3.6 QUALITY ASSURANCE AND VERIFICATION

- .1 The HVAC system will be visually inspected to confirm no visual contaminants are present.
 - .1 If visible contaminants are evident, those portions of the system shall be re-cleaned and re-inspected.
- .2 A NADCA vacuum test analysis and particulate count will be performed by a qualified third party.
- .3 Submit a report to the Consultant confirming that the HVAC system and its components have been successfully cleaned and verified by visual inspection, and that any parts of the HVAC system damaged by this work have been identified and corrective measures have been undertaken.
- .4 Repeat duct cleaning procedures on all sections found not satisfactory by independent test agency hired by the Owner.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section provides General, Product, and Execution Requirements for HVAC Fans.
- .2 Provide all required HVAC Fans and accessories as indicated, including, but not limited to:
 - .1 Inline Centrifugal Fans
 - .2 Cabinet Fans

1.2 RELATED REQUIREMENTS

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.
- .2 In conjunction with Division 01, Division 20 General Mechanical Provisions shall govern all Division 23 Sections of the work.
- .3 Refer to Section 20 99 60 Mechanical Forms and submit all documentation therein that is applicable to Division 23.
- .4 Refer to and comply with the following sections:
 - .1 General Requirements - Division 01
 - .2 Common Work for Mechanical Systems – Division 20
 - .3 Plumbing Systems - Division 22
 - .4 Heating, Ventilation and Air Conditioning Systems - Division 23
 - .5 Controls and Instrumentation - Division 25
 - .6 Electrical - Division 26/27

1.3 QUALITY ASSURANCE

- .1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards.
- .2 Fans shall conform to AMCA bulletins regarding testing and construction. Airfoil fans shall bear the AMCA certified rating seal for airflow and sound.

1.4 APPLICABLE CODES AND STANDARDS

- .1 Refer to Section 20 05 01, Codes, Bylaws and Standards.
- .2 All equipment, materials, installation, and testing shall conform to the following standards as a minimum:
 - .1 Provincial Building Code
 - .2 Local Building By-Laws
 - .3 Provincial Safety Authority

1.5 QUALITY ASSURANCE

- .1 Refer to Section 20 05 00 General Mechanical Provisions, Quality Assurance for additional details.
- .2 Employ only Tradespeople holding valid Provincial Trade Qualification Certificates.

- .3 Follow manufacturer's recommended installation details and procedures for equipment, supplemented by requirements of Contract Documents.
- .4 Installation shall be done in accordance with well-established practice and standards accepted and recognized by the Consultant and the Trade.

1.6 SUBMITTALS

- .1 Comply with Division 01 and Section 20 05 05 Documentation and Submittals.
- .2 Comply with Section 23 05 00 Common Work for HVAC Systems, Submittals
- .3 Refer to Section 20 99 60 Mechanical Forms and submit all documentation therein that is applicable to this Specification Section.
- .4 Shop Drawings
 - .1 Submit shop drawings in accordance with Division 01 and Section 20 05 05 Documentation and Submittals.
 - .2 Shop drawings are required for all materials and equipment.
 - .3 Fan shop drawings shall include motor efficiencies. Refer to Section 20 05 03 for minimum motor efficiencies.
 - .4 Fan shop drawings shall include sound rating data and fan curves showing operating point plotted on curves.
 - .5 Submit fan sound power levels with shop drawings measured to applicable AMCA standards, or other data acceptable to the Consultant. Provide test data, if requested.
 - .1 Indicate on shop drawings the test configuration, including ductwork, and any end reflection corrections applied to the data and / or if such corrections have been omitted.
- .5 Product Options and Substitutions
 - .1 Refer to Division 01 and Section 20 05 00, for requirements pertaining to product options and substitutions.
- .6 Maintenance Data
 - .1 Refer to Division 01 and Section 20 05 05 Documentation and Submittals.
 - .2 Submit manufacturer's recommended maintenance tasks for a one-year period. Include maintenance schedules and lubrication products.
 - .3 Submit operating and maintenance data for inclusion into the manuals.
- .7 Occupancy Documentation Requirements
 - .1 Refer to Division 01 and Section 20 05 05 Documentation and Submittals.

Part 2 Products

2.1 GENERAL

- .1 Refer to Section 20 05 03 Electric Motors. Comply with all requirements of that Section of work as related to general requirements, products, and execution.
- .2 All fan motors shall be UL listed and CSA certified.
- .3 The noise level of each motor shall comply with NEMA standards, less than 80 dBA at 1 meter.
- .4 Motors and Variable Speed Drives

- .1 Provide motors generating noise levels which are imperceptible in the occupied space, and outside building, relative to fan noise.
 - .1 Provide acoustical data confirming required performance prior to RFP closing.
 - .2 If approval is not obtained prior to RFP closing, provide equipment meeting specified imperceptible requirement without loss in efficiency.
- .5 Motors powered by variable speed drive controllers shall be EEMAC class B with Type F "inverter duty" insulation, shall have a 1.15 service factor on sine wave power, 1.0 service factor on PWM power and meet NEMA Code MG-1.
- .6 Full Voltage Start Applications:
 - .1 All motors shall be in accordance with NEMA standards, and CSA C390-93, or the latest version as is applicable.
 - .2 Motors also shall comply with the applicable portions of the Canadian Electrical Code.
- .7 Provide fans selected for maximum efficiency and generating noise levels on site not exceeding the level calculated from the ASHRAE Guides.
 - .1 If fans are not specified at maximum efficiency, advise the Consultant before RFP closing and submit alternate price for maximum efficiency fans.
 - .2 If approval to supply noisier fans is not obtained prior to RFP closing, provide equipment meeting ASHRAE levels on site without loss in efficiency.
- .8 All fans shall be statically and dynamically balanced, constructed in conformity with AMCA-99.
 - .1 Dynamically balance fans to 1.5-mm/s vibration amplitude, maximum measured on bearing housings.
 - .2 Provide fan shafts with critical speed at least 1.5-times operational speed.
- .9 Fans shall conform to AMCA bulletins regarding testing and construction.
 - .1 Airfoil fans shall bear the AMCA certified rating seal for airflow and sound.
- .10 Ratings: based on tests performed in accordance with AMCA 210, and ASHRAE 51. Units shall bear AMCA certified rating seal.
- .11 Refer to Section 20 05 03 for high efficiency motor requirements.
- .12 All motors shall be TEFC unless noted otherwise.
- .13 All motors shall be provided with premium efficiency classification.
- .14 Refer to drawings for motor position, rotation, and discharge arrangements.
- .15 For motors less than 10 H.P. provide standard adjustable pitch drive sheaves having +/-10% range. Use mid-position of range for specified RPM.
- .16 Match drive and driven sheaves.
- .17 Minimum drive rating shall be 150% of nameplate rating of motor
- .18 Bearings shall have a minimum L-10 life of 100,000 hours based on the maximum safe speed of the fan class.
- .19 Fans shall be treated to suit the airstream in which they are used.
- .20 Provide secure attachment points for seismic restraints. Mounting brackets shall be suitable for seismic loading.

2.2 CENTRIFUGAL FANS - GENERAL

- .1 Refer to equipment schedules on the drawings for performance data and additional information.
- .2 Minimum Requirements:

- .1 Welded steel fan wheel with airfoil [backward inclined] blades, unless otherwise specified.
- .2 Bearings: Heavy-duty pillow-block grease lubricated ball or roller self-aligning type.
- .3 Gasketed scroll access panel, secured with quick release fasteners.
- .4 20 mm [3/4"] scroll drain and brass plug.
- .5 Enamel painted steel fan wheels and inside scrolls.
- .6 Prime coat painted outside scroll including supports and steel accessories.
- .7 Rust preventative coating on fan shafts.
- .8 Drip proof motor.
- .9 On single inlet fans provide extended lubricators on inlet side bearings.

2.3 IN-LINE CENTRIFUGAL FANS

- .1 Refer to equipment schedules on the drawings for performance data and additional information.
- .2 Minimum Requirements:
 - .1 In-line centrifugal fan with axial flow construction.
 - .2 Square housing, steel with galvanized finish.
 - .3 Access panel to provide cleaning and service access.
 - .4 Backward inclined, non-overloading wheel.
 - .5 Drip-proof motor.
 - .6 Permanently lubricated pillow block ball bearings.
 - .7 Rust preventative coating on shafts.
 - .8 Belt or direct driven as scheduled.
- .3 Accessories:
 - .1 Belt guard, motor cover, where externally belt driven.
 - .2 Plug-in electrical disconnect switch, mounted on the outside of the fan housing.
 - .3 Insulated housing lining.
 - .4 Solid state speed controller where scheduled.

Part 3 Execution

3.1 FANS

- .1 Install fans as indicated, complete with vibration isolators and seismic restraints as specified in Sections 20 05 48 Vibration Isolation and 20 05 49 Seismic Restraints.
- .2 Install fans with flexible connections on inlet ductwork and on discharge ductwork.
 - .1 Ensure metal bands of connectors are parallel with minimum 25 mm [1"] flex between ductwork and fan during running.
- .3 Install connectors such that connectors are clear of the air stream. Provide flange extensions as necessary.
 - .1 Ensure accurate alignment of duct to fan.
- .4 Provide safety screens where fan inlet or outlet is exposed.
- .5 Provide belt guards on belt driven fans.

- .6 Provide and install sheaves and belts required for final air balance.
- .7 Assist the Balancing Agency in altering blade pitch angles as required for final air balance.
 - .1 Provide access to fan wheel for blade adjustment.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section provides General, Product, and Execution Requirements for Air Outlets and Inlets.
- .2 Provide all required Air Outlets as indicated, including, but not limited to:
 - .1 Grilles, registers, and diffusers, (inlet and outlet)
 - .2 Louvers
 - .3 Goosenecks
 - .4 Roof curbs where scheduled or specified
 - .5 Other related equipment

1.2 RELATED REQUIREMENTS

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.
- .2 In conjunction with Division 01, Division 20 General Mechanical Provisions shall govern all Division 23 Sections of the work.
- .3 Refer to Section 20 99 60 Mechanical Forms and submit all documentation therein that is applicable to Division 23.
- .4 Refer to and comply with the following sections:
 - .1 General Requirements - Division 01
 - .2 Common Work for Mechanical Systems – Division 20
 - .3 Plumbing Systems - Division 22
 - .4 Heating, Ventilation and Air Conditioning Systems - Division 23
 - .5 Controls and Instrumentation - Division 25
 - .6 Electrical - Division 26/27

1.3 APPLICABLE CODES AND STANDARDS

- .1 This project is deemed to be a post-disaster design.
- .2 Refer to Section 20 05 01, Codes, Bylaws and Standards.
- .3 All installation, workmanship, and testing shall conform to the following standards as a minimum:
 - .1 SPEC NOTE: Modify the following list as applicable to the project.
 - .2 Provincial Building Code
 - .3 Local Building By-Laws
 - .4 SMACNA
 - .5 ASHRAE

1.4 QUALITY ASSURANCE

- .1 Follow manufacturer's recommended installation details and procedures for equipment, supplemented by requirements of Contract Documents.

- .2 Installation shall be in accordance with well-established practice and standards accepted and recognized by the Consultant and the Trade.

1.5 SUBMITTALS

- .1 Comply with Division 01 and Section 20 05 05 Documentation and Submittals.
- .2 Comply with Section 23 05 00 Common Work for HVAC Systems, Submittals
- .3 Refer to Section 20 99 60 Mechanical Forms and submit all documentation therein that is applicable to this Specification Section.
- .4 Shop Drawings
 - .1 Submit shop drawings in accordance with Division 01 and Division 20 05 05 Documentation and Submittals.
 - .2 Shop drawings are required for all materials and equipment.
- .5 Product Options and Substitutions
 - .1 Refer to Division 01 and Section 20 05 00, for requirements pertaining to product options and substitutions.
- .6 Samples
 - .1 Refer to Division 01 and Section 20 05 05 Documentation and Submittals.
- .7 Maintenance Data
 - .1 Refer to Division 01 and Section 20 05 05 Documentation and Submittals.
 - .2 Submit manufacturer's recommended maintenance tasks for a one-year period. Include maintenance schedules and lubrication products.
 - .3 Submit operating and maintenance data for inclusion into the manuals.
- .8 Occupancy Documentation Requirements
 - .1 Refer to Division 01 and Section 20 05 05 Documentation and Submittals.

Part 2 Products

2.1 GENERAL

- .1 Refer to equipment schedules on the drawings for performance data and additional information.
- .2 Grilles, registers, and diffusers shall be product of one manufacturer.
- .3 Refer to drawings for sizes and air quantities.
- .4 Base air outlet application as follows:
 - .1 Maximum Allowable Background Noise Levels, NC
 - .1 NC 30: Director's Office, Managers' Office
 - .2 NC 30-35: Exam Rooms, Therapy Rooms, Private Treatment Rooms, Offices, Psych. Assessment, Counselling
 - .3 NC 35-40: Corridors and Public Areas
 - .4 NC 40-45: Exercise rooms, Gyms
 - .5 NC 45: Storage
- .5 All ceiling mounted air inlets and outlets shall be checked for compatibility with ceiling types.
 - .1 Refer to Architectural reflected ceiling plans.

- .6 Ceiling tee-bar modules are in soft conversion metric, [SI metric] measurements unless where specifically noted otherwise.
- .7 The manufacturer (other than the design listed) shall match performance data and indicate a specific comparison for each item, with the shop drawing submission.
- .8 All ceiling mounted air inlets and outlets shall be provided with means for attachment of two seismic security wires at opposite corners of each air terminal.
- .9 Provide concealed baffles, where necessary, to direct air away from walls, columns, or other obstructions within the radius of air terminal operation.
- .10 Provide auxiliary frames for air inlets and outlets located in gypsum board ceilings.

2.2 LOUVRES - STATIONARY

- .1 Standard of Acceptance: E.H.Price
- .2 Refer to drawings for sizes and air quantities.
- .3 Minimum Requirements:
 - .1 Extruded aluminum frames and blades.
 - .2 All welded construction with exposed joints ground flush and smooth or mechanically fastened with stainless steel fasteners.
 - .3 Lower assembly sealed and watertight.
 - .4 Removable 1.3 mm [16 ga] dia. aluminum wire birdscreen with 12 mm [1/2"] mesh.
 - .5 Birdscreen mounted in 0.66 mm [20 ga] thick aluminum folded frame. Frame to be installed inside louvre.
 - .6 Formed metal sill plate, 1.6mm [14 gauge] aluminum, finished to match louvre.
 - .7 Jamb drainable blade
 - .8 Continuous blade appearance.

2.3 HOODS - GOOSENECK

- .1 Minimum Requirements:
 - .1 Galvanized steel construction.
 - .2 Thickness and fabrication to ASHRAE & SMACNA standards.
 - .3 12 mm [1/2"] aluminum wire birdscreen mounted in removable U-frame.
 - .4 Mount unit on minimum 900 mm [36"] high field-built insulated roof curb.

Part 3 Execution

3.1 AIR TERMINALS

- .1 Install with cadmium plated screws in countersunk holes where fastenings are visible.
- .2 Install ductwork as high as practical, using offsets where required to obtain maximum duct neck lengths for diffusers.
- .3 Refer to Architectural Reflected Ceiling plans for exact locations of air inlets and outlets.
- .4 Paint ductwork behind grilles with matte black paint where duct or insulation surfaces are visible.
- .5 Attach registers and grilles to branch ducts with duct necks having minimum length to prevent grille or register damper from protruding into branch duct.

- .6 Where air inlets and outlets are installed in mechanical grid ceilings, provide at least two 12 ga. galvanized steel wire seismic security bridles per grille tied either to the building structure or to ceiling hanger wires.
 - .1 Attach security bridles at opposite corners of each air inlets and outlets and in such a manner that the air terminal cannot fall.
- .7 Hand over door grilles to the General Contractor for installation.
- .8 Diffuser, grille, and register cores in air systems shall be removable for cleaning

3.2 ADJUSTING

- .1 Ensure supply air to the laminar flow diffusers by performing pitot traverse of the main supply duct.
- .2 Balance outlets according to manufacturer's recommendations.
- .3 Verify that field measurements are as shown on the drawings.

3.3 LOUVRES

- .1 Provide all necessary flashing and counterflashing for louvres installed in walls.
- .2 Caulk louvre and flashing and counterflashing to make installation watertight.
- .3 Blank-off panels shall be constructed to SMACNA standards, minimum 20 Ga. Sandwich panel with 25 mm [1"] thick fibreglass insulation.
- .4 All blank-off panels shall have a painted flat black enamel finish.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section provides General, Product, and Execution Requirements for Particulate Air Filtration.
- .2 Provide all required Particulate Air Filtration and accessories as indicated, including, but not limited to:
 - .1 Prefilters
 - .2 Panel Filters
 - .3 Final Filters
 - .4 Rigid Filters
 - .5 Filter Holding Frames

1.2 RELATED REQUIREMENTS

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.
- .2 In conjunction with Division 01, Division 20 General Mechanical Provisions shall govern all Division 23 Sections of the work.
- .3 Refer to Section 20 99 60 Mechanical Forms and submit all documentation therein that is applicable to Division 23.
- .4 Refer to and comply with the following sections:
 - .1 General Requirements - Division 01
 - .2 Common Work for Mechanical Systems – Division 20
 - .3 Plumbing Systems - Division 22
 - .4 Heating, Ventilation and Air Conditioning Systems - Division 23
 - .5 Controls and Instrumentation - Division 25
 - .6 Electrical - Division 26/27

1.3 APPLICABLE CODES AND STANDARDS

- .1 Refer to Section 20 05 01, Codes, Bylaws and Standards.
- .2 All equipment, materials, installation, and testing shall conform to the following standards as a minimum:
 - .1 Provincial Building Code
 - .2 Local Building By-Laws
 - .3 Provincial Safety Authority

1.4 QUALITY ASSURANCE

- .1 Refer to Section 20 05 00 General Mechanical Provisions, Quality Assurance for additional details.
- .2 Follow manufacturer's recommended installation details and procedures for equipment, supplemented by requirements of Contract Documents.
- .3 Installation shall be done in accordance with well-established practice and standards accepted and recognized by the Consultant and the Trade.

- .4 Filters shall be product of and supplied by one manufacturer.
- .5 Filter media shall be ULC listed and labelled, Class I or Class II.
- .6 Filters suitable for air at 100% RH and air temperatures between 3oC [37oF] and 50oC [122oF].
- .7 Dust holding capacity: Air Filter Institute (AFI) Test.
- .8 Efficiency: based on ASHRAE 52-76, atmospheric dust spot efficiency. "Absolute filter" efficiency shall be tested with 0.3 Poly-alpha-olefin (P.A.O.) smoke.
- .9 Representative filters shall have been tested by an independent test laboratory and test results shall be made available on request.

1.5 SUBMITTALS

- .1 Comply with Division 01 and Section 20 05 05 Documentation and Submittals.
- .2 Comply with Section 23 05 00 Common Work for HVAC Systems, Submittals
- .3 Refer to Section 20 99 60 Mechanical Forms and submit all documentation therein that is applicable to this Specification Section.
- .4 Shop Drawings
 - .1 Submit shop drawings in accordance with Division 01 and Section 20 05 05 Documentation and Submittals.
 - .2 Shop drawings are required for all materials and equipment.
 - .3 Shop drawings shall include MERV rating data, pressure drop data, media materials, and flame and smoke ratings.
 - .4 Include all data for holding frames and housings.
- .5 Product Options and Substitutions
 - .1 Refer to Division 01 and Section 20 05 00, for requirements pertaining to product options and substitutions.
- .6 Maintenance Data
 - .1 Refer to Division 01 and Section 20 05 05 Documentation and Submittals.
 - .2 Submit manufacturer's recommended maintenance tasks for a one-year period. Include maintenance schedules and lubrication products.
 - .3 Submit operating and maintenance data for inclusion into the manuals.
- .7 Occupancy Documentation Requirements
 - .1 Refer to Division 01 and Section 20 05 05 Documentation and Submittals.

Part 2 Products

2.1 FILTERS - GENERAL

- .1 Filter identification shall be clearly marked on each filter.
- .2 Provide a minimum of two (2) sets of spare filter media (for each filter) - one for installation at completion of the work and one for handover to the Owner as a spare.
 - .1 Obtain signed receipt.
- .3 All filter media used during "temporary heating" shall be replaced by new media prior to Substantial Completion.
- .4 All filters shall be designed for 2.5 M/s [490 ft/min] maximum air velocity.

- .5 Roll type filters, automatic advance or otherwise will not be considered as an acceptable means of filtration.
- .6 Bag type filters will not be considered as an acceptable means of filtration.
- .7 The use of permanent washable type impingement filters is not acceptable.

2.2 FILTERS - PANEL TYPE

- .1 Standard of Acceptance:
 - .1 Camfil 30/30.
- .2 Minimum Requirements:
 - .1 50 mm [2"] thick disposable, pleated, woven cotton and synthetic fabric media.
 - .2 Enclosing frame shall be constructed from rigid, heavy-duty high wet strength beverage board with diagonal support members bonded to both sides of each pleat.
 - .3 Efficiency: MERV 8 per ASHRAE Standard 52.2 and an average dust spot efficiency of 30% per ASHRAE Standard 52.1.
- .3 Panel filters shall be installed in premanufactured holding frames, face load or side load as required.

2.3 FILTERS - PANEL TYPE (SYNTHETIC)

- .1 Standard of Acceptance:
 - .1 Tri-Deck
- .2 Minimum Requirements:
 - .1 Multi-graduated laminant of variable density 3 ply Dacron fibers permanently bonded.
 - .2 Self-gasketing friction fit.
 - .3 Unitized internal heavy wire frame.
 - .4 Efficiency: MERV 8 per ASHRAE Standard 52.2 and an average dust spot efficiency of 25% to 30% per ASHRAE Standard 52.1.

2.4 FILTER - HOLDING FRAMES

- .1 Built-up Frames:
 - .1 Provide separate holding frames for each bank of panel filters and each bank of final filters.
 - .2 Factory fabricated from 1.6 mm [16 ga] galvanized steel with spring retaining clips and neoprene gaskets.
- .2 Slide-in-Frames:
 - .1 Provide slide-in-channels for filters mounted in ductwork where noted. Provide hinged and gasketed access doors.

2.5 FILTER HOUSINGS - DUCT MOUNTED

- .1 Standard of Acceptance:
 - .1 Camfil GlidePack
- .2 Minimum Requirements:
 - .1 Factory manufactured with duct connection flanges.
 - .2 Rigid galvanized steel casing, minimum 1.47 mm [16 ga] thick.

- .3 Housing shall have a high degree of sealing integrity. Filters shall fit tightly in housing with no air leakage between filters and between filters and housing.
- .4 Extruded aluminum or steel tracks for slide-out, side withdrawal of filters.
- .5 Hinged access door for filter servicing.

Part 3 Execution

3.1 FILTERS

- .1 Do not operate fan system connected to filter banks until filters (temporary or permanent) are in place.
 - .1 Provide new filters at handover to the Owner.
 - .2 Replace filters used during construction.
- .2 Provide filter banks in arrangement shown with removal and access indicated. Demonstrate removal of filters prior to substantial completion.
- .3 Provide and install Dwyer filter pressure gauges across each filter installation.

3.2 FILTER HOLDING FRAMES

- .1 Built-up frames shall be installed and bolted together (and sealed air-tight with specified duct and plenum sealers) to form a filter bank.
- .2 Provide necessary reinforcing for filter banks over three frames high.
 - .1 Brace with vertical steel stiffeners, min. 1.78 mm thick [14 ga] riveted or bolted to frames and attached to top and bottom of plenum.
 - .2 When bolting frames together provide spaces between holding frames as necessary to centre filters on coils.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section provides General, Product, and Execution Requirements for Custom Air Handling Units.
- .2 Provide all required Custom Air Handling Units and accessories as indicated, including, but not limited to:
 - .1 Custom Air Handling Units, Outdoor

1.2 RELATED REQUIREMENTS

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.
- .2 In conjunction with Division 01, Division 20 General Mechanical Provisions shall govern all Division 23 Sections of the work.
- .3 Refer to Section 20 99 60 Mechanical Forms and submit all documentation therein that is applicable to Division 23.
- .4 Refer to and comply with the following sections:
 - .1 General Requirements - Division 01
 - .2 Common Work for Mechanical Systems – Division 20
 - .3 Plumbing Systems - Division 22
 - .4 Heating, Ventilation and Air Conditioning Systems - Division 23
 - .5 Controls and Instrumentation - Division 25
 - .6 Electrical - Division 26/27

1.3 APPLICABLE CODES AND STANDARDS

- .1 Refer to Section 20 05 01, Codes, Bylaws and Standards.
- .2 All equipment, materials, installation, and testing shall conform to the following standards as a minimum:
 - .1 Provincial Building Code
 - .2 Local Building By-Laws
 - .3 Provincial Safety Authority

1.4 QUALITY ASSURANCE

- .1 Refer to Section 20 05 00 General Mechanical Provisions, Quality Assurance for additional details.
- .2 Follow manufacturer's recommended installation details and procedures for equipment, supplemented by requirements of Contract Documents.
- .3 Installation shall be done in accordance with well-established practice and standards accepted and recognized by the Consultant and the Trade.
- .4 Unit and major components shall be product of the same manufacturers regularly engaged in production of such units who issues complete catalogue data on such products.
- .5 Units and major components shall be produced by a recognized manufacturer who maintains a local service agency and parts stock.

- .1 Unit and major components shall be product of the same manufacturers regularly engaged in production of such units who issues complete catalogue data on such products.
- .2 Unit shall be factory built and carry all necessary approvals.
- .6 Air handling units and major components shall be products of manufacturing firms regularly engaged in production of such equipment whose products have been in satisfactory use in similar service for not less than 10 years.
- .7 Fans shall conform to AMCA bulletins regarding testing and construction.
 - .1 Airfoil fans shall bear the AMCA certified rating seal for airflow and sound. Fan shall be run and tested to performance.
 - .2 Test results shall be submitted for vibration sound and airflow performance.
- .8 Unit shall be factory built and carry all necessary approvals.
 - .1 Coils shall be water tested and ARI certified.
 - .2 Fans shall be run and tested to performance.
 - .3 Test results shall be submitted for vibration sound and airflow performance.
- .9 Units with factory wiring shall be factory UL/ETL/CSA approved and labeled.
 - .1 Failure to comply with this requirement will necessitate the manufacturer, at his expense, to have a certified UL/ETL/CSA representative inspect the equipment prior to affixing a label.
- .10 Air filter maximum face velocity shall be 2.0 m/s.
- .11 Air filter media shall be ULC listed.
- .12 The following shall be used as selection criteria and shall be as specified: airflow rates, external static pressures, water flow rates.
 - .1 The following are to be equaled or bettered: coil face velocities, filter face velocities, casing leakage rates, casing, and base deflection.
 - .2 The following shall be met within 10% of specified values: water pressure drops.
- .13 Review project schedule and ensure that shop drawing submission and review unit delivery is compatible with project requirements.
 - .1 Allow a minimum of 6 weeks for shop drawing review process.
- .14 Manufacturers shall provide construction methods to achieve sound data as specified and provide data obtained by either:
 - .1 AMCA lab simulation
 - .2 Test data of actual unit
 - .3 All sound data shall be measured and provided in accordance with ARI Standard 260P
- .15 Units shall not be operated for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and the fan has been test-run under observation.

1.5 SUBMITTALS

- .1 Comply with Division 01 and Section 20 05 05 Documentation and Submittals.
- .2 Comply with Section 23 05 00 Common Work for HVAC Systems, Submittals
- .3 Refer to Section 20 99 60 Mechanical Forms and submit all documentation therein that is applicable to this Specification Section.
- .4 Shop Drawings

- .1 Submit shop drawings in accordance with Division 01 and Section 20 05 05 Documentation and Submittals.
- .2 Shop drawings are required for all materials and equipment.
- .3 Product data shall include dimensions, weights, capacities, certifications, component performance, electrical characteristics, casing construction details, wiring interconnections, gauges, and material finishes.
- .4 The submittal shall provide all technical information relevant to the product being provided, including but not limited to, all the information shown in the schedules of this specification.
 - .1 It is the responsibility of the supplier to highlight any variances his equipment has with the requirements of this specification whether or not pre-approval has been obtained.
 - .2 Information shall be provided in the same measurement units as indicated elsewhere in this specification.
- .5 Provide all technical information relevant to the product being provided, including but not limited to all the information shown in the schedules.
- .6 Product data shall include dimensions, weights, capacities, certifications, casing construction details, gauges and finishes of material.
- .7 The submittal shall provide fan curves, not fan tables, with specified operating points clearly plotted.
 - .1 Submit fan curve details, showing operating points at clean filter, dirty filter and mid-point loaded filter with the parameters specified.
 - .2 Select fans at maximum efficiency for specified duty.
- .8 The submittal shall provide coil selection worksheets, clearly showing proper consideration for altitude, air density, glycol corrections and indicate coil tube fin and casing construction.
- .9 The submittal shall provide filter information, including initial APD, final APD, dust spot efficiency, final dust holding capacity, filter media description, filter frame details, and filter removal details.
- .10 The manufacturer shall submit sound power levels for both air handling unit inlet, outlet and radiated at rated capacity.
 - .1 If the unit exceeds sound power levels at scheduled conditions, the manufacturer must provide sound attenuators and meet specified BHP.
 - .2 Submit the AHU sound data for 90% (current demand) and 100% (future demand) airflows.
- .11 Submit sound power levels for air handling unit inlet and outlet and casing radiation at rated capacity in accordance with AMCA.
- .12 The manufacturer shall submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field installed wiring.
- .13 Submit the manufacturers recommended installation instructions.
- .14 Omission of any of the above information will cause shop drawings to be immediately returned without review.
- .15 Shop drawings shall include motor efficiencies for all motors.
 - .1 Refer to Section 20 05 03 Electric Motors for minimum motor efficiencies.
- .16 Submit each air-handling unit on a separate scale drawing showing construction details and dimensions of entire unit and internal components.

- .5 Product Options and Substitutions
 - .1 Refer to Division 01 and Section 20 05 00, for requirements pertaining to product options and substitutions.
- .6 Maintenance Data
 - .1 Refer to Division 01 and Section 20 05 05 Documentation and Submittals.
 - .2 Submit manufacturer's recommended maintenance tasks for a one-year period. Include maintenance schedules and lubrication products.
 - .3 The manufacturer shall include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.
 - .4 Submit operating and maintenance data for inclusion into the manuals.
- .7 Occupancy Documentation Requirements
 - .1 Refer to Division 01 and Section 20 05 05 Documentation and Submittals.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 The manufacturer shall deliver products to site on a factory-installed base rail or shipping skid and ship units by truck with 10 mil poly shrink-wraps.
- .2 The contractor shall store and protect products.
- .3 The contractor shall store products in a clean dry place, protect them from weather and construction traffic, and shall handle products carefully to avoid damage to components, enclosures, and finish.
 - .1 Units shall be heated and ventilated during storage.

1.7 EXTRA STOCK

- .1 The manufacturer shall provide two sets of filters (one of which shall be a spare set) and one set of spare belts.

Part 2 Products

2.1 GENERAL REQUIREMENTS

- .1 General
 - .1 Factory fabricated and assembled modular components as indicated.
 - .1 Field fabrication of the units will not be accepted.
 - .2 Field assembly of unit sections is acceptable if the unit cannot be transported or installed as a single unit. Include for cost of any field assembly.
 - .2 Overall dimensions and configurations are to be as shown on the plans.
 - .1 However, such a constraint, as this may impose, does not absolve the manufacturer from responsibility for the engineering, operational integrity and performance of the unit provided.
 - .3 Unit shall carry all necessary approvals.
 - .4 Refer to Mechanical Equipment Schedules for capacity requirements / design parameters / component type.
 - .1 All other features normally required for complete and safe operation are an implicit requirement and shall be included.
 - .5 Refer to separate items in this specification section for detailed requirements, arrangement of components and additional references.

2.2 ELECTRICAL

- .1 Wiring shall be factory CSA approved.
- .2 Provide breaker panel on exterior of unit for field connection of single point 120V power connection.
- .3 Provide factory installed power wiring in EMT from each fan motor to junction boxes located on the outside of the unit casing for field installation of VFD and connection of main power.
- .4 Provide factory installed empty 25mm [1"] conduit throughout the length of the unit with J-boxes in each section for control contractor's use.
- .5 Provide factory installed power wiring in EMT conduit from lights, receptacles and low voltage transformers to 120V breaker panel.
- .6 Provide a 120V GFI duplex receptacle in any service corridor.
- .7 Provide exterior units with exterior mounted 120V GFI duplex receptacle.
- .8 Provide service corridors on exterior units with electric heat to maintain the minimum temperature at 18oC [65oF].
 - .1 Wire to breaker panel.
- .9 Electrical Contractor to provide disconnects, starters and power wiring to unit junction boxes.
- .10 Provide LED marine lights with protective metal cage and glass seals in all unit compartments c/w extra-long-life bulbs (60 W min equivalent).
 - .1 Light switches with indicator lights shall be installed outside next to each plenum door complete with appropriate identification.
- .11 Provide fan bearing ground straps.
- .12 The manufacturer shall label and number code all wiring and electrical devices in accordance with the unit electrical diagram.
 - .1 The manufacturer shall mount the diagram and devices in a panel inside the unit's service enclosure or on the outside and ensure the panel meets the CSA, ETL or UL.

2.3 FANS

- .1 Refer to Section 23 34 00 HVAC Fans for detailed fan requirements.
- .2 Fan sections shall be equipped with a structural steel channels located under the isolator loads to add rigidity, eliminate floor deflection, and distribute loads to the perimeter structural channel.
- .3 Centrifugal fans shall be rated in accordance with AMCA Standard Test Code Bulletin 210. Fans shall bear the AMCA sticker.
- .4 All fans and fan assemblies shall be dynamically balanced during factory test run.
- .5 Fan shafts shall be selected for stable operation at least 25% below the first critical RPM.
- .6 Fan speeds at final operating point shall not exceed 75% of maximum for the fan class.
- .7 Provide fully welded airfoil fans.
- .8 Bearings:
 - .1 Heavy-duty pillow-block grease lubricated ball or roller self-aligning type.
 - .2 Bearings shall have an L10 Life rating of 100,000 hours at design operating conditions in accordance with AMSI B3.15.
- .9 Inboard bearing lube line shall be extended to the outboard bearing.
- .10 Bearing support shall be from a rigid structural steel base frame.

- .1 This frame shall be internally isolated and seismically restrained from the fan cabinet structural frame.
- .11 Plenum fan assemblies fully enclosed with expanded mesh screen on the inlet and outlet, conforming to provincial safety regulations.
- .12 All fans shall be complete with a piezometer ring flow sensor mounted in the throat of the fan and a static pressure tap mounted on the face of the inlet cone.
 - .1 Provide a differential pressure transducer and a direct CFM digital display readout on the exterior of the unit.
- .13 All fans on dual fan units shall have inlet and outlet control dampers.

2.4 MOTORS

- .1 Refer to Section 23 34 00 HVAC Fans.
- .2 Refer to Section 20 05 03 Common Motor Requirements for HVAC.
- .3 Fan motors shall be heavy duty, operable at the electrical characteristics indicated on the equipment schedules, and as indicated on the electrical design documentation.
 - .1 Motors shall comply with USA EPACT OF 1992.
 - .2 Motors shall conform to ASHRAE 90.1
- .4 Fan motors shall be mounted and isolated on the same integral base as the fan.
- .5 All motors shall be TEFC.
- .6 All motors shall be provided with premium efficiency classification.
- .7 Motor mounting shall be adjustable to allow for variations in belt tension.

2.5 DRIVES - GENERAL

- .1 Refer to Section 23 34 00 HVAC Fans.
- .2 Belt drives shall be complete with belt guards with tachometer holes.
- .3 Drives shall be adjustable on fans with motors 3.73 kW [5 HP] or smaller.
 - .1 On fans with motors above 3.73 kW [5 HP] fixed drive shall be provided. Include for one sheave change per fan, during the air balance procedure.
- .4 Drives shall be selected for 150% of motor nameplate horsepower and including 2 belts minimum.
- .5 Sheaves shall be keyed to drive shafts.
- .6 The v-belt drive shall have a variable pitch sheave for motors less than 7.5 hp and a constant pitch sheave for motors of 7.5 or greater hp rated at 1.5 times the motor nameplate.

2.6 MOUNTING FRAME

- .1 Casings shall be supported on welded structural channel supports designed for support of entire unit without deflection.
- .2 Steel base shall be suitable for seismically bolting unit to roof curbs or housekeeping pads or welding unit to embedded steel plates in concrete roof curbs or housekeeping pads/curbs.
 - .1 Refer to 20 05 49 Seismic Restraints for additional requirements.
- .3 Integral lifting lugs for hoisting.
- .4 Provide suitable means for seismically securing units.
- .5 Unit(s) shall be mounted on metal seismic roof curb(s) provided with the unit(s).
 - .1 Roof curbs shall be seismically secured to the roof.

- .2 When flashed to the mounting curb it shall provide a weatherproof whole.

2.7 DRAINS

- .1 The manufacturer shall provide 25mm [1"] floor drain connections on the accessible side of the unit for complete drainability of the base pan
- .2 The drain pan shall be double pitched to the drains, piped separately through the perimeter of the curb with stainless steel tubing.
- .3 Provide drains in the following sections:
 - .1 Sections upstream and downstream of coils

2.8 DRAIN PANS

- .1 Provide drain pans for supply and exhaust side of heat pipe.
- .2 The drain pan shall be sloped to outlet and outlet pipe bottom invert shall be below bottom of pan.
 - .1 The drain pan shall be provided with an interior 32 mm [1-1/4"] copper pipe drain piped to the outside of the unit.

2.9 CASING

- .1 Walls and roofs shall be constructed of 1.47 mm [16 ga] galvanized sheet metal with 100 mm (4") thick acoustic thermal panels.
 - .1 Insulation shall be 100 mm (4") thick 48 kg/m³ [3 lb/ft³] density fiberglass with a neoprene liner to seal the insulation.
 - .2 All permanently joined flanged panel surfaces shall be sealed with an individual strip of 3 mm x 9.5 mm [1/8" x 3/8"] tape sealer.
 - .3 Wall (and roof for indoor units) seams shall be turned inward to provide a clean flush exterior finish.
 - .4 All panel seams shall be sealed during assembly to produce an airtight unit.
 - .5 Finish coat shall be air-dry enamel, to all exposed surfaces.
- .2 Generally, all walls and roofs shall be of interlocking construction, with at least two breaks at each interlocking joint.
 - .1 Joints shall be secured by cadmium plated TEK screws or pop rivets.
- .3 Stiffeners of angle steel shall be supplied as required to maintain casing deflection criteria of 1/200 at 150% of the working pressure.
 - .1 If panels cannot meet this deflection, an additional internal reinforcing shall be added.
- .4 Insulate all interior walls with 50 mm [2"] thick, 48 kg/m³ [3 lbs/ft³] min. density glass fibre neoprene coated acoustic insulation.
 - .1 All edges of insulation shall be covered with metal Z bars.
 - .2 All insulation pins shall be secure and ends trimmed and covered with neoprene caps.
- .5 Outdoor units shall be weatherproofed and equipped for installation outdoors.
 - .1 This shall include, generally, for the prevention of the infiltration of rain and snow into the unit.
 - .2 Outdoor units shall have roof panels broken outward to provide rigidity and a lapped joint watertight seal.
 - .3 All joints shall be caulked with a UV resistant, water impervious flexible sealant.
 - .4 Outdoor roofs shall be sloped a minimum of 16 mm [5/8"] away from the access side.

- .5 Outdoor units shall be of a colour indicated by the Architects.
- .6 Units shall be tested to 3% leakage at 150% of the operating pressure.
- .7 All required holes in casing for controls, electrical, piping etc. shall have grommets.
 - .1 Seal all factory utilized openings neatly and airtight.
 - .2 Site sealed openings shall be to the standard set by the manufacturer.
- .8 Provide radiused bell mouth duct outlet connections for supply plenum installations and for plug fan inlet.

2.10 AIR FLOW TESTING

- .1 The unit manufacturer shall factory test each unit to ensure it meets the specified air flow requirements.
- .2 The test shall be carried out in accordance with the guidelines set forth in the SMACNA HVAC AIR TEST MANUAL.

2.11 AIR LEAKAGE TESTING

- .1 The unit manufacturer shall factory pressure test each air handling unit to ensure the leakage rate of the casing does not exceed 1.0% of the unit air flow at 150% of the rated static pressure.
 - .1 A leakage test shall be performed with the VSD and humidification panels installed.
 - .2 The test shall be conducted in accordance with SMACNA duct construction manual.
 - .1 A calibrated orifice shall be used to measure leakage airflow.
 - .3 An Officer of the Manufacturing Company shall certify test results and forward copies of certified test results to the Consultant.
 - .1 The Consultant shall witness the air leakage test on the first two units.
 - .2 The Manufacturer shall provide transportation for the Consultant, the Contractor, and the Owner to the factory.
 - .4 "Double duct" or "side by side" units shall have each duct or side tested independently.
 - .5 Positive pressure plenums shall be tested positively and negative pressure plenums shall be tested negatively.

2.12 VIBRATION TESTING AND BALANCING

- .1 Fans and motors shall be dynamically balanced to not exceed a BV-4 criterion as per AMCA 204.
 - .1 The test shall be conducted after the fan and motor base assembly has been completed.
 - .2 The entire fan assembly including fan wheels, shafts, bearings, drives, belts, motors, isolation bases shall be tested.
 - .3 During the test, the fan and motor base shall be supported by its isolators which are set in the freely floating operating position.
 - .4 In cases where a concrete inertia base is provided, the factory poured concrete shall be installed at the time of the vibration test.
- .2 The required measurement points are as follows: one horizontal measurement and one vertical measurement shall be taken for each fan and motor bearing and one axial measurement shall be taken for each shaft.
 - .1 A total of 10 points for a typical belt driven fan-motor assembly.

- .2 The measurements shall be taken using calibrated, magnetically mounted accelerometers and a calibrated measuring instrument.
- .3 Vibration measurement locations shall be as close as possible to the bearing or shaft centerlines.
 - .1 Measurements shall be taken from the bearing housings, bearing pedestals, or motor casings.
 - .2 Measurements shall not be taken from flexible covers or shields.
- .4 Fans and motors shall be tested at the design RPM and the maximum overall filter-in vibration levels at each measurement point shall be less than or equal to 3.8mm [0.15"] per second peak velocity at the operating speed.
 - .1 If any measurements exceed the above criterion, the assembly shall be rebalanced and re-tested until the criterion is achieved.
- .5 Certified measurements shall be provided to the Consultant.

2.13 ACOUSTICAL PERFORMANCE:

- .1 The housing shall have been tested for acoustical performance by an accredited independent laboratory.
- .2 Test methods and facilities used to establish sound transmission loss values shall conform explicitly with the ASTM designation E90-85 and E413-73.
- .3 Test methods and facilities used to establish sound absorption values shall conform explicitly with the requirements of the ASTM Standard Test Method for Sound Absorption Coefficients by the Reverberation Method: ASTM C423-84A and E795-83
- .4 The manufacturer shall submit the lab report for approval.
- .5 Sound power levels shall not exceed the data indicated in the specific unit details.

2.14 ACCESS DOORS

- .1 Access doors shall be provided for access to all internal parts, fully lined, with welded steel door frame and Ventlock 310 latches c/w front and inside handles and front door pull.
 - .1 Arrange access doors so that they open against the airflow and static pressure.
 - .2 Door seal shall be close cell neoprene bulb type.
 - .3 Hinges shall be continuous stainless steel piano hinges.
- .2 Access doors shall be manufactured from 1.47 mm [16 ga] galvanized steel.
 - .1 The doors shall be double wall construction with 0.76 mm [22 ga] solid metal liner on the inside.
 - .2 Corners of the doors shall be continuously welded for rigidity. 100mm [4"] 48 kg/m3 [3 lbs/cu. ft.] density insulation shall be sandwiched between the 1.47 mm [16 ga] outer layer and the 0.76 mm [22 ga] inner layer.
 - .3 Doors MUST be the same thickness as the unit casing to maximize thermal and acoustical resistance.
- .3 Doors shall be 600 mm [24"] wide by 1500 mm [60"] high unless casing size requires a shorter door or equipment removal requires a wider door.
- .4 Access doors shall include minimum 300 mm [12"] diameter double pane hermetically sealed windows.
 - .1 Windows should be a maximum of 1700mm from roof or mechanical room floor.
 - .2 This includes outdoor units.

- .5 Access doors for exterior units shall be hollow-core insulated metal doors with 45mm [1-3/4"] thickness, set in formed metal frames.
 - .1 Provide two Ventlock handles and lock set, which shall be equivalent to Corbin-Mortised manufacture.
- .6 Provide rain excluding seals and gutters for external access doors.

2.15 VIBRATION ISOLATION

- .1 Vibration isolators and seismic restraints shall be in strict accordance with Section 20 05 48 Vibration Isolation.
 - .1 Substitute vibration isolators will not be accepted.
- .2 Isolators shall be free standing with sound deadening pads and leveling bolts.
- .3 The spring diameter to compressed operating height ratio shall be 1 to 1.
- .4 The spring deflection shall be 100mm [4"].

2.16 SEISMIC RESTRAINTS

- .1 Refer to Section 20 05 49 Seismic Restraints for requirements.
- .2 Isolators shall have earthquake restraints.
 - .1 Submittal drawings of concrete inertia base with isolation and restraints shall be stamped by a Professional Engineer that is licensed to practice in the Province where the project is located.

2.17 CONTROL DAMPERS

- .1 Control dampers to be T.A. Morrison – (1000) airfoil or Ruskin CD-50.
- .2 Control dampers to be located on the inside of the unit so that damper actuators are accessible from inside the unit.

2.18 LOUVRES (FOR EXTERIOR UNITS)

- .1 Provide weather hoods to prevent entry of rain, complete with birdscreens.
- .2 Louvres shall be designed and sized to prevent all rain penetration.
- .3 Louver blades shall be of extruded aluminum construction shall be fixed on a 45° angle and on 100mm (4") centers.
- .4 Frames shall be of extruded aluminum, minimum 4" wide.
- .5 Birdscreen shall be galvanized mesh with 12.5 x 12.5 mm [0.5" x 0.5"] openings and shall be fixed to the rear with cadmium plated screws.
- .6 The finish shall match the casing of the unit.

2.19 FILTERS - GENERAL

- .1 Refer to Section 23 41 00 Air Filtration for details.
- .2 Filter media shall be ULC listed, Class I or Class II.
- .3 Filters shall be suitable for air at 100% RH and air temperatures between 3oC [37oF] and 50oC [122oF].
- .4 Efficiency: based on ASHRAE 52, atmospheric dust spot efficiency.
- .5 Dust holding capacity: Air Filter Institute (AFI) Test.
- .6 Representative filters shall have been tested by an independent test laboratory and test results shall be made available on request.

- .7 Filter identification shall be clearly marked on each filter.
- .8 Provide two (2) sets of filter media (for each filter) -one for installation and one for handover to the Owner as a spare. Obtain signed receipt.
- .9 Filter holding frames fabricated from 1.6 mm [16 ga] galvanized steel with spring retaining clips and neoprene gaskets.
- .10 No air bypass around filter frames will be allowed. Provide access space for servicing all filters. Install filter slide rails and doors for side access where required.
- .11 Each filter section shall be designed to receive standard sized filters only. The use of odd-sized filters is not permitted.
- .12 Filter types, holding frames, and arrangement shall be as defined for each Air Handling Unit:
 - .1 MERV ratings
 - .2 Panel filters
 - .3 Summer/winter filters
 - .4 Rigid cartridge filters
 - .5 HEPA filters
 - .6 Carbon filters
 - .7 Electrified filters
 - .8 Chemical absorbing media trays

2.20 HEAT RECOVERY UNITS

- .1 Provide packaged heat recovery units or sections as specified in the schedules.
- .2 Provide access to unit for cleaning.
- .3 Provide integral drain pan in floor under entire unit with exterior drain connection.
- .4 Provide by-pass dampers for:
 - .1 100% outside air flow not through unit.
 - .2 100% by-pass of warm air stream (return air) when not needed.
 - .3 Freeze/frost protection.

2.21 UNIT CLEANLINESS

- .1 Wash and clean all components before shipping.
- .2 Wash and clean all components before operating.
- .3 Wash and clean all components before requesting final review and turn over to Owner.

2.22 UNIT SPECIFICS - AIR HANDLING UNIT AHU-01

- .1 Refer to equipment schedules on the drawings for performance data and additional information.
- .2 Area Served: New Foyer Area
- .3 General Arrangement:
 - .1 Access plenum with return air inlet damper
 - .2 Access plenum with exhaust air dampers
 - .3 Plenum type exhaust air fan with access
 - .4 2" pleated filter section, MERV 8
 - .5 Heat recovery pipe with bypass

- .6 Access plenum with exhaust air dampers
- .7 Outside air inlet damper
- .8 Electric Heating Coil
- .9 Access plenum
- .10 Plenum type supply air fan with access
- .11 Plenum with supply air damper

Part 3 Execution

3.1 UNIT INSTALLATION

- .1 Where Air Handling Units are fabricated and shipped in component sections, the components shall be field assembled using bolted, gasketed companion flanges to make a single airtight unit.
 - .1 Test for leakage and seal as required after reassembly.
- .2 Install units as indicated and to Manufacturers' recommendations.
- .3 Maintain proper clearance around equipment to permit performance of service maintenance, coil removal and repair.
- .4 Make ductwork, piping, and wiring connections to the unit in accordance with the drawings.
- .5 Seismically secure floor/roof mounted AHU's to curbs or housekeeping pads by either bolting or welding to embedded steel plates.
 - .1 Ensure curbs/housekeeping pads are securely attached to structure.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section provides General, Product, and Execution Requirements for Packaged Indoor Heating/Cooling Units.
- .2 Provide all required Packaged Indoor Heating/Cooling Units and accessories as indicated, including, but not limited to:
 - .1 Air Curtain Units
 - .2 Heating and Ventilating Units
 - .3 Forced Air Furnaces
 - .4 Cabinet Unit Heaters, Electric

1.2 RELATED REQUIREMENTS

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.
- .2 In conjunction with Division 01, Division 20 General Mechanical Provisions shall govern all Division 23 Sections of the work.
- .3 Refer to Section 20 99 60 Mechanical Forms and submit all documentation therein that is applicable to Division 23.
- .4 Refer to and comply with the following sections:
 - .1 General Requirements - Division 01
 - .2 Common Work for Mechanical Systems – Division 20
 - .3 Plumbing Systems - Division 22
 - .4 Heating, Ventilation and Air Conditioning Systems - Division 23
 - .5 Controls and Instrumentation - Division 25
 - .6 Electrical - Division 26/27

1.3 APPLICABLE CODES AND STANDARDS

- .1 Refer to Section 20 05 01, Codes, Bylaws and Standards.
- .2 All equipment, materials, installation, and testing shall conform to the following standards as a minimum:
 - .1 Provincial Building Code
 - .2 Local Building By-Laws
 - .3 Provincial Safety Authority

1.4 QUALITY ASSURANCE

- .1 Refer to Section 20 05 00 General Mechanical Provisions, Quality Assurance for additional details.
- .2 Employ only Tradespeople holding valid Provincial Trade Qualification Certificates.
- .3 Follow manufacturer's recommended installation details and procedures for equipment, supplemented by requirements of Contract Documents.
- .4 Installation shall be done in accordance with well-established practice and standards accepted and recognized by the Consultant and the Trade.

- .5 Units shall be products of manufacturers who provide local service personnel from factory representative, franchised dealer, or certified maintenance service shop.
- .6 Provide start-up service and report.
- .7 Fibre type insulation in supply or return airstreams is not permitted in healthcare facilities.

1.5 SUBMITTALS

- .1 Comply with Division 01 and Section 20 05 05 Documentation and Submittals.
- .2 Comply with Section 23 05 00 Common Work for HVAC Systems, Submittals
- .3 Refer to Section 20 99 60 Mechanical Forms and submit all documentation therein that is applicable to this Specification Section.
- .4 Shop Drawings
 - .1 Submit shop drawings in accordance with Division 01 and Section 20 05 05 Documentation and Submittals.
 - .2 Shop drawings are required for all materials and equipment.
- .5 Product Options and Substitutions
 - .1 Refer to Division 01 and Section 20 05 00, for requirements pertaining to product options and substitutions.
- .6 Record Drawings
 - .1 Refer to Division 01 and Section 20 05 05 Documentation and Submittals.
- .7 Maintenance Data
 - .1 Refer to Division 01 and Section 20 05 05 Documentation and Submittals.
 - .2 Submit manufacturer's recommended maintenance tasks for a one-year period. Include maintenance schedules and lubrication products.
 - .3 Submit operating and maintenance data for inclusion into the manuals.
- .8 Occupancy Documentation Requirements
 - .1 Refer to Division 01 and Section 20 05 05 Documentation and Submittals.

1.6 WARRANTY

- .1 Refrigeration compressors to be warrantied for five [5] years.

Part 2 Products

2.1 GENERAL

- .1 Refer to Section 20 05 03 Electric Motors for HVAC and 20 05 04 Variable Speed Drives for additional requirements.

2.2 AIR CURTAIN UNITS

- .1 Standard of Acceptance:
 - .1 Berner MK-1
- .2 Refer to equipment schedules on the drawings for performance data and additional information.
- .3 SPEC. NOTE: Fibre type insulation in supply or return airstreams is not permitted in healthcare facilities.
- .4 Minimum Requirements

- .1 SPEC NOTE: Modify the following as applicable to the project
- .2 Base frame of 1.4 mm [17 ga] thick steel.
- .3 2-speed direct driven double inlet forward curved fans.
- .4 Fans balanced and rubber isolated.
- .5 Aluminum cover housing with inlet grille.
- .6 Hot water [electric] heating coil where scheduled.
- .7 [Inlet filters].
- .8 Discharge grille with adjustable vanes integral with the unit or remote mounted in the ceiling.
 - .1 Provide duct extension for ceiling mounted units.
- .9 High-off-low fan switch integral with unit suitable for remote mounting.
- .10 Sound level 3 m [10 ft] in front of the unit in free field shall not exceed 59 dbA on high speed and 54 dbA on low speed.
- .11 Unit shall be ULC listed and shall bear the AMCA certified ratings seal.
- .12 Unit mounted controller complete with DDC system interface.

2.3 AIR CONDITIONING UNITS - COMPUTER ROOM

- .1 SPEC. NOTE: Vertical free-standing units, DX or hydronic.
- .2 Standard of Acceptance:
 - .1 ???
- .3 Refer to equipment schedules on the drawings for performance data and additional information.
- .4 SPEC. NOTE: Fibre type insulation in supply or return airstreams is not permitted in healthcare facilities.
- .5 SPEC NOTE: Modify the following as applicable to the project
- .6 General
 - .1 System Type:
 - .1 Air flow arrangement: [down-flow] [up-flow].
 - .2 [Arrangement suitable for mounting in the corner as indicated.]
 - .3 Cooling: [direct expansion] [chilled water].
 - .4 Condensing: [water cooled] [glycol cooled] [air cooled].
 - .2 Unit controls shall not permit dehumidification and humidification to occur simultaneously.
- .7 Cabinet
 - .1 Free standing, welded steel, unit construction, corrosion protected, 20 mm [3/4"] thick acoustic insulation, factory baked on external finish. Colour to be approved by the Consultant.
 - .2 Cabinet to house: [compressors], [condensers], [liquid receiver], cooling coil, reheat coil, fans, filters, humidifier, unit environmental control system, motor starters or contactors [and electrical disconnect switch].
 - .3 Provide adequate access to all components for servicing.
 - .4 SPEC. NOTE: Select the following clause if a floor stand is required for down flow units.

- .5 Complete with welded structural steel floor stand having adjustable feet and locking device on each corner, vibration isolators and compatible with raised floor system.
- .8 Discharge Plenum
 - .1 SPEC. NOTE: Choose either .1 or .2 below. Both items apply to upflow unit only.
 - .2 Welded steel, unit construction, corrosion protected, 20 mm [3/4"] thick acoustic insulation, factory baked on external finish.
 - .1 Colour to match cabinet.
 - .2 Double deflection grille on front end [both] side[s] as indicated.
 - .3 Plenum to be suitable for connecting to supply ducting as indicated.
 - .4 Welded steel, unit construction, corrosion protected, 20 mm [3/4"] thick acoustic insulation, constructed to assure proper air distribution to space under raised floor.
- .9 Fan
 - .1 DWDI centrifugal, statically, and dynamically balanced, direct or V-belt drive, complete with self-aligning, permanently lubricated, 100,000 hr. minimum life ball or roller bearings.
 - .2 If V-belt driven provide two [2] belt adjustable pitch pulleys with belts sized for 200% of motor capacity.
- .10 Fan Motor(s)
 - .1 Drip-proof permanently lubricated bearings for continuous duty, 40oC maximum rise and with variable pitch sheaves on belt driven systems.
- .11 Compressors
 - .1 SPEC. NOTE: Smaller size cooling units have only 1 compressor. Modify the following clause as necessary.
 - .2 Semi or full hermetic type, [minimum 2 required], complete with: vibration isolators, adjustable high- and low-pressure switches, anti-slug device, motor overload and over temperature protection pump down controls, crank case heater, [compressor lead/lag switch,] refrigerant service valves and capacity controls.
- .12 Cooling Coil
 - .1 Aluminum fins, mechanically bonded to copper tubes, maximum face velocity 2.8 m/s [550 f/m], complete with stainless steel condensate tray and drain connections.
 - .2 Direct expansion: [with separate refrigerant circuit for each compressor].
- .13 Reheat Coil
 - .1 Coils: located down-stream of cooling coil.
 - .1 SPEC. NOTE: Select either of the following two clauses to suit unit selected.
 - .2 Electric: CSA or ULC approved, stainless steel or copper fin-tubular construction.
 - .3 Hot gas refrigerant: aluminum or copper fins mechanically bonded to copper tubes, complete with refrigerant diverting valve and interconnecting piping.
- .14 Filters
 - .1 Mount in corrosion resistant racks complete with service access.
 - .1 Filters: pleated type. Initial Dust Spot efficiency, 45% [60%] to ASHRAE 52.
- .15 Humidifier
 - .1 Located downstream of cooling coil complete with water level control, overflow, and drain, strainer and automatic flush, CSA or ULC approved.

- .1 SPEC. NOTE: Select either of the following two clauses to suit unit selected.
 - .2 Evaporative pan type: stainless steel construction, electric finned resistance element or infra-red heater, complete with automatic flush or;
 - .3 Steam generator type: plastic disposable reservoir-boiler, latticed electrode heating elements complete with steam distributor.
- .16 Condenser
- .1 SPEC. NOTE: Select air cooled or water cooled as required.
 - .2 [Water] [Glycol] cooled: coaxial or shell and tube type, sized for each compressor/evaporator combination; complete with head pressure actuated water regulating valve for each refrigerant circuit.
 - .3 Air cooled; free standing, welded steel unit construction, corrosion protected.
 - .1 Circuited to provide separate refrigerant circuit for each compressor/evaporator combination.
 - .2 Aluminum fins mechanically bonded to copper tubes.
 - .3 Propeller or centrifugal type fans. Direct or V-belt drive.
 - .4 Electrical and control components housed in weather-tight access panels with electrical disconnect switch and control cable for control interconnection and designed for year-round operation.
- .17 Heat Exchanger
- .1 SPEC. NOTE: Specify heat exchanger for glycol units only.
 - .2 Packaged, glycol to air: free standing, welded steel unit construction, corrosion protected.
 - .3 Coil: aluminum fins mechanically bonded to copper tubes.
 - .4 Axial or centrifugal fans: [direct] [V-belt] drive.
 - .5 Control systems to:
 - .1 Regulate the glycol condenser coolant temperature.
 - .2 Divert chilled glycol flow from chiller circuits to heat exchanger circuits during periods of low ambient temperatures.
 - .6 Electric disconnect switch and control cables for control interconnection and designed for year-round operation.
- .18 Refrigerant Piping, Valves, Fittings and Accessories Within Unit
- .1 To CSA B52.
 - .2 Include for each refrigerant circuit:
 - .1 Thermal expansion valve, external equalizing type.
 - .2 Combination filter-dryer.
 - .3 Solenoid valves.
 - .4 Liquid sight glass with moisture indicator.
 - .5 Suction line insulation: flexible elastomeric unicellar, 12 mm [1/2"] minimum thickness.
- .19 Environmental Controls
- .1 SPEC. NOTE: Select the following items to be project specific.
 - .2 Solid state electronic control system.
 - .3 Front mounted operating panel with visual display.
 - .4 Panel to include the following:

- .1 Manual operation and adjustment:
 - .1 On-off air conditioning system control.
 - .2 Room temperature set point, indicator, and sensitivity adjustment controller.
 - .3 Room humidity set point, indicator, and sensitivity adjustment controller.
 - .4 Alarm silencing switch for each alarm point.
 - .5 Compressor lead-lag selection switch.
 - .6 Alarm circuits test switch.
- .2 Operational: Visual and Audible Alarm:
 - .1 Loss of air flow.
 - .2 [Loss of glycol flow].
 - .3 High room temperature.
 - .4 Low room temperature.
 - .5 High humidity.
 - .6 Low humidity.
 - .7 High head pressure.
 - .8 Water underfloor.
- .3 Operational: Visual Display:
 - .1 Cooling each stage.
 - .2 Reheat stage 1 and 2.
 - .3 Humidification.
 - .4 Dehumidification.
 - .5 [Glycol to Air Heat Exchanger Operating].
 - .6 Change filter.
- .5 Remote Communication:
 - .1 Dry contacts for connection of common alarm to Building Automation System.
- .20 Electrical:
 - .1 Electrical components including electrical disconnect switch, all contactors, relays, control transformers and capacitors shall be prewired and mounted within the hermetic cooling section.
 - .1 Terminal blocks shall be provided for both control and power connections.
- .21 Refrigerant Charge
 - .1 Charge refrigerant system at factory, and factory test prior to shipment.
- .22 Accessories
 - .1 Remote control panel.
 - .2 Hot gas bypass.
 - .3 Underfloor water detectors.
 - .4 Main power disconnect switch.
 - .5 Condensate pump.

2.4 AIR CONDITIONING UNITS - COMPUTER ROOM

- .1 SPEC. NOTE: Based on Airflow Datahook. (Split system - water-cooled; air-cooled available).

- .2 Standard of Acceptance:
 - .1 Airflow Datahook
- .3 Refer to equipment schedules on the drawings for performance data and additional information.
- .4 SPEC. NOTE: Fibre type insulation in supply or return airstreams is not permitted in healthcare facilities.
- .5 SPEC NOTE: Modify the following as applicable to the project
- .6 General
 - .1 Split system with ceiling mounted evaporator section and remote water-cooled condensing section.
- .7 Evaporator Cabinet
 - .1 Cabinet to house cooling coil, reheat coil, fan, filter, humidifier, control system and motor starters.
 - .2 Cabinet frame, welded steel, corrosion protected, 20 mm [3/4"] thick acoustic insulation, factory baked enamel finish.
 - .3 Provide access to all components for servicing.
 - .4 Discharge duct connections.
- .8 Fan
 - .1 DWDI centrifugal with forward curved blades, statically and dynamically balanced, direct driven.
- .9 Cooling Coil
 - .1 Aluminum fins, mechanically bonded to copper tubes, maximum face velocity 2.8 m/s [550 F/m], complete with stainless steel condensate tray and drain connections.
 - .2 Direct expansion.
- .10 Reheat Coil
 - .1 Electric coil, CSA or ULC approved, non-corrosive metal sheath.
- .11 Filters
 - .1 Filter access from bottom.
 - .2 Pleated type, initial dust spot efficiency, 45% to ASHRAE 52.
- .12 Humidifier
 - .1 Steam generator type: plastic disposable reservoir-boiler, latticed electrode heating elements complete with steam distributor.
- .13 Condenser
 - .1 Coaxial, counter flow design made to ASME specifications.
 - .1 Condenser shall be piped into the refrigeration system.
 - .2 Head pressure shall be controlled by an adjustable head pressure actuated 2-way regulating valve.
- .14 Compressor
 - .1 Hermetically sealed, complete with vibration isolators, crankcase heater, thermal overload protection and refrigerant service valves.
- .15 Refrigerant System
 - .1 Refrigerant system shall include thermal expansion valve with external equalizer, liquid sight glass with moisture indicator, high and low safety pressure switches.

- .16 Controls
 - .1 Solid state electronic control system.
 - .2 Remote control/status panel with LED indicators for:
 - .1 ON power, heating, cooling, humidification, dehumidification, filter.
- .17 Electrical:
 - .1 Electrical components including electrical disconnect switch, all contactors, relays, control transformers and capacitors shall be prewired and mounted within the hermetic cooling section.
 - .1 Terminal blocks shall be provided for both control and power connections.
 - .2 A "Liqui-Tect" sensing device shall be installed at the evaporator drain pan to stop unit operation prior to an overflow condition.
- .18 Accessories:
 - .1 Precharged suction and liquid refrigerant line kit.
 - .2 Dry contacts for connection of common alarm to Building Management System.

2.5 AIR CONDITIONING UNITS - COMPUTER ROOM

- .1 SPEC. NOTE: Ceiling mounted unit based on Liebert Mini-Mate.
- .2 SPEC. NOTE: Fibre type insulation in supply or return airstreams is not permitted in healthcare facilities.
- .3 Standard of Acceptance:
 - .1 Liebert Mini-Mate
- .4 Refer to equipment schedules on the drawings for performance data and additional information.
- .5 SPEC NOTE: Modify the following as applicable to the project
- .6 General:
 - .1 Packaged unit for ceiling mounting and sized to fit 600 mm x 1200 mm [2 ft. x 4 ft.] Tee-bar grid ceiling opening.
- .7 Cabinet:
 - .1 Zinc coated cabinet with baked enamel finish insulated with 25 mm [1"] thick insulation.
 - .2 Hinged supply and return grilles.
 - .3 All components shall be serviceable through removable side panels and hinged grilles.
 - .4 25 mm [1"] thick disposable air filters.
- .8 Fan:
 - .1 Centrifugal double width, 3 speed direct drive fan.
- .9 Refrigeration System:
 - .1 Fully protected heat pump duty rated hermetic compressor with vibration isolation, seamless copper tube, aluminum fin evaporator coil stainless steel condensate pan, expansion valve with external equalizer, filter drier, manual reset high head pressure switch and refrigerant sight glass.
- .10 Condenser:
 - .1 Coaxial, counter flow design made to ASME specifications.
 - .1 Condenser shall be piped into the refrigeration system.

- .2 Head pressure shall be controlled by an adjustable head pressure actuated 2-way regulating valve.
- .11 Electrical:
 - .1 Electrical components including all contactors, relays, control transformers and capacitors shall be prewired and mounted within the hermetic cooling section.
 - .2 Terminal blocks shall be provided for both control and power connections.
 - .3 A "Liqui-Tect" sensing device shall be installed at the evaporator drain pan to stop unit operation prior to an overflow condition.
- .12 Controls:
 - .1 SPEC. NOTE: Select unit or remote mounted controls.
 - .2 [A remote control panel shall be provided with thermostat, humidistat and a system on/off switch].
 - .3 [The thermostat, humidistat and on/off switch shall be mounted in the return air stream].
- .13 Reheat:
 - .1 Low-watt density reheat elements, tubular construction with a non-corrosive metal sheath, thermally protected.
- .14 Humidifier:
 - .1 SPEC. NOTE: Select humidifier required.
 - .2 [Steam generating humidifier].
 - .3 [Humidifier shall be of the evaporative pad type stainless steel construction, complete with solenoid valve and calrod heating element].

2.6 AIR CONDITIONING UNITS – UNITARY

- .1 SPEC. NOTE: Fibre type insulation in supply or return airstreams is not permitted in healthcare facilities.
- .2 Standard of Acceptance:
 - .1 ???
- .3 Refer to equipment schedules on the drawings for performance data and additional information.
- .4 SPEC NOTE: Modify the following as applicable to the project
- .5 General:
 - .1 Provide self-contained, packaged, factory assembled, pre-wired unit, consisting of cabinet, compressor, condensing coil, evaporator fan(s), evaporator coil, (discharge plenum), (outside air connection), filters and controls.
- .6 Cabinet:
 - .1 Fabricate of heavy gauge galvanized steel with baked enamel finish, easily removed access doors or panels with quick fasteners.
 - .1 Insulate cabinet interior with minimum of 12 mm [½"] thick rigid glass fibre.
 - .2 Provide drain pan with bituminous coating.
 - .2 Provide secure attachment points for seismic anchoring.
- .7 Compressor:
 - .1 Provide hermetic compressor, 3600 r/min maximum resiliently mounted with positive lubrication and inherent motor protection.

- .8 Condenser:
 - .1 Provide coaxial, tube within a shell, refrigerant water-cooled condenser with finned copper inner tube and steel outer shell.
 - .2 Provide water regulating valve and stubbed off piping inside cabinet for easy external connections.
- .9 Evaporator Fan(s):
 - .1 Provide double width, double inlet, belt driven, forward curved centrifugal fan(s), statically and dynamically balanced, with permanently lubricated ball bearings.
- .10 Evaporator Coil:
 - .1 Provide direct expansion type cooling coil with seamless copper tubes and aluminum fins.
 - .2 Refrigerant circuit shall include thermal expansion valve, filter-drier, and charging valves.
- .11 Air Filters:
 - .1 Provide easily removed flat filters with 50 mm [2"] thick disposable fibreglass media).
- .12 Controls:
 - .1 Factory wired controls shall include contactor, high and low-pressure cutouts, internal winding thermostat for compressor, control circuit transformer, non-cycling reset relay, temperature controller, fan-off-cool switch.

2.7 AIR CONDITIONING UNITS – DUCTLESS SPLIT

- .1 SPEC. NOTE: Fibre type insulation in supply or return airstreams is not permitted in healthcare facilities.
- .2 Standard of Acceptance:
 - .1 ???
- .3 Refer to equipment schedules on the drawings for performance data and additional information.
- .4 SPEC NOTE: Modify the following as applicable to the project
- .5 General:
 - .1 Indoor Unit:
 - .1 Packaged, air cooled, factory assembled, pre-wired and pre-piped unit, consisting of cabinet, evaporator fans and motors, refrigerant coils, discharge grilles, permanent removable filters, controls and refrigerant.
 - .2 Outdoor Unit:
 - .1 Packaged, self-contained, factory assembled pre-wired and pre-piped unit consisting of cabinet, compressor, outdoor refrigerant coil and fan, service valves, check valves, reversing valves, filter strainer, gauge ports, relays, contactors, circuit breakers, and starters.
 - .3 Indoor unit and outdoor unit shall be of same manufacturer and shall be matched for performance.
- .6 Refrigeration Compressors:
 - .1 Compressor shall be high performance rotary type.
 - .2 Units must be equipped with high-pressure cut-off with manual reset.
 - .3 Mounted enclosed panel shall include:
 - .1 Suction and discharge refrigerant pressure gauge tapings.

- .2 High and low pressure cut out.
- .3 Low ambient kit for operation to -17.8°C [0°F].
- .4 Time delays to prevent repeated cycling of compressor on low loads, crank case heater.
- .7 Outdoor Condensing Units:
 - .1 Weatherproof outdoor unit with compressors for horizontal air flow, factory prewired and pre-piped, baked enamel finish.
 - .2 Single circuited coils with mechanical expanded copper tubing into aluminum fin.
 - .1 Clean, dehydrate and test coils.
 - .2 Seal and ship with holding charge of refrigerant.
 - .3 Fan section with direct drive propeller fan. drip-proof motors, resiliently mounted, pre-lubricated with built-in overload protection.
 - .1 Fan and coil guards.
- .8 Indoor Evaporator Units:
 - .1 Provide indoor unit for recirculating air flow with evaporator fan, 30% pleated, filters, duct connections, evaporator coils, condensate drain, factory pre-wired and pre-piped.
 - .2 Coils shall be ARI certified, single circuited, constructed of seamless copper tubing force fitted to aluminum continuous flat plate.
 - .3 Clean and dehydrate coils, charge with inert gas and seal for shipment.
 - .4 Electric reheat coils.
- .9 Refrigerant Piping and Accessories:
 - .1 Refrigerant grade angle, globe, and ball shut-off valves.
 - .2 Pressure gauge taps at compressor inlet and outlet and at all other locations required.
 - .3 Staged oil traps where evaporator is below compressor.
 - .4 Reversing valves and control circuitry.
- .10 Controls:
 - .1 Provide programmable, solid state electronic, microprocessor controls as specified and required, including relays and control devices.
 - .2 Provide control devices to maintain proper compressor head pressures. Interlock condenser operation to refrigeration cycle and to switch reversing valves, etc.
 - .3 Provide 7-day programmable time schedules with night setback scheduling and automatic/on fan control.
 - .1 Provide auto restart backup for program protection on power failure.

2.8 AIR CONDITIONING UNITS – DUCTED SPLIT

- .1 SPEC. NOTE: Fibre type insulation in supply or return airstreams is not permitted in healthcare facilities.
- .2 Standard of Acceptance:
 - .1 ???
- .3 Refer to equipment schedules on the drawings for performance data and additional information.
- .4 SPEC NOTE: Modify the following as applicable to the project
- .5 General

- .1 Package system, factory assembled and tested with pre-charged refrigeration piping, refrigerant, and oil charge.
- .2 Ready for connection of electric power at evaporator unit and condensing unit and control wiring between units.
- .3 Hard wired electronic thermostat and control module to operate cooling in sequence in response to thermostat sensed temperature, with indication
- .4 For details and performance, refer to separate equipment lists.
- .6 Shop Drawings
 - .1 Submit shop drawings for each condensing unit and evaporator with,
 - .1 Equipment model number,
 - .2 Outline dimensions,
 - .3 Enclosure details,
 - .4 Space requirements for service and maintenance,
 - .5 Support arrangements.
 - .2 Provide rating information showing capacity and power input requirements for heating and cooling at full load.
 - .3 Provide diagrams showing,
 - .1 Requirements for field assembly with air flows, duct opening sizes, connection pipe sizes and rated air flow,
 - .2 Unit internal and external electrical power and control wiring with motors, starters, relays, and interlocks identified, and with terminal and wire numbers marked.
- .7 Evaporator Unit
 - .1 Concealed indoor evaporator unit,
 - .2 Pre-charged direct expansion type cooling coil, arranged with counter flow between air and refrigerant,
 - .3 Three speed fans statically and dynamically balanced,
 - .4 Supply and return air openings for field-supplied ducting,
 - .5 Disposable filters for particulate and odour control,
 - .6 Condensate pan draining to 20 mm [$\frac{3}{4}$ in] side outlet connection.
 - .7 Exposed: plastic enclosure with removable panels for servicing,
 - .8 Concealed: enamel sheet metal enclosure with access doors and concealed fasteners,
 - .9 Concealed suspension brackets
 - .10 Operating sound level less than 45dB(A)
- .8 Condensing unit
 - .1 Outdoor, air cooled, hermetic compressor mounted on vibration isolators,
 - .2 Air cooled condensing coil,
 - .3 Condenser fans, motor starters, and controls,
 - .4 Sheet metal enclosure with mounting lugs and fan safety grille primed and enameled to withstand 1000 hr salt spray test.
 - .5 Low ambient operation to -22oC [-7oF]
 - .6 Operating sound level less than 55dB(A)

- .9 Refrigerant circuit
 - .1 Piping, valves, fittings, and related parts to CSA B52.
 - .2 Pipe insulation: 19 mm [$\frac{3}{4}$ in] thick flexible elastomeric insulation on suction line.
- .10 Temperature control system
 - .1 Hard wired electronic thermostat and control module to operate cooling in sequence in response to thermostat sensed temperature, with indication for,
 - .1 Operating mode (cool only)
 - .2 Compressor operation,
 - .3 No heat,
 - .4 Touch sensitive keypad to allow hour/day operating program and adjustment of thermostat set point.

2.9 INDIRECT FIRED INDOOR PACKAGED UNIT

- .1 SPEC. NOTE: This is based on an Engineered Air DJX high efficiency unit, HEATING ONLY with an option of adding cooling Engineered Air DJX-FWE. Edit as necessary for correct selection of required components.
- .2 SPEC. NOTE: This unit can be 100% outside air supply only, or recirculating with full economizers and with or without return air fans.
- .3 SPEC. NOTE: Fibre type insulation in supply or return airstreams is not permitted in healthcare facilities.
- .4 Standard of Acceptance:
 - .1 Engineered Air DJX – Heating only
 - .2 Engineered Air FWE-DJX – Heating and cooling
- .5 Refer to equipment schedules on the drawings for performance data and additional information.
- .6 SPEC NOTE: Modify the following as applicable to the project
- .7 General:
 - .1 Indoor packaged single zone heating (and cooling) unit, bearing CSA, CGA and ULC labels.
 - .2 Completely factory assembled, pre-charged, piped and wired, ready for field connections.
 - .1 Manufacturer shall test operate unit at the factory before shipment.
 - .3 Units shall consist of but not be limited to the following components:
 - .1 Cabinet and frame with lifting lugs
 - .2 Insulated and seismic rated roof curb
 - .3 Intake [hood] [louvre] [Ducted] inlet.
 - .4 Outdoor air damper
 - .5 Relief damper and return air damper
 - .6 Supply air fan, (forward curved, backward inclined, airfoil, plenum)
 - .7 Return air fan (forward curved, backward inclined, airfoil, plenum)
 - .8 Variable speed drive
 - .9 [Natural gas] [Propane LPG burner]
 - .10 Titanium stainless-steel heat exchanger
 - .11 (Electric heating elements)

- .12 Electronic controller
- .13 Air filters (HEPA, synthetic, pleated)
- .14 (Heat wheel) (QDT) (Plate to plate) (Glycol run-around) heat recovery
- .15 DX cooling system (packaged) (split) R-410, (refrigerant cooling coil) (compressor, condenser coil and fan).
- .4 Units shall be cETL compliant for both sea level or high altitude areas.
- .5 Outdoor units shall be approved for -40oC (-50oC) operation.
- .6 Units shall be assembled on an integral base frame, factory wired and all operating functions factory tested.
- .8 Construction:
 - .1 Cabinet: Weatherproof, watertight, (16 gauge) (18 gauge) satin coat galvanized steel with electrostatic applied enamel finish.
 - .2 Units shall be insulated internally with coated 25mm [1"] 50mm [2"] fiberglass insulation of 48 kg/cu.m [3 lb/cu.ft] density and secured with welded steel pins and 100% coverage of fire retardant adhesive (with perforated metal liner) (solid liner) on surface).
 - .3 Insulation in the heat exchanger section shall be 25mm [1"] non-coated, and covered with a heat reflective galvanized steel liner.
 - .4 Hinged access doors with (liners) and (camlock handles) (leverlock handles) (lockable handles).
 - .5 Insulation:
 - .1 (25 mm [1"]), (50 mm [2"]) (Neoprene coated glass fibre) (Fibre free) (with perforated metal liner) (solid liner) on surface) where conditioned air is handled.
 - .2 Protect edges from erosion.
 - .6 Supply (and Return) Fan:
 - .1 Centrifugal type rubber mounted V-belt drive.
 - .2 Complete fan assembly shall be mounted on vibration isolators. [Provide variable speed drives.]
 - .7 Air Filters:
 - .1 50 mm [2"] thick glass fibre disposable media minimum [MERV 8 30%] efficiency in metal frames.
 - .8 Provide secure attachment points for seismic anchoring.
- .9 Burner:
 - .1 Gas Burner:
 - .1 (Natural gas) (Propane LPG), forced or induced draft type burner with adjustable combustion air supply, 15:1 high turndown, pressure regulator, gas valves, manual shut-off, intermittent spark or glow coil ignition, flame sensing device and automatic 100% shut-off.
 - .2 Burner shall be CGA approved.
 - .3 Modulating gas burner shall be capable of a minimum 91% efficiency through all firing rates, and up to 97% efficient operation at 25% firing rate.
 - .2 Heat Exchangers:
 - .1 Titanium stainless steel; welded construction.
 - .3 Gas Burner Safety Controls:

- .1 Energize ignition, limit time for establishment of flame, prevent opening of gas valve until pilot flame is proven.
- .2 Stop gas flow on ignition failure.
- .3 Energize blower motor.
- .4 After proven airflow and slight delay, gas valve to open.
- .4 High Limit Control:
 - .1 With fixed stop at maximum permissible setting, de-energize burner on excessive bonnet temperature and energize burner when temperature drops to lower safe value.
 - .2 Include auto reset high limit.
- .5 Control supply fan in accordance with bonnet temperatures and independent of burner controls. Include switch for continuous fan operation.
- .6 Provide flue-gas condensate acid neutralizer for the drain.
- .10 Electric Heating Coil:
 - .1 [Open] [Sheathed] element type, nickel-chrome resistance heaters, [SCR] [2 stage], with pre-wired contactors, high limit, air proving switch primary and secondary overcurrent thermal protection as well as branch circuit protection, within a weatherproof control panel.
- .11 Evaporator Coil:
 - .1 Rated to AHRI Standard 210/240.
 - .2 Copper tube / aluminum fin coil assembly with galvanized drain pan, capillary tubes, and expansion valve.
 - .1 Provide intermediate drain pans piped to lower drain pan as required.
 - .2 Ensure no air by-pass at coil.
- .12 Compressor:
 - .1 Rated to AHRI Standard 210/240.
 - .2 Hermetic or semi-hermetic compressor, 3600 r/min maximum, resiliently mounted with positive lubrication, crankcase heater, high- and low-pressure safety controls, motor overload protection, service valves, filter drier, and braided steel flex connections to refrigerant piping.
 - .3 Timed off-circuit shall limit number of compressor starts to twelve (12) per hour.
 - .4 Outdoor thermostat shall de-energize compressor below 12.8°C [55°F].
 - .5 Provide part load capacity by (compressor staging) (hot gas bypass setup) (cycling the compressors) (cylinder unloading).
- .13 Condenser:
 - .1 Rated to AHRI Standard 210/240.
 - .2 Copper tube / aluminum fin coil assembly with sub-cooling rows.
 - .3 Direct drive axial fans, resiliently mounted with fan guard, motor overload protection, wired to operate with compressor.
 - .4 Provide refrigerant pressure switch to cycle condenser fans.
- .14 Fan:
 - .1 Provide statically and dynamically balanced centrifugal fan mounted on solid steel shaft with heavy-duty self-aligning pre-lubricated ball bearings and V-belt drive with matching motor sheaves and belts.

- .15 Control Dampers:
 - .1 SPEC. NOTE: Select outdoor air control from one of the following clauses.
 - .2 Manual outside (and return) air dampers for fixed outside air quantity.
 - .3 Remote controlled outside (and return) air dampers with damper operator and remote rheostat package for adjusting minimum outside air quantity.
 - .4 Provide outside, return and relief dampers with damper operator and control package to automatically vary outside air quantity.
 - .1 Outside air damper shall fail to close position.
 - .2 Relief dampers may be gravity balanced and shall be sized to relieve 100% of the design air volume.
 - .5 Mixed Air Controls:
 - .1 Maintain selected mixed air (temperature) (enthalpy), lock out compressor below approximately 13.9°C [57°F] ambient, return dampers to minimum position above approximately 13.9°C [57°F] or 23.9°C [75°F] ambient.
 - .6 Provide tight fitting dampers with edge gaskets.
 - .7 Damper Operator: [0-10V] [24V], spring return.
- .16 Operating Controls:
 - .1 SPEC. NOTE: Select from one of the following control options.
 - .2 Factory installed pre-programmed packaged electronic control system complete with the following integrated control features.
 - .1 Fan start/stop functions, as per remote / BMS control input
 - .2 Outside air damper control
 - .3 All heating controls to suit the discharge temperature setpoint
 - .4 Default Data
 - .5 All cooling system controls including compressor staging, compressor minimum run and stop times
 - .6 Provide (up to 5) stages of cooling control to maintain a set discharge air (room) temperature.
 - .7 Automatic changeover from heating to cooling (and visa-versa).
 - .1 The need for change from one mode to another must be both time and demand proven before switching.
 - .8 Mechanical cooling shall be enabled only after the outdoor ambient dry bulb temperature rises to 12oC [55°F] (adjustable), and the free cooling (economizer) cycle can no longer maintain setpoint.
 - .1 Then the outside air dampers shall return to minimum position
 - .9 Discharge temperature setpoint with remote / BMS reset
 - .10 Night setback with signal from remote / BMS reset with the following external inputs provided by the [BMS system] [remote control panel]
 - .1 Unit on/off
 - .2 Discharge temperature setpoint with remote / BMS reset
 - .3 Occupied/unoccupied modes
 - .4 Night temperature setback
 - .5 Low voltage adjustable thermostat shall control (burner operation) (heater stages in sequence with delay between stages), compressor and condenser fan, and supply fan to maintain temperature setting.

- .3 Thermostat shall include system selector switch, heat-cool-off and fan control switch, on-auto.
- .4 Double acting thermostat shall have minimum () stage heating and () stage cooling.
- .5 Single acting thermostat shall have minimum () stage cooling.
- .6 Provide remote mounted fan control switch on-auto.
- .7 Provide in supply air; low limit thermostat to close outside air damper and stop supply fan.
- .8 Locate thermostat in (room as shown), (supply air), (return air).
- .9 Provide night control energized by central timeclock (programmable thermostat) to (maintain lower thermostat setting), (maintain night thermostat setting), (lock out refrigeration), (close outside air damper and open air return air damper), (stop supply air fan), (set fan control switch to auto position), for night and unoccupied operation.
- .17 Remote Panel:
 - .1 SPEC. NOTE: The following is only applicable to non-BMS control systems. For BMS based project, these functions would be included there instead.
 - .2 Provide remote readout panel containing:
 - .1 Signal lights indicating:
 - .1 System status
 - .2 Heating system failure
 - .3 Cooling system failure
 - .4 Dirty filters
 - .2 Check switches proving signal light operation
 - .3 System on-off switch
 - .4 Cooling system on-off switch.
 - .3 Provide in panel manual twelve (12) hour timer to override night control, remote damper control, low limit manual reset, remote thermostat temperature set point.

2.10 FORCED AIR FURNACE (WITH DX COOLING)

- .1 SPEC. NOTE: Fibre type insulation in supply or return airstreams is not permitted in healthcare facilities.
- .2 Standard of Acceptance:
 - .1 ???
- .3 Refer to equipment schedules on the drawings for performance data and additional information.
- .4 SPEC NOTE: Modify the following as applicable to the project
- .5 General:
 - .1 Self-contained, (upflow) (counterflow) (horizontal) type packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, heat exchanger, (gas burner) (oil burner) (electric heating elements), burner or heater control, air filter, refrigerant cooling coil and outdoor package containing compressor, condenser coil and condenser fan.
- .6 Construction:
 - .1 Cabinet:

- .1 Heavy gauge galvanized steel with baked enamel finish, easily removed and secured access doors, high temperature glass fibre insulation and reflective liner (and welded steel base).
- .2 Heat Exchanger:
 - .1 (Aluminized), (stainless steel) of welded construction.
- .3 Combustion Chamber:
 - .1 (Welded stainless steel) (Precast refractory).
- .4 Supply Fan:
 - .1 Centrifugal type rubber mounted with direct drive motor with multiple speed switches.
- .5 Air Filters:
 - .1 25 mm [1"] thick fibrous glass disposable type arranged for easy replacement.
- .6 Provide secure attachment points for seismic anchoring.
- .7 Oil Burner:
 - .1 High pressure atomizing type, rubber mounted with adjustable combustion air blower, fuel pump, hinged flame inspection port, cadmium sulphide flame sensor, electrodes, ignition transformer and oil nozzle.
 - .2 Oil Burner Safety Controls:
 - .1 Thermostat energizes burner motor and electric ignition.
 - .2 Time delay relay limits time for establishment of main flame.
 - .3 Flame sensor monitor flame continuously during burner operation and stops burner on flame failure with manual reset necessary.
 - .4 Solenoid oil delay valve opens after burner motor is energized and closes instantly when burner motor is de-energized.
- .8 Gas Burner:
 - .1 Atmospheric type with adjustable combustion air supply, equipped with combination gas valve and pressure regulator incorporating manual shut-off, pilot valve, automatic 100% shut-off and thermocouple pilot safety device.
 - .2 Gas Burner Operating Controls
 - .1 Low voltage, adjustable room thermostat, controls burner operation to maintain room temperature setting.
 - .2 High limit control, with fixed stop at maximum permissible setting, de-energize burner on excessive bonnet temperature and energize burner when temperature drops to lower safe value.
 - .3 Control supply fan in accordance with bonnet temperatures independent of burner controls. Include manual switch for continuous fan operation.
 - .3 Gas Burner Safety Controls:
 - .1 Thermocouple sensor prevents opening of solenoid gas valve pilot flame is proven and stops gas flow on ignition failure.
- .9 Electric Heater
 - .1 Finned tube metal sheath heating elements arranged in incremental stages of 5 kW maximum each, easily accessible with protection against no or low air flows, shorts and grounds, and failure of protection devices.
- .10 Electric Heater Operating Controls

- .1 Low voltage adjustable room thermostat energizes heater stages in sequence with pre-determined delay between heating stages to maintain room temperature setting.
- .2 High limit temperature control de-energized heating elements to protect against overheating.
- .3 Supply fan starts before electric elements are energized and continues operating after thermostat is satisfied until bonnet temperature reaches minimum setting. Include manual switch for continuous fan operation.
- .11 Humidifier
 - .1 Wetted (drum, power) type with float-controlled water supply mounted on furnace return air plenum.
 - .2 Include low voltage motor, transformer, by-pass duct and damper, and replaceable evaporator media.
 - .3 Electric adjustable room humidistat energizes humidifier when fan operating to maintain setting.
- .12 Draft Control
 - .1 Provide each furnace with galvanized steel flue pipe having airtight joints.
 - .2 For oil burner, provide barometric draft regulator in flue pipe.
 - .3 For gas burner, provide furnace with suitable draft diverter.
- .13 Evaporator Coil
 - .1 Mount in furnace supply plenum copper tube aluminum fin coil assembly, with galvanized drain pan, drain connection, refrigerant piping connections and factory housing to enclose cooling coil.
 - .2 Factory installed thermostatic expansion valve.
- .14 Refrigeration Package:
 - .1 Compressor: Hermetic, 3600 r/min maximum, resiliently mounted integral with condenser, with positive lubrication, crankcase heater, high pressure control, motor overload protection, service valves and drier.
 - .2 Air Cooled Condenser: Aluminum fin and copper tube coil, direct drive axial propeller fan resiliently mounted, galvanized fan guard.
 - .3 Water Cooled Condenser: Co-axial condenser with fined copper inner tube and steel outer shell, factory mounted thermostatic water valve.
- .15 Refrigeration Operating Controls
 - .1 Low voltage, adjustable room thermostat controls compressor, condenser fan and supply fan to maintain room temperature setting.
 - .2 Include thermostat system selector switch (heat-cool-off) and fan control switch (on-auto).
 - .3 Timed off circuit shall limit number of compressor starts to 12 per hour.

2.11 DIRECT FIRED MAKE-UP UNITS - INDOOR

- .1 SPEC. NOTE: Fibre type insulation in supply or return airstreams is not permitted in healthcare facilities.
- .2 Standard of Acceptance:
 - .1 ???
- .3 Refer to equipment schedules on the drawings for performance data and additional information.

- .4 SPEC NOTE: Modify the following as applicable to the project
- .5 General:
 - .1 Construct heater casing and components of 1.2 mm [18 ga] steel panels, reinforced with structural angles and channels to ensure rigidity. Provide access panels to burner and blower motor assemblies from either side of unit.
 - .2 Locate observation port on burner section of observing main and pilot flames.
 - .3 Insulate complete unit with 25 mm [1"] thick foil faced fiberglass insulation.
 - .4 Finish casing and components with heat resistant baked enamel.
 - .5 For suspended installations, provide service platforms complete with handrails and access.
 - .6 For outdoor installation, provide weatherproof casing with intake louvre or hood and insulated seismic roof curb.
 - .7 Provide secure attachment points for seismic anchoring.
- .6 Filters:
 - .1 Provide filter section complete with removable 50 mm [2"] thick disposable filters in metal frames.
- .7 Burners:
 - .1 Provide gas burner suitable for natural gas and capable of modulating turn down ratio of 25:1.
 - .1 Burner assembly and gas piping arrangement to include electric modulating main gas valve, motorized shutdown valve, main and pilot gas regulators, pilot electric gas valve, manual shut-off valve, and pilot adjustment valve.
 - .2 Furnish gas burner with electrically ignited supervised pilot.
 - .1 Pilot automatically ignited by spark rod through high voltage ignition transformer.
 - .3 Provide motorized damper complete with end switch to prove position before fan starts and burner will fire.
- .8 Fan:
 - .1 Provide statically and dynamically balanced centrifugal fan mounted on solid steel shaft with heavy-duty self-aligning pre-lubricated ball bearings and V-belt drive with matching motor sheaves and belts.
- .9 Controls:
 - .1 Pre-wired unit completely so connection of power supply and field wiring from unit to remote control panel shall make unit operative.
 - .2 Remote control panel shall contain on-off (auto) switch, (summer-winter switch), indicating lights for supply fan (exhaust fan), pilot operation, burner operation, clogged filter indication (and lockout indication).
 - .3 Interlock unit to start when exhaust fan is running.
 - .1 Interlock burner to operate when flow switch located in exhaust duct proves flow. (Interlock exhaust fan speed control with inlet damper and burner profile damper to provide dual volume air capacity). (Interlock exhaust fans to inlet damper and burner profile to provide dual volume operation).
 - .4 Fan discharge thermostat shall control modulating gas valve to maintain supply air temperature. (Provide remote discharge thermostat adjustment). (Provide room thermostat to reset discharge thermostat minimum of three temperature levels).

- .5 Provide time clock to operate fan system (off at night) (on low volume at night).
- .6 Interlock with carbon monoxide monitoring system to operate fan on high volume when pre-determined carbon monoxide concentration detected.
- .7 Provide safety controls to provide correct air flow before energizing pilot and to sense pilot ignition before activating main gas valve.
- .8 Provide manual reset low and high limit controls to maintain supply air temperature between set point and shut fan down if temperature are exceeded.
- .9 Provide purge period timer to delay burner ignition and automatically bypass low limit control.
- .10 Refrigeration Package:
 - .1 Evaporator Coil: Copper tube aluminum fin coil assembly with galvanized drain pan and expansion valve.
 - .2 Compressor: Hermetic, 3600 r/min maximum resiliently mounted with positive lubrication, crankcase heater, high pressure control, motor overload protection, service valves and drier.
 - .3 Condenser: Aluminum fin and copper tube coil, direct drive axial fan resiliently mounted, galvanized fan guard.
 - .4 Operating Controls: Low voltage, adjustable room thermostat controls compressor, condenser fan and supply fan to maintain room temperature setting.

2.12 FAN-COIL UNITS – HYDRONIC – 2 PIPE AND 4 PIPE

- .1 SPEC. NOTE: Fibre type insulation in supply or return airstreams is not permitted in healthcare facilities.
- .2 Standard of Acceptance:
 - .1 ???
- .3 Refer to equipment schedules on the drawings for performance data and additional information.
- .4 SPEC NOTE: Modify the following as applicable to the project
- .5 General:
 - .1 Factory assembled, draw-through or blow through type fan coil unit for ducted installation above the ceiling.
 - .1 Unit shall be complete with water coil(s), centrifugal fan, internal motor, belt drive, drain pan, filters, and fan speed controller.
- .6 Construction
 - .1 Cabinet:
 - .1 Steel frame and sheet metal cabinet housing fan, coil, drain pan, filters, and controls.
 - .2 mm thick [18 ga] galvanized steel casing with outlet duct collar, rear filter plenum and inlet duct connection.
 - .1 Cabinet lined with 12 mm [1/2"] 25 mm [1"] thick acoustic insulation.
 - .1 Exposed face of insulation to be faced with non-woven mat.
 - .2 All exposed raw edges and joints to be sealed with glasfab and or metal nosing insulation coating / sealer.
 - .2 Access to all components.
 - .3 Condensate drain pan.

- .3 Cabinet finished with baked enamel.
- .4 Access panel to blower, coil, and filter.
- .5 25 mm [1"] thick disposable media filters.
- .2 Coils:
 - .1 Aluminum fins bonded to seamless copper tubes.
 - .1 Auxiliary heating coil where scheduled.
 - .2 Removable galvanized steel drain pan.
- .3 Refrigerant Circuits:
 - .1 Refrigerant circuits controlled by factory installed thermal expansion valves.
- .4 Fan:
 - .1 Double width centrifugal fan, shaded pole type motor, thermal overload protection.
 - .2 3 speed settings.
 - .3 Fan drive shall consist of variable-pitch motor pulley, fixed-pitch fan pulley and V-belt. Bearings shall be ball bearings.
 - .4 Direct drive fans may be used for applications less than 470 L/s [1,000 cfm] airflow.
- .5 Controls:
- .6 Accessories:
 - .1 Electric heater as scheduled.
 - .2 Discharge plenum with grilles.

2.13 FAN-COIL UNITS – HYDRONIC – 2 PIPE WITH DX COOLING

- .1 SPEC. NOTE: Fibre type insulation in supply or return airstreams is not permitted in healthcare facilities.
- .2 Standard of Acceptance:
 - .1 ???
- .3 Refer to equipment schedules on the drawings for performance data and additional information.
- .4 SPEC NOTE: Modify the following as applicable to the project
- .5 General:

2.14 FAN-COIL UNITS – ELECTRIC HEAT

- .1 SPEC. NOTE: Fibre type insulation in supply or return airstreams is not permitted in healthcare facilities.
- .2 Standard of Acceptance:
 - .1 ???
- .3 Refer to equipment schedules on the drawings for performance data and additional information.
- .4 SPEC NOTE: Modify the following as applicable to the project
- .5 General:

2.15 FAN-COIL UNITS – ELECTRIC HEAT WITH DX COOLING

- .1 SPEC. NOTE: Fibre type insulation in supply or return airstreams is not permitted in healthcare facilities.
- .2 Standard of Acceptance:
 - .1 ???
- .3 Refer to equipment schedules on the drawings for performance data and additional information.
- .4 SPEC NOTE: Modify the following as applicable to the project
- .5 General:

2.16 CONDENSATE PUMP

- .1 Standard of Acceptance:
 - .1 ???
- .2 Refer to equipment schedules on the drawings for performance data and additional information.
- .3 SPEC NOTE: Modify the following as applicable to the project
- .4 General:
 - .1 Unit shall be designed for automatic collection and removal of condensate from evaporator drip pans.
 - .2 Vertical centrifugal pump
 - .3 Automatic start and stop operation
 - .4 float activated switch for automatic high-level water detection (safety overflow switch)
 - .5 9 mm [3/8"] discharge adapter with built-in check valve
 - .6 Three 28 mm [1-1/8"] diameter inlet openings (two fitted with removable cap plug)
 - .7 Thermally protected, fan cooled motor
 - .8 Built-in wall mount tabs on tank
 - .9 Removable pump float locking tab for safety during transportation (remove at time of installation)
 - .10 Suitable for maximum water temperature of 60oC [140°F].
 - .11 m [6 ft], 3-conductor cable with grounded 3-prong plug
 - .12 Construction
 - .1 Motor – 25w [1/30 hp]
 - .2 Housing/tank cover - ABS
 - .3 Volute - ABS
 - .13 Collection tank - 1.9L [0.5 USgal] ABS
 - .1 Impeller - Glass filled polypropylene
 - .2 Check valve - Acetal

2.17 CONDENSING UNITS - AIR COOLED

- .1 Standard of Acceptance:
 - .1 Trane "Split" System BTA
- .2 Refer to equipment schedules on the drawings for performance data and additional information.

- .3 SPEC NOTE: Modify the following as applicable to the project
- .4 Casing:
 - .1 Heavy welded steel frame and galvanized steel panels, baked enamel finish.
 - .2 Removable access panels.
- .5 Compressors:
 - .1 Hermetic reciprocating compressors with internal spring isolation.
 - .2 Centrifugal oil pump.
 - .3 Crankcase heater.
- .6 Refrigerant circuit:
 - .1 Liquid line filter drier(s).
 - .2 Liquid line service valve(s) with gauge port.
 - .3 Suction line service valve(s) with gauge port.
- .7 Condenser:
 - .1 Direct drive propeller fans, vertical discharge.
 - .2 Fan safety guards.
 - .3 Condenser coil with aluminum fins bonded to copper tubes.
- .8 Controls:
 - .1 Factory wired in separate enclosure.
 - .2 24-volt control circuit, control power transformer.
 - .3 Magnetic contactors.
 - .4 Overload devices for compressor(s) and fan(s).
 - .5 Anti-short cycle timer.

2.18 CABINET UNIT HEATERS – HYDRONIC

- .1 SPEC. NOTE: Fibre type insulation in supply or return airstreams is not permitted in healthcare facilities.
- .2 Standard of Acceptance:
 - .1 ???
- .3 Refer to equipment schedules on the drawings for performance data and additional information.
- .4 SPEC NOTE: Modify the following as applicable to the project
- .5 Cabinet:
 - .1 Arrangement as scheduled.
 - .2 mm [16 ga] thick cold rolled steel suitably braced for rigidity.
 - .3 Easily removable front panels on floor or wall mounted units.
 - .4 Hinged front panel on ceiling mounted units.
 - .5 Integral inlet and outlet grilles or duct collars.
 - .6 Prime coat painted internally and externally.
- .6 Coils: Aluminum fins mechanically bonded to seamless copper tubes.
- .7 Fans: Centrifugal double width wheels, statically and dynamically balanced, direct driven, sleeve bearings, resiliently mounted.

- .8 Motors: Multi-speed, tapped wound permanent split capacitor type with sleeve bearings, built-in thermal overload protection and resilient rubber isolation mounting.
- .9 Accessories:
 - .1 3 speed switch mounted inside cabinet [wall mounted].
 - .2 Access door with screw or camlock fastener

2.19 CABINET UNIT HEATERS - ELECTRIC

- .1 SPEC. NOTE: Fibre type insulation in supply or return airstreams is not permitted in healthcare facilities.
- .2 Standard of Acceptance:
 - .1 Chromalox CH series
- .3 Refer to equipment schedules on the drawings for performance data and additional information.
- .4 SPEC NOTE: Modify the following as applicable to the project
- .5 CSA approved.
- .6 Steel cabinet with baked enamel finish. Inlet and outlet bar grilles on front face. Surface mounting arrangement
- .7 Two speed direct drive fan assembly.
- .8 Stainless steel sheathed heating elements, with corrosion protected steel fins.
- .9 Factory installed switching relays, fan delay switch, on-off switch, over-temperature protection and two position speed switch.
- .10 Accessories:
 - .1 Line voltage wall mounted thermostat, [unit mounted thermostat].
- .11 Capacity:
 - .1 As noted on the drawing.
 - .2 Electrical service: [600/3/60]

2.20 UNIT HEATERS – SUSPENDED HYDRONIC

- .1 Standard of Acceptance:
 - .1 ???
- .2 Refer to equipment schedules on the drawings for performance data and additional information.
- .3 SPEC NOTE: Modify the following as applicable to the project
- .4 Application: Horizontal or vertical arrangement as scheduled.
- .5 Casing: 1.2 mm [18 ga] thick cold rolled steel, gloss enamel finish, with threaded connections for hanger rods.
- .6 Coils: Seamless copper tubing, silver brazed to steel headers and with evenly spaced aluminum fins mechanically bonded to tubing.
- .7 Fan: Direct drive propeller type, factory balanced, with anti-corrosive finish and fan guard on horizontal units.
- .8 Motor: speed as indicated, continuous duty, built-in overload protection, and resilient motor supports.
- .9 Air Outlet:
 - .1 Horizontal Unit: [two-way] [four-way] adjustable louvres.

- .2 Vertical Unit : [adjustable multi-vane diffuser].

2.21 UNIT HEATERS - SUSPENDED GAS

- .1 Standard of Acceptance:
 - .1 Reznor FE.
- .2 Refer to equipment schedules on the drawings for performance data and additional information.
- .3 SPEC NOTE: Modify the following as applicable to the project
- .4 Minimum Requirements:
 - .1 CGA approved for natural gas.
 - .2 Aluminized steel heat exchanger.
 - .3 Power vented with vent terminal cap suitable for wall or roof termination.
 - .4 Burners in pullout drawer.
 - .5 Spark ignited intermittent safety pilot with electronic flame supervision.
 - .6 24-volt automatic gas valve, pressure regulator, pilot valve and gas cock.
 - .7 Motor contactor, terminal block wiring.
 - .8 Fan and high limit controls.
 - .9 Door interlock for burner circuit, combustion air pressure switch and time delay pre-purge switch.
 - .10 Propeller [centrifugal] blowers.
 - .11 Direct drive totally enclosed motor with overload protection.
 - .12 Steel cabinet with baked enamel finish, complete with suspension couplings.
 - .13 Adjustable horizontal [and vertical] discharge louvres.
 - .14 Warranty: [10 year] parts warranty on heat exchanger.
- .5 Accessories:
 - .1 Low voltage space thermostat.

2.22 UNIT HEATERS - SUSPENDED ELECTRIC

- .1 Standard of Acceptance:
 - .1 ???
- .2 Refer to equipment schedules on the drawings for performance data and additional information.
- .3 SPEC NOTE: Modify the following as applicable to the project
- .4 C.S.A. approved.
- .5 Electric Coils: Nickel - chrome electric resistance coils embedded in refractory material and enclosed in steel sheathing.
- .6 Fan: Direct drive propeller type.
- .7 Motor: Thermally protected, prelubricated sealed bearings and resilient motor supports.
- .8 Air Outlet: Independently adjustable horizontal louvres.
- .9 Controls:
 - .1 Overheat protection (automatic and manual reset).
 - .2 Magnetic contactor.

- .3 Transformer for [600/3/60 to 240/1/60].
- .4 Control relay for control by BMS
- .5 Shop drawings to include wiring diagrams.
- .10 Finish: Factory baked enamel.
- .11 Accessories:
 - .1 Mounting bracket for wall mounting.

2.23 PACKAGED HEAT PUMP UNITS – WATER TO AIR

- .1 SPEC. NOTE: On larger projects it may be a good idea to specify one spare heat pump unit for each size unit on the project.
- .2 SPEC. NOTE: Fibre type insulation in supply or return airstreams is not permitted in healthcare facilities.
- .3 Standard of Acceptance:
 - .1 Water Furnace, EW Series
- .4 Refer to equipment schedules on the drawings for performance data and additional information.
- .5 SPEC NOTE: Modify the following as applicable to the project
- .6 General:
 - .1 Water to Air - ground source heat pumps.
 - .2 A.R.I. 320 certification, U.L. And C.S.A. Approvals.
 - .3 Rated in compliance with the ARI/ISO Standard 13256-1.
 - .4 Factory packaged, self-contained and pre-wired.
 - .5 The unit and all refrigeration components shall be rated for use with an environmentally friendly refrigerant (R-134a, R-407C, R-410A). CFC and HCFC refrigerants, subject to Montreal Protocol, are not acceptable. Field conversion of refrigerants will not be acceptable.
 - .6 All heat pumps shall be guaranteed to produce an average Energy Efficiency Ratio (EER) of 16.0 or better and a weighted average Coefficient of Performance (COP) of 3.4 or better when tested in accordance with ARI/ISO Standard 13256-1.
 - .7 All heat pumps shall be hooked up to water and functionally tested at the factory including safety controls, and operation over the voltage tolerance range.
 - .8 The entire refrigeration circuit shall be warranted against defects in material and workmanship for a period of five (5) years.
 - .9 Cabinet:
 - .1 Heavy gauge galvanized steel finished with baked enamel.
 - .2 12 mm [1/2"] thick high density and coated cabinet insulation; insulated access panels; insulated partition between the blower and compressor compartments.
 - .3 Disposable type air filter return duct collar designed to accept the filter, with filter replacement access, discharge duct collar. Provide MERV 13 minimum efficient air filter.
 - .4 Galvanized steel condensate drain pan. Pan insulated and pitched for drainage.
 - .10 Air Coil:
 - .1 Copper tubes with aluminum fins.

- .11 Blower:
 - .1 Double inlet, centrifugal forward curve, statically and dynamically balanced.
 - .2 Direct driven by permanent split capacitor motor with integral thermal overload protection and 2 speed taps.
- .12 Compressor:
 - .1 Heat pump duty hermetic, internally sprung and externally isolated.
 - .2 Thermal overload protection.
 - .3 Insulated compressor for noise attenuation.
 - .4 Capillary expansion device to meter refrigerant between the air and water coils.
 - .5 Factory-sealed refrigeration system.
 - .6 Schrader access valves on high- and low-pressure lines.
- .13 Reversing Valve:
 - .1 Hermetic construction with replaceable external electrical solenoid coil.
- .14 Water Coil:
 - .1 Axial tube-in-tube type with water flowing through inner serpentine copper coil, designed for low water pressure drop and low water flow.
 - .2 Cupronickel inner tube.
- .15 Control Panel:
 - .1 Controls shall interface with the B.M.S. The B.M.S. shall monitor room temperature and provide start stop signal, and supply air temperature re-set signal.
 - .2 Factory wired and mounted control circuit c/w compressor contactor, 24-volt transformer and blower relay.
 - .3 Controls shall include high pressure and freeze protectors.
 - .4 Relays and transformers suitable for 24-volt remote control.
 - .5 Lock-out relay reset from the B.M.S.
 - .6 Status and alarm monitoring through the B.M.S.
- .7 Accessories:
 - .1 Hanger/vibration isolator kit c/w brackets.
 - .2 Thermostats as specified.
 - .3 Hose kits - all hose kits shall include two 300 mm [12"] long flexible reinforced rubber hoses (rated at 1380 kPa [200 psig] working pressure) with brass pipe connections (swivel on one end).
 - .4 One spare set of filters for each unit.

2.24

PACKAGED HEAT PUMP UNITS – WATER TO WATER

- .1 SPEC. NOTE: On larger projects it may be a good idea to specify one spare heat pump unit for each size unit on the project.
- .2 SPEC. NOTE: Fibre type insulation in supply or return airstreams is not permitted in healthcare facilities.
- .3 Standard of Acceptance:
 - .1 ???
- .4 Refer to equipment schedules on the drawings for performance data and additional information.

- .5 SPEC NOTE: Modify the following as applicable to the project
- .6 Heat Pump General:
- .7 Water to water (fluid to fluid) extended range units, suitable for ground source heat pump application.
 - .1 A.R.I. 320 certification, U.L. And C.S.A. Approvals.
 - .2 Rated in compliance with the ARI/ISO Standard 13256-1, and ARI/ASHRAE/ISO Standard 13256-3 – Ground-Loop Heat Pump.
 - .3 Units shall comply with the applicable codes and standards, including NFPA-70 National Electrical Code, meet or exceed all applicable Underwriters' Laboratories safety requirements, ASHRAE-90A Energy Conservation in New Building Design, ARI/ASHRAE/ISO Standard 13256-3 – Ground-Loop Heat Pump.
 - .4 Factory packaged, self-contained and pre-wired.
 - .5 The unit and all refrigeration components shall be rated for use with an environmentally friendly refrigerant (R-134a, R-407C, R-410A). CFC and HCFC refrigerants, subject to Montreal Protocol, are not acceptable. Field conversion of refrigerants will not be acceptable.
 - .6 All heat pumps shall be guaranteed to produce an average Energy Efficiency Ratio (EER) of 16.0 or better and a weighted average Coefficient of Performance (COP) of 3.4 or better when tested in accordance with ARI/ISO Standard 13256-1.
 - .7 All heat pumps shall be hooked up to water and functionally tested at the factory including safety controls, and operation over the voltage tolerance range.
 - .8 The entire refrigeration circuit including microprocessor-based controls shall carry a warranty against defects in material and workmanship for a period of five (5) years.
- .8 Cabinet:
 - .1 Heavy gauge galvanized steel finished with baked enamel or powder coat paint.
 - .2 mm [10 ga] welded steel frame
 - .3 12 mm [1/2"] thick high density and coated cabinet insulation; insulated access panels for inspection and access to internal components; insulated partition between the blower and compressor compartments.
 - .4 Galvanized steel condensate drain pan. Pan insulated and pitched for drainage.
- .9 Compressor:
 - .1 Heat pump duty hermetic, internally sprung and externally isolated.
 - .2 Thermal overload protection.
 - .3 Capillary expansion device to meter refrigerant between the air and water coils.
 - .4 Compressor motor overload protection.
 - .5 Capability to reset compressor lockout circuit at either remote thermostat or circuit breaker.
 - .6 Insulated compressor (high density sound attenuating blanket) for noise attenuation.
- .10 Refrigerant Loop and Reversing Valve:
 - .1 Factory-sealed refrigeration system.
 - .2 Schrader access valves on high- and low-pressure lines.
 - .3 Insulated refrigerant loop to prevent condensation at low temperatures.
 - .4 Liquid line filter dryers on each refrigerant circuit
 - .5 High and low temperature cutouts,

- .6 Hermetic construction with replaceable external electrical solenoid coil.
- .11 Water Coil:
 - .1 Axial tube-in-tube type with water flowing through inner serpentine copper coil, with cupronickel inner tube designed for low water pressure drop and low water flow, or brazed plate type heat exchangers with 316 stainless steel plates capable of withstanding 4480 kPa [650 psig] working pressure on the refrigerant side and 3100 kPa [450 psig] on the water side.
 - .2 Insulated to prevent condensation. The insulation shall be manufactured without the use of CFC's or HFC's.
- .12 Control Panel:
 - .1 Controls shall interface with the B.M.S. The B.M.S. shall monitor room temperature and provide start stop signal, and supply air temperature re-set signal.
 - .2 Factory wired and mounted control circuit c/w compressor contactor, 24-volt transformer and blower relay.
 - .3 Controls shall include high pressure and freeze protectors.
 - .4 Relays and transformers suitable for 24-volt remote control.
 - .5 Lock-out relay reset from the B.M.S.
 - .6 Status and alarm monitoring through the B.M.S.
- .13 Accessories:
 - .1 Hanger/vibration isolator kit c/w brackets.
 - .2 Controller capable of supporting the building DDC system protocol.
 - .3 Hose kits - all hose kits shall include two 300 mm [12"] long flexible reinforced rubber hoses (rated at 1380 kPa [200 psig] working pressure) with brass pipe connections (swivel on one end).
 - .4 One spare set of filters for each unit.
- .14 Heat Pump Loop Control Panel
 - .1 General:
 - .1 To be supplied by heat pump unit supplier.
 - .2 Minimum Requirements:
 - .1 Solid-state components, NEMA enclosure, lockable front cover.
 - .2 Clearly labelled terminal strips for field connections.
 - .3 LED lamps on front panel to indicate normal operating conditions and alarm conditions.
 - .4 Audible alarm with silence and reset buttons.
 - .5 Manual selection switch for interchanging operational lead and lag pumps.
 - .6 Remote water loop temperature sensor and brass well suitable for connection to panel by a twisted pair cable. No shielding necessary.
 - .7 Loop water temperature meter mounted on front panel.
 - .8 Control transformer.
 - .9 Control relays for 4 stages of cooling and 1 stage of heat.
 - .10 Remote alarm panel to provide audible and visual indication of an alarm. Remote alarm terminals.
 - .3 Note:

- .1 All field wiring from panel to flow switch(es), remote sensor, remote alarm panel, cooling tower damper motor(s), fan and spray pump starters, system loop pump starters, heat exchanger control circuit and to power contactors to interrupt power to heat pump units shall be under the Control Section.
- .2 Manufacturer's representative shall check out installation of this panel in the presence of the Contractor and shall verify the settings of control and alarms as specified to the Consultant.
- .4 Sequence of Operation:
 - .1 The water loop temperature shall be controlled by the control panel.
 - .2 The heat pumps shall not be operated in air temperatures below 15.6oC [60oF]. Attention should be paid to this during commissioning/start-up of the system.
 - .3 The heat pump units shall not be operated with water loop temperatures below 15.6oC [60oF] or above 40.6oC [105oF]. Failure to observe these operational temperature limits may result in damage to the heat pump units.
 - .4 If system loop water temperature drops to 12.8oC [55oF], an alarm shall sound, and a red light shall indicate low water temperature.
 - .5 If system loop water temperature rises to 37.8oC [100oF], an alarm shall sound, and a red light shall indicate high water temperature. The cooling tower shall continue to run.
 - .6 If system loop water flow stops, the standby pump shall be automatically started, and a red light shall indicate that the standby pump is operating.
 - .7 For approximately 1 minute after standby pump is energized an alarm shall sound and a red light shall indicate no flow. If starting of the standby pump fails to restore system water flow the alarm and red "no-flow" light shall remain.
 - .8 At high or low system loop water temperature and a loss of system water flow, a relay shall open to interrupt operation of the heat pump units.
 - .9 With the system loop water temperature between approximately 15.6oC [60oF] and 32.2oC [90oF] heat will be neither added nor rejected from the system load.
 - .10 As system loop temperature rises to 28.3oC [83oF], the cooling tower's normally closed discharge dampers shall open.
 - .11 As the loop temperature falls to 27.2oC [81oF], the cooling tower's discharge dampers shall close.
 - .12 As the loop temperature rises to 30oC [86oF], the cooling tower spray pump shall start.
 - .13 As the loop temperature falls to 28.6oC [83.5oF], the cooling tower spray pump shall stop.
 - .14 As the loop temperature rises to 31.7oC [89oF], the cooling tower temperature control circuit for the fan and scroll dampers shall be activated.
 - .15 As the loop temperature falls to 30.3oC [86.5oF], the cooling tower control circuit shall be deactivated.
 - .16 At approximately 15.6oC [60oF], the heat exchanger's control circuit shall be activated.
 - .17 At 16.9oC [62.5oF], the heat exchangers control circuit shall be deactivated.
- .15 Heat Pump Thermostats
 - .1 Design:
 - .1 ?????

- .2 Minimum Requirements:
 - .1 To be supplied by heat pump manufacturer.
 - .2 Low-voltage, electronic programmable setback thermostat.
 - .3 Automatic or manual changeover, field selectable, with heat/cool/off/auto system switch positions.
 - .1 Occupied hours fan switch: on/automatic.
 - .2 Setback hour fan switch: automatic/use occupied setting.
 - .3 Setback fan switch shall be hidden from the occupant.
 - .4 5-1-1 programming:
 - .1 5: four programmable time/temperature periods, having different heating temperatures, cooling temperatures and start times for each period. The same schedule is reported for each of five consecutive days (Monday - Friday).
 - .2 1: same as above for the sixth day only (Saturday).
 - .3 1; same as above for the seventh day only (Sunday).
 - .5 The thermostat control logic shall be of the preferential rate control type and shall use the current room temperature, current temperature setpoint, and rate of change in room temperature in its control logic to minimize temperature drift and droop.
 - .6 Built-in short-cycle protection.
 - .7 The thermostat shall have the ability to have its program entered or changed when the thermostat is on or off the wall, ie.,
 - .1 The electronic/keypad module shall be removable for the remote programming.
 - .8 The thermostat shall have the following displays:
 - .1 Digital display of current room temperature and current time of day.
 - .2 Display indicating current day of the week, current temperature setpoints in effect, and the number of stages of cooling and heating that are energized.
 - .9 The thermostat shall have a battery back-up to prevent program loss during power outages.
 - .1 A battery shall be factory supplied with each thermostat. In addition, a low battery indicator shall flash to a low battery/replace battery condition.
 - .10 The thermostat shall have the following user selectable options:
 - .1 The time display shall be either in 24 hour format or 12 hour format with AM and PM indicators.
 - .1 The display in effect shall be controlled with a concealed switch in the thermostat.
 - .2 The temperature display shall be either in degrees Fahrenheit or degrees Celsius.
 - .1 The display in effect shall be controlled with a concealed switch in the thermostat.
 - .3 The thermostat shall have a timed override where the override time is adjustable from 1 hour to 31 days.
 - .4 The occupant shall be able to override the thermostat to either the occupied or unoccupied settings.
 - .5 The thermostat shall have a concealed switch to disable the keypad.

- .1 If selected, this will prevent an occupant from tempering with temperature setpoints, occupied/unoccupied times, or override time, but will still allow the occupant to initiate an override.
- .6 The thermostat shall have the ability to use a remote temperature sensor.
- .11 The thermostat shall be of 100% solid state design for reliable operation.
 - .1 The temperature sensor shall be accurate to +/-0.25oC [+/-0.5oF] and the clock shall be accurate to +/-90 seconds per month.

Part 3 Execution

3.1 GENERAL

- .1 Install units as indicated and to manufacturers' recommendations.
- .2 Provide and install all necessary refrigerant piping and electrical connection between "split" units.

3.2 EQUIPMENT PREPARATION AND START-UP

- .1 Provide services of manufacturer's field engineer to set and adjust equipment for operation as specified.

3.3 AIR CURTAIN UNITS

- .1 Air curtain units to be mounted as shown on the drawings (exposed above the door or concealed above the ceilings).
 - .1 On ceiling located units, install the discharge grille supplied with the unit in the ceiling and connect to unit with the duct extension.

3.4 AIR CONDITIONING UNITS - COMPUTER ROOM

- .1 Co-ordinate installation of computer room air conditioning unit with computer room raised floor installer.
 - .1 Position air outlets to suit computer equipment locations.
- .2 The refrigeration contractor shall install and terminate interlock wiring between the air conditioning units and the associated remote condensing units on the roof.
- .3 Provide a condensate drain trap at each unit.
 - .1 The inlet leg of the traps should be a minimum of 25 mm [1"] higher than the outlet leg.
- .4 Condensate drain piping should be graded towards the plumbing drain at minimum 1:200 [1/16" per foot].
- .5 Install remote control panel, liquid detection panel.
- .6 Secure unit and floor stand to structure in accordance with seismic loading requirements
- .7 For glycol cooled condenser, provide all required piping components such as isolation valves for each air conditioning unit and condenser, hose bibs, air vents etc.
 - .1 The expansion tank supplied with the unit shall be field installed at the highest point in the system.
 - .2 Provide enough glycol to fill the system.
- .8 Manufacturer's representative to check out and start up units.

- .9 Ceiling tiles used for access to service units to be clearly marked and shall be easily removable.
 - .1 Avoid running electrical and mechanical services close to tile.

3.5 AIR CONDITIONING UNIT (UNITARY) INSTALLATION

- .1 Piping connections to units to be made with braided flexible hoses.
- .2 Provide a balancing valve in the return piping connection and an isolating valve in the supply piping connection to each unit.
- .3 Provide a condensate drain trap at each unit.
 - .1 The inlet leg of the traps should be a minimum of 25 mm [1"] higher than the outlet leg.
- .4 Condensate drain piping should be graded towards the plumbing drain at minimum 1:200 [1/16" per foot].
- .5 Provide flex connections to ductwork.
- .6 Provide vibration isolation hangers with seismic restraints.

3.6 HEATING UNITS INSTALLATION

- .1 Install according to piping layout.
 - .1 Provide for pipe movement during normal operation.
- .2 Refer to manufacturer's installation drawings.
- .3 Verify electrical service work with characteristics stamped on unit.
- .4 Venting:
 - .1 On up-fed units provide screwdriver vent on convectors and standard air vent with cock on continuous wall convectors.
 - .2 On unit heaters and cabinet unit heaters provide standard air vent with cock unless piping is installed above units and is self-venting into mains.
 - .3 Pitch heating elements to assist air venting.
- .5 Valves:
 - .1 Install isolating gate valve on supply and lock shield globe valve on return, together with control valve shown or specified in the Controls Section.
 - .2 In public areas use lock shield type on supply and return for isolation.
- .6 Install, where indicated, 32 mm [1-1/4"], all copper flexible expansion compensator.
- .7 Check for correct element lengths in heating cabinets as work progresses. Scheduled length is actual finned length.
- .8 Field measure for lengths of convector, wall fin or other cabinetry prior to manufacture.
 - .1 Install cabinets and fins including all supports as recommended by manufacturer.
- .9 Install unit heaters at heights indicated.
 - .1 Where not indicated, follow Consultant's instruction.
 - .2 Set discharge pattern required.
- .10 Provide supplementary suspension steel as required.
- .11 Touch up scratches in factory paint finishes on units.

3.7 FAN COIL UNITS - HYDRONIC

- .1 Install trapped drain line fabricated from type L copper tube.
 - .1 Slope drain away from unit and insulate.
- .2 Install isolation valves in coil supply and return connections and balancing valves on coil return connection.
- .3 Install unit on hanger rods with rubber-in-shear isolators and slack cable restraints.
- .4 Installation shall allow for proper access to panels, filters, belts, valves, etc.

3.8 DUCTED SPLIT AIR CONDITIONERS

- .1 Installation
 - .1 Install evaporator unit in space, route supply ducting, return ducting and drain piping.
 - .2 Install condensing unit with adequate clearance for service and maintenance.
 - .3 Run refrigeration suction and liquid piping in accordance with manufacturer's instructions with respect to horizontal and vertical length limitations
 - .4 Charge systems and leak test in accordance with manufacturer's instructions
 - .5 Provide un-fused weatherproof disconnect on or adjacent condenser and evaporator units and run electric power and control wiring.
 - .6 As required, depending on manufacturer, sub-feed electrical power for evaporator unit from condenser unit.
 - .7 Provide sheet-metal wind-baffle shield on condenser as required by manufacturer's instructions for low ambient operation.
- .2 Start-up service
 - .1 Arrange for manufacturers' field representative to supervise installation, start-up system and instruct Owner's operations and maintenance personnel.

3.9 HEAT PUMP UNIT INSTALLATION

- .1 Install in accordance with manufacturer's recommendations.
- .2 Piping connections to units to be made with flexible hoses.
- .3 Provide a balancing valve in the return piping connection and an isolating valve in the supply piping connection to each unit.
- .4 Provide a condensate drain trap at each unit. The inlet leg of the traps should be a minimum of 25 mm [1"] higher than the outlet leg.
- .5 Condensate drain piping should be graded towards the plumbing drain at minimum 1:200 [1/16" per foot].
- .6 P/T plugs shall be provided on the supply and return piping connections to each unit.
- .7 Install temporary bypass piping arrangement, using flexible hoses, before piping is chemically cleaned.
 - .1 Replace permanent connections after piping has been flushed out.
- .8 Manufacturer's representative to check out and start up units.
- .9 Ceiling tiles used for access to service units to be clearly marked and shall be easily removable.
 - .1 Avoid running electrical and mechanical services close to tile.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section provides General, Product, and Execution Requirements for Heating/Cooling Coils.
- .2 Provide all required Heating/Cooling Coils and accessories as indicated, including, but not limited to:
 - .1 Electric Heating Coils

1.2 RELATED REQUIREMENTS

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.
- .2 In conjunction with Division 01, Division 20 General Mechanical Provisions shall govern all Division 23 Sections of the work.
- .3 Refer to Section 20 99 60 Mechanical Forms and submit all documentation therein that is applicable to Division 23.
- .4 Refer to and comply with the following sections:
 - .1 General Requirements - Division 01
 - .2 Common Work for Mechanical Systems – Division 20
 - .3 Plumbing Systems - Division 22
 - .4 Heating, Ventilation and Air Conditioning Systems - Division 23
 - .5 Controls and Instrumentation - Division 25
 - .6 Electrical - Division 26/27

1.3 APPLICABLE CODES AND STANDARDS

- .1 Refer to Section 20 05 01, Codes, Bylaws and Standards.
- .2 All equipment, materials, installation, and testing shall conform to the following standards as a minimum:
 - .1 Provincial Building Code
 - .2 Local Building By-Laws
 - .3 Provincial Safety Authority

1.4 QUALITY ASSURANCE

- .1 Refer to Section 20 05 00 General Mechanical Provisions, Quality Assurance for additional details.
- .2 Follow manufacturer's recommended installation details and procedures for equipment, supplemented by requirements of Contract Documents.
- .3 Installation shall be done in accordance with well-established practice and standards accepted and recognized by the Consultant and the Trade.

1.5 SUBMITTALS

- .1 Comply with Division 01 and Section 20 05 05 Documentation and Submittals.
- .2 Comply with Section 23 05 00 Common Work for HVAC Systems, Submittals

- .3 Refer to Section 20 99 60 Mechanical Forms and submit all documentation therein that is applicable to this Specification Section.
- .4 Shop Drawings
 - .1 Submit shop drawings in accordance with Division 01 and Section 20 05 05 Documentation and Submittals.
 - .2 Shop drawings are required for all materials and equipment.
- .5 Product Options and Substitutions
 - .1 Refer to Division 01 and Section 20 05 00, for requirements pertaining to product options and substitutions.
- .6 Maintenance Data
 - .1 Refer to Division 01 and Section 20 05 05 Documentation and Submittals.
 - .2 Submit manufacturer's recommended maintenance tasks for a one-year period. Include maintenance schedules and lubrication products.
 - .3 Submit operating and maintenance data for inclusion into the manuals.
- .7 Occupancy Documentation Requirements
 - .1 Refer to Division 01 and Section 20 05 05 Documentation and Submittals.

Part 2 Products

2.1 COILS - ELECTRIC (DUCT HEATERS)

- .1 Standard of Acceptance:
 - .1 Thermolec
- .2 Refer to equipment schedules on the drawings for performance data and additional information.
- .3 Applicable standards
 - .1 Electrical equipment and wiring to conform to Canadian Electrical Safety Code
 - .2 Heater package to bear ULC, or CSA label.
- .4 Minimum Requirements:
 - .1 Insert type for installing in ductwork.
 - .2 Nickel-chrome electric resistance wire embedded in refractory material and enclosed in steel sheathing with low watt density extended fins.
 - .3 Rated for capacity in kW, with voltage and phase arrangement as required.
- .5 Power and control:
 - .1 modulating SCR control
 - .2 NEMA 1 power panel with hinged door and catch,
 - .3 fan interlock,
 - .4 high temperature limit switch,
 - .5 air flow proving switch mounted on coil unit,
 - .6 fuses,
 - .7 unfused disconnect,
 - .8 SCR controlled from signal from Building Automation System,
 - .9 Three phase power: refer to separate equipment lists.

Part 3 Execution

3.1 INSTALLATION

- .1 Refer to manufacturer's installation drawings.
- .2 Provide airtight seal between coil and duct or unit cabinets.
- .3 Verify electrical service work with characteristics stamped on unit.
- .4 All bolts and fastenings shall be stainless steel.
- .5 Ensure coils and fins and flanges are not damaged. Replace loose and damaged fins. Comb out bent fins unless they need to be replaced.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section provides General, Product, and Execution Requirements for Radiant Heating and Cooling Equipment and accessories.
- .2 Provide all required Radiant Heating and Cooling Equipment and accessories as indicated, including, but not limited to:
 - .1 SPEC NOTE: Modify the following list as applicable to the project
 - .2 Radiant Heating Panels, Modular
 - .3 Radiant Heating Panels, Linear Extrusion
 - .4 Radiant Heating Panels, Electric
 - .5 Radiant Infrared Heaters, Electric
 - .6 Radiant Infrared Heaters, Gas Fired
 - .7 Radiant Floor Heating
 - .8 Radiant Heating/Cooling Ceiling Mats
 - .9 Chilled Beams

1.2 RELATED REQUIREMENTS

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.
- .2 In conjunction with Division 01, Division 20 General Mechanical Provisions shall govern all Division 23 Sections of the work.
- .3 Refer to Section 20 99 60 Mechanical Forms and submit all documentation therein that is applicable to Division 23.
- .4 Refer to and comply with the following sections:
 - .1 SPEC NOTE: Modify the following list as applicable to the project.
 - .2 General Requirements - Division 01
 - .3 Common Work for Mechanical Systems – Division 20
 - .4 Plumbing Systems - Division 22
 - .5 Heating, Ventilation and Air Conditioning Systems - Division 23
 - .6 Controls and Instrumentation - Division 25
 - .7 Electrical - Division 26/27

1.3 APPLICABLE CODES AND STANDARDS

- .1 SPEC. NOTE: Include the following clause only when it is applicable.
- .2 This project is deemed to be a post-disaster design.
- .3 Refer to Section 20 05 01, Codes, Bylaws and Standards.
- .4 All equipment, materials, installation, and testing shall conform to the following standards as a minimum:
 - .1 SPEC NOTE: Modify the following list as applicable to the project.
 - .2 Provincial Building Code

- .3 Local Building By-Laws
- .4 Provincial Safety Authority

1.4 QUALITY ASSURANCE

- .1 Refer to Section 20 05 00 General Mechanical Provisions, Quality Assurance for additional details.
- .2 Follow manufacturer's recommended installation details and procedures for equipment, supplemented by requirements of Contract Documents.
- .3 Installation shall be done in accordance with well-established practice and standards accepted and recognized by the Consultant and the Trade.

1.5 SUBMITTALS

- .1 Comply with Division 01 and Section 20 05 05 Documentation and Submittals.
- .2 Comply with Section 23 05 00 Common Work for HVAC Systems, Submittals
- .3 Refer to Section 20 99 60 Mechanical Forms and submit all documentation therein that is applicable to this Specification Section.
- .4 Shop Drawings
 - .1 Submit shop drawings in accordance with Division 01 and Section 20 05 05 Documentation and Submittals.
 - .2 Shop drawings are required for all materials and equipment.
 - .3 Shop drawings shall show the physical dimensions of the radiant ceiling panels, all mounting details and pipe connections.
- .5 Product Options and Substitutions
 - .1 Refer to Division 01 and Section 20 05 00, for requirements pertaining to product options and substitutions.
- .6 Maintenance Data
 - .1 Refer to Division 01 and Section 20 05 05 Documentation and Submittals.
 - .2 Submit manufacturer's recommended maintenance tasks for a one-year period. Include maintenance schedules and lubrication products.
 - .3 Submit operating and maintenance data for inclusion into the manuals.
- .7 Occupancy Documentation Requirements
 - .1 Refer to Division 01 and Section 20 05 05 Documentation and Submittals.

Part 2 Products

2.1 RADIANT CEILING PANELS - MODULAR PANELS

- .1 Standard of Acceptance:
 - .1 Sterling / Frenger Modular Panels.
- .2 Heat Output and Dimensions:
 - .1 Refer to equipment schedules on the drawings for performance data and additional information.
- .3 Construction: 1 mm [0.04"] thick aluminum un-perforated faceplate, 12 mm [$\frac{1}{2}$ "] nominal bore dia. copper tube "6 Pass" serpentine coil, mechanically bonded to face plate.
- .4 Finishes:

- .1 All panels in tee-bar ceilings shall be silk-screened to match the adjacent ceiling panels.
- .2 All panels (and recessed frames) in gypsum board ceilings shall be finished in a standard manufacturer's colour as selected by the Architect.
- .5 General:
 - .1 Pipe connections (soft copper type L) from each radiant ceiling panel shall include a minimum of 1000 mm [39"] excess length of soft copper piping for panel removal, as follows:
 - .1 Each connection to mains.
 - .2 Connections between each adjoining panel or non-adjoining panel.
 - .2 All piping from panel to piping mains shall be insulated.
 - .1 Refer to Section 23 07 13 HVAC Pipe Insulation.
 - .2 Piping between panels does not require insulation.
 - .3 Radiant panel shall be placed into tee-bar ceilings or recessed into gypsum board ceilings.
 - .4 Where panels are to be recessed into a gypsum board ceiling, the panels shall be supplied with a one piece welded recessed frame of extruded aluminum.
 - .1 The frames shall be painted to match radiant panels.
 - .5 For radiant panels in suspended tee-bar ceilings refer to Architectural specification to determine metric or Imperial sizing.

2.2 RADIANT CEILING PANELS - LINEAR EXTRUSION

- .1 Standard of Acceptance:
 - .1 Sterling / Frenger Linear Panels
- .2 Heat Output and Dimensions:
 - .1 Refer to equipment schedules on the drawings for performance data and additional information.
- .3 Quality Assurance:
 - .1 Test data to be based on a panel installed in the ceiling with 21°C [70°F] ambient air temperature and 19.5°C [67°F] AUST with natural convection. Certified test data shall clearly indicate AUST.
- .4 Construction:
 - .1 The radiant ceiling system shall consist of extruded aluminum having an overall thickness of approximately 3 mm [0.11"].
 - .1 Copper tubing of 12 mm [1/2"] ID shall be mechanically attached to the aluminum faceplate.
 - .2 A non-hardening heat conductive paste shall be placed between the copper tubing and the aluminum faceplate.
 - .2 The surface configuration of the radiant panel extrusions shall be fine fluted and designed to conceal the longitudinal extrusion seams from the room.
 - .1 The use of paint to fill the seams shall not be permitted.
 - .3 Panel sections shall be 127mm [5"], 152mm [6"] and 203mm [8"] wide in multiples as indicated on the drawings.
- .5 Finish: Panels shall be finished with manufacturer's standard white colour unless specified otherwise.

- .6 General:
 - .1 Manufacturer shall submit complete (scale) drawings showing layouts, inter-connections, and circuiting details of areas where radiant panels are indicated.
 - .1 These drawings shall be coordinated with, and interference shall be cleared with other trades.
 - .2 Shop drawings shall indicate locations of supply and return hook-ups in addition to inter-connection details for each zone.
 - .2 Pipe connections (soft copper, type L) from radiant panel sections or from the pipe headers at the extruded panel assemblies to the main piping shall include a minimum of 1000mm [39"] excess length for panel removal.
 - .3 All piping from panels to piping mains shall be insulated.
 - .1 Refer to Section 23 07 13 HVAC Pipe Insulation.
 - .2 Piping between panels does not require insulation.
 - .4 Panel sections shall be at the factory.
 - .1 The interlocking shall be such that no differential displacement occurs between the panels.
 - .2 Interlocked sections shall be parallel.
 - .5 Radiant panels shall run continuous from wall-to-wall and shall be field trimmed to length ensuring adequate expansion allowance while maintaining panel end coverage by architectural moldings.
 - .1 Inactive filler panels will be permitted only where indicated on drawings.
 - .6 Inter-connection of radiant panels by the mechanical contractor shall consist of 12 mm ID [½"] Type "L", soft copper tubing or other devices as recommended by the manufacturer (i.e. 360° interconnecting loops and 180° return U-bends).
 - .1 Multiple panels shall be circuiting to ensure serpentine flow over complete length of zone.
 - .2 Individual serpentine panel coils connected in series is unacceptable for multiple panel zones.
 - .7 Ceiling support moldings for radiant panels to be supplied and installed by Division 9.
 - .1 Ensure ceiling openings and wall moldings are installed as per radiant panel shop drawings.
 - .8 Hanger wires for safety and seismic restraint shall be installed at 1200mm [4ft] on centre or as recommended by the manufacturer.

2.3 RADIANT CEILING PANELS - ELECTRIC

- .1 Standard of Acceptance:
 - .1 Qmark CP series
- .2 Heat Output and Dimensions:
 - .1 Refer to equipment schedules on the drawings for performance data and additional information.
- .3 C.S.A. or cUL approved.
- .4 Construction:
 - .1 Panels shall be constructed from 22-gauge (front) and 24-gauge (back) galvanized steel panels with overlapping sides riveted together.

- .2 Heating element shall be cassette element and shall be enveloped by a dielectric insulation.
- .3 High temperature fibreglass insulation shall cover heating element.
- .4 Panels shall have an integral thermal cutoff device.
- .5 Panels shall have earthquake restraint clips
- .5 Panels shall be suitable for "lay-in" arrangement in inverted tee-bar ceiling.
 - .1 Refer to Architectural specification to determine hard metric or imperial sizing.
- .6 [Panels shall be suitable for surface mounting and complete with extruded aluminum decorative frame.]
- .7 [Panels shall be suitable for recess mounting in a drywall ceiling and complete with extruded aluminum mounting frame].

2.4 RADIANT INFRARED HEATERS - ELECTRIC

- .1 Standard of Acceptance:
 - .1 Qmark BRM series, Qmark FRP series, Qmark HRK series
- .2 Heat Output and Dimensions:
 - .1 Refer to equipment schedules on the drawings for performance data and additional information.
- .3 Minimum Requirements:
 - .1 Narrow beam comfort heater.
 - .2 Metal sheath tubular element.
 - .3 Highly-corrosion resistance.
 - .4 2 to 5 minute heat response time.

2.5 RADIANT FLOOR HEATING SYSTEM

- .1 Standard of Acceptance:
 - .1 Polytherm Floor Heating System.
- .2 Heat Output and Dimensions:
 - .1 Refer to equipment schedules on the drawings for performance data and additional information.
- .3 Minimum Requirements:
 - .1 Underfloor polyethylene pipe of 16 mm [5/8"] diameter with CPVC 90oC elbow rated for operation at 93oC [200oF].
 - .2 Rigid floor element (less insulation backing), pipe tracks, pipe fasteners, staples and tacks.
 - .3 Distribution manifold in steel plate cabinets and complete with isolating valve, electric control valve, air vent and thermometer for each zone.
 - .4 Mixing valve, circulating pump and automatic bypass valve.
 - .5 Automatic controls complete with indoor/outdoor temperature reset control and timeclock.
 - .6 10-year manufacturers guarantee on in-slab materials.
- .4 The heating system shall be capable of maintaining all areas heated at 22oC [72oF] measured at 1500 mm [5 ft.] off the floor.
- .5 The maximum permissible floor surface temperature is 27.8oC [82oF].

- .6 Underfloor distribution pipes shall be configured to provide even temperature distribution throughout all the rooms heated and considering localized heat losses such as glass doors, windows, etc.
- .7 The underfloor heating contractor shall work with the other contractors to ensure that the heating system is fully coordinated with all other trades (general contractor, insulation contractor, electrical contractor, plumbing and ventilation contractor, etc.).
 - .1 Refer to the architectural specification for the proposed floor systems.
- .8 Control System:
- .9 SPEC. NOTE: This clause should be included in Division 25 if there is a Controls Contractor on the project.
 - .1 The radiant floor heating system shall be the responsibility of the system manufacturer and shall be fully automatic.
 - .2 The system shall include a PID heating system controller, 4-way mixing valve, automatic bypass valve, actuators, sensors including outdoor sensor for inside/outside temperature reset, boiler control and alarm and time clock control function.
 - .3 The individual room temperature control shall be fully electronic sensors which shall be wired back to its respective zone control valve, to provide the required zone temperature control.

2.6 RADIANT HEATING & COOLING CEILING MATS – (DRYWALL CEILING)

- .1 SPEC. NOTE: This spec is based on the KaRo mats.
- .2 Standard of Acceptance:
 - .1 KaRo K.G10 radiant heating and cooling mat.
- .3 Heat Output and Dimensions:
 - .1 Refer to equipment schedules on the drawings for performance data and additional information.
- .4 Construction: Polypropylene Random Copolymer type 3 according to DIN 8078.
- .5 Components:
 - .1 KaRo mat with quick-connect fittings on supply and return headers (sizes per schedule).
- .6 Accessories:
 - .1 A.S 10mm [0.4"] stainless-steel braided hose connectors (min. 810mm [32"] long), with quick connect to pipe thread fittings.
 - .2 M.TG.1 Dew point sensors for drywall mounting. One dew point sensor is required for each space temperature sensor.
 - .3 M.R2/3 wall mounted room temperature control units. Refer to drawings for quantity and locations.
 - .1 Provide 6 spare temperature control units.
 - .4 24-volt thermoelectric control valves for secondary chilled and hot water circuits. Quantities as indicated on the drawings.
 - .5 Provide 6 spare thermoelectric control valves.

2.7 RADIANT HEATING & COOLING CEILING MATS – (T-BAR)

- .1 SPEC. NOTE: This spec is based on the KaRo mats. Supplied by Olympic International.
- .2 Standard of Acceptance:

- .1 KaRo Metal Lay-in T-Bar Panels c/w K.G10 Heating and Cooling Mat.
- .3 Heat Output and Dimensions:
 - .1 Refer to equipment schedules on the drawings for performance data and additional information.
- .4 Construction: Perforated Metal Panels, Polypropylene Random Copolymer type 3 mat, 25mm [1"] thick fiberglass insulation with backing; all assembled as a drop-in panel.
- .5 Components:
 - .1 610 mm x 1220 mm [24" x 48"] perforated steel T-bar panels with mat, insulation and quick-connect fittings on supply and return headers (quantities per room schedules).
- .6 Accessories:
 - .1 A.S 10mm Stainless Steel braided hose connectors (min. 810 mm [32"] long), with quick connect to pipe thread fittings.
 - .2 M.TG.1 Dew point sensors for metal T-bar ceilings mounting. One dew point sensor is required for each temperature sensor.
 - .3 M.R2/3 wall mounted room temperature control units. Refer to drawings for quantity and locations.
 - .4 24-volt thermoelectric control valves for secondary chilled and hot water circuits. Quantities as indicated on the drawings.
- .7 Finish: Panels shall be finished with manufacturer's standard white colour unless specified otherwise.

Part 3 Execution

3.1 RADIANT CEILING PANEL INSTALLATION

- .1 Panel to be installed in drywall ceilings or in tee-bar ceilings as shown.
- .2 Cooperate with other trades to achieve a neat well-coordinated overall installation.
- .3 The panel manufacturer shall supervise the installation of the panels and shall submit an inspection report after inspecting the completed installation.
- .4 All radiant panels shall be installed by personnel wearing white gloves to avoid soiling the panels.
- .5 Provide all necessary trim to properly install the radiant panels in ceiling areas.
 - .1 Trim or cut the radiant panels to fit in any ceiling openings less than the required size.
 - .2 This trimming shall be done by skilled personnel and in such a way that the trimming is not visible once the panel is installed.
- .6 All radiant panels shall be insulated on the non-active face, refer to Section 23 07 16 HVAC Equipment Insulation.
- .7 All isolating valves and balancing fittings for panels shall be located over adjoining accessible tee bar ceilings only.
- .8 Check that the tee-bar ceiling modules have been installed to correct module sizes.
- .9 The panel manufacturer shall ensure that the panel sizes suit the ceiling modules to allow clearance for the thermal expansion of the lay-in radiant panels.
- .10 Check that each panel rests flat on the supporting tee bars or mounting frame along the full length and the full width.
- .11 The tee-bar members in tee-bar ceilings will be provided by others. The tee-bar members will suit the panel installation.

- .12 The panels shall be located where shown on the architectural reflected ceiling plans.
- .13 All system piping shall be thoroughly cleaned, flushed, drained and refilled before radiant panels are connected into the system.
 - .1 Refer to Section 23 25 00 Water Treatment.

3.2 RADIANT FLOOR HEATING SYSTEM

- .1 Locate piping within concrete for all areas shown on drawing.
- .2 Install loops in each zone with maximum 75 m [250 ft.] coil length.
 - .1 Pipe spacing to be as required to satisfy the heat loss scheduled for each zone.
- .3 Provide sleeve one diameter larger than heating pipe where heating pipe crosses an expansion joint 150 mm [6"] on either side.
- .4 Pressure test system to a minimum of 1034 kPa [150 psig] for a period of not less than 12 hours prior to placing concrete.
 - .1 During concrete pouring the pressure is to be checked at regular intervals to ensure no leakage has occurred.
- .5 No in-slab pipe joints shall be allowed.
- .6 All system piping shall be thoroughly cleaned, flushed, drained and refilled before radiant panels are connected into the system.
 - .1 Refer to Section 23 25 00 Water Treatment.

3.3 RADIANT HEATING & COOLING CEILING MATS INSTALLATION

- .1 Radiant mats/panels to be installed in drywall ceilings or in tee-bar ceilings as shown and scheduled.
- .2 Cooperate with other trades to achieve a neat well-coordinated overall installation.
- .3 The radiant mat manufacturer's representative shall supervise the installation of the radiant mats/panels and shall submit an inspection report after inspecting the completed installation.
- .4 Type A Mats to be suspended between steel stud supports, using electrical cable ties.
 - .1 The mats should be stretched only so much, so that they sag slightly, in order that they will contact the drywall ceiling when installed.
 - .2 Batt insulation, which is to be installed above the mats, is specified in Section 23 07 16 HVAC Equipment Insulation.
- .5 All isolating valves, control valves and balancing fittings for radiant mats shall be located over accessible ceilings / access door openings only.
- .6 For tee-bar panels the tee-bar members in tee-bar ceilings will be provided by others.
 - .1 The tee-bar members will suit the panel installation.
- .7 All system piping shall be thoroughly cleaned, flushed, drained, and refilled before radiant panels are connected into the system.
 - .1 Refer to Section 23 25 00 Water Treatment.
- .8 The KaRo heating and cooling mats are normally operated between 0 and 415 kPa [0 and 60 psig].
 - .1 The system shall be pre-tested with compressed air at 1000kPa [145 psig] for 1 hour to assure the tightness of the system including heating and cooling mats and supply/return pipes.

- .9 The system shall then be tested for water tightness to 1000kPa [145 psig] pressure for 10 hours.
- .1 Until completion of the work, up to the startup of system, the system should be maintained at a pressure of 206 to 310 kPa [30 to 45 psig].
- .10 The secondary water system should be filled with clean city water.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 This section provides guidance and requirements to indicate HVAC Equipment manufacturers that are generally acceptable for proposing for the project.
- .2 The named manufacturers shall comply with all specific requirements of the Project, as well as details and performance as indicated by the Standard of Acceptance named in the individual specification sections and the equipment schedules.
- .3 Where a manufacturer's name below is underlined, that manufacturer is generally used as the Basis of Design.
- .4 Refer to Specification Section 20 05 00 General Mechanical Provisions for details regarding Standard of Acceptance, Addition of Acceptable Manufacturers, and Alternate Materials and Equipment.
- .5 Shop Drawings are required to be submitted for all equipment.
- .6 This section refers to Division 23 only. Each of the other Mechanical Divisions (20, 21, 22, and 25) contain a similar section for equipment that falls under that division.
 - .1 For General Mechanical refer to section 20 99 65
 - .2 For Fire Suppression Systems refer to section 21 99 65
 - .3 For Plumbing Systems refer to section 22 99 65
 - .4 For Instrumentation and Controls items refer to section 25 99 65

Part 2 Products

2.1 ACCESS DOORS – BUILDING SURFACES

- .1 Refer to Specification Section 20 05 33

2.2 ACCESS PANELS - DUCTS/PLENUMS

- .1 Specification Section 23 33 00
- .2 Nailor, Ventlok

2.3 AIR CURTAIN UNITS

- .1 Berner, Mars, Miniviel, Fantech

2.4 AIR HANDLING UNITS

- .1 Custom - Engineered Air, Haakon, Huntair, Scott Springfield, York

2.5 AIR OUTLETS AND INLETS

- .1 Price, Nailor, Titus

2.6 BACKDRAFT DAMPERS

- .1 Light Duty - Price CBD, Ruskin B02/A1, Nailor

- 2.7 CONTROL DAMPERS**
- .1 Low Leakage Type - Arrow-Foil PBDAF & OBDAF, Honeywell Moduflow D642 & D643, Johnson Proportion/Aire D-1200 & D-1300, Ruskin CD36, Tamco 1000, Nailor 1010
 - .2 Not Low Leakage Type - Honeywell, Johnson, Ruskin CD35, Nailor 1012
 - .3 Round - Ruskin DCRS-25, Nailor 1090
- 2.8 DUCT CONNECTORS (FLEXIBLE)**
- .1 Duro Dyne "Durolon", Ventfabrics "Ventlon", Dynair Hypalon
- 2.9 DUCTWORK (SPIRAL)**
- .1 United Sheet Metal, B.C. Ventilating, Spiro-Lok
- 2.10 DUCTWORK (FLEXIBLE)**
- .1 Plain - Thermaflex SLP10, Flexmaster FAB4, Wiremold 57
 - .2 Insulated Acoustic - Thermaflex MKE, Glassflex ABL-181, Wiremold WK
 - .3 Insulated – Thermal - Thermaflex MKC, Micro-Aire JFLX SL, Glassflex D-181, Wiremold WGC
 - .4 Sawdust Exhaust - Flexible Tubing Spiratube NC-2R
- 2.11 EXPANSION JOINTS**
- .1 Refer to Division 20
- 2.12 FANS (COMMERCIAL)**
- .1 Inline (Square) – Loren Cook, Greenheck, Twin City
- 2.13 FAN COIL UNITS**
- .1 Commercial - Carrier, Trane, Engineered Air, Mcquay
 - .2 Institutional - Pace, Engineered Air, Buffalo, Scott Springfield, Haakon
 - .3 Fan Terminal Units - E.H. Price, Tempmaster, Titus
 - .4 Filters - AAF, Cambridge, Camfil Farr
 - .5 Filters - Fibreglass Free - Viledon, Tridec
 - .6 Filter Gauges - Refer to Division 20
- 2.14 GAS DETECTORS**
- .1 C.E.T., QEL, Honeywell
- 2.15 GAUGES, AIR PRESSURE**
- .1 Refer to Division 20
- 2.16 GROOVED JOINT COUPLINGS & FITTINGS**
- .1 Victaulic
- 2.17 INSULATION (DUCT, PIPE, EQUIPMENT)**
- .1 Fibre -

.2 Fibre Free -

2.18 LOUVRES

.1 Price, Airo-lite, Alumavent, Westvent, Ruskin

2.19 PIPE CONNECTORS (FLEXIBLE)

.1 Mason, Victaulic (Flexible Couplings)

2.20 PRESSURE GAUGES

.1 Refer to Division 20

2.21 PRESSURE REDUCING VALVES

.1 Steam - Armstrong, Fisher, Jordon, Leslie, Spirax/Sarco, Spence, Watson McDaniel

2.22 PRESSURE RELIEF VALVES

.1 Steam - Consolidated, Crosby, Kunkle, Lonergan, Spirax/Sarco

.2 Water (Bypass) - Braukmann, Fulflo, Lonergan

.3 Water - Watts

2.23 PUMPS

.1 Pipe Mounted - Armstrong, Bell & Gossett, Grundfos, Taco

.2 Vertical Inline - Aurora, Armstrong, Bell & Gossett, Grundfos, Leitch, Paco, Taco

2.24 RADIANT CEILING PANELS

.1 Electric - Qmark, Thermaray

2.25 SEISMIC ISOLATORS

.1 Refer to Specification Section 20 05 49

2.26 THERMOMETERS

.1 Refer to Specification Section 20 05 19

2.27 VALVES

.1 Jenkins, Anvil, Crane, Red-White, Toyo, Kitz, Nibco, Apollo

2.28 VIBRATION ISOLATORS

.1 Refer to Specification Section 20 05 48

Part 3 Execution

3.1 NOT APPLICABLE.

END OF SECTION

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Part 1 General

1.1 RELATED WORK

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.
- .2 Refer to Section 20 05 06 - Commissioning, Demonstration, and Instruction and 20 05 08 – Equipment Testing and Start-up for additional responsibilities of the BAS contractor
- .3 This section shall review the shop drawings of the fire alarm system as provided by Division 26, with respect to the devices affecting the mechanical control system.

1.2 SCOPE OF WORK

- .1 The new control system shall be an expansion of the existing Arena Building Automation System.
- .2 The new system shall be fully integrated with the existing system. An additional operator interface shall be installed in Mechanical Utility 106E. Existing operator's workstation is in Geothermal Mechanical Room 113. The new workstation will provide access to BMS system and relevant programs. The intent is to have new mechanical equipment interface through new workstation. Areas within controls scope of work include:
 - Electrical Room 120E
 - Electrical Room 134E
 - Universal Washroom 101N
 - Janitors Room 102N
 - Storage/Maintenance 111N
 - Main Entry 103N
 - Hall A 117E
 - Hall A 118E
 - Arena Viewing 119E
 - New Dryland Training 110N
 - Men's Washroom 123N
 - Women's Washroom 124N
 - Mechanical Utility 106E
 - Managers Office 107N
 - Service Counter Storage 108N
 - Service Counter 109N
- .3 Refer to Section 20 99 60 Mechanical Forms and submit all documentation therein that is applicable to Division 25 Controls and Instrumentation.
- .4 The control will be coordinated and provided by the control's contractor including the generation of new graphics for all control components. Graphics to match existing.

1.3 CODES, BYLAWS, STANDARDS AND APPROVALS

- .1 Where multiple versions of the same code are published, the most recent version shall be applied, unless noted otherwise by building codes and local by-laws.

1.4 GENERAL

- .1 The control system is to be fully microprocessor based.
- .2 The controls system is to be complete with all necessary control components and connections to achieve the specified functions and to permit the H.V.A.C. systems to perform properly in the manner described and as hereinafter specified.
- .3 The controls contractor shall furnish all materials, including all central computer hardware and software, operator input/output peripherals, standalone DDC panels, automation sensors and controls and wiring. The controls contractor shall be responsible for the design, installation, supervision and labour services, calibration, all software programming, and checkout necessary for a complete and fully operational Building Automation System.
- .4 The control system and all controllers and hardware including third party devices shall be BACnet Testing Laboratories (BTL) certified.
- .5 The control system is to be set up and adjusted to achieve optimum operation of the H.V.A.C. system. This includes sequencing, timing and readjustment, as required. Modifications to the sequence of operation using points indicated will not be considered as extra to the Contract. These modifications to continue through the construction period, commissioning period and warranty period as required to achieve optimum operation of the mechanical system.
- .6 All new outputs shall each have an integral HOA toggle switch.
- .7 New controllers shall have a minimum 10% spare points at each location.
- .8 Program a trend log and, where appropriate, totalization for each point.
- .9 This Section is a performance specification clarified in certain sections to establish minimum standard of equipment, installation, or level of control. The specification describes the basic functions required but not all of the installation details or components. This Trade is expected to have sufficient experience to be able to design and estimate the cost of an appropriate control system. Materials and work necessary to achieve a satisfactory result will not be considered extra to the contract.
- .10 The contractor shall review all contract documents and visit the site if possible, prior to the closing date of the RFP and site confirm the requirements regarding the routing of interconnecting transmission network, etc..
- .11 When preparing shop drawings, review the proposed sequences, suggest improvements and review these with the Consultant.
- .12 Work with the other parties involved in commissioning, assess how the programming can be modified to improve function, review this with the Consultant and modify the programming as instructed by the Consultant.
- .13 The control system shall be a modular, flexible and fully commissioned Direct Digital Control (DDC) System except that controls not scheduled on the points list may be electric. Items identified in the sequence of operation as being under DDC control but which are not included in the points list shall be included in the DDC system.

1.5 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Division 20 and Division 23.
- .2 Shop drawings shall include:
 - .1 Control centre layouts.
 - .2 Manufacturer's descriptive technical literature for all equipment and devices.
 - .3 Interconnection schematics.
 - .4 Wiring and piping diagrams.
 - .5 One-line diagram from sensor and control points to Field Interface device and/or standalone DDC panel including all components and cables.

- .6 Terminal cabinets, including termination listing.
- .7 Written description indicating sequence of operation. Shop drawings will be rejected if the written description is not included with the submission. Sequences should reference English descriptors and labels for each point described.
- .8 All input/output points which shall include the following information associated with each point.
 - .1 Sensing element type and location.
 - .2 Details of associated field wiring schematics and schedules.
 - .3 Software and programming details.
- .9 Detailed block diagrams of transmission trunk routing and configuration.
- .10 Valve and damper schedules indicating size, configuration, capacity, and locations. If size varies greater than 10%, obtain approval of the Consultant.
- .11 Copies of all system graphics complete with system specific point labels.

1.6 OPERATING & MAINTENANCE MANUALS

- .1 The maintenance manual data is intended to cover the operation and maintenance of all control systems and equipment installed. Forward three (3) copies of the Controls and Instrumentation section of the operating and maintenance manuals to the Balancing Agency to ensure the binding and format of material are compatible. Ensure sufficient time has been given to the Balancing Agency for the compiling of the complete operating and maintenance manuals by the commissioning deadline. One complete manual shall be furnished prior to the time that system or equipment tests are performed.
- .2 The manuals shall include the name, address and telephone number of the control subcontractor installing the systems and a list of emergency numbers for service personnel. The manuals shall have a table of contents and be assembled to conform to the table of contents with the tab sheets placed before instructions covering the subject.
- .3 Manuals shall be furnished which provide full and complete coverage of the following subjects:
 - .1 Operational Requirements: This document shall describe, in concise English terms, all the functional and operational requirements for the system and its functions that have been established. It shall not require knowledge of digital processor programming or electronic techniques or control system theory.
 - .2 System Operation: Complete guidance and procedures for operation of the system, including required actions at each operator station; operation of computer peripherals; input and output formats and procedures; and emergency, alarm, and failure recovery procedures. Provide step-by-step instructions for system startup, back-up equipment operation, and execution of all system functions and operating modes.
 - .3 Functional Description: Detailed documentation, in language readily understandable to engineering personnel, of the theory of operation and specific functions of the system. Provide full details of data communications, including data types and formats, data processing and disposition data link components and interfaces and operator test or self-test of data link integrity for all system components and computer peripherals during each system function and operating mode. Hardware and software functions, interfaces, and requirements shall be explicitly detailed for all system components in all system functions and operating modes. Any operating procedures currently implemented or planned for implementation in an automatic mode shall be stated and described.

- .4 Software: Documentation of the theory, design, interface requirements, and functions of all software modules and systems for all digital processors. Include test and verification procedures and detailed descriptions of program requirements and capabilities. Provide all data necessary to permit modification, relocation, or other reprogramming and to permit combination of new and existing software modules to respond to changing system functional requirements without disrupting normal control system operation. Include, as a minimum, for all software modules, fully annotated source code listings, error-free object code files ready for loading via a peripheral device, and complete program cross reference, plus any calling requirements, data exchange requirements, necessary subroutine lists, data file requirements, and other information necessary to ensure proper loading, integration, interfacing, and program execution. All DDC panel software shall be provided individually for each DDC panel while a single section shall reference all DDC panel common parameters and functions.
 - .5 Maintenance: Documentation of all maintenance on all system components including inspection, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective units. Include calibration, maintenance, and repair of all sensors and controls, plus diagnosis and repair or replacement of all system hardware.
 - .6 Test Procedures and Reports: The test implementation shall be recorded with a description of the test exercise script of events and documented as Test Procedures. A provision for the measurement or observation results, based on the previously published Test Specification, forms the Test Reports. The procedures record and the results of these exercises shall be conveniently bound and documented together.
- .4 Refer to Section 23 05 00 for additional requirements.

1.7

WARRANTY

- .1 Refer to General Conditions for additional information.
- .2 The system including all hardware and software components shall be warranted for a period of one year following the date of final acceptance per department. Any manufacturing defects arising during this warranty period shall be corrected without cost to the Owner.
- .3 All applicable software as detailed in this specification shall be updated by the Controls Contractor free of charge during the warranty period. This will ensure that all system software will be the most up-to-date software available from the Controls Contractor. All future patches to the software shall be made available to the Owner.
- .4 Repairs required by a total system failure, or the malfunction of any priority portion of the system shall be considered an emergency repair and shall be performed within eight (8) hours of the report of the failure.
- .5 Repairs of a non-emergency nature shall be promptly repaired on the next normal business day.
- .6 Provide written assurance that a local service centre will be maintained with a complete stock of replacement parts, and capable of servicing all troubles in the system.
- .7 Use of installed equipment during construction shall not shorten or alter the warranty period as specified in the General Conditions.
- .8 Take note of and provide any extended warranties specified.

1.8 ELECTRICAL COMPONENTS, WIRING AND CONDUIT

- .1 By Division 25 Control Systems Contractor:
 - .1 All control system components to make a complete and operable system, except those supplied as part of packaged equipment controls, but including all auto-sequencing devices and electrical interlocks required to accomplish the sequences specified hereafter. Refer to the electrical equipment schedule, the electrical drawings and the electrical specification, which describes the limits of the extent to the work in Division 26 serving mechanical systems. Materials, equipment, connections and power not provided by Division 26 but required for the Control System shall be provided under this section.
 - .2 All control circuit transformers (120/1/60 or 24/1/60 and as designated).
 - .3 All control wiring and metallic conduit for mechanical system controls.
 - .4 Supply, installation and connection of all electric control items including: damper motors, relays, outside sensors, sub-master control circuits, safety devices, electric thermostats, aquastats, flow switches, wiring to terminal strips, proportional controllers, controllers, etc.
 - .5 All wiring and conduit from power distribution system to any control devices needing power (including B.M.S components)
 - .6 Be responsible for coordinating with Division 26.
 - .7 Electrical work installed under Division 25 shall be to the standards specified under Division 26.
- .2 By Division 26 Electrical:
 - .1 All power wiring and conduit from power distribution system up to and including connection to all motors and starters.
 - .2 All disconnect switches required (unless specified in schedules as being integral with equipment).
 - .3 All motor protection switches, stop-start switches, magnetic starters, contactors and hand-off-automatic selector switches except those supplied as part of packaged equipment.
 - .4 Terminal strips within the motor control centres (MCC) for control connections.
 - .5 Fire alarm signals.
- .3 Note:
 - .1 All magnetic starters for equipment shall have the following features supplied under this Division:
 - .1 Hand-off-automatic selector or on-off selector or start-stop buttons in cover with hand-automatic bridge if applicable.
 - .2 Pilot light,
 - .3 120-volt coils,
 - .4 120-volt control transformer and,
 - .5 Four auxiliary dry contacts for interlocks; two normally open and two normally closed.
 - .2 The Controls Contractor is responsible for reading Division 26 plans and specifications to determine scope of responsibility and standards.
- .4 Wiring:
 - .1 General:

- .1 Run carrier system parallel to building lines.
- .2 Support conduit carrier system one meter on centre independent of piping, ductwork and equipment.
- .3 Seal all penetrations through fire separations or walls as per code requirements.
- .4 Identify all junction box covers with control company label.
- .5 Identify with colour bands, all conduits at all junction and pullboxes, at both sides of wall and floors and at not more than 7.5 m [25 ft] intervals along the length. Identification bands to be sprayed on and not less than 100mm [4"] wide. Bands to be purple in colour unless in conflict with Division 26 colours.
- .6 Use colour coded conductors.
- .7 Adhere to all applicable electrical codes and regulations.
- .8 Obtain electrical permit.
- .9 For non-CSA equipment where required by electrical code, submit to Inspection Authorities and obtain approval prior to installation of equipment on site.
- .10 Refer to Division 26 Electrical for overall wiring requirements.
- .11 Wiring shall match electrical wiring requirements to ensure consistent wiring is provided throughout the project.
- .2 Carrier System – In stud walls, and all open, exposed areas including mechanical, electrical and equipment rooms:
 - .1 All wiring for 24 volts or less shall be run in EMT conduit except wiring to all operators and to all sensors subject to vibration shall be run in flexible metallic conduit for the final 900mm (3 feet).
 - .2 All wiring for over 24 volts shall be run in EMT conduit.
 - .3 All wiring between the fire alarm panel and the DDC panels. shall be run in EMT conduit.
 - .4 Provide steel fittings with nylon throats for all conduit connections.
 - .5 All conduit containing control wiring shall loaded to a maximum of 75% full upon project completion
 - .6 Wires not in conduit shall be organized using Panduit or similar.
- .3 Carrier System – Concealed, accessible areas.
 - .1 Wires not in conduit shall be organized using Panduit or similar.
 - .2 Class II low voltage BMS open cable, neatly bundled, shall be routed parallel to building lines.
 - .3 Cable may follow ductwork routing and may be tied to the side or top of the ducting at duct supports, using suitable cable ties. If cabling does not follow ducting, it shall be fixed to the structure, supported at a minimum of every 5m.
 - .4 Open cable must be rated plenum cable.
- .4 Wire:
 - .1 Line voltage power or switched power wiring - #12 gauge copper wire minimum.
 - .2 Line voltage control wiring - #14 gauge copper wire, length not to exceed 50 meters; #12 gauge copper wire, lengths exceeding 50 meters.
 - .3 Low voltage – wire as directed by applicable electrical codes and requirements but minimum #20 gauge.

- .4 All DDC wiring ran in ceiling spaces must be strapped every 3 feet, and not run through sharp edges or corners, cables should not be ran crisscross but in a straight organized fashion.
- .5 All DDC wiring to have wire tags at both ends.
- .5 Cable:
 - .1 Data transmission cable shall be minimum 18-gauge twisted pairs (shielding as per manufacturers recommendations).
 - .2 All new cabling used for network installation shall be a minimum of CAT6 or as recommended by the equipment manufacturer.
- .5 Wiring for B.M.S Life Safety Systems:
 - .1 Conductors for communications between the front-end CPU and standalone DDC panels and between DDC panels shall be high temperature, 200°C, Teflon FEP insulated and jacketed, shielded twisted cable pairs of minimum 18 gauge provided by the controls contractor for the distances involved. Wiring shall be fully redundant for separate channels of communication to the CPU via a different route (so as to protect the communication links in the event of a fire in a particular area).

1.9 EQUIPMENT SUPPLIED FOR INSTALLATION UNDER OTHER SECTIONS

- .1 Refer to Section 25 09 13 – Instrumentation and Control Devices for equipment to be supplied under this section but installed under the appropriate trade sections.
- .2 The Controls Subcontractor shall be responsible for arranging, coordinating and supervising the installation of the above devices in a suitable manner and readily accessible location.

1.10 FREEZE PROTECTION

- .1 The Building Automation system shall shut down all supply air handling units containing coils, upon sensing air off the coils at 4°C.
- .2 Restart of the units shall be by the B.M.S. operator from the keyboard.

1.11 ALARMS - GENERAL

- .1 No alarm shall be triggered for a device until the device has been started and is in stable operation. Use software time delays to achieve this effect.
- .2 Generate an alarm on the B.M.S. if any equipment is not in the intended operating condition or if any analog input is not within the intended operating range.

1.12 IDENTIFICATION

- .1 Identify all panels and points with a numbering system consistent throughout the DDC network.
- .2 Identify all controls with symbols relating directly to the control diagram. Use plasticized tags, engraved brass, aluminum, metal-photo, or laminated plastic labels and secure them to, or adjacent to the control devices with key chains.
- .3 Identify all junction box covers with control company label. Paint junction box covers to match conduit colour coding purple

- .4 Identify with colour bands, all conduits at all junction and pull-boxes, at both sides of wall and floors and at not more than 7.5m (25 ft.) intervals along the length. Identification bands to be sprayed on and not less than 100mm (4") wide.
- .5 Use colour coded conductors, white for neutral.
- .6 All manual switches, unless they come with standard nameplates, shall be labelled with engraved plastic laminate nameplates to clearly indicate the service. Wording on nameplates shall be subject to approval by the Consultant.
- .7 Identify all DDC panels and associated devices with symbols relating directly to the control diagram. Provide plastic labels for each input and output point with the following information:
 - .1 Point descriptor.
 - .2 Point type and channel number.
 - .3 Corresponding DDC panel number.
- .8 Mount an input-output legend sheet within each DDC panel. This sheet shall include the name of the points connected to each controller, the end device manufacture, part number, model number and shall describe the I/O range. If an I/O module is remotely located, a separate legend sheet for that module shall be included at both locations.
- .9 All Relays shall be labeled and have wire tags.
- .10 Motor control centre and motor starters shall be provided with labels identifying those motors are under remote control.

1.13 SYSTEM COMMISSIONING AND CALIBRATION

- .1 Program each standalone DDC panel immediately following installation.
- .2 Set up and calibrate all control loops and sensors during the initial start-up of the systems and check, recalibrate and readjust as necessary during the Owner's Demonstration and Instruction period.
- .3 Upon completion of the installation, perform all necessary testing and debugging operations satisfactorily.
- .4 Perform all modifications and alterations as required to correct any deficiencies noted during these tests.
- .5 Check sensor calibration and control system operation during the first heating season and prior to the first cooling season.
- .6 Following each visit submit printed graphs of trend logs one week in duration with hourly samples for all analog inputs connected to each DDC panel.

1.14 VERIFICATION OF SYSTEM COMMISSIONING

- .1 Preliminary Tests
 - .1 After installation of each part of the system and completion of mechanical and electrical hook-up, perform tests to confirm correct installation and functioning of equipment.
 - .2 Notify the Consultant in writing at least seven days before testing is to take place stating the following:
 - .1 Location and part of system to be tested.
 - .2 Describe testing procedure and anticipated results.
 - .3 Provide all necessary testing equipment and personnel.
 - .4 Provide portable 2-way radios for communications during demonstrations. Provide three units on the same frequency and of sufficient power and quality as to be useful throughout the building.
 - .5 Perform tests in presence of the Consultant.

- .6 Demonstrate the proper operation of each component.
- .7 Correct any deficiencies and re-test in the presence of the Consultant, until designated part of the system performs satisfactorily.
- .2 Final Operational Acceptance Test
 - .1 A final operational test of not less than thirty (30) consecutive days, twenty-four (24) hours per day, shall be conducted on the complete and total installed and operational Control System to demonstrate that it is functioning properly in accordance with all requirements of this specification.
 - .2 The correct operation of all monitored and controlled points shall be demonstrated as well as the operation and capabilities of all sequences, reports, specialized control algorithms, diagnostics, and all other software. If the equipment operates at an average effectiveness level (AEL) of at least 95% during the performance test period of thirty (30) consecutive calendar days, it will be deemed to have met the Acceptable Standard of Performance, and final acceptance of the system shall be made, provided the contractor has satisfied all other requirements of this specification.
 - .3 The average effectiveness level (AEL) is defined as the ratio between the total thirty-day test period less any system downtime accumulated within that period, and the thirty-day test period.
 - .4 In the event the required AEL is not reached during the initial thirty (30) consecutive calendar day period, the final operational acceptance test period shall be extended on a day-to-day basis until the required AEL is reached for thirty (30) consecutive calendar days.
 - .5 Downtime shall result whenever the control system is unable to fulfill all required functions detailed within this specification due to any malfunction of either BMS hardware or software. Any defect of hardware or software shall be corrected when it occurs before the test may be resumed. Downtime created by non-BMS equipment or activities will not be considered as downtime for the AEL calculation.

1.15 DEMONSTRATION AND INSTRUCTION TO OWNER

- .1 The Controls Contractor shall provide the services of competent instructors who will give full instruction to designated personnel in the adjustment, operation and maintenance, including pertinent safety requirements, of the equipment and system specified.
- .2 The training shall be oriented toward the system installed rather than being a general (canned) training course. Instructors shall be thoroughly familiar with all aspects of the subject matter they are to teach.
- .3 The number of person-days (eight hours) of instruction furnished shall be as specified below as a minimum.
- .4 A training manual shall be provided for each trainee which describes in detail the data included in each training program. All equipment and material required for classroom training shall be provided by the Contractor.
- .5 Training Program: The training program shall be accomplished in two phases.
 - .1 First phase: this phase shall be for a period of at five days at a time mutually agreeable between the Contractor and Owner. Operating personnel will be trained in the functional operations of the system installed and the procedures that the operators will employ for system operation. First phase training shall include the following:
 - .1 General control system architecture.

- .2 System communications.
- .3 Operation of computer and peripherals.
- .4 Elementary preventative maintenance.
- .5 Report generation.
- .6 Operator control functions.
- .7 Colour graphics generation.
- .2 Second phase: this phase of training shall be conducted four to eight weeks after system acceptance for a period of three days. The training shall include as a minimum, but not be limited to:
 - .1 A review of Phase 1 training.
 - .2 Equipment maintenance - this training shall include:
 - .1 General equipment layout.
 - .2 Trouble shooting of all control system components.
 - .3 Preventative maintenance of all control system components.
 - .4 Sensors and controls maintenance and calibration.
 - .3 Programming - this training shall include:
 - .1 System architecture.
 - .2 Application programs.
 - .3 DDC panel programming.
 - .4 Software access code review.
- .6 Demonstration of the Life Safety System:
 - .1 Perform all tests as required by the authorities having jurisdiction, of the firefighter's pressurization control system.

1.16 MAINTENANCE SERVICE DURING THE WARRANTY PERIOD

- .1 The Contractor shall provide all services, materials, and equipment necessary for the maintenance of the entire Control System, for a period concurrent with the warranty period. Any necessary material required for the maintenance work shall be provided by the Contractor.
- .2 The Controls Contractor shall provide one minor and major inspection per quarter or as required by the manufacturer and two major inspections per year, and all service for the required maintenance.
- .3 Major Inspections: these inspections shall include but not be limited to the following:
 - .1 Work as detailed hereinafter for minor inspections.
 - .2 Clean all peripheral equipment, CPU, interface panels, multiplexing panels and microprocessor interior and exterior surfaces.
 - .3 Provide signal, voltage and system isolation checks of all CPU, interface panels, multiplexing panels and peripherals.
 - .4 Provide mechanical adjustments, new ribbons and necessary maintenance on printers.
 - .5 Check and/or calibrate each field input/output device.
 - .6 Run system software diagnostics as required.

- .4 Minor Inspections: These inspections shall include but not be limited to the following:
 - .1 Provide visual and operational checks to all CPU, peripheral equipment, interface panels, multiplexing panels, and field devices.
 - .2 Change filter and check fan for all CPU's peripheral equipment as required.
 - .3 Provide complete back up of BMS system.
 - .4 Regular service calls: these calls shall be performed during regular working hours, 8:00 a.m. to 4:30 p.m. Monday through Friday excluding legal holidays.
- .5 Emergency Service:
 - .1 The Owner will initiate service calls when there is indication that the control system is not functioning properly.
 - .2 The Contractor shall have qualified control personnel available during the warranty period to provide service to the "critical" control system components whenever required at no additional cost to the Owner.
 - .3 The Contractor shall furnish the Owner with a telephone number where the service mechanic can be reached at all times. The service mechanic shall be on the job ready to service the control system within the next eight (8) hours, after receiving a request for service and the work shall be performed continuously until the control system is back in reliable operating condition.
 - .4 Repairs of a non-emergency nature shall be promptly repaired on the next normal business day.
- .6 Records and Logs: records and logs shall be kept of each maintenance task.
- .7 System Modifications: recommendations for system modification shall be provided in writing to the Consultant. No system modification, including operating parameters and control settings, shall be made without prior approval.
- .8 Software: provide implementation of all software maintenance updates. These shall be accomplished as required and full coordination with control system supervisory personnel shall be maintained.

END OF SECTION

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Part 1 - General

1.1 DOCUMENTS

- .1 This section, along with the Drawings and Division 20 - General Requirements, forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 SECTION INCLUDES

- .1 Includes:
 - .1 Control devices integral to the Building Management System: transducers, damper operators, dampers, transmitters, switches, controls, sensors, low voltage current transformers.
 - .2 Related Sections:
 - .1 Section 25 05 00 – Controls Work for Control Systems.
 - .2 Section 25 90 01 – Control Sequences of Operations.
 - .3 Section 26 05 00 - Common Work Results.
 - .4 Section 26 27 26 - Wiring Devices & Plates.

1.3 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI).
 - .1 ANSI C12.7-2014, Requirements for Watthour Meter Sockets.
 - .2 ANSI/IEEE C57.13-2016, Standard Requirements for Instrument Transformers.
- .2 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM B148-18, Standard Specification for Aluminum-Bronze Sand Castings.
- .3 National Electrical Manufacturer's Association (NEMA).
 - .1 NEMA 250-2020, Enclosures for Electrical Equipment (1000 Volts Maximum).
- .4 Air Movement and Control Association, Inc. (AMCA).
 - .1 AMCA Standard 500-D-18, Laboratory Method of Testing Dampers For Rating.
- .5 American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc. (ASHRAE).
 - .1 ASHRAE 2019, Applications Handbook, SI Edition.
- .6 Canadian Standards Association (CSA International).
 - .1 CSA-C22.1-21, Canadian Electrical Code, Part 1 (19th Edition), Safety Standard for Electrical Installations.

1.4 DEFINITIONS

- .1 Acronyms and Definitions: refer to Section 25 05 01 - EMCS: Division 01 - General Requirements.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit shop drawings and manufacturer's installation instructions in accordance with Section 20 05 05 – Documentation and Submittals, Section 25 05 00 – Common Work for Control Systems.
- .2 Manufacturer's Instructions:
 - .1 Submit manufacturer's installation instructions for specified equipment and devices.

Part 2 - Products

2.1 GENERAL

- .1 All materials used shall be new, without defects and free of repairs. The quality of the materials used shall be in conformance with the performance requirements as specified herein.
- .2 Control devices of each category to be of same type and manufacturer.
- .3 External trim materials to be corrosion resistant. Internal parts to be assembled in watertight, shockproof assembly.
- .4 Operating conditions: 0 - 32 degrees C with 10 - 90 % RH (non-condensing) unless otherwise specified.
- .5 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.
- .6 Transmitters and sensors to be unaffected by external transmitters including walkie talkies.
- .7 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.
- .8 Outdoor installations: use weatherproof construction in NEMA 4X enclosures.
- .9 All components will be designed to default to a safe position upon failure and will be installed to ensure reliable operation at any failure situation.
- .10 Provide all control devices of high industry standards for intended operation of BMS. Such devices but not limited to the following: end switches, differential pressure transmitters, flow switches, temperature sensors, pressure sensors, flow measurement devices, space thermostat, etc.
- .11 Devices installed in user occupied space not exceed Noise Criteria (NC) of 25. Noise generated by any device must not be detectable above space ambient conditions.
- .12 Temperature range as indicated in Section 25 90 10 – Control Sequences and Operations.

2.2 BEACON TYPE PILOT LIGHTS

- .1 Housing and Lens material: shatter resistant polycarbonate.
- .2 Flash rate 0.51 m/s.
- .3 Candle Power: 6600 Candelas per second.
- .4 Operating temperature range: -35°C to 65°C.
- .5 120V operating voltage, 0.2A.
- .6 ULC listed.

2.3 BINARY TEMPERATURE DEVICES

- .1 Low-voltage space thermostat shall be 24 V, bimetal-operated, mercury-switch type, with either adjustable or fixed anticipation heater, concealed setpoint adjustment, 13°C to 30°C (55°F to 85°F) setpoint range, 1°C (2°F) maximum differential, and vented ABS plastic cover.
- .2 Line-voltage space thermostat shall be bimetal-actuated, open contact type, or bellows-actuated, enclosed, snap-switch type or equivalent solid-state type, with heat anticipator, UL listed for electrical rating, concealed setpoint adjustment, 13°C to 30°C (55°F to 85°F) setpoint range, 1°C (2°F) maximum differential, and vented ABS plastic cover.
- .3 Low-limit thermostats. Low-limit airstream thermostats shall be UL listed, vapor pressure type, with an element of 6 m (20 ft) minimum length. Element shall respond to the lowest temperature sensed by any 30 cm (1 ft) section. The low-limit thermostat shall be manual reset only.

2.4 TEMPERATURE SENSORS

- .1 General: Temperature sensors shall be resistance temperature device (RTD) or thermistor type to following requirements:
 - .1 RTD's: 100 or 1000 ohm at 0 degrees C (plus or minus 0.2 ohms) platinum element with strain minimizing construction, 3 integral anchored leadwires. Coefficient of resistivity: 0.00385 ohms/ohm degrees C.
 - .2 Thermistors shall be 3,000 or 10,000 ohms.
 - .3 Sensing element: hermetically sealed.
 - .4 Stem and tip construction: copper or type 304 stainless steel.
 - .5 Time constant response: less than 3 seconds to temperature change of 10 degrees C.
 - .6 Immersion sensors shall be provided with a separable stainless steel well. Pressure rating of well is to be consistent with the system pressure in which it is to be installed. The well must withstand the flow velocities in the pipe.
 - .7 Duct sensors shall be single point or averaging as shown. Averaging sensors shall be a minimum of 1.5 m (5 ft) in length per 1 m² (10 ft²) of duct cross section.
 - .8 Space sensors shall be equipped with setpoint adjustment, override switch, display, and/or communication port.
 - .9 Provide matched temperature sensors for differential temperature measurement.
- .2 Room temperature sensors and display wall modules.
 - .1 Temperature sensing and display wall module.
 - .2 LCD display to show space temperature and temperature setpoint.
 - .3 Buttons for occupant selection of temperature setpoint and occupied/unoccupied mode.
 - .4 Jack connection for plugging in laptop personal computer [contractor supplied palm compatible handheld device] [contractor supplied zone terminal unit] for access to zone bus.
 - .5 Integral thermistor sensing element 10,000 ohm at 24 degrees.
 - .6 Accuracy 0.2 degrees C over range of 0 to 70 degrees C.
 - .7 Stability 0.02 degrees C drift per year.
 - .8 Separate mounting base for ease of installation.

- .3 Room temperature sensors.
 - .1 Wall mounting, in slotted type covers having brushed stainless steel finish, with or without protective guard.
 - .2 Element 10-50 mm long RTD with ceramic tube or equivalent protection or thermistor, 10,000 ohm, accuracy of plus or minus 0.2 degrees C.
 - .3 Sensor shall have a set-point adjustment and occupancy override.
- .4 Duct temperature sensors:
 - .1 General purpose duct type (DTS): suitable for insertion into ducts at various orientations, insertion length shall be suitable for application. Copper sheathed construction.
 - .2 Averaging duct type (ATS): incorporates numerous sensors inside assembly which are averaged to provide one reading. Minimum insertion length 6000 mm. Bend probe at field installation time to 100 mm radius at point along probe without degradation of performance. Copper sheathed construction.
- .5 Outdoor air temperature sensors:
 - .1 Outside air type: complete with probe length 100 - 150 mm long, non-corroding shield to minimize solar and wind effects, threaded fitting for mating to 13 mm conduit, weatherproof construction in NEMA 4 enclosure.

2.5 TEMPERATURE TRANSMITTERS (TTR)

- .1 Requirements:
 - .1 Input circuit: to accept 3-lead, 100 or 1000 ohm at 0 degrees C, platinum resistance detector type sensors.
 - .2 Power supply: 24 V DC into load of 575 ohms. Power supply effect less than [.01 degrees C per volt change.
 - .3 Output signal: 4 - 20 mA into 500 ohm maximum load.
 - .4 Input and output short circuit and open circuit protection.
 - .5 Output variation: less than 0.2 % of full scale for supply voltage variation of plus or minus 10 %.
 - .6 Combined non-linearity, repeatability, hysteresis effects: not to exceed plus or minus 0.5 % of full scale output.
 - .7 Maximum current to 100 or 1000 ohm RTD sensor: not to exceed 25 mA.
 - .8 Integral zero and span adjustments.
 - .9 Temperature effects: not to exceed plus or minus 1.0 % of full scale/50 degrees C.
 - .10 Long term output drift: not to exceed 0.25 % of full scale/6 months.
 - .11 Transmitter ranges: select narrowest range to suit application from following:
 - .12 Minus 50 degrees C to plus 50 degrees C, plus or minus 0.5 degrees C.
 - .13 0 to 100 degrees C, plus or minus 0.5 degrees C.
 - .14 0 to 50 degrees C, plus or minus 0.25 degrees C.
 - .15 0 to 25 degrees C, plus or minus 0.1 degrees C.

.16 10 to 35 degrees C, plus or minus 0.25 degrees C.

2.6 PRESSURE TRANSDUCERS (PTD)

.1 Requirements:

- .1 Transducer sensing elements shall withstand continuous operating conditions of positive or negative pressure 50% greater than calibrated span without damage.
- .2 Water pressure transducer shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Transducer shall be complete with 4 to 20 mA output, required mounting brackets, and block and bleed valves.
- .3 Water differential pressure transducer shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Over-range limit (differential pressure) and maximum static pressure shall be 300 psi. Transducer shall be complete with 4 to 20 mA output, required mounting brackets, and five-valve manifold.
- .4 Differential pressure type switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum), NEMA 1 enclosure, with scale range and differential suitable for intended application.
- .5 Combined sensor and transmitter measuring pressure.
- .6 Internal materials: suitable for continuous contact with industrial standard instrument air, compressed air, water, as applicable.
- .7 Output signal: 4 - 20 mA into 500 ohm maximum load.
- .8 Output variations: less than 0.2 % full scale for supply voltage variations of plus or minus 10 %.
- .9 Combined non-linearity, repeatability, and hysteresis effects: not to exceed plus or minus 0.5 % of full scale output over entire range.
- .10 Temperature effects: not to exceed plus or minus 1.5 % full scale/50 degrees C.
- .11 Over-pressure input protection to at least twice rated input pressure.
- .12 Output short circuit and open circuit protection.
- .13 Accuracy: plus or minus 1 % of Full Scale.

2.7 DIFFERENTIAL PRESSURE TRANSMITTERS (DPT)

.1 Requirements:

- .1 Internal materials: suitable for continuous contact with process material measured including compressed air, water, glycol, steam, as applicable.
- .2 Output signal: 4 - 20 mA into 500 ohm maximum load.
- .3 Output variations: less than 0.2 % full scale for supply voltage variations of plus or minus 10%.
- .4 Combined non-linearity, repeatability, and hysteresis effects: not to exceed plus or minus 1 % of full scale output over entire range.
- .5 Integral zero and span adjustment.
- .6 Temperature effects: not to exceed plus or minus 1.5 % full scale/50 degrees C or less.
- .7 Over-pressure input protection to at least twice rated input pressure.
- .8 Output short circuit and open circuit protection.

- .9 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit.

2.8 STATIC PRESSURE SENSORS

- .1 Requirements:
 - .1 Multipoint element with self-averaging manifold.
 - .2 Maximum pressure loss: 160 Pa at 10 m/s. (Air stream manifold).
 - .3 Accuracy: plus or minus 1 % of actual duct static pressure.

2.9 STATIC PRESSURE TRANSMITTERS

- .1 Requirements:
 - .1 Output signal: 4 - 20 mA linear into 500 ohm maximum load.
 - .2 Calibrated span: not to exceed 150 % of duct static pressure at maximum flow.
 - .3 Accuracy: 1 % of span.
 - .4 Repeatability: within 0.5 % of output.
 - .5 Linearity: within 1.5 % of span.
 - .6 Deadband or hysteresis: 0.1 % of span.
 - .7 External exposed zero and span adjustment.
 - .8 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit

2.10 VELOCITY PRESSURE SENSORS

- .1 Requirements:
 - .1 Multipoint static and total pressure sensing element with self-averaging manifold with integral air equalizer and straightener section.
 - .2 Maximum pressure loss: 37 Pa at 1000 m/s.
 - .3 Accuracy: plus or minus 1 % of actual duct velocity.

2.11 VELOCITY PRESSURE TRANSMITTERS (VPT)

- .1 Requirements:
 - .1 Multi-point static and total pressure sensing element with self-averaging manifold with integral air equalizer and straightener section
 - .2 Output signal: 4 - 20 mA linear into 500 ohm maximum load.
 - .3 Calibrated span: not to exceed 125 % of duct velocity pressure at maximum flow.
 - .4 Accuracy: 1 % of span.
 - .5 Repeatability: within 0.1 % of output.
 - .6 Linearity: within 0.5 % of span.
 - .7 Deadband or hysteresis: 0.1 % of span.
 - .8 External exposed zero and span adjustment.
 - .9 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit.

2.12 FLOW SWITCHES

- .1 Flow-proving switches shall be either paddle or differential pressure type.
- .2 Paddle type switches (water service only) shall be UL listed, SPDT snap-acting with pilot duty rating (125 VA minimum) and shall have adjustable sensitivity with suitable enclosure unless otherwise specified.
- .3 Differential pressure type switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum), enclosure to suit environment, with scale range and differential suitable for intended application.

2.13 ELECTRONIC AIR FLOW MEASURING STATIONS

- .1 Thermal dispersion technology for air flow measurement suitable for installation in large ducts up to 3000 mm.
- .2 Multi point independent sensors. Sensor density selected as per manufacturer's recommendation to suit the available unobstructed straight length of ducts upstream and downstream of air flow measuring stations installation.
- .3 Probe constructed from 316 stainless steel with 304 SS mounting brackets.
- .4 Minimum Sensor Accuracy:
 - .5 Airflow $\pm 2\%$
 - .6 Temperature $\pm 0.08^{\circ}\text{C}$
 - .7 Calibrated Range: 0-25.4 m/s
 - .8 Operating temperatures range -31 deg. C to 40 deg. C

2.14 PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES

- .1 Requirements:
 - .1 Internal materials: suitable for continuous contact with water, etc., as applicable.
 - .2 Adjustable setpoint and differential.
 - .3 Switch: snap action type, rated at 24 V DC or 120V, 15 amps AC.
 - .4 Switch assembly: to operate automatically and reset automatically when conditions return to normal. Over-pressure input protection to at least twice rated input pressure.
 - .5 Accuracy: within 2 % repetitive switching.
 - .6 Provide switches with isolation valve and snubber, where code allows, between sensor and pressure source.
 - .7 Switches on steam and high temperature hot water service: provide pigtail syphon.

2.15 TEMPERATURE SWITCHES (TSW)

- .1 Requirements:
 - .1 Operate automatically. Reset automatically, except as follows:
 - .2 Low temperature detection: manual reset.
 - .3 High temperature detection: manual reset.
 - .4 Adjustable setpoint and differential.
 - .5 Accuracy: plus or minus 1 degrees C.
 - .6 Snap action rating: 24V DC or 120V, 15 amps as required. Switch to be DPST for

hardwire and EMCS connections.

- .7 Type as follows:
- .8 Room: for wall mounting on standard electrical box with or without protective guard as indicated.
- .9 Duct, general purpose: insertion length = 460 mm.
- .10 Thermowell: stainless steel, with compression fitting for NPS 3/4 thermowell. Immersion length: 100 mm.
- .11 Low temperature detection: continuous element with 6000 mm insertion length, duct mounting, to detect coldest temperature in any 30 mm length.
- .12 Strap-on: with helical screw stainless steel clamp.

2.16 RELAYS

- .1 Control relays shall be UL listed plug-in type with dust cover and LED "energized" indicator. Contact rating, configuration, and coil voltage shall be suitable for application.
- .2 Time delay relays shall be UL listed solid-state plug-in type with adjustable time delay. Delay shall be adjustable $\pm 200\%$ (minimum) from setpoint shown on plans. Contact rating, configuration, and coil voltage shall be suitable for application. Provide enclosure suitable for environment when not installed in local control panel.

2.17 SOLID STATE RELAYS

- .1 General:
 - .1 Relays to be socket or rail mounted.
 - .2 Relays to have LED Indicator
 - .3 Input and output Barrier Strips to accept 14 to 28 AWG wire.
 - .4 Operating temperature range to be -20 degrees C to 70 degrees C.
 - .5 Relays to be CSA Certified.
 - .6 Input/output Isolation Voltage to be 4000 VAC at 25 degrees C for 1 second maximum duration.
 - .7 Operational frequency range, 45 to 65 HZ.
- .2 Input:
 - .1 Control voltage, 3 to 32 VDC.
 - .2 Drop out voltage, 1.2 VDC.
 - .3 Maximum input current to match AO (Analog Output) board.
- .3 Output:
 - .1 AC or DC Output Model to suit application.

2.18 CURRENT TRANSDUCERS

- .1 Requirements:
- .2 Purpose: combined sensor/transducer, to measure line current and produce proportional signal in one of following ranges:
 - .1 4-20 mA DC.
 - .2 0-1 volt DC.

- .3 0-10 volts DC.
- .4 0-20 volts DC.
- .3 Frequency insensitive from 10 - 80 hz.
- .4 Accuracy to 0.5% full scale.
- .5 Zero and span adjustments. Field adjustable range to suit motor applications.
- .6 Adjustable mounting bracket to allow for secure/safe mounting inside MCC.

2.19 CURRENT SENSING RELAYS

- .1 Requirements:
 - .1 Suitable to detect belt loss or motor failure.
 - .2 Trip point adjustment, output status LED.
 - .3 Split core for easy mounting.
 - .4 Induced sensor power.
 - .5 Relay contacts: capable of handling 0.5 amps at 30 VAC/DC. Output to be NO solid state.
 - .6 Suitable for single or 3 phase monitoring. For 3-Phase applications: provide for discrimination between phases.
 - .7 Adjustable latch level.

2.20 CURRENT SWITCHES

- .1 Current-operated switches shall be self-powered, solid-state with adjustable trip current. The switches shall be selected to match the current of the application and output requirements of the DDC system.

2.21 OVERRIDE TIMERS

- .1 Override timers shall be spring-wound line voltage, UL Listed, with contact rating and configuration as required by application.

2.22 PANELS

- .1 wall mounted or Free-standing enamelled steel cabinets with hinged and key-locked front door.
- .2 Multiple panels as required to handle requirements with additional space to accommodate 25% additional capacity as required by Consultant without adding additional cabinets.
- .3 Panels to be lockable with same key.

2.23 TRANSFORMERS

- .1 24 volt step down transformer designed to power 24-volt control systems.
- .2 "Overload" protection.
- .3 29°C to 41°C temperature rating.
- .4 Energy limiting, meets NEMA Standard DC20
- .5 Mount within proper enclosure.
- .6 Colour code lead wires for primary connections.

2.24 WIRING

- .1 In accordance with Section 26 27 26 - Wiring Devices.
- .2 For wiring under 70 volts use FT6 rated wiring where wiring is not run in conduit. Other cases use FT4 wiring.
- .3 Wiring must be continuous without joints.
- .4 Sizes:
 - .1 Field wiring to digital device: #18AWG.
 - .2 Analog input and output: shielded #18 minimum solid copper.

Part 3 -

Execution

3.1

INSTALLATION

- .1 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.
- .2 Install field control devices in accordance with manufacturers recommended methods, procedures and instructions.
- .3 Temperature transmitters, humidity transmitters, current-to-pneumatic transducers, solenoid air valves, controllers, relays: install in NEMA I enclosure or as required for specific applications. Provide for electrolytic isolation in cases when dissimilar metals make contact.
- .4 Support field-mounted panels, transmitters and sensors on pipe stands or channel brackets.
- .5 Electrical:
 - .1 Complete installation in accordance with Section 26 05 00 - Common Work Results.
 - .2 Modify existing starters to provide for BMS as indicated in Section 25 05 00 – Common Work Control Systems.
 - .3 Refer to summaries in Section 25 90 10 – Control Sequences of Operations for controls logic.
 - .4 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.
 - .5 Install communication wiring in conduit.
 - .6 Provide complete conduit system to link Building Controllers, field panels and OWS(s).
 - .7 Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems.
 - .8 Maximum conduit fill not to exceed 40%.
 - .9 Design drawings do not show conduit layout.
 - .10 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Consultant to review before starting Work. Wiring in mechanical rooms, wiring in service rooms and exposed wiring must be in conduit.

3.2

TEMPERATURE SENSORS

- .1 Stabilize to ensure minimum field adjustments or calibrations.
- .2 Readily accessible and adaptable to each type of application to allow for quick easy

- replacement and servicing without special tools or skills.
- .3 Outdoor installation:
 - .1 Protect from solar radiation and wind effects by non-corroding shields.
 - .2 Install in NEMA 4 enclosures.
 - .4 Duct installations:
 - .1 Do not mount in dead air space.
 - .2 Locate within sensor vibration and velocity limits.
 - .3 Securely mount extended surface sensor used to sense average temperature.
 - .4 Thermally isolate elements from brackets and supports to respond to air temperature only.
 - .5 Support sensor element separately from coils, filter racks.
 - .5 Averaging duct type temperature sensors.
 - .1 Install averaging element horizontally across the ductwork starting 300 mm from top of ductwork. Each additional horizontal run to be no more than 300 mm from one above it. Continue until complete cross sectional area of ductwork is covered. Use multiple sensors where single sensor does not meet required coverage.
 - .2 Wire multiple sensors in series for low temperature protection applications.
 - .3 Wire multiple sensors separately for temperature measurement.
 - .4 Use software averaging algorithm to derive overall average for control purposes.
 - .6 All sensors shall be stabilized to such a level as to permit on-the-job installations that will require minimum field adjustments or calibration.
 - .7 Sensor assemblies shall be readily accessible and adaptable to each type of application in such a manner as to allow for quick, easy replacement and servicing without special tools or skills.
 - .8 Install space instruments at a height of 1.5 m above the finished floor, unless otherwise indicated.
 - .9 Install corridor instruments at a height of 2.1 m above the finished floor.
 - .10 Locate instruments in the same vertical centreline as light switches.
 - .11 Where instruments are indicated on an outside wall install on a stand-off wall bracket which provides an air space between the instrument and the wall; or on an insulating Base (e.g. a cork pad).
 - .12 Install protective metal guards on instruments in areas where they may be subject to damage (loading areas, workshops, public corridors and storage areas). Bolt guards, independent of instruments to separate baseplates. Provide backing in wall for securing mounting Bases.
 - .13 Sensors in ducts shall be mounted in locations to sense the correct temperature of the air only, and shall not be located in dead air spaces. The location shall be within the vibration and velocity limits of the sensor. Where an extended surface element is required to properly sense the average temperature it shall be securely mounted within the duct to measure the best average temperatures. Elements shall be thermally isolated from brackets and supports to respond to air temperature only. Sensor element to be supported separately and not connected to coils or filter racks.

- .14 Wells shall be installed in the piping at elbows where piping is smaller than the length of the well to effect proper flow across the entire area of the well. Well shall not restrict flow area to less than 70 percent of line-size-pipe normal flow area.

3.3 PANELS

- .1 Arrange for conduit and tubing entry from top, bottom or either side.
- .2 Wiring and tubing within panels: locate in trays or individually clipped to back of panel.
- .3 Identify wiring and conduit clearly.

3.4 PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES AND SENSORS

- .1 Install isolation valve and snubber on sensors between sensor and pressure source where code allows.
 - .1 Protect sensing elements on steam and high temperature hot water service with pigtail syphon between valve and sensor.

3.5 IDENTIFICATION

- .1 Identify field devices in accordance with Section 25 05 53 – Mechanical Systems Identification.

3.6 AIR FLOW MEASURING STATIONS

- .1 Protect air flow measuring assembly until cleaning of ducts is completed.

3.7 TESTING AND COMMISSIONING

- .1 Calibrate and test field devices for accuracy and performance in accordance with Section 20 05 12 – Coordination with The Balancing Agency.
- .2 All field devices shall be properly calibrated and tested for performance and accuracy.

END OF SECTION

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Part 1 General

1.1 SYSTEM DESCRIPTION

.1 Fort Saint James Arena consists of the following infill and renovation components:

The mechanical systems for the renovation generally consist of the following:

- .1 A new air handling unit (AHU-1), located outside on the west side of the building. AHU-1 provides heating, cooling, heat recovery, and ventilation to the space via the building BMS system based on adjustable occupancy schedule.
 - .1 Refer to 23 73 11 for the new rooftop unit (AHU-1) components.
 - .2 The AHU-1 is an electric appliance and will provide heating, cooling, and ventilation.
 - .3 The AHU-1 is equipped controller with BACNET interface
- .2 In addition to the heating from AHU-1, duct heaters are used to supplement the heating demand. Duct heaters are controlled by BMS based on heating demand.
- .3 Areas that are not served by AHU-1 have electric baseboard heaters to provide heating. Electric baseboard heaters are controlled by BMS based on heating demand.
- .4 The men's and women's washroom are provided heat by ceiling mounted electric radiant panel heaters. These are controlled by BMS based on heating demand.
- .5 The janitor and the storage/maintenance rooms are exhausted by dedicated ceiling hung exhaust fans. These are controlled by BMS based on adjustable occupancy schedule.
- .6 Air curtains (EAC-X) serving the main entry doors to building are interlocked with the door switch. When the doors are opened air curtains will turn on. Air curtains are controlled and monitored by BMS.
- .7 Refer to Section 25 09 13 for scope of work involving integration of new mechanical equipment controls into existing BMS system

Part 2 Products – Refer to Section 25 05 00

Part 3 Execution

3.1 HVAC CONTROL OBJECTIVES

- .1 Program the system to meet the following objectives:
- .2 Temperature: Control the temperature in the occupied space.
- .3 Ventilation: Control the system's minimum outdoor air intake and the supply to the room to meet code ventilation requirements under all operating conditions. Control the systems minimum exhaust to applicable rooms to meet code ventilation requirements under all operating conditions
- .4 Energy:
 - .1 Provide no more heating than is essential (no reheat).
 - .2 Provide no more cooling than is essential (no reheat).
 - .3 Shut systems down if the building is unoccupied unless the temperature falls below the night setback temperature.

- .4 Utilize outdoor air for free cooling whenever possible, to maintain the space temperature setpoint.
- .5 Incorporate setback temperatures during unoccupied periods.
- .6 Operate equipment at high efficiency under all load conditions.
- .5 General
 - .1 Set points shall be adjustable on the BMS OWS. All default set-points shall be tested, set and recorded during testing and balancing. Work with testing and balancing agency to assist setting up and verifying default set-points.
 - .2 Final sequence of control shall be optimized by Consultant, Commissioning Agent and Controls Contractor.
 - .3 Ventilation:
 - .1 Control the system's outdoor air intake and the supply to each space to achieve the specified air volumes under all operating conditions.
 - .2 System shall be able to reduce the airflow in all areas to minimum levels, in accordance with ASHRAE 62.1 in unoccupied mode.
 - .4 Energy conservation:
 - .1 Provide no more heating than is essential and as a minimum incorporate the followings for energy conservation while meeting indoor design parameters.
 - .2 Utilize outdoor air for free cooling whenever possible, to maintain the space temperature setpoint.
 - .3 Incorporate heat recovery devices on building exhaust in accordance with code to pre-heat outdoor air.
 - .4 Control the supply air temperature downstream of heat transfer devices to meet space temperature setpoint at lowest energy consumption.
 - .5 Operate equipment at high efficiency under all load conditions.
 - .5 Demand Limiting:
 - .1 Incorporate controls on heat recovery devices to prevent frosting on heat transfer coil or surface.
 - .2 Occupied rooms shall be provided with a means to:
 - .3 Adjust the room temperature setpoint without affecting adjacent rooms.
 - .4 Activate the HVAC system if in an unoccupied mode.
 - .6 Room and Space Monitoring:
 - .7 Occupied rooms and spaces shall be monitored for temperature.
 - .8 Equipment Monitoring
 - .9 Unit Control Panel provided by AHU manufacturer under Div 23 shall include Hand-Off-Auto (H-O-A) switch to accommodate testing as well standalone control of all heating, cooling, and economizer functions. Controller to respond to BMS inputs and permit remote control as per Sequence of operation specified. Manual mode shall not bypass safeties.
 - .10 Equipment which does not provide points for monitoring shall be carefully reviewed for the following aspects:

- .11 Consultation with specified equipment manufacturers for recent improvements and upgrades.
- .12 Alternative equipment manufacturers that do provide the necessary function.
- .13 Provision of auxiliary field wired devices such as pressure switches, current sensors, thermocouples, etc.
- .14 Provision of a network thermostat which can provide a basic level of information such as on/off, heat/cool, space temperature, setpoint.
- .15 Provision of a smart motor control which can provide a basic level of information such as on/off, motor load, overload.
- .16 Equipment provided with field-wired devices shall have a supplementary wiring schematic which clearly identifies the location and purpose of each device and the additional wiring provided. The devices and wiring shall be clearly labelled and referenced to the supplementary schematic.
- .17 Equipment Interlocks and Shutdowns
 - .1 Where equipment is required to be shut down due to Code or other safety-related reasons, the equipment shut down shall be accomplished utilizing the equipment shut down contact(s) via a hard-wired connection to the interlocking device or system.
 - .2 Duct smoke detectors shall be provided on HVAC equipment serving fire compartment.
 - .3 Incorporate high temperature protection and alarm on air handling units when return air temperature exceeds 50 deg. C (adjustable).
 - .4 Ventilation air flow shall be proved utilizing a positive failsafe method. The standard of acceptance shall be a differential pressure air flow switch with an upstream pitot tube facing into the air stream and a downstream pitot tube facing away from the air stream.
 - .5 Ventilation air flow proving switches shall be hard-wired to the equipment being interlocked.
- .18 Fans:
 - .1 Incorporate controls on fans to prevent air handling component failure due to the development of excessive pressure conditions during the operation of the system. This shall include consideration for the failure of controls for dampers etc.
 - .2 Incorporate synchronization controls to enable start-up and speed control of supply and interlocked exhaust fans without losing on space pressurization goal.
 - .3 Incorporate controls to modulate speed of exhaust fan(s) within AHU to maintain space pressure set point under variable operating conditions from purge exhaust and/or engine/welding exhaust in bays.
 - .4 Monitor source capture exhaust fans and other local exhaust fans and modulate the speed for general exhaust fan(s) and /or operate relief damper(s) so as to maintain space static pressure set point.
- .19 Control dampers:

- .1 Provide end switches on control dampers to provide positive feedback to BMS on the position of dampers where malfunction of dampers could result in damage to system component or property.
- .2 Incorporate sequences to operate control dampers on air handling units and exhaust fans to meet the following performance objectives:
- .3 Outside air and exhaust or relief/exhaust dampers shall remain closed when fan system is not running.
- .4 Respective fans to run only when related control damper(s) are open as sensed by end switches.
- .5 Modulate control dampers where required to meet design air flows under variable operating conditions.
- .6 Operate outside air and exhaust air control dampers to operate packaged air conditioning units in economizer or free cooling mode when outside ambient air temperature or humidity is lower than return temperature or humidity.
- .7 Operate control dampers on ducts, intake and/or exhaust louvers to meet the space temperature setpoint.
- .8 Ensure that control sequences do not result in unsafe operation of fan system or freezing condition with equipment or energy loss.
- .20 Manual operation:
 - .1 Incorporate stations for local activation of HVAC system as called for in the Contract Document.
 - .21 BMS will monitor the outdoor temperature and relative humidity and use their values appropriately in control programs that it performs.

3.2 ALARMS AND SAFETIES

- .1 The room temperature sensors shall alarm their high or low alarm condition, as defined in the system database, at the operators Terminal Display Unit (TDU). Alarm points will be taken from dry contacts on the TDU and connected to the existing BMS.
- .2 An alarm shall be generated at the BMS when any motor status as sensed by a current sensing relay does not match the commanded value for that motor.

3.3 SEQUENCE OF OPERATION

3.3.1 Environmental Control Setpoints

- .1 Occupied mode temperature setpoint during heating mode (Winter): 20 deg. C (adjustable).
- .2 Unoccupied mode temperature setpoint during heating mode (Winter): 13 deg. C (adjustable).
- .3 Heating mode (Winter) activation: OAT below space temperature setpoint by 1 deg. C (adjustable) .
- .4 Occupied mode temperature setpoint during cooling mode (Summer): 22 deg. C (adjustable).
- .5 Unoccupied mode temperature setpoint during cooling mode (Summer): 28 deg. C (adjustable).

3.3.2 Equipment Operation

3.3.2.1 Air Handling Unit AHU-1

1. Air Handling Unit AHU-1 for Foyer area comprised of the following components:
 - .1 Outdoor air damper
 - .2 Return air damper
 - .3 Frost control face and bypass dampers
 - .4 Filter
 - .5 Supply fan section
 - .6 Return fan section
 - .7 Electric heating coil
 - .8 Heat recovery heat pipe between return air and outdoor air streams
2. Ventilation System Stopped:
 - .1 Supply fan stopped.
 - .2 Outdoor air damper closed.
 - .3 Return air damper open.
 - .4 Return fan stopped.
3. Unoccupied Mode:
 - .1 All equipment deactivated. Start system in 100% return air mode only if required to maintain minimum low setback temperature of 10°C(adjustable).
 - .4 System Operation:
 - a. AHU-1 shall be activated through BMS or by manual override.
 - b. On system start, open return air damper to 100% and outdoor air damper to minimum position.
 - c. When proved open, start supply fan (ramp fan up to speed).
 - d. Supply air temperature control:
 - e. BMS shall generate a supply air temperature setpoint. This setpoint shall be automatically reset in order to maintain space temperature setpoint.
 - f. Unit shall alarm if any of the following conditions are met:
 - Condensate drain pan heat trace malfunction
- .5 Heating mode:
 - .1 BMS shall reset supply air temperature setpoint to meet the heating demand of the space.
 - .2 BMS shall control unit heat recovery heat pipe, to preheat outdoor air as required in heating mode.
 - .3 On a call for heating, BMS shall send a signal to AHU-1 control panel to initiate the electric coil, to increase heating as required to maintain supply air setpoint.
 - .4 Internal frost control: Unit measures the exhaust air temperature leaving the unit and modulates the face and bypass damper in order to maintain it above freezing.

- .6 Cooling mode:
 - .1 No mechanical Cooling.
 - .7 Economizer mode:
 - .1 Economizer or free cooling mode shall be enabled whenever the outside air temperature is lower than return air temperature AND outside air enthalpy is lower than the return air enthalpy. Economizers enable and disable setpoints to include suitable dead band on humidity differential for stable operation. Unit controller shall operate outside and return air dampers to meet the mixed air temperature set point. Unit controller to operate mechanical cooling when needed to meet mixed air temperature set point.
 - .2 Economizer shall be capable of reducing outdoor air to design minimum when outdoor air intake no longer reduces cooling energy.
 - .8 Fire alarm shutdown: Fire alarm shall cause air handling unit to shut down.
- 3.3.2.5 Electric Duct Heater EDH-1 to EDH-6
- .1 BMS to control heater remote temperature sensor to maintain room setpoint of 22°C. During fire alarm unit to shut down.
 - .2 Supply air temperature control: BMS shall generate a supply air temperature setpoint. This setpoint shall be automatically reset in order to maintain space temperature setpoint.
- 3.3.2.6 Electric Radiant Panel ERP-1 to ERP-4
- a. Wall-mounted thermostat shall cycle unit blower and operate electric heating elements to maintain space temperature. Setpoint to be 22°C unless indicated otherwise. During fire alarm unit to shut down.
 - b. Unoccupied Mode:
 - .1 ERP-X unit off. Start unit only if required to maintain a minimum low setback temperature of 10°C (adjustable).
 - c. Occupied Mode:
 - .2 Unit shall provide heating to maintain a room temperature of 22°C (adjustable).
- 3.3.2.7 Exhaust Fan EF-1 to EF-2
- a. DDC shall turn on fan motor when system schedule is set to occupancy mode. Fan motor shall keep running until schedule changes to unoccupied mode. During fire alarm unit to shut down.
 - b. Unoccupied Mode:
 - .1 EF-1 unit off.
 - .2 EF-2 unit off.
 - c. Occupied Mode:
 - .1 EF-1 shall run exhausting air from space.
 - .2 EF-2 shall run exhausting air from space
- 3.3.2.8 Electric Air Curtain EAC-1 to EAC-4

- a. Interlock door switch shall turn on air curtain and shall keep running for a minimum run time of 5 minutes or until door remains closed for 5 minutes. This timer delay is to be controllable by BMS.
- b. Air curtain supply air temperature and status shall be monitored by BMS. Emergency stop shall be engaged runtime exceeds 20 minutes. This timer is to be controllable by BMS.
- c. During fire alarm air curtain to shut down.

3.3.2.9 Electrical Rooms: BMS shall monitor room temperature via a temperature sensor.

3.3.2.10 Electric baseboard heaters shall operate electric heating elements to maintain space temperature. Electric baseboard heaters to be controlled by BMS. Electric baseboard heater temperature setpoints to be 22°C for the following spaces:

- Universal Washroom 101N
- Janitors Room 102N
- Storage/Maintenance 111N
- Storage Counter Storage 108N

Electric baseboard heater temperature setpoints to be 10°C for Electrical Room 120E and Electrical Room 134E.

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 / RFP). This section covers items common to all Electrical sections and is intended only to supplement the requirements of Division 01.
- .2 Reference to "Electrical Divisions" shall mean all sections of Divisions 26, 27, 28, 33, 34 & 48 in the Master Format or the Canadian Master Specifications.
- .3 The word "Provide" shall mean "Supply and Install" the products and services specified. "As Indicated" means that the item(s) specified are shown on the drawings.
- .4 Provide materials, equipment and plant, of specified design, performance and quality; and, current models with published certified ratings for which replacement parts are readily available. Provide project management and on-site supervision to undertake administration, meet schedules, ensure timely performance, ensure coordination, and establish orderly completion and the delivery of a fully commissioned installation.
- .5 The most stringent requirements of this and other electrical sections shall govern.
- .6 All work shall be in accordance with the Project Drawings and Specifications and their intent, complete with all necessary components, including those not normally shown or specified, but required for a complete installation.
- .7 Provide seismic restraints for all required equipment and wiring systems.
- .8 Connect to equipment specified in other Sections and to equipment supplied and installed by other Contractors or by the Owner. Uncrate equipment, move in place and install complete; start-up and test. Include all field assembly of loosely/separately packaged accessories
- .9 "Consultant" shall mean Stantec Consulting Ltd.

1.2 REFERENCES

- .1 Install in accordance with CSA C22.1 - 2021
- .2 Refer to CSA C22.1 Appendix A "Safety Standards for Electrical Equipment" for applicable codes and the related revisions
- .3 Refer to CSA C22.1 Pages xxix - xxxii for related 'Reference Publications'
- .4 Refer to NBCC Table 1.3.1.2 for applicable codes and the related revisions.
- .5 Comply with Local Electrical Bulletins and by-laws relating to the Authority having Jurisdiction.
- .6 Install overhead and underground systems in accordance with CSA C22.3 No.1 (current adopted edition) - except where specified otherwise.
- .7 Preferred Voltage Levels for AC Systems, 0-50,000V in accordance with CAN3-C235 (current adopted edition)

1.3 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- current edition
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

1.5 SUBMITTALS

- .1 Submittals to be in accordance with Division 01.
- .2 Product Data: submit WHMIS MSDS in accordance with Division 01 - Sustainable Requirements and Division 02- Hazardous Materials
- .3 Single Line Diagram**
- .4 Provide single line electrical diagrams under plexiglass as follows:
 - .1 Submit full size plot for review prior to installing:
 - .2 Electrical distribution system: locate in main electrical room.
- .5 Fire Alarm Riser:**
- .6 Provide fire alarm riser diagram, plan and zoning of building under plexiglass at fire alarm control panel and annunciator. Submit full size plot for review prior to installing.
- .7 Shop Drawings:**
- .8 Submit shop drawings, product data and samples in accordance with Division 01. The submission shall be reviewed, signed and processed as described in Division 01.
- .9 Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.
- .10 Where applicable, include wiring, line and schematic diagrams. Include wiring drawings or diagrams showing interconnection with work of other Sections.
- .11 Content
 - .1 Shop drawings submitted title sheet.
 - .2 Data shall be specific and technical.
 - .3 Identify each piece of equipment.
 - .4 Information shall include all scheduled data.
 - .5 Advertising literature will be rejected.
 - .6 The project and equipment designations shall be identified on each document.
 - .7 Information shall be given in S.I. units.
 - .8 The shop drawings/product data shall include:
 - .1 Dimensioned construction drawings with plans and sections showing size, arrangement and necessary clearances, with all equipment weights and mounting point loads.
 - .2 Mounting arrangements.
 - .3 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.

- .12 Format
 - .1 PDF
 - .2 Bill of Quantities for related components, identified by model number, listed on the front cover with item identification numbers.
- .13 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 Consultants.
- .14 Keep one [1] copy of shop drawings and product data, on site, available for reference.
- .15 Quality Control: in accordance with Division 01 - Quality Control
 - .1 Provide CSA certified equipment and material. Where CSA certified equipment and/or material is not available, submit such equipment and/or material to the authority having jurisdiction for special approval before delivery to site.
 - .2 Submit test results of installed electrical systems and instrumentation.
 - .3 Submit, upon completion of Work, the electrical "load balance" report.
- .16 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.

1.6 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Division 01 - Quality Control
- .2 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license or apprentices in accordance with authorities having jurisdiction as per the conditions of Provincial and/or Territorial Act respecting manpower vocational training and qualification.
 - .1 Employees registered in provincial apprentices program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.
 - .2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.
- .3 Site Meetings: in accordance with Division 01 - Construction Progress Schedule
 - .1 Site Meetings: as part of Manufacturer's Field Services: schedule site visits, to review Work, at stages listed below:
 - .1 At time of initial shop drawing submission to confirm any existing conditions and to coordinate with the project schedule and any cross discipline requirements.
 - .2 After delivery and storage of products, and when preparatory Work is complete but before installation begins.
 - .3 During progress of Work at key schedule points as determined.
 - .4 At commissioning.
 - .5 Upon completion of Work, after cleaning is carried out.

- .4 Health and Safety Requirements: do construction occupational health and safety in accordance with Division 01 - Health and Safety Requirements.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Material Delivery Schedule: provide Consultant 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 Division 01 Construction/Demolition Waste Management and Disposal.

1.8 SYSTEM START-UP

- .1 Refer to Division 01, and as follows.
- .2 Instruct Consultant and operating personnel in the operation, care and maintenance of equipment.
- .3 Arrange and pay for services of manufacturer's factory service Engineer to supervise start-up of installation, check, adjust, balance and calibrate components, where required in these specifications.
- .4 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

1.9 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.

1.10 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Division 01 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Work plan.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.

- .3 Place materials defined as hazardous or toxic waste in designated containers.

1.11 ASBESTOS REMOVAL

- .1 Refer to specification Division 01 for procedures, removal and disposal of asbestos.
- .2 If during renovations / demolition, asbestos is discovered (or material suspected to be asbestos), all work in that area shall immediately cease and the General Contractor advised. The General Contractor shall take immediate appropriate action to verify presence of friable asbestos and be responsible for the removal of all friable asbestos.
- .3 This division will not be entitled to a claim for any delays resulting from the investigation of or removal of asbestos.

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 Consultant where definite locations are not indicated.
- .3 Take field measurements, where equipment and material dimensions are dependent upon building dimensions.
- .4 Where imperial units have been indicated in brackets [] following the requirements in SI units, the conversion is approximate and provided for convenience. The SI units shall govern.

1.13 PROJECT COORDINATION

- .1 Check drawings of all trades to verify space and headroom limitations for work to be installed. Coordinate work with all trades and make changes to facilitate a satisfactory installation. Make no deviations to the design intent involving extra cost to the Owner, without the Consultant's written approval.
- .2 The drawings indicate the general location and route to be followed by the electrical services. Where details are not shown on the drawings or only shown diagrammatically, the services shall be installed in such a way as to conserve head room and interfere as little as possible with the free use of space through which they pass. Service lines shall run parallel to building lines. All services in the ceiling shall be kept as tight as possible to beams or other limiting members at high level. All electrical services shall be coordinated in elevation to ensure that they are concealed in the ceiling or structural space provided unless detailed otherwise on drawings.
- .3 Work out jointly all interference problems on the site and coordinate all work before fabricating, or installing any material or equipment. Where necessary, produce interference/coordination drawings showing exact locations of electrical systems or equipment within service areas, shafts and the ceiling space. Distribute copies of the final interference/coordination drawings to the Architect and Consultant and all affected parties.
- .4 Ensure that all materials and equipment fit into the allotted spaces and that all equipment can be properly serviced and replaced, if and when required. Advise the Consultant of space problems before installing any material or equipment. Demonstrate to the Consultant on completion of the work that all equipment installed can be properly, safely serviced and replaced, if and when required.

1.14 PROVISION FOR FUTURE EQUIPMENT AND CONSTRUCTION

- .1 Leave clear spaces designated for future equipment or building expansion where indicated. Plan for the installation under this contract and ensure clear accessible, unhindered access to the space is allowed for.
- .2 Where contract documents don't clearly indicate the future expansion requirements, but known services are required, provide written "request for information" to the consultant before making assumptions as to intent.

1.15 SPRINKLER PROOF REQUIREMENTS

- .1 All equipment and wiring systems shall be sprinklerproof standard where sprinkler fire protection systems are installed.
- .2 In rooms where electrical equipment is installed surface mounted, electrical equipment contained in these rooms to be protected by non-combustible driphoods, shields, and gasketed doors as applicable to inhibit water ingress into electrical equipment. Exposed conduits connected to equipment to utilize watertight connectors. Top entry to be avoided where possible
- .3 In particular all unit substations, transformers, switchgear, motor control and panelboard shop drawings shall be certified 'sprinkler proof' design.

1.16 EQUIPMENT RESTRAINT

- .1 Related Section: 26 05 05 Seismic Restraint.
- .2 It is the entire responsibility of equipment manufacturers to design their equipment so that the strength and anchorage of internal components of the equipment exceeds the force level used to restrain and anchor the unit itself to the supporting structure.

1.17 REUSED EQUIPMENT

- .1 Where existing equipment is being relocated and re-used, check and report on the condition to the Consultant before reinstallation. Protect and carefully store equipment designated for reuse.

1.18 SEQUENCE OF WORK

- .1 Before interrupting major services notify the Owner well in advance and arrange an acceptable schedule for the interruptions.
- .2 Before interrupting any services complete all preparatory work as far as reasonably possible and have all necessary materials on site and prefabricated (where practical) and work continuously to keep the length of interruption to a minimum.
- .3 Include for the cost of all work that may be required out of regular hours to minimize the period of service interruption when modifying the existing systems.
- .4 All trades in this Division shall make allowance for the implications of having to totally complete all work in the new addition before proceeding with work in the existing building.

1.19 WARRANTY

- .1 Use of installed equipment during construction shall not shorten or alter the warranty period as specified in the Division 01.
- .2 Take note of any extended warranties specified.

- .3 Furnish a written warranty stating that all work executed under this Division will be free from defects of material and workmanship for a period of one (1) year from the date of substantial performance.
- .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.

1.20 RFP INQUIRIES

- .1 All contractor queries during the RFP period shall be made in writing to the consultant. Contractor queries will be collected and suitable addenda will be issued for clarification. No verbal information will be considered valid or issued by the consultant's office during RFP period. All RFP queries may be faxed, mailed or couriered to the consultant's office. No telephone questions will be answered.

1.21 EXAMINATION

- .1 Visit the site before preparing the Proposal and examine all existing conditions. No extra cost will be considered for any misunderstanding of work to be done resulting from failure to visit the site.
- .2 Examine the documents for details of work included. Obtain a written clarification in the event of conflict within the specification, between the specification and the drawing, or in the drawing. Obtain written clarification from the Consultant if work affecting the installation is not clear. Where this is not done in advance, allow in the Proposal sum for providing the more costly alternative.

1.22 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 Where the Contract Documents do not contain sufficient information for the proper selection of equipment for Proposal, notify the Consultant during the RFP period. If clarification is not obtainable, allow for the most expensive arrangement. Failure to do this shall not relieve the Contractor of responsibility to provide the intended equipment.
- .3 Protect equipment and material from the weather, moisture, dust and physical damage.
- .4 Cover equipment openings and open ends of conduit, piping and pullboxes as work progresses. Failure to do so will result in the Trade being required to adequately clean or replace materials and equipment at no extra cost to the Owner.
- .5 Protect all existing services encountered. Obtain instructions from the Engineer when existing services require relocation or modification.
- .6 Refinish damaged or marred factory finish to factory finish.
- .7 The specifications and drawings form an integral part of the Contract Documents. Neither the drawings nor the specifications shall be used alone. Work omitted from the drawings but mentioned or reasonably implied in the specifications, vice versa, shall be considered as properly and sufficiently specified and shall be provided. Misinterpretation of any requirement of either plans or specifications shall not relieve this Contractor of the responsibility of properly completing his trade to the approval of the Consultant.

1.23 STANDARD OF ACCEPTANCE

- .1 Standard of Acceptance means that the item named and specified by manufacturer and/or catalogue number forms part of specification and sets standard regarding

performance, quality of material and workmanship and when used in conjunction with a referenced standard, shall be deemed to supplement the standard.

- .2 Where two or more manufacturers are listed, the manufacturer's name shown first or underlined or shown with a model name and/or number was used in preparing the base design. Proposals may be based on any one of those named, provided that they meet every aspect of the base design and every aspect of the drawings and specifications.
- .3 Where other than the first named or the underlined manufacturer or scheduled/specified manufacturer is selected or approved, include for the cost of any resulting work (both under this Division and other Divisions) and any necessary redesign of installation or structure. Submit redesign drawings for review with Shop Drawings. Maintain installation, access and servicing clearances. Equipment/materials shall not exceed the available space limitations. Redesign drawings shall be to scale and of a standard equal to the Project Drawings.
- .4 A visible manufacturer's nameplate shall indicate manufacturer's name, model number, serial number, capacity data, electrical characteristics and approval stamps.

1.24 ADDITION OF ACCEPTABLE MANUFACTURERS

- .1 Material/products considered to satisfy the specification, but of a manufacturer other than those named may be submitted to the Consultant for consideration not later than five (5) working days prior to RFP closing or of RFP depository subtrade tender whichever is earlier.
- .2 Alternate approvals will be given by written addendum only. No other substitution will be permitted after RFP closing.
- .3 Alternate approvals granted before the RFP closing will be limited to a manufacturer's system and/or series only. This limited approval will not preclude substitute equipment/material from complying with specific features included with equipment/material specified. Determine that the alternate product meets the specification intent before basing a Proposal on the product
- .4 Where alternate equipment/materials are selected, allow for effects on other parts of the work of this Trade and other Trades. Where substantial changes in arrangement are required, submit shop drawings of the proposed changes with Plan and Section views and show effects on work of other Trades. Alternate equipment/materials shall not exceed the available space limitations. Maintain installation, access and servicing clearances. No extra will be allowed due to the use of alternate equipment/materials.
- .5 Where two or more items of equipment and/or material, of the same type, are required, provide products of a single manufacturer.
- .6 Install and test all equipment and material, in accordance with the detailed recommendations of the manufacturer.

1.25 CASH ALLOWANCES

- .1 Coordinate cash allowances with RFP documents. Allowances directly affecting this Division include: 1.26, 1.27

1.26 PREPARATION OF RECORD DRAWINGS – CASH ALLOWANCE

- .1 Refer to Section 01210 for Preparation of Record Drawings – Cash Allowance.

1.27 SEISMIC ENGINEER SERVICES - CASH ALLOWANCE

- .1 Refer to Section 01210 for Seismic Engineer Services - Cash Allowance.

1.28 EQUIPMENT LIST

- .1 Submit a completed Equipment List, showing the make of equipment and material included in the Proposal, including the names of the subtrades, 10 days after the award of the Contract. **Form EF110** in Appendix A shall be used for this purpose.
- .2 The equipment list shall be a full list of materials or systems intended for installation.

1.29 PROGRESS CLAIM AND CHANGEORDER BREAKDOWNS

- .1 Ten (10) days after the award of contract, submit price breakdowns on photocopies of the Price Breakdown **Form EF112** included in Appendix A.
- .2 In particular cases more detail may be necessary to properly assess a change order or progress claims. This additional information could include all suppliers and all sub-contractors when requested by the Consultant. Provide details for each section of the electrical work listed for each separate electrical change order item exceeding \$10,000.00.
- .3 Mark-up information is required for change orders but is optional on the original Proposal price.
- .4 Progress claims will not be certified nor payment made beyond 90% of the overall Electrical contract until commissioning and verification of the systems are complete. This procedure is to allow for any necessary deficiency holdbacks on items which do not become apparent until the systems are commissioned.

1.30 PROJECT CLOSE-OUT REQUIREMENTS

- .1 Refer to detailed specifications in each section for detailed requirements. Also refer to Specification Appendix A Form EF-142 for list of required substantial completion submissions. Record drawings to be submitted to Consultant and all life safety systems must be operational, verified and tested and demonstrated to Consultant prior to issuance of Schedule C.

1.31 SUBSTANTIAL PERFORMANCE REQUIREMENTS

- .1 Before the Consultant 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. **Form EF143** in Appendix A should be used for this purpose.
 - .3 A complete list of incomplete or deficient items shall be provided. If, in the opinion of the Consultant, 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 Consultant.
 - .5 All demonstrations to the owner have been completed.

- .6 All documents required on **Form EF142** in Appendix A have been submitted.
- .7 All documentation required for LEED™ certification has been submitted.
- .3 Consultants Letters of Assurance will not be issued until the following requirements have been met:
 - .1 All items listed in .1 above have been completed or addressed.
 - .2 Certificate of Penetrations through separations (**Form EF130**).
 - .3 Provincial or City Electrical Inspection - Certificate of inspection.
 - .4 Seismic Engineers letter of Assurance and final inspection report.
 - .5 Certificate of Substantial Performance (**Form EF143**).
 - .6 Signed off copy of Consultants final inspection report.
 - .7 Fire alarm verification.

1.32 DEFICIENCY HOLDBACKS AND DEFICIENCY INSPECTIONS

- .1 Work under this Division which is still outstanding when substantial performance is certified will be considered deficient and a sum equal to at least twice the estimated cost of completing that work will be held back.
- .2 It is expected that outstanding work will be completed in an expeditious manner and the entire holdback sum will be retained until the requirements for Total Performance of Division 26, 27, 28, 33 (electrical) work have been met and verified.

Part 2 Products

2.1 SUSTAINABLE REQUIREMENTS

- .1 Materials and products in accordance with Division 01 - Sustainable Requirements: Construction
- .2 Do verification requirements in accordance with Division 01 Sustainable Requirements: Contractor's Verification.

2.2 MATERIALS AND EQUIPMENT

- .1 Provide materials and equipment in accordance with Division 01 and as follows.
- .2 Material and equipment to be CSA certified. Where CSA certified material or equipment is not available, obtain special approval from authority having jurisdiction before delivery to site and submit such approval.
- .3 Where equipment or materials are specified by technical description only, they are to be of the best 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 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 the requirements of Inspection Department, Authority having Jurisdiction, Engineer and Architect.
- .2 Use decal signs, minimum 175 x 250 mm [7" x 10"] size

2.5 WIRING TERMINATIONS

- .1 Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum 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 Lamicoid 3 mm [0.125"] thick plastic engraving sheet, white face, black core, self adhesive unless specified otherwise. Provide white face, red core for all essential distribution equipment.
 - .2 Nameplate Sizes:

Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters
- .3 Typical Labelling:
 - .1 Panelboard & CDP – 5 lines
 - .1 Line 1 – Panel/CDP designation – Size 4 lettering
 - .2 Line 2 – eg 225A, 120/208V, 3 phase 4W – Size 2 lettering
 - .3 Line 3 – Feeder: eg 4#3 – 35mm C – Size 2 lettering
 - .4 Line 4 – Origin eg: Main Elect. Room – Size 2 lettering
 - .2 Distribution Circuit Breakers – 4 lines
 - .1 Line 1 – Main Circuit Breaker – Size 4 lettering
 - .2 Line 2 – Feeder: eg 4#3 – Size 2 lettering
 - .3 Line 3 – Origin: eg K1 Sub-station – Size 2 lettering
 - .3 Label colours unless otherwise indicated:
 - .1 120/208V labels: white letters on black base.
 - .2 347/600V labels: Black letters on white base.
- .4 Wording on nameplates to be approved prior to manufacture.
- .5 Allow for average of twenty-five (25) letters per nameplate.
- .6 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .7 Terminal cabinets and pull boxes: indicate system and voltage.
- .8 Transformers: indicate capacity, primary and secondary voltages.

- .3 Labels:
 - .1 Identify each outlet, starter, disconnect and all items of fixed equipment with the appropriate panel and circuit number origin by means of a small but good quality vinyl, self-laminating label such as T & B E-Z Code WSL, Dymo Letratag or Brother P-Touch equivalent printable markers. Embossed Dymo or any labels with edges and corners that are prone to lift will be rejected. Confirm location of labels with Consultant before installing. Circuit number to agree with Record Drawings.
- .4 Provide plastic covered panel directory with circuits and areas served typed in, and mounted on inside of door. Directory to conform to Record Drawings.

2.7 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.
- .4 Use colour coded wires in communication cables, matched throughout system.

2.8 CONDUIT, CABLE AND PULLBOX IDENTIFICATION

- .1 Colour code conduits, metallic sheathed cables, pullboxes and junction boxes.
- .2 Code with 25 mm plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor and at 15 m intervals.
- .3 Refer to Specification Appendix A Electrical **Form EF120**. Obtain the Building Owners representative sign off for the colour coding prior to the identification process. Use **Form EF 120** for this purpose.

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.
- .4 Paint outdoor electrical equipment "equipment green" finish.
- .5 .Paint indoor switchgear and distribution enclosures light gray unless otherwise indicated in particular specification sections for specialised or emergency power equipment.

2.10 ACCESS PANELS (DOORS)

- .1 Unless otherwise noted, access doors shall be minimum: 450mmx450mm [18"x18"] for body entry; 300mmx300mm [12"x 12"] for hand entry.
- .2 Access doors in fire separations of 3/4 hour rating, and higher, and firewalls shall have a compatible fire rating and a ULC label with tamper-proof latch, self closing.

- .3 Minimum Requirements:
 - .1 180 degree door swing, mitred rounded safety corners flush welded, concealed hinges, screwdriver latches, and anchor straps or lugs to suit construction, all steel prime coated.
 - .2 Plaster or wet wall construction: 14 gauge bonderized steel flush with wall or ceiling type with concealed flange.
 - .1 Acceptable Product: Acudor PS-5030.
 - .3 Masonry or drywall construction: 16 gauge for 400 mm [16"] x 400 mm [16"] and smaller, 14 gauge for 450 mm [18"] x 450 mm [18"] and larger bonderized steel face of wall type with exposed flange.
 - .1 Acceptable Product: Acudor UF-5000.
 - .4 Tile, ceramic tile, marble, terrazzo, plaster or wet wall construction in washrooms and other special areas: 14 gauge stainless steel flush with wall or ceiling type with concealed flange.
 - .1 Acceptable Product: Acudor PS-5030 stainless.
 - .5 Acoustical tile ceiling and similar block materials: 14 gauge bonderized steel recessed ceiling type.
 - .1 Acceptable Product: Acudor AP-5010 or AT-5020.
 - .6 Feature wall construction: Recessed wall type that is selected to complement and conform to the architectural module, treatment, or panelling. The size shall conform to adjacent finishes.
 - .7 Access panels in fire separations and fire walls shall have a compatible fire rating and ULC label. (ie. Acudor Fire Rated FW-5050 or FB-5060).
- .4 Standard of Acceptance : Zurn, Wade, Acudor, Can-Aqua, Milcor, Maxam, Van-Met.

2.11 ANCHOR BOLTS AND TEMPLATES

- .1 Supply anchor bolts and templates for installation by other Divisions.

2.12 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] [refer to structural drawings].
 - .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.

2.13 EQUIPMENT SUPPORTS

- .1 Provide stands and supports for equipment and materials supplied.
- .2 Lay out concrete bases and curbs required under Electrical Divisions. Coordinate with Concrete Divisions.
- .3 Concrete bases shall be a minimum of 100 mm [4"] thick, or as noted and shall project at least 150 mm [6"] outside the equipment base, unless otherwise directed. Bases and curbs shall be keyed to the floor and incorporate reinforcing bars and/or steel mesh. Chamfer edges of bases at 45 degrees.
- .4 Equipment with bedplates shall have metal wedges placed under the edges of the bedplates to raise them 25mm [1"] above the base after levelling. The wedges shall be left permanently in place. Fill the space between the bedplate and the base with non-shrink grout - Embeco or In-Pakt.
- .5 Construct equipment supports of structural steel. Securely brace. Employ only welded construction. Bolt mounting plates to the structure.
- .6 Support ceiling hung equipment with rod hangers and/or structural steel.

2.14 MISCELLANEOUS METAL

- .1 Be responsible for all miscellaneous steel work relative to Electrical Divisions of the Specifications, including but not limited to:
 - .1 Support of equipment .
 - .2 Hanging, support, anchoring, guiding and relative work as it applies to wiring raceways and electrical equipment.
 - .3 Earthquake restraint devices - refer also to "Seismic Restraint" sections

- .4 Bridle rings - secure to structure or steel supports.
- .2 All steel work shall be prime and undercoat painted ready for finish under the related Division.

2.15 MAINTENANCE MATERIALS AND CABINET

- .1 Provide maintenance materials in accordance with Division 01 and specified in appropriate Sections.
- .2 Refer to Specification Appendix A Electrical **Form EF140** "Items to be handed to the Owner" Obtain the Building Owners representative sign off. Use **Form EF 140** for this purpose.
- .3 Provide a finished painted sheet steel "spare equipment cabinet". Cabinet to have a continuous hinge and complete with shelves and hasp to suit padlock. Minimum size 600 [24"] x 900 [36"] x 200 [8"] deep. Mount on wall in the Electrical Room. Provide a plastic covered typewritten list of spare parts and affix to the inside of the door.

2.16 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for incorporation into maintenance manual specified in Division 01 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 troubleshooting instructions.
 - .4 Local source of supply for each item of equipment.
 - .5 Wiring and control diagrams.
 - .6 Spare parts list.
 - .7 Copies of guarantees and certificates.
 - .8 Manufacturer's maintenance brochures and shop drawings.
- .4 The manual information shall be bound in a three "D-ring" hard back reinforced vinyl covered ("bar lock" post type where more than 50mm [2"] rings required) binder c/w index tab separators to divide the different sections. The binder cover shall be black with white lettering. Printing of the binder cover shall be completed before the binder is manufactured and the wording shall be approved by the Consultant before printing.

- .5 Submit a draft copy to the Consultant for review thirty (30) days prior to start up of the systems and equipment.
- .6 Submit three (3) copies in the final approved form.

2.17 PROJECT RECORD DRAWINGS

- .1 Provide project record documents as specified in Division 01 as further called for in this Division.
- .2 During the construction period, keep on Site a clean set of drawings marked up to reflect the "As-Built" state, for examination by the Consultant on a regular basis. Include elevations and detailed locations of buried services, empty conduit systems and junction and pull boxes.
- .3 Submit the "Record Drawing" CAD files and one set of plots to the consultant prior to Total Performance of the contract.

Part 3 Execution

3.1 INSTALLATION

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.

3.2 NAMEPLATES AND LABELS

- .1 Ensure manufacturers nameplates and CSA labels to be visible and legible after equipment is installed.

3.3 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete: schedule 40 steel pipe, sized for free passage of conduit and protruding 50 mm [2"].
- .2 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.
- .3 Install roof jacks where conduit and cables penetrate roofs. Apply sealant after installation.
- .4 All cables and conduits to be installed concealed in finished areas.

3.4 LOCATION OF OUTLETS

- .1 Do not install outlets back-to-back or in the same stud space in wall; allow minimum 400mm [16"] horizontal clearance between boxes.
- .2 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000mm [10'- 0"] and information is given before installation.
- .3 Locate light switches on strike side of doors unless otherwise indicated.
- .4 Locate light switches on latch side of doors.
- .5 Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

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 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	450 [18"]	General
Wall receptacles/data	200 [8"]	Above top of continuous baseboard heater
Wall receptacles/data	175 [7"]	Above top of counters or counter splash backs – coordinate with Architectural detail
Wall receptacles/data	900 [36"]	In mechanical rooms
Wall receptacles/data Health Care	450 to 900 [18"] to [36"]	Confirm before installation
Panelboards	2000 [80"]	Panelboards: as required by Code or as indicated.
Wall mtd telephone	1500 [60"]	
Card Readers	1200 [48"]	Confirm before installation
Fire alarm stations	1350 [54"]	ULC S524 requires not less than 1200mm or more than 1400mm.
Fire alarm bells/audio	2200 [88"]	ULC S524 requires not less than 1800mm to centre. In any event not closer than 50mm to the ceiling
Fire alarm visual devices	2000 [80"]	ULC S524 requires not more than 2000mm to centre. In any event not closer than 150mm to the ceiling
Fire alarm Annunciator	1800 Top [72"]	ULC S524 requires not more than 1800mm above finished floor.
End of line resistors	1800 [72"]	
Television outlets		As receptacles –coordinate with equipment location
Wall mounted speakers & clocks	2100 [84"]	Coordinate with equipment location
Door bell pushbuttons	1500 [60"]	Coordinate with location
Emergency Lighting (wall mounted)		150mm below ceiling or 4800mm max.

3.6 COORDINATION OF PROTECTIVE DEVICES

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to the required values and settings to provide a fully coordinated system.

3.7 FIELD QUALITY CONTROL

- .1 Load and Balance:
 - .1 Measure voltage and phase & neutral currents to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
 - .2 Measure phase and neutral currents to dry-core transformers and motor control centres, operating under normal load,
 - .3 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
- .2 Conduct and pay for the following tests:
 - .1 Power generation and distribution system including phasing, voltage, grounding and load balancing.
 - .2 Circuits originating from branch distribution panels.
 - .3 Lighting and its control.
 - .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
 - .5 Systems: fire alarm system and communications.
 - .6 Main ground resistance (at all grounding locations).
 - .7 Insulation resistance testing:
 - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
 - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
 - .3 Check resistance to ground before energizing.
- .3 Provide Consultant with at least one weeks notice prior to testing.
- .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .5 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports.
 - .2 Furnish manufacturer's certificate or letter conforming that entire installation as it pertains to each system has been installed to manufacturer's instructions.
 - .3 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .4 Schedule site visits to review Work.
- .6 Reports:
 - .1 Provide written reports in a timely manner upon completion of the testing and load balance. Indicate test hour and date.

3.8 CLEANING

- .1 Do final cleaning in accordance with Division 01.
- .2 At time of final cleaning, clean lighting reflectors, lenses and other lighting surfaces that have been exposed to construction dust and dirt.

- .3 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .4 Clean and prime paint exposed non-galvanised hangers, racks, fastenings to prevent rusting. Coordinate finish painting with Division 09.

3.9 WORKMANSHIP

- .1 Workmanship shall be in accordance with well established practice and standards accepted and recognized by the Consultant and the Trade.
- .2 The Consultant 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 Consultant.

3.10 PROTECTION OF WORK

- .1 Protect equipment and materials, stored or in place, from the weather, moisture, dust and physical damage.
- .2 Mask machined surfaces. Secure covers over equipment openings and open ends of equipment and conduit, as the installation work progresses.
- .3 Equipment having operating parts, bearings or machined surfaces, showing signs of rusting, pitting or physical damage will be rejected.
- .4 Refinish damaged or marred factory finish.

3.11 PROTECTION OF ELECTRICAL EQUIPMENT

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

3.12 CONCEALMENT

- .1 Conceal wiring and conduit in partitions, walls, crawlspace and ceiling spaces, unless otherwise noted.
- .2 Do not install wiring and conduit on outside walls or on roofs unless specifically directed.

3.13 SERVICE PENETRATIONS IN RATED FIRE SEPARATIONS

- .1 All 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.
- .2 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.
- .3 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.

- .4 Install firestopping and smoke seal material and components in accordance with ULC certification and manufacturer's instructions. The Applicator shall be approved, licensed and supervised by the manufacturer in the installation of firestopping and are to follow the requirements of a rated system as detailed above.
- .5 Contractors are expected to submit system information detailing firestopping product, backing, penetrant, penetrated assembly, Fire (F) and Temperature (T) rating, and ULC or cUL system number.
- .6 Provide fire stopping material and system information in the maintenance manuals and via labels at major penetrations that are likely to be repenetrated.
- .7 Allow openings for 100% capacity of raceway or 200% capacity of J-hooks.
- .8 Provide split systems where existing cables are involved.
- .9 Provide Firestopping approval certificate in including a Building Code / By-Law Schedule B-1, B-2 & C-B signed by a BC registered Professional Consultant. Submit a letter certifying that all work is complete and in accordance with this specification. Electrical Form EF130 should be used for this purpose.

3.14 SERVICE PENETRATIONS IN NON-RATED SEPARATIONS

- .1 All cabling, wiring, conduits, cable trays, etc. passing through non-rated fire separations and non-rated walls and floors shall be tightly fitted and sealed on both sides of the separation with caulking or silicon sealant to prevent the passage of smoke and/or transmission of sound.

3.15 CONDUIT SLEEVES

- .1 Provide conduit sleeves for all conduit and wiring passing through rated walls and floors. Sleeves to be concentric with conduit or wiring.
- .2 Except as otherwise noted conduit sleeves are not required for holes formed or cored in interior concrete walls or floors.
- .3 Conduit sleeves shall extend 50 mm [2"] above floors in unfinished areas and wet areas and 6 mm [1/4"] above floors in finished areas.
- .4 Conduit sleeves shall extend 25 mm [1"] on each side of walls in unfinished areas and 6 mm [1/4"] in finished areas.
- .5 Conduit sleeves shall extend 25mm [1"] beyond exterior face of building. Caulk with flexible caulking compound.
- .6 Sleeve Size: 12 mm [1/2"] clearance all around, between sleeve and conduit or wiring.
- .7 Paint exterior surfaces of ferrous sleeves with heavy application of rust inhibiting primer.
- .8 Packing of Sleeves:
 - .1 Where sleeves pass through foundation walls and perimeter walls the space between sleeve and conduit shall be caulked with waterproof fire retardant non-hardening mastic.
 - .2 Pack future-use sleeves with mineral wool insulation and then seal with ULC approved fire stop sealant for rated fire separations.

3.16 ACCESSIBILITY AND ACCESS PANELS

- .1 Install all equipment, controls and junction boxes so as to be readily accessible for future modification, adjustment, operation and maintenance as appropriate.

- .2 Provide access panels where required in building surfaces. Do not locate access panels in panelled or special finish walls, without prior approval of the Consultant.
- .3 Access panels in U.L.C. fire separations and fire walls shall have a compatible fire rating and U.L.C. label. Acquire approval in writing from the local fire authority if required.
- .4 Access panels shall be painted with a primer coat if applicable and then with a finish coat, colour and type to the Consultant's approval.
- .5 Locate equipment and junction boxes in service areas wherever possible.

3.17 EQUIPMENT INSTALLATION

- .1 Provide means of access for servicing equipment.
- .2 CSA identification and equipment labels to be clearly visible after installation.

3.18 CUTTING, PATCHING, DIGGING, CANNING , CORING & CONCRETE

- .1 Lay out all cutting, patching, digging, canning and coring required to accommodate the electrical services. Coordinate with other Divisions. The performance of actual cutting, patching, digging, canning and coring is specified under other Divisions.
- .2 Be responsible for all cutting, patching, digging, canning and coring required to accommodate the electrical services.
- .3 Be responsible for correct location and sizing of all openings required under Electrical Divisions, including piped sleeves.
- .4 Verify the location of existing and planned service runs and structural components within concrete floor and walls prior to core drilling and/or cutting. Repairs to existing services and structural components damaged as a result of core drilling and cutting is included in this section of the work.
- .5 Openings through structural members of the building shall not be made without the approval of the Structural Consultant.
- .6 Openings in Concrete:
 - .1 Be responsible for the layout of all openings in concrete, where openings are not left ready under previous contract.
 - .2 All openings shall be core drilled or diamond saw cut.
 - .3 Refer to structural drawings for permissible locations of openings and permissible opening sizes in concrete floors and walls.
 - .4 Refer to structural drawings for locations of steel reinforcing.
 - .5 Be responsible for repairing any damage to steel reinforcing.
- .7 Openings in building surfaces other than concrete:
 - .1 Lay out all openings required.
- .8 Poured concrete for duct encasements, pole bases, transformer pads and housekeeping pads shall be provided by other Divisions, coordinated and supervised by the Electrical Divisions.
- .9 Precast concrete items such as transformer pad bases, pull boxes and light pole bases to be provided and installed by the Electrical Divisions unless otherwise specified.
- .10 Excavation and backfilling will be provided by other Divisions. This Division to superintend the work and provide all layouts and parameters.

3.19 PAINTING

- .1 Clean exposed bare metal surfaces supplied under the Electrical Divisions removing all dirt, dust, grease and millscale. Apply at least one coat of corrosion resistant primer paint to all supports and equipment fabricated from ferrous metal.
- .2 Paint all hangers and exposed sleeves, in exposed areas, with a rust inhibiting primer, as they are installed.
- .3 Repaint all marred factory finished equipment supplied under the Electrical Divisions, to match the original factory finish.
- .4 Coordinate with Division 09.

END OF SECTION

Part 1 General

1.1 RELATED WORK

- .1 This Section of the Specification is to be read, coordinated and implemented in conjunction with all other parts of the Contract Documents.

1.2 REGULATORY REQUIREMENTS

- .1 Restraints shall meet the requirements of the latest edition of the British Columbia Building Code and amendments.
- .2 The Seismic Consulting Engineer should be able to provide a proof of professional insurance and the related practice credentials if requested by the Electrical Consultant. The Seismic Consulting Engineer should be familiar with SMACNA, ECABC & NFPA guidelines as well as BCBC and VBBL requirements.
- .3 The Contractors Seismic Consultant shall submit original signed BC Building Code "Letters of Assurance" "Schedules B1, B2, and C-B" to the Prime Consultant or Electrical Consultant.
- .4 Use the City Vancouver details in the absence of any local requirements.
- .5 The above requirements shall not restrict or supplant the requirements of any local bylaws, codes, or other certified agencies which may have jurisdiction over all or part of the installation.

1.3 SCOPE

- .1 It is the responsibility of equipment manufacturers to design their equipment so that the strength and anchorage of internal components of the equipment exceeds the force level used to restrain and anchor the unit itself to the supporting structure.
- .2 Manufacturer's shop drawings to be submitted with seismic information on equipment structure, bracing and internal components and as required by Division 01.
- .3 Provide restraint on all equipment and machinery, which is part of the building electrical services and systems, to prevent injury or hazard to persons and equipment in and around the structure. Restrain all such equipment in its normal position in the event of an earthquake.
- .4 The total electrical seismic restraint design and field review and inspection will be by a B.C. registered professional structural engineer who specializes in the restraint of building elements. Contractor to allow for coordination, provision of seismic restraints, as well as all costs for the services of the Seismic Restraint Engineer. This engineer, herein referred to as the Seismic Consultant, will provide normal engineering functions as they pertain to seismic restraint of electrical installations.
- .5 The Contractor shall be aware of, and comply with, all current seismic restraining requirements and make provision for those that may come into effect during construction of the project. Make proper allowance for such conditions in the Proposal.
- .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 Proposal.

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 Products

2.1 SLACK CABLE SYSTEMS

- .1 Slack cable restraint systems shall be as designed and supplied by Vibra-Sonic Control or equal.
- .2 Slack cable restraints shall be provided on suspended and shelf mounted transformers along with associated equipment and assemblies connected to them at the points of vertical support (4 points). The restraint wires shall be oriented at approximately 90° to each other (in plan), and tied back to the ceiling slab or its structure at approximately 45° to the slab or basic structure. The restraints shall be selected for a 1 g earthquake loading, i.e. each wire shall have a working load capacity equal to the weight of the transformer. The anchors in the structure shall be selected for a load equal to the weight of the transformers at a 45° pull.
- .3 Slack cable systems to allow normal maintenance of equipment and shall not create additional hazard by their location or configurations. Contractor shall rectify any such installations at no additional cost, all to the satisfaction of the engineer and inspection authority having jurisdiction.
- .4 Coordinate requirements of slack cables with suppliers prior to installation.

Part 3 Execution

3.1 GENERAL

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

3.2 CONDUITS

- .1 Provide restraint installation information and details on conduit and equipment as indicated below:
- .2 Vertical Conduit:
 - .1 Attachment - Secure vertical conduit at sufficiently close intervals to keep the conduit in alignment and carry the weight of the conduits and wiring. Stacks shall be supported at their bases and, if over 2 stories in height, at each floor by approved metal floor clamps.
 - .2 At vertical conduit risers, wherever possible, support the weight of the riser, at a point or points above the center of gravity of the riser. Provide lateral guides at

the top and bottom of the riser, and at intermediate points not to exceed 9.2 m [30 ft] o.c.

- .3 Riser joints shall be braced or stabilized between floors.
- .4 Horizontal Conduits:
 - .1 Supports - Horizontal conduit shall be supported at sufficiently close intervals to keep it in alignment and prevent sagging.
 - .2 EMT tubing - tubing shall be supported at approximately 1.2 m [4 ft] intervals for tubing.
- .5 Provide transverse bracing at 12.2 m [40 ft] o.c. maximum unless otherwise noted. Provide bracing at all 90° bend assemblies, and pull box locations.
- .6 Provide longitudinal bracing at 24.4 m [80 ft] o.c. maximum unless otherwise noted.
- .7 Do not brace conduit runs against each other. Use separate support and restraint system.
- .8 Support all conduits in accordance with the capability of the pipe to resist seismic load requirements indicated.
- .9 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.
- .10 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.
- .11 Provide large enough conduit sleeves through walls or floors to allow for anticipated differential movements with firestopping where required.
- .12 It is the responsibility of the contractor to ascertain that an appropriate size restraint device be selected for each individual piece of equipment. Submit details on shop drawings. Review with seismic consultant and submit shop drawings to consultants for their reference.

3.3 FLOOR MOUNTED EQUIPMENT

- .1 Bolt all equipment, e.g. transformers, switchgear, generators, motor control centres, free standing panelboards, control panels, capacitor banks, etc. to the structure. Design anchors and bolts for seismic force applied horizontally through the center of gravity to a seismic force of 0.5g. For equipment which may be subject to resonances, use a nominal 1.0 g seismic force.
- .2 Provide flexible conduit connections between floor mounted equipment to be restrained and its adjacent associated electrical equipment.

3.4 LIGHT FIXTURES

- .1 LED fixtures in suspended ceilings shall be hung independently of the ceiling system. Fixtures shall be secured to concrete or structural deck above by at least two taut 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 taut cables.
- .3 Fixtures which are hung independently of ceiling systems shall have minimum of one seismic cable in addition to the chain or cable used to support the fixture. Seismic restraint cables shall be secured into the concrete or structural deck above.

- .4 Cables shall be corrosion resistant and approved for the application.
- .5 Fixtures which are rod hung shall have seismic ball alignment fittings at the ceiling and fixture.

END OF SECTION

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 SUSTAINABLE REQUIREMENTS

- .1 Materials and products in accordance with Division 01 Sustainable Requirements: Construction.
- .2 Do verification requirements in accordance with Division 01 Sustainable Requirements: Contractor's Verification.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Division 01 - Construction/Demolition Waste Management And Disposal and with the Waste Reduction Workplan.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.

1.4 ASBESTOS

- .1 Refer to specification Division 01 for procedures, removal and disposal of asbestos.
- .2 If during renovations / demolition, asbestos is discovered (or material suspected to be asbestos), all work in that area shall immediately cease and the General Contractor advised. The General Contractor shall take appropriate action without delay to verify presence of friable asbestos and be responsible for the removal of all friable asbestos.
- .3 This division will not be entitled to a claim for any delays resulting from the investigation of or removal of asbestos.

1.5 PCB (POLYCHLORINATED BIPHENYLS)

- .1 Carefully remove any electrical items containing PCB's (eg light fixture ballasts) from equipment or fixtures to be renovated or demolished. Removed items (containing PCB's) to be catalogued and stored on site in approved labelled storage containers in accordance with regulations.

1.6 SCOPE

- .1 The Electrical Division to also take note of the dust containment requirements as outlined in the architectural and front end specification.
- .2 Electrical RFP documents do not show all existing luminaires, wiring devices, conduit, boxes or wire. Conduit routing and wire grouping is not known. During demolition, the Electrical trade(s) are to deactivate all existing electrical and communication systems affected in such a manner that complete systems are not deactivated and system circuits affected in party wall partitions to be reactivated immediately on a temporary or permanent basis as site conditions dictate.
- .3 Any discrepancies appearing on the drawings or in this specification are to be brought to the attention of the Consultant who will provide instruction.
- .4 Where devices are not shown on the new plans in walls that are not being removed, such devices are to be reinstated and remain.

1.7 SCHEDULING

- .1 Refer to Prime Consultant divisions.

1.8 EXAMINATION

- .1 Refer to Prime Consultant divisions.

1.9 PHASING

- .1 Refer to Prime Consultant divisions.

1.10 PROTECTION

- .1 Refer to Prime Consultant divisions.

Part 2 Products

2.1 STANDARDS

- .1 Refer to applicable material standards in other specification sections and/or as detailed on drawings.

Part 3 EXECUTION

3.1 DEMOLITION

- .1 Demolition to be carried out in strict conformance to provincial, local and municipal authorities and Part 8 of the B.C. Building Code current edition.
- .2 All redundant electrical components in the areas of demolition excluding those specifically identified in the following clauses shall become the property of the Electrical Division and shall be removed from site.
- .3 The following existing electrical components to be disconnected by the Electrical Trade(s), cleaned and suitably packaged where applicable, and turned over to the Owner at designated location established on site. If the Owner refuses these items they become property of the Electrical Division and are to be removed from site
 - .1 All fluorescent luminaires complete with lamps and ballasts.
 - .2 Fire alarm components.
 - .3 Call system and components.
 - .4 Security devices.
 - .5 Speakers.
 - .6 Clocks.

3.2 DISRUPTION TO OPERATIONS

- .1 Contractor to issue a scheduled shutdown time and coordinate installation of the new equipment as appropriate. All equipment installed and modified requires testing before start-up.
- .2 Contractor to provide temporary connections to all required equipment for temporary power during the installation of any new equipment.

3.3 REUSE OF EXISTING COMPONENTS

- .1 Existing components may be reused only where so specifically indicated on the drawings or in the specifications, however in all cases all wiring shall be new and no splicing shall be permitted at any location.

3.4 DISTRIBUTION OF CIRCUITS

- .1 Circuit: power, voice/data, fire alarm, control etc. which are disrupted during demolition and are essential, to be made good immediately. The Electrical Trade(s) to identify these circuits to the Consultant. Specific tasks involving the demolition of essential circuits will require that the contractor to obtain permission from the Owner before proceeding.

3.5 ABANDONED CONDUIT, WIRE AND EXISTING CIRCUITS

- .1 All abandoned conduit and wire to be removed and disposed of by the Electrical Divisions.
- .2 Remove all accessible (eg. Surface) wiring and cables back to source.
- .3 Remove abandoned outlets and raceway, even if in or behind drywall, where they are located behind millwork or in locations unsuitable for reuse i.e. not at standard heights for switches or outlets.
- .4 All remaining circuits to be rerouted as required and suitably secured to the building structure.
- .5 Any cabling, including voice/data wiring, presently resting on any suspended ceiling system to be removed as part of the renovation process and shall be neatly bundled, protected and permanently secured to building structure. No cabling is permitted to rest on the ceiling system.

3.6 EXCAVATION AND CUTTING DAMAGE

- .1 Circuits disrupted by floor cutting or drilling (ie. buried cables) to be brought to the attention of the consultant. Obvious systems disturbed because due care and attention was not followed, shall be repaired immediately at no additional cost to owner.

3.7 FIRE ALARM SYSTEM

- .1 Construction/demolition activities in existing building may require that certain fire alarm devices are protected from construction dust, damage etc. Coordinate with the Owners representative as required to protect components of the fire alarm system to prevent nuisance operation and alarms.
- .2 Provide, install and test temporary heat detectors in the area of construction where the construction area is not protected by an active supervised fire protection sprinkler system. The "construction" detectors to be removed and discarded at the end of the project.
- .3 Provide temporary replacement of smoke detectors with heat detectors including interim programming and testing and final re-verification where deemed necessary to minimize false alarms and to ensure other occupants of the building are protected.
- .4 Maintain existing fire alarm system in areas under construction where practical. Relocate, rewire and provide interim connections as required while installing the new system to replace the existing. Provide temporary fire alarm devices and audible signals to suit any temporary EXITing provisions.
- .5 Contractor to check in with the Owners representative at the start and end of each working day to confirm the fire alarm status in the area of work. Arrange for the related fire alarm zone card or area to be deactivated either to suit the progress of the work and/or where dust will be present on a day to day basis. Bag and protect fire detectors in dusty areas during construction. Remove any bagging at the end of the work day. Any existing detectors subject to construction dust to be immediately vacuumed and marked to be replaced at the end of the project. Any fire alarm devices subject to moisture to be replaced immediately.
- .6 The fire alarm system is to be fully functional in the area of construction when the contractor is neither on site nor after the Contractor's normal work hours. (ie overnight, holidays, weekends)

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.
- .2 Refer to Division 27 & 28 for particular Communications, Electronic Safety & Security wiring systems and types.

1.2 TERMS OF REFERENCE

- .1 Typically use insulated 98% conductivity copper conductor Flexible Armoured Cabling (BX) for the general wiring systems unless otherwise indicated.
- .2 Where exposed, wiring to be run in EMT conduit.
- .3 Aluminium conductors only permitted where indicated on drawings and then typically only for feeder conductors larger than 3/0 AWG. All conductor sizes indicated on drawings are based on copper conductors unless otherwise noted.
- .4 Teck cable may only be used where specifically indicated on the drawings or in the specifications. Where permitted, Teck wiring up to 750 system volts to be PVC jacketed armoured cable, multi-copper conductor type Teck90 1000 volt having a PVC jacket with FT-4 flame spread rating.
- .5 Provide all control wiring except HVAC controls as specified in Mechanical Divisions.
- .6 Refer to Equipment Schedule(s) for detailed responsibilities.
- .7 Non-metallic sheathed wiring is not to be used on this project.

1.3 PRODUCT DATA

- .1 Provide product data in accordance with Division 01

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Division 01 - Construction/Demolition Waste Management And Disposal and with the Waste Reduction Workplan.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.

Part 2 Products

2.1 WIRING & CABLES – GENERAL

- .1 Conductors: stranded for 10 AWG and larger. Minimum size #12 AWG.
- .2 Insulation to be 600 volt R90 for the general building wiring in conduit.
- .3 Use RWU90XLPE for underground installations.
- .4 Site services sub-circuits, including site lighting, to be minimum #10 AWG for power and #12 for controls. Increase wiring size for lengthy and/or loaded circuits so that system will not exceed the maximum voltage drop as recommended by the Canadian Electrical Code CSA 22.1.

- .5 Main feeders to be conduit and copper insulated wiring unless otherwise noted on drawings. Provide ground wiring for all conduits in or below slabs. Increase conduit size as required.
- .6 Armoured (BX) cable utilized for recessed tee bar luminaire drops from ceiling mounted outlet boxes. "Tite Bite" connectors and their counterparts of other manufacturers shall not be used. Use anti-short connectors. Allow nominally 900mm [3'] extra cable looped and supported in the ceiling space to permit fixture relocations of one tile space.
- .7 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 conduit fittings. Conductors not to be painted.

2.2 TECK 90 CABLE

- .1 Cable: to CAN/CSA-C22.2 No. 131.
- .2 Conductors: copper and sized as indicated.
- .3 Insulation: Chemically cross-linked thermosetting polyethylene rated type RW90XLPE,600V
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: flat galvanized steel.
- .6 Overall covering: PVC jacket with FT-4 flame spread rating. PVC flame retardant jacket over armour meeting requirements of Vertical Tray Fire Test of CSA C22.2 No. 0.3 with maximum flame travel of 1.2 m.
- .7 Fastenings:
 - .1 One (1) hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
 - .2 Channel type supports for two (2) or more cables.
 - .3 Threaded rods: 6 mm dia. to support suspended channels.
- .8 Connectors: Watertight approved for TECK cable

2.3 ARMoured CABLE (BX)

- .1 Conductors: insulated, copper, size as indicated.
- .2 Type: AC90 600 V rated.
- .3 Armour: interlocking type fabricated from galvanized steel.
- .4 Anti-short connectors.

2.4 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).

2.5 WIRE & BOX CONNECTORS

- .1 Pressure type wire connector current carrying parts to be copper and sized to fit conductors used.
- .2 Fixture type splicing connector current carrying parts to be copper sized to fit conductors 10 AWG or less.
- .3 Bushing stud connectors to EEMAC 1Y-2 and suitable for stranded copper conductors
- .4 Clamps or connectors for armoured cable, flexible conduit, as required.

Part 3 Execution

3.1 INSTALLATION

- .1 Install all cables and wiring.
- .2 Conductor length for parallel feeders to be identical. Provide permanent plastic nametag indicating load fed.
- .3 Group Teck and Armoured cables on channels wherever possible.
- .4 Lace or clip groups of feeder conductors at all distribution centres, pullboxes, and termination points.
- .5 Wiring in walls should typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls should be avoided unless indicated.
- .6 All grounding conductors and straps to be copper. All bonding conductors to have green insulation jacket.
- .7 Colour coding to be strictly in accordance with Section 26 05 00.
- .8 Provide sleeves where cables enter or exit cast concrete or masonry.
- .9 Power wiring up to and including No.6 gauge shall be spliced with nylon-insulated expandable spring-type connectors. Large conductors shall be spliced using split-bolt or other compression type connectors wrapped with cambric tape then PVC tape.
- .10 Wires shall be sized for 2% maximum voltage drop to farthest outlet on a loaded circuit. Increase home run cable size to meet these requirements.
- .11 All branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be 2-wire circuits only, i.e. common neutrals not permitted.
- .12 Install all control cables in conduit.
- .13 Provide numbered wire collars for all control wiring. Numbers to correspond to control drawing legend. Obtain wiring diagram for control wiring of other Divisions.

3.2 VOLTAGE REGULATION

- .1 The drawings are diagrammatic and indicate the general routing of conduit runs and not exact routing, either horizontally or vertically.
- .2 Branch circuit conductor sizes shall be #12 AWG or larger based on the Canadian Electrical Code CSA 22.1 Section 8, which allows a maximum 3% voltage drop for branch circuits.

3.3 WIRE & BOX CONNECTORS

- .1 Remove insulation carefully from ends of conductors and:
 - .1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65
 - .2 Install fixture type connectors and tighten. Replace insulating cap.
 - .3 Install bushing stud connectors in accordance with EEMAC 1Y-2

END OF SECTION

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 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Division 01 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Workplan.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.

1.3 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)
- .2 Transformer grounding shall comply with CSA C22.2 No.41.
- .3 All grounding conductors to be stranded soft annealed copper unless otherwise noted.
- .4 Install complete grounding and bonding system in accordance with Canadian Electrical Code and local inspection authority requirements.

1.4 TESTING REQUIREMENTS

- .1 Perform ground continuity and resistance tests using method appropriate to site conditions. Measure existing ground grid resistance.
- .2 Any third party testing agency costs for the testing and reporting shall be included in the Electrical Division base Proposal and shall be carried out by a pre-approved testing agency.

1.5 ADDITIONAL SCOPE

- .1 Refer to drawings for extent of grounding in addition to code requirements.

Part 2 Products

2.1 MATERIALS

- .1 Grounding equipment to: CSA C22.2 No.41.

2.2 EQUIPMENT

- .1 Clamps for grounding of conductor, size as required.
- .2 System and circuit, equipment, grounding conductors, bare stranded copper, soft annealed, sized as indicated. Insulation where specified or required to be green.
- .3 Non-corroding accessories necessary for grounding system, type, size material as indicated, including but not necessarily limited to:
 - .1 Grounding and bonding bushings.
 - .2 Protective type clamps.
 - .3 Bolted type conductor connectors.

- .4 Thermit welded type conductor connectors.
- .5 Bonding jumpers, straps.
- .6 Pressure wire connectors.

2.3 STANDARDS OF ACCEPTANCE

- .1 Acceptable manufacturers:
 - .1 Burndy Corp.
 - .2 Erico Inc
 - .3 Cadweld.

Part 3 Execution

3.1 INSTALLATION GENERAL

- .1 Extend, as required, existing permanent, continuous grounding system including, electrodes, conductors, connectors, accessories.
- .2 Provide ground wire in EMT conduits installed in grade or below slabs.
- .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 flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.
- .10 Install separate ground conductor to each outdoor lighting standard.
- .11 Connect building structural steel and metal siding to ground by welding copper to steel.
- .12 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- .13 Bond single conductor, metallic armoured cables to cabinet at supply end and provide non-metallic entry plate at load end.
- .14 Ground secondary service pedestals.
- .15 Coordinate ground rod installation with local soil conditions to assure proper grounding system.
- .16 Provide a grounding/bonding bus in each electrical room and in the Generator room. Connect a #2/0cu bonding conductor or as shown on the drawings between grounding/bonding buses.
- .17 Provide a bonding conductor appropriately sized within each raceway routed within the building.

- .18 All bonding and grounding connections to be compression type unless noted otherwise.
- .19 Supply and install complete grounding and bonding system as indicated and as required by Canadian Electrical Code and the local electrical inspection authorities.
- .20 Provide grounding/bonding bus bars mounted on standoff insulators or as shown on the drawings.
- .21 All components shall be securely and adequately bonded and where required to accomplish this, bonding jumpers, grounding studs and bushings shall be used.
- .22 Ensure that all raceways, terminal panels, etc. for fire alarm, etc. are securely and adequately bonded and provide grounding conductor to main ground bus where called for or when required.
- .23 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.
- .24 Bond all low tension equipment with #6 AWG bonding conductor.
- .25 Bond all structural steel, all concrete reinforcing steel and all metal systems with a #2 copper bonding conductor. Connect to closest ground bus or bonding point.
- .26 All metallic conduits longer than 1m in length, containing a single grounding or bonding conductor, shall be bonded.

3.2 EQUIPMENT GROUNDING OR BONDING

- .1 Install grounding or bonding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, UPS, control panels, building steel work, generators, elevators, distribution panels and outdoor lighting.
- .2 Provide a grounding conductor from the secondary of every distribution transformer to the grounding system. Ground conductor to be sized and installed in accordance with Canadian Electrical Code.
- .3 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.

3.3 MECHANICAL EQUIPMENT GROUNDING

- .1 Provide a #2 ground conductor from the mechanical room ground bus to each MCC.
- .2 Provide a #6 ground conductor from the mechanical room ground bus to each VFD
- .3 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.

3.4 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00.
- .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 1Ω .

- .4 Carry out all tests required by the Electrical Inspection Authority and provide all required reports and copied to the Consultant. Include all associated costs.
- .5 Provide "Fall of Potential" tests and the corresponding "Touch & Step" calculations for new high voltage installations. Confirm test results in writing to the Consultant.
- .6 Ensure test results are satisfactory before energizing the electrical system.

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 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data for cabinets in accordance with Section 26 05 00.

Part 2 Products

2.1 MATERIALS

- .1 Cabinets: Code gauge metal primed and coated, locking door, concealed flush hinges, flush lock and catch assembly. Apply finishes in accordance with Section 26 05 00.
- .2 Backboard: 19mm [3/4"] G1S fir plywood, one piece per installation painted with fire retardant paint.

2.2 COMPONENTS

- .1 Terminal Blocks and Strips: screw terminal type.
- .2 Signage: number identify terminal strips with permanent numbers. Provide wiring diagram on inside of terminal cabinet door showing units and conductors connected to terminal cabinet.

Part 3 Execution

3.1 INSTALLATION

- .1 Mount cabinets with top not higher than 2m [6"] above finished floor or as noted on drawings or indicated on architectural details.
- .2 Surface or flush mount cabinets as indicated or appropriate.
- .3 Cabinets located in mechanical, electrical and service rooms to be mounted on "Unistrut" channels.
- .4 Terminate conduit in cabinet with lock nut metal bushing and/or locknut and grounding bushing where required.
- .5 Terminate wiring in screw type terminal blocks or strips.
- .6 Vacuum clean cabinet on completion of installation as detailed in Section 26 05 00
- .7 Provide three (3) spare 21mm [3/4"] conduits from each flush mounted panel into accessible ceiling space.

3.2 FINISH

- .1 Colour code cabinets in unfinished areas to colour code specified in Section 26 05 00 with enamel paint.
- .2 Paint cabinets in finished areas same colour as for adjacent wall finish.

3.3 IDENTIFICATION

- .1 Install size 2 identification labels indicating system name, voltage and phase in accordance with Section 26 05 00

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 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data for cabinets in accordance with Section 26 05 00

Part 2 Products

2.1 SPLITTERS

- .1 Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.
- .2 Main and branch lugs, connection bars to match required size and number of incoming and outgoing conductors as indicated.
- .3 At least three spare terminals on each set of lugs in splitters less than 400 A.

2.2 JUNCTION AND PULL BOXES

- .1 Welded steel construction with screw-on flat covers for surface mounting.
- .2 Covers with 25 mm [1"] minimum extension all around, for flush-mounted pull and junction boxes.

2.3 CABINETS

- .1 Type E: sheet steel, hinged door and return flange overlapping sides, handle and catch, for surface mountings.
- .2 Type T: sheet steel cabinet, with full length hinged door, latch, lock, 2 keys, containing 19 mm G1S fir plywood backboard for surface or flush mounting as appropriate.
- .3 Include filtered vents and/or fan-cooling when enclosed equipment is heat producing.

2.4 FINISHES

- .1 Apply finishes in accordance with Section 26 05 00.

Part 3 Execution

3.1 SPLITTER INSTALLATION

- .1 Install splitters as indicated and mount plumb, true and square to the building lines.
- .2 Extend splitters full length of equipment arrangement except where indicated otherwise.

3.2 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

- .1 Install pull boxes in inconspicuous but accessible spaces.
- .2 Only main junction and pull boxes are indicated. Provide pull boxes so as not to exceed 30 m of conduit run between pull boxes.
- .3 Provide pull boxes and junction boxes in locations shown on the drawings and as required to suit job conditions.

- .4 Locate pull boxes and junction boxes above removable ceilings, in electrical rooms, utility rooms or storage areas.
- .5 Junction boxes, when used, to be installed in areas that are accessible through luminaire openings, and/or access panels.
- .6 Where pull boxes are flush mounted, provide overlapping covers with flush head cover retaining screws, prime coated and painted to match wall or ceiling finish.
- .7 Where cast corrosion resistant boxes are used, covers to be of matching type and gasketed.
- .8 For special (not 100mm [4"] square or octagonal) pull boxes and/or junction boxes, paint identification for the system and provide lamicaid nametags to box covers with a size 2 nameplate 5mm [0.25"] lettering identifying system.
- .9 Interior of all pull boxes and junction boxes for each system to be spray painted with colour as specified in Section 26 05 00
- .10 All pull boxes, junction boxes and cabinets to be supported directly from building structure using one or a combination of galvanized screws, galvanized bolts, galvanized rods, and approved box clip.
- .11 Support of pull boxes, junction boxes by conduit fittings or wire is not acceptable.

3.3 CABINETS INSTALLATION

- .1 Mount cabinets with top not higher than 2 m [6'] above finished floor.
- .2 Cabinets shall be flush mounted in finished areas where depth can be accommodated in the walls. Provide flush trim to suit.
- .3 Provide fit up in Type T cabinets as indicated.

3.4 IDENTIFICATION

- .1 Install size 2 identification labels indicating system name, voltage and phase in accordance with Section 26 05 00

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 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Division 01 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Workplan.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.

1.3 REFERENCES

- .1 All conduits and accessories to be manufactured and certified by the related CSA standard.

1.4 SCOPE

- .1 Drawings do not show all conduits. Those shown are in diagrammatic form only.
- .2 Conceal all conduits where possible in finished areas. Conduits may be surface mounted either only where indicated or in service areas accessible only to authorized personnel.
- .3 If a finished area is concrete (existing) or concealment is not practical, obtain ruling from Consultant where exposed wiremold may be substituted.
- .4 Note particular requirements for routing of conduits where detailed.
- .5 Provide polypropylene pull cord in all "empty" conduits.

Part 2 Products

2.1 CONDUITS

- .1 Rigid metal conduit: to CSA C22.2 No.45 Galvanized Steel.
- .2 Electrical Metallic Tubing (EMT): to CSA C22.2 No.83.

2.2 CONDUIT FASTENINGS

- .1 One hole steel straps to secure surface conduits 41mm [1.5"] and smaller. Use two hole steel straps to conduits larger than 41mm [1.5"].
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits.
- .4 10mm [3/8"] threaded rods to support suspended channels.

2.3 CONDUIT FITTINGS

- .1 Fittings manufactured for use with conduits specified. Coating same as conduit.
- .2 Provide factory "ells" where 90 degree bends are required for 27mm [1"] and larger conduits.

- .3 EMT couplings and connectors shall be steel, or Regal Die-cast zinc alloy. Couplings used on conduit containing fire-rated cable shall be steel. Regular die-cast alloy fittings and couplings are not acceptable. Provide plastic bushings (insulated throat) for all connectors 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 21mm [3/4"] deflection in all directions.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel as required.

2.5 RIGID P.V.C. CONDUIT

- .1 Conduit: rigid non-metallic conduit of unplasticized polyvinyl chloride as manufactured C.G.E. "Sceptre" or equal.
- .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 SURFACE RACEWAYS

- .1 Removable cover finished painted steel surface raceways.
- .2 Internal barriered to provide physical separation between power and communication cabling.
- .3 Colour to be as indicated on the drawings or where not indicated confirm with Consultant before ordering.
- .4 All raceway fittings to be accessories available from the manufacturer.
- .5 Standard of acceptance:
 - .1 Wiremold 3000 (39mm x 70mm), 4000 (44mm x 121mm), or 6000 (90mm x 121mm), as indicated on the drawings or as required for wiring capacity.
 - .2 Approved equal
- .6 All product to be from the same manufacturer.

2.7 OUTLET AND CONDUIT BOXES IN GENERAL

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm [4"] square or larger outlet boxes as required for special devices.
- .3 Gang boxes where wiring devices are grouped. Do not use sectional boxes.
- .4 Blank cover plates for boxes without wiring devices.
- .5 347V outlet boxes for 347V switching devices.
- .6 Combination boxes with barriers where outlets for more than one system are grouped.
- .7 Bushing and connectors with nylon insulated throats.
- .8 Knock-out fillers to prevent entry of foreign materials.
- .9 Conduit outlet bodies for conduit up to 35 mm[1.25"]. Use pull boxes for larger conduits.

- .10 Double locknuts and insulated bushings on sheet metal boxes.

2.8 SHEET STEEL OUTLET BOXES

- .1 Electro-galvanized steel single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm [3" x 2" x 1.5"] or as indicated. Larger 102 mm square x 54mm deep [4"x 2"] outlet boxes (No. 52151 or 52171) to be used when more than one conduit enters one side. Provide extension and plaster rings as required.
- .2 For larger boxes use GSB solid type as required.
- .3 Boxes for surface mounted switches, receptacles, communications, telephone to be 100mm square No. 52151 or 52171 with Taylor 8300 series covers.
- .4 Lighting fixture outlets: 102 mm [4"] square outlet boxes (No 52151, 52171 or 72171) or octagonal outlet boxes (No 54151 or 54171).
- .5 102 mm [4"] square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster and/or tile walls.

2.9 MASONRY BOXES

- .1 Electro-galvanized steel masonry single and multi gang type MDB boxes for devices flush mounted in exposed block walls.

2.10 CONCRETE BOXES

- .1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.11 FLOOR BOXES

- .1 Concrete tight electro-galvanized sheet steel floor boxes with adjustable finishing rings to suit floor finish with faceplate. Device mounting plate to accommodate short or long ear receptacles. Minimum depth: 28 mm [1.1"] for receptacles; 73 mm [2.9"] for communication equipment.
- .2 Adjustable, watertight, concrete tight, cast floor boxes with openings drilled and tapped for 16 mm [0.5"] and 21 mm [0.75"] conduit. Minimum size: 73 mm [2.9"] deep

2.12 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 conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass. Set out the work and coordinate with other services prior to installation. Maintain access to junction and pull boxes.
- .3 Where practical conceal conduits.
- .4 Any conduit exposed in finished areas to be free of unnecessary labels and trade marks.
- .5 All conduit ends to be reamed to ensure a smooth interior finish that will not damage the insulation of the wiring.

- .6 Ensure grounding continuity in all conduit systems.
- .7 Surface conduits are acceptable in mechanical and electrical service rooms and in unfinished areas or where indicated.
- .8 Use rigid galvanized steel (RGS) threaded conduit where the installation is subject to mechanical injury. In any event, use RGS conduit for surface installations up to 1.5m [5'] above the finished floor.
- .9 Field threads on rigid conduit shall be sufficient length to draw conduits ends together.
- .10 Unless otherwise noted and where practical, all conduits to be routed through the ceiling space rather than in, or below, slabs or floor structures to facilitate future changes.
- .11 Conduits in walls should typically drop (or loop) vertically from above to better facilitate future renovations. Generally conduits from below and horizontal conduits in walls and concrete structures should be avoided unless indicated.
- .12 All branch circuit conduit, home-runs and communication/data conduits to be minimum 21 mm [3/4"] diameter unless otherwise indicated.
- .13 Generally use Rigid PVC conduits in or below ground level slab unless otherwise noted. Transition to RGS conduit in exposed locations: eg where conduits emerge from ground level slab.
- .14 Conduits are not permitted in terrazzo or concrete toppings.
- .15 Cap turned up conduits to prevent the entrance of dirt or moisture during construction.
- .16 Locate conduits more than 75mm [3"] parallel to steam or hot water lines with a minimum of 25mm [1"] at crossovers.
- .17 Bend conduits cold, so that conduit at any point is not flattened more than 1/10th of its original diameter. Conduits bent more than this or kinked to be replaced.
- .18 Provide polypropylene pull cord in empty conduits to facilitate pulling wiring in future.
- .19 Where conduits become blocked, the use of corrosive agents is prohibited. Remove and replace blocked section.
- .20 Damaged conduits to be repaired or replaced.
- .21 Dry conduits out thoroughly before installing wiring. Swab out conduit and thoroughly clean internally before wires and cables are pulled.
- .22 Conduits shall not pass through structural members except as indicated.
- .23 Conduit sizes indicated on drawings are minimum only. Increase sizes as required to suit alternative wiring types 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 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 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with minimum 1.5m [5'] clearance.
- .3 Conduits to be run in flanged portion of structural steel.
- .4 Group conduits wherever possible on suspended and/or surface channels.
- .5 Surface conduits will not be accepted in finished areas unless detailed.

3.3 SPARE CONDUITS

- .1 Provide spare conduits as indicated.
- .2 Provide 2x27 mm [1"] spare conduits up to ceiling space and 2x27 mm [1"] spare conduits down to ceiling space below from each flush panel. Terminate the conduits in 150x150x100 mm [6"x6"x4"] junction boxes in ceiling spaces or in case of an exposed concrete slab, terminate each conduit in a flush concrete box. Provide coverplates for all junction boxes.

3.4 SURFACE RACEWAYS

- .1 Where practical provide regularly spaced device outlets and factory pre-cut raceway covers and cover plates. Field install outlets where factory installation is not possible due to delivery issues or irregularly spaced outlet requirement. In this event covers may be field cut with proprietary factory cover shear equipment with sharp blades.
- .2 Raceways shall be free of burrs inside and out.
- .3 Covers to be matching colour, smooth, free of burrs and parallel with no gaps.
- .4 Preserve and organize the space within the wireway to facilitate multiple wiring runs and future additions. In finished areas and where practical, conduit to feed the surface raceway from a box recessed behind and via grommetted openings to the back of the surface raceway. Maintain pullbox access as required by the Canadian Electrical Code.

3.5 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 [0.25"] of opening.
- .5 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers not to be used.
- .6 All outlet boxes to be flush mounted in all areas, excluding mechanical rooms, electrical rooms, and above removable ceilings.
- .7 Adjust position of outlets in finished masonry walls to suit masonry course lines. Coordinate cutting of masonry walls to achieve neat openings for all boxes. All cutting of masonry work for installation of electrical fittings to be done using rotary cutting equipment.
- .8 No sectional or handy boxes to be installed.
- .9 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

Part 1 General

1.1 RELATED WORK

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
- .2 Section 26 05 00 Common Work Results
- .3 Section 26 27 26 Wiring Devices
- .4 Section 26 24 16 Panelboards – Breaker Type

1.2 SYSTEM DESCRIPTION

- .1 The lighting control system will be a line voltage, local control system only. Provide low voltage equipment,

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings & product data in accordance with Section 26 05 .00.
- .2 Retain the equipment supplier's representative to assist with the review of the equipment application at the shop drawing stage.
- .3 Provide custom schematic shop drawings of the complete systems and devices specified in this section.

Part 2 Products

2.1 RELAYS (LINE VOLTAGE)

- .1 Line voltage relays to be rated at a minimum of 20 Amp, 300 volt, with contacts as required and 120 volt coil. Relays to be mounted in separate identified enclosure.

2.2 OCCUPANCY SENSORS WALL SWITCHES (LINE VOLTAGE)

- .1 Line voltage wall switch sensors shall be capable of detecting presence, in the floor area to be controlled, by detecting shifts in infrared energy and/or doppler shift ultrasonic
- .2 Provide a neutral wire at each switch position using ultrasonic or dual technology.
- .3 Sensors shall be complete with the following:
 - .1 Override push switch.
 - .2 LED detection status indicator.
 - .3 Low profile recessed design to suit "Decorator Plate
 - .4 Dual level lens to enhance detection at desk top level.
 - .5 Ability to maintain luminaires in operation when occupancy is only one person sitting at a desk in accordance with NEMA WD7 guidelines.
 - .6 Temperature and humidity resistance.
 - .7 Time delay range from 30 seconds to 30 minutes.
 - .8 Sensitivity adjustment from 20% to 100%.
 - .9 Compatible with electronic ballasts and CF ballasts.
 - .10 Immunity to RFI and EMI interference.
 - .11 Integrated light level sensor option holds light off when the natural light are above the preset levels.

- .12 CSA approved
- .13 Five-year warranty.
- .4 Standard of Acceptance:
 - .1 Watt Stopper PW-100 120V PIR (or 374V as required)
(UW-100 = Ultrasonic & DW-100 is Dual Technology)
 - .2 Pre approved product

2.3 OCCUPANCY SENSORS WALL SWITCHES

- .1 Occupancy sensors shall be capable of detecting presence in the floor area to be controlled using dual technology: passive infrared (PIR) and microphonics. Upon sensing motion using PIR technology, the sensor signals ON, activates the sound detector and starts an internal timer. Timer will be continually reset whenever motion is seen or sound is detected.
- .2 Sensors shall be complete with the following:
 - .1 LED status indicator.
 - .2 Low profile recessed design to suit faceplate.
 - .3 Time delay range from 30 seconds to 20 minutes.
 - .4 Auto On or Manual ON selectability.
 - .5 Manual override capability.

2.4 OCCUPANCY SENSORS – CEILING MOUNTED

- .1 Occupancy sensors shall be capable of detecting presence in the floor area to be controlled using dual technology: passive infrared (PIR) and microphonics. Upon sensing motion using PIR technology, the sensor signals ON, activates the sound detector and starts an internal timer. Timer will be continually reset whenever motion is seen or sound is detected.
- .2 Provide a bypass switch (or pin) to defeat automatic function that shall be visible from the floor when installed. Function selection: on/off switching or off-only switching.
- .3 Sensors shall have the ability to directly control up to four low voltage relays directly and have the ability to connect low voltage wall switches in parallel to each relay for occupant override.
- .4 LED status indicator.
- .5 Low profile recessed design not protrude more than 25mm down from the ceiling.
- .6 Multi-directional 360 degree detection.
- .7 Time delay range from 30 seconds to 20 minutes.
- .8 PIR lens capable of being rotated or swivelled.
- .9 Unit assembly shall have one set of normally open and one set of normally closed auxiliary contacts.

2.5 POWER PACKS:

- .1 Power Packs shall be self contained transformer relay module complete with snap-in nipple for installation in a typical electrical box knockout.
- .2 Unit shall have dry contacts capable of switching line voltage (120V or 347V) relays controlling up to 20 Amp ballast load or 13 Amp incandescent or 13 Amp fluorescent ballast load.

- .3 Unit shall provide 24 volt DC @ 150 mA output capable for controlling a minimum of three (3) occupancy sensors plus remote slave packs as required.
- .4 Unit shall be capable of parallel wiring without regard to primary AC phasing.
- .5 Unit shall be CSA approved.
- .6 Provide addressable Power Pack as required to suit system.
- .7 Standard of Acceptance:
 - .1 Watt Stopper B120E-P (or B347D-P – 347V) (Addressable type equal to LC 100)
 - .2 Pre approved product

2.6 SLAVE PACK:

- .1 Slave pack shall have similar features as the Power Packs but without transformer.
- .2 Standard of Acceptance:
 - .1 Watt Stopper S120/347EP
 - .2 Pre approved product

2.7 WIRING

- .1 Provide all control wiring as required and recommended by the manufacturer.
- .2 The removal of any addressable device shall have no effect on the communication between other devices and the relay panels in the rest of the lighting control network.

Part 3 Execution

3.1 INSTALLATION

- .1 Provide and install all equipment including all components needed to make the system work in the intended manner.
- .2 Confirm control wiring individual conductor sizes with equipment manufacturer prior to installation.
- .3 Retain the equipment supplier's representative to assist with the proper device placement at the rough-in stage.
- .4 Confirm control wiring individual conductor sizes with equipment manufacturer prior to installation.

3.2 INSPECTION

- .1 Coordinate controls and interfaces to other Divisions including the BMCS.

3.3 COMMISSIONING

- .1 Check and confirm that all control devices and sensors work in the intended manner.
- .2 Retain the equipment supplier's representative to review the coverage patterns and finally adjust sensor settings after the move in and furniture installation. Provide a Suppliers sign off letter and a schedule indicating the set points of all devices.

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 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Division 01 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Workplan.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.

1.3 REFERENCES

- .1 Use transformers of one manufacturer throughout the project.
- .2 Canadian Standards Association (CSA International)
 - .1 CAN/CSA C22.2 No.47, Air Cooled Transformers (Dry Type).
 - .2 CSA C9, Dry Type Transformers.

1.4 PRODUCT DATA

- .1 Submit shop drawings in accordance with Section 26 05 00.

Part 2 Products

2.1 STANDARD TRANSFORMERS (TYPE I)

- .1 Type: ANN, 600 volts, 3 phase delta primary.
- .2 Primary taps: 2x 2 1/2% full capacity taps above and 2x 2 1/2% taps below the nominal voltage.
- .3 Secondary: 3 phase, 60 Hz 120V/208V 4 wire Y (see drawings for kVA rating). Electrostatic shielded grounded star secondary.
- .4 Class H, 220°C insulation with temperature rise not exceeding 150°C maximum in 40°C ambient.
- .5 Efficiency: Energy Star rating
- .6 Basic Impulse Level (BIL): standard.
- .7 Hipot: standard.
- .8 Windings: High grade aluminum or copper windings, double dipped, vacuum impregnated high temperature non hygroscopic silicon varnish.
- .9 Impedance: Sizes 225 kVA and below to be between 4.5 and 5%.
- .10 Average Sound Level: Noise emission shall not exceed 50 dB at full-load
- .11 Impedance at 17 degrees C: standard.
- .12 Enclosure: air ventilated EEMAC 1, removable metal front panel "sprinkler-proof" design. Provide angled louvres for ventilation slots to prevent entrance of water from the sprinkler fire protection system. Air cooled type, natural circulation in ventilated enclosure.
- .13 Mounting: provide external vibration isolator kit. Provide "Super W Pads" Neoprene.

2.2 VIBRATION AND SEISMIC CONTROL

- .1 Vibration and Seismic control shall meet the requirements of current BC Building Code and Supplements, and the seismic consultant.
- .2 Vibration and Seismic hardware to control static deflection.
- .3 Transformer equipment to be vibration isolated from the building structure by means of approved Neoprene isolators. Isolation system to have a mutual frequency no higher than one-third of the fundamental frequency.
- .4 Provide inspection services by a qualified isolator manufacturers representative during and after installation. Provide concise written reports accepting the installation and stating any deficiencies. Correct any deficiencies noted. Include all costs associated with the above in the base Proposal. Use Electrical Form EF132 bound with this specification in Appendix A.
- .5 Refer to Section 26 05 00 for Vibration Isolation of Electrical Equipment

2.3 STANDARD OF ACCEPTANCE

- .1 Delta
- .2 Hammond
- .3 Schneider
- .4 Marcus
- .5 Pre approved equal

Part 3 Execution

3.1 MOUNTING

- .1 Mount dry type transformers on floor unless otherwise noted on drawings.
- .2 Provide 100 mm [4"] concrete house-keeping base pad unless otherwise detailed.
- .3 Ensure adequate clearance around transformer for ventilation.
- .4 Install transformers in level upright position.
- .5 Remove shipping supports only after transformer is installed and just before putting into service.
- .6 Loosen isolation pad bolts until no compression is visible.

3.2 CONNECTIONS

- .1 Make primary and secondary connections in accordance with the manufactures diagrams.
- .2 Check all factory connections for correct tightness before energization.
- .3 Torque the building system wiring transformer connections using a torque wrench set to the manufacturers recommended settings. Note the torque setting on the equipment identification label for future maintenance reference.
- .4 All external wiring connections to transformer casing shall be enclosed in flexible conduit. Typically minimum 900mm[36"] flex to minimize vibration transmission to building structure.
- .5 Conduit to only enter transformers within the bottom third of the transformer casing. (to minimize heat transfer to conduit).
- .6 Energize transformers immediately after installation is completed, where practicable.

3.3 EQUIPMENT IDENTIFICATION

- .1 Size 7 label in accordance with Section 26 05 00.
-

- .2 Include the transformer identification (as indicated on the project drawings), primary power source equipment designation, equipment served and torque setting of connections. Eg Transformer T1, served from CDPH-1, serving CDPL-1, Cable Connection Torque x Nm.

3.4 GROUNDING

- .1 Provide a ground conductor with all feeder runs to dry type transformer installations. The ground shall be either green insulated or identified and connected as a ground to the ground pad in the transformer enclosure and thence to the secondary neutral of the transformer. From the transformer ground pad make cable connection to non-current carrying ground of the distribution centre or panel supplied from transformer.

END OF SECTION

Part 1 General

1.1 RELATED WORK

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
- .2 Section 26 09 24 "Lighting Controls" includes low voltage relays assemblies that are to be factory installed and prewired, within adjoined matching panel tubs and trims that are part of this section. Refer to section 26 09 24 for scope and extent.

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Division 01 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Workplan.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 26 05 00.
- .2 Shop drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.
- .3 Shop drawings to include matching tub and trim details for factory installed low voltage relay cabinets where specified.

1.4 PLANT ASSEMBLY

- .1 Install circuit breakers in panelboards before shipment from plant.
- .2 Install and prewire low voltage relays assemblies where indicated.
- .3 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.
- .4 All panelboards to be of a common manufacturer.

1.5 FINISH

- .1 Apply finishes in accordance with Section 26 05 00.
- .2 Panel finish in electrical and equipment rooms and closets to be standard ASA Grey baked enamel for normal power service and Blue for emergency power service. Confirm with Consultant prior to shop finishing panels.
- .3 Panels in finished and/or public areas to be either as clause .2 above or prepared to accept painting to closely match surroundings as directed by the Architect. In the later instance, the final paint coat to be done by Division 09 but coordinated by the Electrical Division in particular for protection and masking of locks and sensitive parts. Confirm with Consultant prior to paint finishing panels.

Part 2 Products

2.1 PANELBOARDS, DOORS AND TRIMS

- .1 Panelboards: to CSA C22.2 No. 29 and product of one manufacturer.

- .2 Bus and breakers rated for 10 KA symmetrical, minimum, interrupting capacity or as indicated.
- .3 Tin plated aluminum bus with full size neutral.
- .4 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number.
- .5 Mains, number of circuits and number and size of branch circuit breakers as indicated.
- .6 Provide all necessary connectors and mounting hardware in every space to facilitate installation of future breakers. Provide blank fillers for all spaces.
- .7 Concealed hinges and concealed trim mounting screws, hinged locking door with flush catch.
- .8 Panelboards to have flush doors. (Gasketed where required).
- .9 Provide two keys for each panelboard and key similar voltage panelboards alike.
- .10 Panel tubs to be typically 600mm [20"] wide.
- .11 Provide "sprinkler-proof" design in areas where sprinkler fire protection is installed. In any event, all surface mounted enclosures to be complete with sprinkler drip cover.

2.2 BREAKERS

- .1 All breakers to be bolt on type, moulded case, non adjustable and non interchangeable trip, single, two and three pole, 120/208(240)V or 347/600V and with trip free position separate from "On" or "Off" positions.
- .2 Two and three pole breakers to have common simultaneous trip and able to be located in any circuit position within the panelboard. Minimum interrupting rating of breakers to be as follows:
 - .1 See Single Line Diagram
- .3 Main breaker to be separately mounted at top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.
- .4 Provide circuit breakers with indicated trip ratings as shown in the panelboard schedules.
- .5 Provide at least 10% spare 15 Amp single pole breakers whether indicated or not.
- .6 Provide GFI type breakers as indicated.
- .7 Provide Lock-on devices as indicated and in any event for Fire Alarm circuits, Security equipment circuits, EXIT sign circuits and Emergency Battery equipment circuits.

2.3 PANELBOARD IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00
- .2 Nameplate for each panelboard size 5 (2 line) engraved as indicated and include panel designation and voltage/phase.
- .3 Complete circuit directory with typewritten card(s) located in slide-in plastic pocket(s) fixed to the back of the related door. Directory card to indicate the panel designation, mains size, voltage/phase and the location and load controlled of each circuit. Include a "letter sized" paper copy of each directory in the project maintenance manual.
- .4 Provide a plasticized typewritten information card fixed to the back of the each panel door. Information card to indicate the panel designation and location, feeder type and size and locations of any controlling contactors and feeder pullboxes. Include a "letter sized" paper copy of each information card in the project maintenance manual.

2.4 STANDARD OF ACCEPTANCE

- .1 Cutler Hammer Type PRL Door within door trim where indicated.
- .2 Schneider,. Type NQOD Door within door trim where indicated.
- .3 Siemens Canada.

Part 3 Execution

3.1 INSTALLATION

- .1 Locate panelboards as indicated and mount securely, plumb true and square, to adjoining surfaces.
- .2 Panelboards located in service rooms, mechanical rooms, and electrical rooms to be mounted on unistrut supports.
- .3 Mount panelboards to height given in Section 26 05 00 or as indicated.
- .4 Connect loads to circuits as indicated.
- .5 Connect neutral conductors to common neutral bus with respective neutral identified.
- .6 Install 4x27mm [1"] empty conduits (or equivalent) from each flush mounted panelboard single tub to ceiling space above and 2x27mm [1"] empty conduits (or equivalent) from each flush mounted panelboard single tub down to ceiling or space below where space exists. Refer also to Section 26 05 34 "Conduits"

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 SCOPE OF WORK

- .1 In general the HVAC and the Plumbing/Fire Protection motors and drives will be respectively provided under the Mechanical Division and Plumbing/Fire Protection Divisions;. Refer to the related division of the specifications and drawings for exact locations and requirements.
- .2 Provide the following components:
 - .1 All disconnect switches required.
 - .2 All starters, contactors, control transformers, except where supplied by the Mechanical or Plumbing/Fire Protection Divisions as noted in the equipment schedule.
- .3 Thermostats, solenoid valves, pressure switches, aquastats, flow switches, timeclocks are generally provided by the Mechanical or Plumbing Divisions except as noted in the equipment schedule(s).
- .4 Refer to equipment schedule(s) for details of motor controls and devices.
- .5 Provide all power wiring from power distribution centre, through starter and control equipment to the motors.
- .6 Conduit, wire and connections for all HVAC low voltage control wiring shall be the responsibility of Mechanical Division unless otherwise specified.
- .7 Provide, connect and verify all Fire Alarm control wiring and devices.

1.3 CONTROLS - GENERAL

- .1 Mechanical and Plumbing Divisions differ both in regard to the particulars of drives, motors, etc. specified. The Mechanical Division typically includes a major section on controls whereas the Plumbing Division typically includes more package equipment requiring power service connection only. Because of these variations the demarcation point between the work of the Electrical Division and the Mechanical and Plumbing Divisions typically differ.
- .2 Generally for drives, equipment, etc. detailed in the Mechanical Division, the work of the Electrical Division finishes with the supply of a standard terminal block array for each starter. All further wiring, relays, timers, etc., together with control consoles, are provided under the Mechanical Division.
- .3 Generally for the package equipment, drives and special controls detailed in the Plumbing Division, the work of the Electrical Division typically includes the provision of all wiring, devices, etc to complete each system and left ready for commissioning, set up, etc. by the Plumbing Division.

1.4 ELECTRICAL DIVISION RESPONSIBILITIES FOR MECHANICAL DIVISIONS

- .1 Provide a ten point terminal block for each starter or contactor.
- .2 Provide interwiring between starters or contacts and terminal blocks. Starter to be entirely factory-wired.

- .3 Terminals to be as follows:
 - .1 120 V line from control transformer.
 - .2 Terminals for remote 3 wire stop/start.
 - .3 HOA or other control.
 - .4 120V neutral.
 - .5 Normally open dry contact.
 - .6 Common.
 - .7 Normally closed dry contact.
 - .8 Normally open dry contact.
 - .9 Common.
 - .10 Normally closed dry contact.
- .4 Except where otherwise indicated, the work of the Electrical Division shall not extend beyond the control terminal blocks. The Mechanical Division shall provide all conduit, wire, wiring connections and components such as relays, timers, etc. as required to provide the interlocking functions and controls as outlined in the specifications. If the standard terminals supplied by the Electrical Division require supplementation in any way, e.g. by supplying additional N.O. or N.C. contacts, these facilities are included in the Mechanical Division Mech Div scope.
- .5 Mechanical Division shall provide the mechanical control consoles complete with pilot controls, indicating lights, etc., as outlined in the specifications.
- .6 When an item provided under the Mechanical Division is factory supplied with a starter or contactor and it is necessary to alter or add to the control wiring in order to achieve the method of operation specified in the Mechanical Division, this work shall be included in Mechanical Division.
- .7 When control items such as thermostats, float controllers, etc., are connected to power wiring in series with the item being powered (e.g. unit heater motor, fractional HP fans, etc.) the supply and installation of the controller devices are included in Mechanical Division. Power wiring to and from the controllers is included in the Electrical Division. Install line voltage thermostats for single phase motors provided by the Mechanical Division where specifically indicated on the drawings and/or the "Equipment Schedule" of this specification.
- .8 When the electrical characteristics of a controlled item exceed the capacity of a specified controller, provision of a contactor and the required wiring shall be included in the Mechanical Division.

1.5 ELECTRICAL DIVISION RESPONSIBILITIES FOR PLUMBING DIVISIONS

- .1 When a drive, motor, etc. provided under the Plumbing Divisions is factory supplied with a starter, contactor, alternator, pressure switch, etc., the wiring and installation of these items and controls shall be included in the Electrical Division.
- .2 The ten point terminal blocks similar to those specified under the Mechanical Division controls are not mandatory for the Plumbing Division equipment.
- .3 The Electrical Division shall provide stop/start or HOA controls as specified for each item except where these stations are factory supplied with equipment.
- .4 The Electrical Division shall leave each system fully functional and requiring only minor final adjustments (such as pressure or vacuum settings) by the Plumbing Divisions.

Part 2 Products

2.1 MATERIALS

- .1 Refer to appropriate section of the Electrical Division(s).

2.2 CONTROL RELAYS

- .1 Control relays to be rated minimum 10 A, 300V, with contacts as required and 120 V control coil unless otherwise noted. Relays to be typically mounted in CEMA1 enclosures located in control terminal cabinets and/or MCC.
- .2 Provide required fire alarm relays and auxiliary contacts in motor control centres or at the related equipment cabinets to provide activation and deactivation of mechanical fan units as specified in the Mechanical Division.
- .3 Relays for Fire Alarm shutdown system control to be approved for Fire Alarm use and powered from the Fire Alarm panel. Fire Alarm relay enclosures to be finished in red and identified "FIRE ALARM RELAY"
- .4 Time delay relays to incorporate time delay feature to delay either opening or closing as specified. Time period to be adjustable from 0 to 5 minutes unless otherwise specified.

Part 3 Execution

3.1 INSTALLATION

- .1 Provide all labour and materials required to complete power wiring for HVAC, Plumbing and Fire Protection equipment as called for in the project specifications and/or shown on the drawings.
- .2 Provide all single and 3 phase motor protection switches, combination starters and disconnects contactors and relays as required for mechanical equipment unless otherwise specifically noted in these specifications or on the drawings.
- .3 Terminate all line voltage wiring to the designated equipment terminals.
- .4 Obtain a full set of HVAC control shop drawings and have a full understanding of the scope before commencing installation and including any fire alarm interface.
- .5 Verify the recommended overcurrent protection and rating of Mechanical and Plumbing and Fire Protection equipment and equipment supplied by the Owner. Change feeder overcurrent protection as required to comply with equipment recommendations. Notify the Consultant of all revisions.

3.2 FIELD QUALITY CONTROL

- .1 Cooperate with Mechanical Consultant and Contractor and check out the operation of all motor controls with all HVAC systems fully operational. Record all electrical loads. Replace any defective or wrongly sized starter overloads, heaters, fuses or circuit breakers.

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 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 26 05 00.

1.3 RELATED SECTIONS

- .1 Section 26 09 24 Lighting Controls (Occupancy Sensors, Low Voltage Switching Devices, etc.).

1.4 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA-C22.2 No.42, General Use Receptacles, Attachment Plugs and Similar Devices.
 - .2 CSA-C22.2 No.42.1, Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
 - .3 CSA-C22.2 No.55, Special Use Switches.
 - .4 CSA-C22.2 No.111, General-Use Snap Switches (Bi-national standard, with UL 20, twelfth edition).

Part 2 Products

2.1 SWITCHES

- .1 Heavy duty specification grade.
- .2 20 A, 120 V or 347 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 Standard of acceptance:
 - .1 Hubbell HBL.1221 20A series
 - .2 Leviton 1221-20A 120V series – 18221 347V
 - .3 Pass & Seymour PS20AC1 120V series – PS37201(3)0 347V

2.2 RECEPTACLES – GENERAL

- .1 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)
 - .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 Receptacles of one manufacturer throughout project.
- .4 Standard of acceptance:
 - .1 Hubbell 5252 heavy duty, construction series
 - .2 Leviton 5262 series
 - .3 Pass & Seymour 5262 series

2.3 RECEPTACLES – PARTICULAR APPLICATION

- .1 Ground Fault Interrupter type to be 15 Amp, 125 volt duplex receptacles to be 2 pole, 3 wire hospital grade, white face, parallel blade, U ground, impact resistant nylon face, complete with breaker and reset button. Equal to:
 - .1 Hubbell GF8200A series
 - .2 Leviton 7599HG series
 - .3 Pass & Seymour HG1595 series (Décor)
- .2 All other single outlet and special purpose receptacles to be similar to the grade and series indicated above. Confirm ampacity, voltage and pin configuration prior to installation.

2.4 DIMMERS

- .1 Flush mounted - Specification grade.
- .2 Incandescent application: 600-1500 watts based on connected load plus 25% spare.
- .3 Electronic Driver application: compatible with driver specified.
- .4 Radio interference suppression.
- .5 Thin profile: slide to OFF feature.
- .6 Finished in white or as indicated.
- .7 Standard of acceptance:
 - .1 Lutron 'NOVA-T' NT series.
 - .2 Leviton « Illumatech » series.

2.5 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.
- .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. Neutral up when receptacle in mounted horizontal.
 - .3 Install receptacles vertically in gang type outlet box when more than one receptacle is required in one location.
 - .4 Where split receptacles has one portion switched, mount vertically and switch the upper portion.
 - .5 Surge suppression duplex receptacles to be provided for all communication and computer terminal equipment backboards and cabinets including fire alarm, telephone, public address, door security, nurse call, central dictation, RF television, security television, etc. Provide dedicated neutral conductors for each surge suppression receptacle.
 - .6 Ground fault interrupter duplex receptacles to be used, adjacent sinks or water sources.
- .3 Cover plates:
 - .1 Protect 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.

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 PRODUCT DATA

- .1 Submit product data in accordance with Section 26 05 00.

Part 2 Products

2.1 DISCONNECT EQUIPMENT

- .1 "Heavy Duty" class, enclosed manual air break switches in non-hazardous locations: to CSA C22.2 No.4
- .2 Fuseholder assemblies to CSA C22.2 No.39.
- .3 Fusible and non-fusible disconnect switch in CSA enclosure.
- .4 Provision for padlocking in off switch position.
- .5 Fuses as indicated. Allow for Class J or L for general circuits, Class RK5 for transformer, motor or other high inrush current circuits
- .6 Fuseholders in each switch suitable without adaptors, for type of fuse as indicated.
- .7 Quick-make, quick-break action.
- .8 ON-OFF switch position indication on switch enclosure cover.
- .9 Weatherproof as required.

2.2 CONTACTOR EQUIPMENT

- .1 Contactors: to CSA C22.2 No.14.
- .2 Half size contactors not accepted.
- .3 Electrically operated, electrically or mechanically held, multi-pole full voltage type.
- .4 Contactors to have 120V operating (and unlatching) coils unless otherwise noted.
- .5 Controlled by pilot devices as indicated and rated for type of load controlled.
- .6 Breaker or Fused switch combination contactor as indicated.
- .7 Complete with 1 normally open and 1 normally closed auxiliary contacts unless indicated otherwise.
- .8 Provide CEMA enclosure as required for location unless indicated otherwise.

2.3 EQUIPMENT IDENTIFICATION

- .1 Indicate name of load controlled on size 4 name plates to Section 26 05 00.

2.4 STANDARD OF ACCEPTANCE

- .1 Cutler Hammer – Heavy Duty xxxx
- .2 Schneider - Heavy Duty xxxx
- .3 Siemens - Heavy Duty xxxx

Part 3 Execution

3.1 DISCONNECT INSTALLATION

- .1 Install disconnect switches complete with fuses where indicated or required.
- .2 All disconnect switches for elevator machine rooms shall be fused in accordance with the equipment suppliers' requirements.
- .3 Provide an auxiliary switch with dry contacts on all elevator disconnects and as required by the Elevator Code. Review elevator shop drawings to confirm any additional requirements.
- .4 Provide and locate safety disconnect switches to isolate individual items of equipment in accordance with Canadian Electrical Code CSA 22.1 whether indicated or not on the contract drawings.

3.2 MOTOR PLUG/RECEPTACLE AND QUICK DISCONNECTS

- .1 Motor quick disconnects do not negate the requirement for a switched safety disconnect as specified in this Division. A separate disconnect is still required unless the Consultant has given a special pre-approved circumstance.

3.3 CONTACTOR INSTALLATION

- .1 Install contactors and connect auxiliary control devices.
- .2 Pilot lights to be illuminated when contactor is closed.
- .3 Control wire to be minimum #14 AWG. Remote control wiring to be 5A fuse protected and the wiring shall be upsized to limit voltage drop to no more than 2%.
- .4 Control circuits shall fail safe leaving the contactor in the open position if the power fails or where automatic reset could be a safety or operational concern. Provide a control circuit seal-in contact for all momentary contact control devices unless otherwise indicated.
- .5 The contactor shall not automatically reset after a power failure unless otherwise indicated or for such items as automatic freeze protection, snow melting, light control etc.
- .6 Electrically held contactors to be located in service rooms where practical.

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 REFERENCES

- .1 CAN/CSA C22.1-09, Canadian Electrical Code, Part I.
- .2 CAN/CSA C22.2 No.9.0, General Requirements for Luminaires.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Division 01 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Workplan.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.

1.4 ADDITION OF ACCEPTABLE MANUFACTURERS

- .1 Refer to Section 26 05 00 and as noted below.
- .2 Material/products considered to satisfy the specification, but of a manufacturer other than those named may be submitted to the Consultant for consideration not later than five (5) working days prior to RFP closing or of RFP depository subtrade tender whichever is earlier.
- .3 Alternate approvals will be given by written addendum only. No other substitution will be permitted after RFP closing.
- .4 Alternate approvals granted before the RFP closing will be limited to a manufacturer's system and/or series only. This limited approval will not preclude substitute equipment/material from complying with specific features included with equipment/material specified. Determine that the alternate product meets the specification intent before basing a Proposal on the product

1.5 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 26 05 00.
- .2 Submit complete photometric and heat dissipation data prepared by independent testing laboratory for proposed luminaires.
- .3 Photometric data to include VCP Table and spacing criterion.

1.6 INTENT

- .1 Provide lighting fixtures and accessories for all outlets as listed in the Fixture Schedule and as shown on drawings.
- .2 Lighting fixtures shall be structurally well designed and constructed, using new parts and materials of the highest commercial grade available.
- .3 Ground all lighting equipment to grounding system.

- .4 Verify all ceiling types and finishes before ordering fixtures and provide fixtures suitable for mounting in or on ceilings being installed in each area, as specified. Where fixture types specified are not suitable for ceiling being installed, obtain written instructions from the Consultant before ordering fixtures.
- .5 Fixtures of the same or similar type shall be supplied by the same manufacturer.

Part 2 Products

2.1 FIXTURES

- .1 Accessories and components shall comply with relevant CSA Standards.
- .2 Recessed downlight fixtures shall be of the approved prewired type with junction box forming an integral part of the fixture assembly and so located in relation to the fixture that the junction box is CSA approved for 60 degree C wire. The electrical trade shall supply and install all necessary plaster rings, supports, etc., required for complete and proper installation.
- .3 Except where otherwise noted in the Fixture Schedule, depth of recessed fixtures shall not exceed 150 mm, including mounting yokes, or bridges and the distance from the back face of the diffuser or lens to the centre of the lamp shall be not less than 75 mm. Design of reflector and lamp position shall be to provide high efficiency, even brightness and lack of lamp lines.
- .4 Fixtures shall be constructed of not less than code gauge steel. All metal parts shall be thoroughly cleaned and finished in high reflectance baked white enamel over corrosion-resistant primer. Reflecting surfaces and exposed surface shall have not less than two coats of baked white enamel with reflectance of not less than 85%.
- .5 All fixture diffusers, lens panels, lens frames, etc., shall be securely and adequately supported and shall be removable without the use of tools for cleaning.
- .6 Fixtures shall incorporate adequate gasketing, stops and barriers to form light traps and prevent light leaks.
- .7 Fixtures shall be designed for adequate dissipation of heat to avoid short life, nuisance thermal tripping and decreased output. Heat test reports by independent laboratories shall be provided where required by the Consultant.
- .8 Construction of all fixtures shall be such as to provide a rigid well aligned fixture. Formed or ribbed backplates, end plates, reinforcing channel, straps, etc., shall be used where required to accomplish this.
- .9 The construction and performance of all fluorescent fixtures shall be subject to the acceptance of the Consultant. Full photometric data from independent testing laboratory shall be provided when requested by the Electrical Consultant.

Part 3 Execution

3.1 INSTALLATION AND SUPPORTS

- .1 Provide complete and proper support for all fixtures, fixture hangers, etc., including headers in ceiling space, where required, for proper support of outlet boxes and fixture hanger assemblies.
- .2 Support fixtures as shown on the drawings, level, plumb and true with the structure and other equipment in a horizontal or vertical position as intended. Wall or side bracket mounted fixture housings shall be rigidly installed and adjusted to give a neat flush fit to the surface on which it is mounted.

- .3 All hangers, supports, fastenings or accessory fittings shall be protected against corrosion. Care shall be taken during the installation to assure that insulation and corrosion protection is not damaged.
- .4 Self aligning seismically rated ball joint hangers shall be used for rod suspended fixtures. Ceiling canopies or hood assemblies intended to cover the suspension attachments shall be installed to fit tightly to the ceiling without restricting the alignment of the hanger. Support fixtures by hangers and mounting arrangements which will not cause the fixture frame, housing, sides or lens frame to be distorted; or prevent complete alignment of several fixtures in a row.
- .5 The suspension length of all ceiling mounted suspended types of lighting fixtures as listed in the Fixture Schedule shall be the overall length from the ceiling to the lowest point of the fixture body, reflector or glassware in its hanging position.
- .6 Metal inserts, expansion bolts or toggle bolts in concrete slabs for stems which do not carry wiring must be accurately located in relation to the outlet boxes, to allow perfect alignment and spacing of suspension stems.
- .7 Where fixtures are surface mounted on the underside of an inverted tee bar ceiling, the fixture shall be supported either directly from the building structure by means of rod hangers and inserts or by means of metal angle headers, supported from the tee bar framing structure above the tile. Fixtures shall be supported from the quarter points.
- .8 Wiring from outlet boxes to fluorescent fixtures and wiring through fluorescent fixture channels shall be rated for 90 degrees C.
- .9 All recessed fixtures to be installed so that they are removable from below to gain access to outlet box or prewired fixture box. Connect all recessed fixtures to boxes with flexible conduit and approved fixture wire. Provide approved drywall enclosures in insulated ceilings. Volume of enclosure to comply with Electrical Code.
- .10 Install fixture lenses as late as possible to protect from dirt and dust. Remove and clean or replace lenses to the satisfaction of the Consultant.

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 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Division 01 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Workplan.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.

1.3 PRODUCT DATA

- .1 Submit product data in accordance with Section 26 05 00.
- .2 Shop drawings to include a load schedule on each battery pack and spare capacity.

1.4 GUARANTEE

- .1 Provide a written guarantee, stating that the battery for emergency lighting is guaranteed against defects in material and workmanship for a period of ten years, with a no-charge replacement during the first five years and a pro-rate charge on the second five years, from the date of the Final Certificate of Completion.

Part 2 Products

2.1 BATTERY UNIT EQUIPMENT

- .1 Unit equipment for emergency lighting: to CSA C22.2 No.141.
- .2 Supply voltage: 120 V, ac.
- .3 Output voltage: 12 V dc.
- .4 Operating time: 30 minutes.
- .5 Nominal size – 200 watt, or as required to serve number of heads supplied, as indicated on drawings.
- .6 Battery: lead acid, sealed, maintenance free.
- .7 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected, modular constructed.
- .8 Solid state transfer.
- .9 Low voltage disconnect: solid state, modular, operates at 80% battery output voltage.
- .10 Signal lights: solid state, life expectancy 100,000 h minimum, for 'AC Power ON' and 'High Charge'.
- .11 Cabinet: suitable for direct or shelf mounting to wall and c/w knockouts for conduit. Provide shelf mounting brackets.
- .12 Provide integral self diagnostic testing feature which exercises the unit every 30days.
- .13 Auxiliary equipment:

- .1 Test switch.
- .2 Time delay relay.
- .3 Shelf bracket.
- .4 Cord and plug connection for ac.
- .5 Double LED lamp fixtures mounted on unit where noted on plans.

2.2 REMOTE LAMP HEADS

- .1 Min 4 watt LED lamp.
- .2 12 volt DC operation.
- .3 360 degree adjustable rotation without tools.
- .4 Decorative vandal-resistant frosted cube fixtures (double head) in high risk areas or where indicated.
- .5 Provide equipment guards for Gymnasium and similar installations.

2.3 WIRING FOR REMOTE EQUIPMENT

- .1 Conduit to Section 26 05 34
- .2 Wiring 12V battery standby circuits to all EXIT signs and remote heads.
- .3 Low voltage wiring to be installed so that the maximum volt drop does not exceed 5%.
The following wiring/load sizes shall not be exceeded for the 12-volt system:
 - .1 #8 AWG not to exceed 6500 watt feet per run.
 - .2 #10 AWG not to exceed 4000 watt feet per run (minimum size).

2.4 RELAY EQUIPMENT

- .1 Provide 120V relays to control battery packs as required by BC Building code to operate in the event of power failure to the related area lighting circuits.

Part 3 Execution

3.1 INSTALLATION

- .1 Install unit equipment for emergency lighting in accordance with CSA C22.1, Section 46.
- .2 Install unit equipment and remote mounted fixtures as indicated.
- .3 Direct heads as indicated.
- .4 Provide a junction box adjacent to the battery pack for the purpose of splicing the separate wiring runs together.
- .5 Provide a 15 Amp, 125 volt receptacle adjacent to each battery unit.

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 REFERENCES

- .1 Canadian Standards Association:
 - .1 CSA C22.2 No.141, Unit Equipment for Emergency Lighting.
 - .2 CSA C860, Performance of Internally-Lighted Exit Signs.
- .2 BC Building Code, Part 3, Section 3.4.5

1.3 PRODUCT DATA

- .1 Submit product data in accordance with Section 26 05 00.

Part 2 Products

2.1 SCHEDULE

- .1 Refer to drawings for location and types. Provide directional arrows as indicated.

Type	Description
------	-------------

XC1	Ceiling mounted, single face
------------	------------------------------

XC2	Ceiling mounted, double face
------------	------------------------------

XW1	Wall mounted back to wall
------------	---------------------------

XE1	End wall mounted single face
------------	------------------------------

XE2	End wall mounted double face
------------	------------------------------

XR1	Wall mounted recessed into wall or finish.
------------	--

2.2 EXIT SIGNS GENERAL

- .1 Green Pictogram per BCBC.
- .2 Universal mounting.
- .3 Wall, end, or ceiling mounted as shown on drawings.
- .4 Single or double-faced as indicated
- .5 Light Emitting Diode (LED) light source for 120 volt operation.
- .6 Provide 12VDC standby lamps/system and connection points to accommodate standby power from an external 12VDC source.
- .7 Faceplate and housing to have no visible unused knockouts.

- .8 Provide weatherproof exit signs for all exterior installations.
- .9 CSA 860-01 approved.

2.3 THIN PROFILE EXTRUDED ALUMINUM EXIT SIGNS – PICTOGRAM TYPE

- .1 Extruded aluminum faceplate, housing and canopy.
- .2 Nominal 25mm [1"] deep (thin profile).
- .3 Brushed finish on faceplate c/w "hidden" universal knock-outs.
- .4 Standard finish or as indicated.
- .5 Rounded corners.
- .6 Standard of acceptance:
 - .1 Ready-Lite RA series
 - .2 Emergi-lite EA series
 - .3 Pre approved equivalent.

2.4 EDGE LIT EXIT SIGNS

- .1 Extruded aluminum cylindrical housing and canopy.
- .2 White baked powder coat finish or as indicated.
- .3 High clarity solid acrylic faceplate.
- .4 Field removable directional chevron arrows.
- .5 Universal mounting. (ceiling, wall, end)
- .6 Rounded corners.
- .7 Standard of acceptance:
 - .1 Beghelli Ottica series,
 - .2 Pre approved equivalent.

2.5 SELF POWERED EXIT SIGNS

- .1 Exit sign unit(s) to be complete with self contained battery system to maintain illumination during a mains power failure.
- .2 Sealed maintenance free batteries.
- .3 Recharge time 24 hours.
- .4 Solid state charger and transfer technology (no relay contacts)
- .5 Status LED to indicate "AC on"
- .6 Push button test switch.
- .7 Operating time for minimum as required by Building Code. ½ hr

Part 3 Execution

3.1 INSTALLATION

- .1 Install Exit Signs as indicated.
- .2 Connect Exit Signs to dedicated circuits and breakers as required by the Canadian Electrical Code.

- .3 Provide circuit breaker locks for Exit Sign circuits.
- .4 Power to exit lights to be sourced from emergency power were available.
- .5 Provide at least one Exit Sign circuit for each floor level except as noted.
- .6 All Exit Sign wiring to be installed in separate conduit and boxes.
- .7 All conductors to be minimum #12 AWG with RW90 X-link insulation.
- .8 Provide Exit Sign 12VDC standby lighting and separate connection points where standby emergency lighting battery packs are used for the emergency lighting. For remote connections low voltage cable sizing refer to the battery systems specification section.
- .9 Support Exit Signs from ceiling tile in tee bar installation locations so as to provide a flush/neat installation and minimize tile lift.
- .10 Provide approved support hardware to the tee bar rail assembly to minimize tile stress and provide independent seismic cable(s) restraint from building structure.
- .11 Wall mounted exit lights to be mounted 2290mm [7' 6"] to underside or as detailed.
- .12 Ceiling mounted exit lights in all service spaces to be suspended to 2290mm [7' 6"] to the underside.

3.2 FINAL ACCEPTANCE

- .1 Position exit lights to optimize viewing angles and to avoid line of site obstructions.
- .2 Attend the building occupancy review with the Authority Having Jurisdiction and adjust any locations as required.
- .3 Install any additional exit signs as requested in accordance with "Spare Exit Sign Material" clause noted above.

END OF SECTION

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EF 130	Certificate of Penetrations Through Separations
EF 131	Certificate of Seismic Restraint Installation
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EF 140	Check List & Record – Items to be Handed to Owner
EF 141	Check List – Owners Demonstration
EF 142	Check List – Substantial Performance Submissions - Electrical
EF 143	Certificate of Substantial Performance - Electrical
EF 144	Check List – Work Remaining after Substantial Performance
EF 145	Certificate of Total Performance - Electrical

1.1 EF 100 Check List – Submissions to Consultant

ITEM	CHECKED BY	DATE
5 WORKING DAYS BEFORE CLOSE OF SUBTRADE TENDER – Request for addition of acceptable manufacturers		
10 DAYS AFTER AWARD OF THE CONTRACT – List of equipment suppliers and subtrades (EF 110) – Detailed price breakdown (EF 112)		
A.S.A.P. – Shop drawings and Product Samples (EF 111)		
WITH EACH APPLICATION FOR PROGRESS PAYMENT – Price breakdown (EF 112)		
PRIOR TO DEMONSTRATION OF SYSTEMS – Demonstration agenda		
DEMONSTRATION OF SYSTEMS – Checklists for sign off of Demonstrations (EF 141)		
10 DAYS PRIOR TO SUBSTANTIAL PERFORMANCE – Submission of items listed on Form EF-142		
WHEN REQUESTING REVIEW OF OUTSTANDING WORK – Checklist of work remaining (EF 144) – Certificate of total completion (EF 145)		

1.2 EF 110 Equipment/Sub-Trade List

ITEM	COMPANY/SUPPLIER
Switchgear and Distribution	
Motor Control	
Wiring Devices	
Luminaries	
Voice Data Equipment/System	
Voice Data Sub-trade	
Fire Alarm System	
Fire Alarm Verification Agency	
Security System Equipment	
Security Sub-trade	
Seismic Engineer	
Testing and Commission Agency	
Other	
Other	
Other	

1.3 EF 111 Check List –Shop drawings and Product and Samples

ITEM	DATE SUBMITTED	REVIEW	
		ACTION	DATE
Motor Control			
Wiring Devices			
Luminaires (list groups)			
EXIT Signs and Emergency Lighting			
Voice/Data system			
Fire Alarm System			
Security System			

1.4 EF 112 Progress Claim Summary – Division 26, 27, 28, 33

PROJECT: _____ **CLAIM NO:** _____
FOR MONTH OF: _____

ITEM		PRICE	WORK TO DATE		PREVIOUS WORK		THIS MONTH	
		\$	%	\$	%	\$	%	\$
Base Contract:								
General Conditions								
Mobilization (not to exceed 2%)								
Demolition								
Site Work & Utility	Mat Lab.							
Conduit, Boxes & Wire	Mat Lab.							
Distribution	Mat Lab.							
Motor Control	Mat Lab.							
Generator Equipment	Mat Lab.							
Wiring Devices & Plates	Mat Lab.							
Lighting	Mat Lab.							
Voice/Data Systems	Mat Lab.							
Fire Alarm System	Mat Lab.							
Security Systems	Mat Lab.							
O & M								
Testing &								
Other								
Cash Allowances								
Total Base Contract								
Change Order								
Total Change Orders								
Total Contract:								
Amount due less 10% mechanics lien holdback								

Submit this form as called for on **EF 100** for Proposal price breakdown and for each progress claim

1.5 EF 120 Check List –Colour Coding

Obtain sign off from Building Owners representative prior to colour coding systems.

Project Identification: _____

	SYSTEM	MAJOR BAND	MINOR BAND	CHARACTERS
1	120/208 volt			
2	347/600 volt			
3	Fire Alarm			
4	Security/Alarm			
5	Communications			
6	Other			
7	Other			
8	Other			
9	Other			
10	Other			

Prepared By _____

Owners Sign Off _____ DATE _____

1.6 EF 130 Certificate of Penetrations Through Separations

Project Identification: _____

I hereby declare that I _____

am an employee/a principal of _____

have personally witnessed that all electrical service penetrations through fire separations (rated & non-rated) and sound separations in the following areas have been properly sealed in accordance with the specified requirements.

SIGNED _____ DATE _____

AREA	SIGNED	DATE
Level:		
Level:		
Level:		
Level:		
Level:		
Level:		
Level:		
Level:		
Level:		
Level:		

NOTES:

- .1 This certificate shall be submitted to the Consultant prior to Substantial Performance.

1.7 EF 131 Certificate of Seismic Restraint Installation

Project Identification: _____

I hereby declare that I _____

am an employee/a principal of _____

Certify that the seismic restraint of all electrical equipment and wiring system installation meets the requirements of the B.C. Building Code as it relates to seismic restraint and the Schedules B, B1 & CB have been submitted and signed and to the Consultant.

SIGNED _____ DATE _____

NOTES:

- .1 This certificate shall be submitted to the Consultant prior to Substantial Performance

1.8 EF 132 Certificate of Acoustic and Vibration Isolation

Project Identification: _____

I hereby declare that I _____

am an employee/a principal of _____

Certify that the vibration isolation installation for the Electrical Equipment has been satisfactorily completed.

SIGNED _____ DATE _____

NOTES:

- .1 This certificate shall be submitted to the Consultant prior to Substantial Performance

1.10 EF 141 Check List – Owners Demonstration

SYSTEM/ITEM	CONTRACTOR		OWNER	
	SIGNED	DATE	SIGNED	DATE
Motor Control Operation				
Lighting System Controls				
Fire Alarm Systems				
Security Systems				
Data/Voice Systems				
Location of Control Devices				
Access to Equipment				
Review of Maintenance Manual				
Points of required Maintenance				

NOTES:

- .1 Contractor shall submit copies of this form with each appropriate item signed and dated by the person having overall charge of commissioning prior to substantial performance. (See **EF 143**).
- .2 Owners representative shall sign off each item during or after the demonstration.
- .3 Contractor to strike out items where they do not apply to the systems being demonstrated.
- .4 Interlocks and controls to be demonstrated by following the descriptions and diagrams in the contract documents and proving that all controls function as required.
- .5 Where multiple identical controls are installed the Owners representative may elect to only witness sample items, but the person having charge of commissioning is expected to have checked them all.

1.11 EF 142 Check List – Substantial Performance Submissions - Electrical

SECTION	ITEM	DATE	STATUS
260500	Final Electrical Inspector Certificate		
260500	Fire Stop Penetration Certificate. (EF-130)		
260500	Acoustic & Vibration Isolation Certificate. (EF-132)		
260500	Items handed to Owner Checklist (EF 140)		
260500	Identification		
260500	Record Drawings		
260500	Operating & Maintenance Manuals		
260505	Seismic Engineer Report and Schedules (EF131)		
270000	Voice/Data Verification		
280000	Security System Commissioning		
283100	Fire Alarm Verification Report and Appendix C (FA)		
	Contractors Letter of Guarantee		
	Demonstration to Operating Staff agenda		
	Demonstrations Checklists (EF 141)		
	Substantial Performance Certificate (EF143)		
	Checklist of work remaining after Substantial (EF 144).		

NOTES:

- .1 This list is provided as a checklist and may not include all Substantial Performance requirements.

1.12 EF 143 Certificate of Substantial Performance - Electrical

I hereby certify that I _____
am an employee / a principal /an agent

of _____

and have personally witnessed the following with regard to the electrical systems work specified for the above project and that to the best of my knowledge except as noted on **EF 144** (attached);

- The installation is complete and as specified.
- The systems have been commissioned and operate satisfactorily.
- Every control sequence and every control performs as specified.
- The systems are clean.
- All of the required submissions have been made to the consultant.

SIGNED _____ DATE _____

NOTES:

- .1 This certificate must be completed and submitted to the consultant prior to substantial performance.
- .2 If it is apparent that the systems or their operation are seriously deficient then all reasonable costs and consultant time charges relating to any subsequent site reviews shall be deducted from the contract sum.

1.14 EF 145 Certificate of Total Performance – Electrical

I hereby certify that I _____
am an employee / a principal / an agent

of _____

and have personally witnessed that each item of outstanding work on the checklist and record of work remaining after substantial completion EF 144 (attached) has been satisfactorily completed and I hereby certify that the Electrical systems work specified on the above project is complete.

SIGNED _____ DATE _____

NOTES:

- .1 This certificate must be completed and submitted to the Consultant when requesting total performance.
- .2 If it is apparent during the final review that the systems or their operation are seriously deficient then all reasonable costs and consultant time charges relating to any subsequent site reviews shall be deducted from the contract sum.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
- .2 Refer to Section 26 05 00 Common Work Results.
- .3 Complete and operational telecommunications system as required by the drawings and as herein specified.
- .4 Provide all labour, materials, tools, and equipment required for the complete installation of work called for in all sections of the contract documents.

1.2 REFERENCES

- .1 TIA/EIA-568-B.1 Commercial Building Telecommunications Cabling Standard – Part 1: General Requirements
- .2 TIA/EIA-568-B.2 Commercial Building Telecommunications Cabling Standard – Part 2: Balanced Twisted Pair Cabling Components
- .3 TIA/EIA-569-B Commercial Building Standard for Telecommunications Pathways and Spaces
- .4 TIA/EIA-606-B Administration Standard for Commercial Telecommunications Infrastructure.
- .5 J-STD-607-A Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
- .6 NECA/BICSI 568-2006 Standard for Installing Commercial Building Telecommunications Cabling
- .7 ANSI/TIA 568-B.2-10 Augmented Category 6A Cabling
- .8 BICSI Telecommunications Distribution Methods Manual (TDMM), latest edition
- .9 Canadian Electrical Code (CEC)

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Division 01 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Workplan.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.

1.4 SPECIFICATIONS AND DRAWINGS

- .1 The General Conditions, Supplementary Conditions and Division 01 are part of this specification and shall apply to this Division.
- .2 The intent of the specifications and drawings are to include all labour, products and services necessary for complete work, tested and ready for operation.
- .3 Symbols used to represent various telecommunications devices often occupy more space on the drawing than the actual device does when installed. In such instances, do not scale locations of devices from telecommunications symbols. Install these devices

with primary regard for usage of wall space, convenience of operation and grouping of devices.

- .4 These specifications and the drawings and specifications of all other divisions shall be considered as an integral part of the accompanying drawings. Any item or subject omitted from either the specifications or the drawings but which is mentioned or reasonably specified in and by the others shall be considered as properly and sufficiently specified and shall be provided.
- .5 Provide all minor items and work not shown or specified but which are reasonably necessary to complete the work.

1.5 QUALITY ASSURANCE

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 Health and Safety Requirements.

1.6 PRODUCT HANDLING

- .1 Use all means necessary to protect the products of this Division before, during and after installation and to protect products and installed work of all other trades.
- .2 Immediately make good any damage by repair or replacement at no additional cost to the Owner and to the approval of the Consultant.
- .3 Remove advertising labels from all equipment. Do not remove identification or certification labels.

1.7 LABOUR

- .1 The communications contractor must comply with all job-site requirements for the duration of the project.
- .2 The communications contractor agrees to use only trade person who are fully trained, qualified and experienced on the installation, termination and testing of the structured cabling solution. The communications contractor must be an approved installer of the specific structured cabling solution.

Part 2 Products

2.1 SELECTED PRODUCTS & EQUIVALENTS

- .1 Products and materials provided shall be new and free from all defects. Defective products or materials will be rejected, regardless of previous inspections. The contractor shall be responsible to remove and replace defective products at their expense, and shall be responsible for any resulting delays and associated expenses which result from defective products being rejected. Related materials shall be of the same manufacturer throughout the project.
- .2 Products and materials referred to in the specifications by trade names, manufacturer's name and catalogue reference are those which shall be used as the basis for the Proposal.

2.2 QUALITY OF PRODUCTS

- .1 All products provided shall CSA approved, Canadian Underwriters' Laboratory approved where applicable, and new unless otherwise specified.
- .2 If products specified are not CSA approved, obtain special approval from the local regulatory authority. Pay all applicable charges levied and make all modifications required for approval.

- .3 Products provided, if not specified, shall be new, of a quality best suited to the purpose required and their use subject to approval by the Consultant.

2.3 UNIFORMITY OF MANUFACTURE

- .1 Unless otherwise specifically called for in the specifications, uniformity of manufacture shall be maintained for similar products throughout the work.

2.4 USE OF PRODUCTS DURING CONSTRUCTION

- .1 Any equipment used for temporary or construction purposed shall be approved by the Construction Manager and in accordance with the General Conditions, "Use of Premises." Clean and restore to "as new" condition all equipment prior to the time of substantial completion.
- .2 The warranty period shall begin when the date of substantial performance of work on each tranche.

Part 3 Execution

3.1 COORDINATION WITH OTHER DIVISIONS

- .1 Examine the specifications and drawings of all divisions and become fully familiar with their work. Coordinate work with all trades and make changes to facilitate a satisfactory installation.
- .2 Lay out the work and equipment with due regard to architectural, structural, mechanical, electrical and A/V features. Architectural and structural drawings take precedence over the telecommunications drawings regarding locations of wall, door, equipment and location and heights of outlets.
- .3 Coordinate with all Divisions installing and services, and ensure that there are no conflicts.
- .4 Install anchors, bolts, pipe sleeves, hanger inserts, etc. in ample time to prevent delays.

3.2 LOCATION OF OUTLETS

- .1 Telecommunications drawings are, unless otherwise indicated, drawn to scale and approximate distances and dimensions may be obtained by scaling. Figured dimensions shall govern over scaled dimensions. Where exact dimensions and details are required, refer to Architectural and Structural drawings.
- .2 Unless otherwise specified or shown, install products in accordance with recommendations and ratings of manufacturers.

3.3 SEPARATION OF SERVICES

- .1 Maintain separation between electrical wiring system and building piping, ductwork, etc. so that wiring system is isolated (except at approved connections to such systems) to prevent galvanic corrosion.
- .2 In particular, contact between dissimilar metals, such as copper and aluminum, in damp or wet locations is not permitted.
- .3 Do not support wiring from pipes, ductwork, etc. Hangers for suspended ceilings may be used for the support of wiring only when approval is obtained from the Owner and the ceiling installer, and approved clips or hangers are used.

3.4 MOUNTING HEIGHTS

- .1 Refer to section 26 05 00 Common Work Results for general mounting heights specification.
- .2 Refer to all architectural drawings for telecommunications outlet mounting heights direction and requirements.

3.5 SEALING OF WALL AND FLOOR OPENINGS

- .1 All conduit and cable entries through outside walls of building, through partition walls separating electrical rooms from other areas, through fire separations, and through floors above grade shall be sealed to prevent passage of moisture, dust, gases, flame, or to maintain pressurization.
- .2 Openings shall be sealed when all wiring entries shown on the drawings have been completed.
- .3 Sealing material shall be fire resistant and shall not contain any compounds which will chemically affect the wiring jacket or insulating material. Cable penetrations through fire separations to be sealed with approved firestopping material.

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 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Division 01 - Construction/Demolition Waste Management and Disposal and with the Waste Reduction Workplan.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Place materials defined as hazardous or toxic waste in designated containers.

1.3 REGULATORY REQUIREMENTS

- .1 The fire alarm system to be designed and installed to meet the following standards:
 - .1 C.S.A. Standard C22.1, Canadian Electrical Code, Part 1 (current edition) and bulletins & amendments for British Columbia and as adopted by the City of Vancouver (where appropriate).
 - .2 The British Columbia Building Code and as adopted by the City of Vancouver (where appropriate).
 - .3 NFPA 72 National Fire Alarm Code.
 - .4 CAN/ULC S524: Standard for Installation of Fire Alarm System.
 - .5 ULC publications and the related revisions, listed in ULC S524.
 - .6 CAN/ULC S537: Standard for Verification of Fire Alarm System.
 - .7 CAN/ULC S525/S526/S527/S528/S529/S530/S531/ Equipment Standards.
 - .8 CSA-B44. Safety Code for Elevators & Escalators.
- .2 Installation subject to approval of consultant and fire marshal for final acceptance.

1.4 STANDARD OF ACCEPTANCE

- .1 Existing fire alarm system is a Simplex 4010 series system. New devices to be of same manufacturer.
- .2 All products included must be capable of being verified as a complete system under full warranty by the contractor.
- .3 Supply and install a complete system as the scope of this section.
- .4 The pre approved system manufacturers is Simplex.

1.5 SYSTEM

- .1 Existing Fire Alarm System to remain. New devices are to be provided in renovated area and are to be integrated into existing system.

1.6 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 16010 [26 05 00].and as outlined herein. All shop drawings items to be within one complete submission.

- .2 The Electrical Contractor, or their fire alarm sub-trade, is responsible for surveying the existing system and providing all information for production of shop drawing requirements below to the fire alarm system supplier.
 - .3 Shop drawings to include a complete material list with manufacturer, style, model number and quantity. Cable type and size to be included in material list.
 - .4 Shop drawings to include manufacturer's specification sheets with photographic depiction of all system components. Specification and descriptive data to include dimension, weight, appearance, connection provisions, materials, metal gauges and operating specification, characteristics, features and controls.
 - .5 Shop drawings to include the following diagrams:
 - .1 Complete system block diagrams indicating all components, interconnection and cabling in accordance with ULC S524 requirements. Provide an input/output sequence of operation matrix.
 - .2 Complete detailed system circuit and riser diagrams indicating:
 - .1 Main control panel,
 - .2 Alarm devices,
 - .3 Main graphic annunciator,
 - .4 Alphanumeric annunciators,
 - .5 Auxiliary interconnections,
 - .6 Component layout,
 - .7 Identification schedules,
 - .8 Zone wiring designations,
 - .9 Panel interconnect wiring,
 - .10 Detailed wiring connections and wire designations.
 - .3 Complete wiring diagram showing terminal identification, cable type and cable designation, including existing system components.
 - .6 No material or equipment to be delivered to the jobsite prior to final review of shop drawings unless otherwise specified and documented in writing by the Consultant.
 - .7 Provide factory data sheets for new devices.
 - .8 All new system devices indicating:
 - .1 Typical wiring connections,
 - .2 Installation instructions,
 - .3 Control settings,
 - .4 Component limitations.
- 1.7 OPERATING MANUALS**
- .1 Refer to Section 26 05 00.
- 1.8 WARRANTY/SERVICE**
- .1 System installer to include with his base Proposal price a guarantee stating:
 - .1 Service to be provided on system within 24 hours of call origination during the warranty period.
 - .2 Full warranty on new system to be provided for a period of 12 months.

- .3 During warranty period the system installer at his expense shall repair and replace all such defective work and other work to the new system damaged thereby which fails or becomes defective during the term of the warranty, provided that such failure is not caused by improper usage or physical damage.
- .4 Should the system installer fail to comply with Sub-item 1.1, work will be performed by others at the contractors expense.
- .5 Warranty date to commence from date of final acceptance of this work.
- .6 Existing equipment and wiring which is not affected by renovation is to be excluded from warranty.

1.9 TRAINING

- .1 Provide a single 2 hour training session to facility maintenance staff demonstrating changes to existing system.
- .2 Provide summary of maintenance requirements for all components of system.

1.10 TESTS AND ADJUSTMENTS

- .1 Upon completion of system installation, tests to be conducted by the system installer to determine system conformity to requirements of the specification. Tests to be conducted in presence of the Owners representative and Consultant who may suspend or discontinue tests at any time performance is considered unsatisfactory. Resumption of testing to cover the previously untested elements and any completed elements at the discretion of the Consultant.
- .2 All equipment or wiring provided by system installer which tests prove to be defective or operating improperly to be corrected or replaced promptly at no additional cost to the Owner.

1.11 SYSTEM SUPERVISION

- .1 Fire alarm pullstations, detectors, sprinkler (fire protection) circuits, pre-action sprinkler circuits, and annunciation network lines to be fully supervised utilizing a "Class B loop".
- .2 Communication lines between CPU, field transponder panels and fire command centre to be fully supervised utilizing Class A loop.
- .3 Complete system to be supervised against failure of operating power, open circuits, and ground. Supervision to be maintained on all circuits even in the event of a power failure, when the system is on battery standby. Any of the above shall cause trouble buzzer to sound at the main control panel and at the fire command centre and also light a common trouble lamp in the same panels. Trouble on system to produce a tone distinct from the tone of the alarm signals.
- .4 System to incorporate a silencing switch in the main control panel and at the fire command centre, which when operated, silences the trouble bell but causes the trouble lamp to remain illuminated until the trouble is cleared and the system returned to normal. Upon return to normal, trouble signal lamp shall be automatically reset to normal.

1.12 SYSTEM OPERATION

- .1 Existing operation to remain.

1.13 SOURCE OF SUPPLY

- .1 Complete fire alarm system shall be supplied by a single manufacturer unless otherwise noted.

1.14 COORDINATION

- .1 Coordinate installation of fire alarm system with:
 - .1 Mechanical equipment controls.
 - .2 Sprinkler flow and gate valve installation.
 - .3 Building Management system.
- .2 Coordinate with the above noted work as required to provide a complete, integrated, functional system.

1.15 SYSTEM COMMUNICATIONS

- .1 Each node or point shall have the ability to fully operate independently including all voice messaging if the network communication is lost. An open, short or ground on any one loop shall not degrade the network functionality.

1.16 SYSTEM WALK TEST

- .1 System to be able to have one person walk test feature with fully digitized alarm and trouble messages in English language that can either sound over the speakers or be silent and logged at the panel and later printed out. The one person walk test feature shall be zoned in the zones indicated and when a zone is put into the walk test the other areas will still be in alarm monitoring operation. Any alarm from the areas not in a walk test mode will override the area in walk test mode and operate all alarm sequences.

1.17 LABELLING – DEVICES AND PULLBOXES

- .1 Provide a 'Brother' style commercial quality label on each fire alarm device. Label to be clearly visible from the ground and contain the address information to correspond to the walk test voice or page.
- .2 Provide a red lamicoid label on all fire alarm equipment boxes such as isolators, relays, terminal blocks etc and wiring pull boxes. Lamicoid to be a minimum size 25mm x 50mm [1" x 2"] with clear white lettering indicating function, circuit address etc.

1.18 SYSTEM MAINTENANCE AND TESTING FACILITY

- .1 Provide required hardware/software such that ancillary, signal and monitoring station systems can be temporarily disabled by site personnel to enable testing of system. A trouble signal shall be present during testing but system ULC approval will be unaffected.

1.19 FIRE PLAN

- .1 Provide the fire alarm system portion of the "Building Fire Plan". Update and provide input for any existing plan.

Part 2 Products

2.1 FIRE ALARM CONTROL PANEL

- .1 Existing.
- .2 Provide expansion cards or additional panels as required to support new sprinkler system and other devices and equipment.

2.2 MAIN GRAPHIC ANNUNCIATOR PANEL

- .1 Flush mounted cabinet of code gauge metal construction. Custom build to fit available space.
- .2 Front panel door frame constructed of painted welded steel containing a clear lexan window mounted from rear of door frame.
- .3 Door to be complete with hinges, lock and keys.
- .4 Graphic artwork to consist of CAD produced mylar sandwiched between plastic laminated subpanels, hinge mounted to interior of the backbox.
- .5 Graphic to include each floor, floor zones exits, exit corridors, and a "You Are Here" sign, with the proper orientation on the graphic panel.
- .6 Special features:
 - .1 Graphic display panel to have art work to allow for future changes without replacement of total panel.
 - .2 LED (lights) are to be site changeable. LED mounting on a modular design and LED sockets to be mounted to a second interior backplate, hinged from backbox.
 - .3 Allow for a minimum of 20 zone fill colour selections by Consultant.
- .7 LED (lights) to be operated by driver units located within the panel, controlled by a multiplex signal off the system communication network.
- .8 Graphic annunciator panel to be complete with test button with remote transformer. Test to operate all lamps.
- .9 Graphic annunciator panel to be complete with trouble buzzer silence, acknowledge button, alarm silence and system reset.
- .10 Annunciator wiring to be electrically supervised.
- .11 Paint finish and colours to match area décor as selected by the Consultant.
- .12 Main annunciator to be separated into zones – refer to drawings.

2.3 REMOTE LCD ANNUNCIATORS

- .1 Existing main annunciator to remain as remote, secondary annunciator at change room facilities.

2.4 ADDRESSABLE MONITOR MODULES

- .1 Addressable monitor elements to meet or exceed the following technical requirements:
 - .1 Compatible with main fire alarm system.
 - .2 Field programmed.
 - .3 Individually identifiable.
 - .4 Supervised.
 - .5 Supervises normally open contact devices on supervised slave line. Supervision in Class B format with end-of-line resistor.
 - .6 Operating Voltage: 24 volts.
 - .7 Slave Line Resistance: 50 ohms maximum.
 - .8 Ambient Temperature: 0°C - 40°C.
 - .9 Ambient Humidity: 0 - 93%.

- .10 Complete with lamicaid identification on cover identifying address and device monitored.

2.5 ADDRESSABLE CONTROL MODULES

- .1 Addressable control elements to meet or exceed the following technical requirements:
 - .1 Compatible with main fire alarm system.
 - .2 Field programmed.
 - .3 Individually identifiable.
 - .4 Supervised.
 - .5 May be operated by any one or group of identifiable devices.
 - .6 May be operated from control centre or automatically by system.
 - .7 Contact rating: 0.5 amperes 120 volts AC, 2 amperes at 24 volt DC, with one (1) set of Type C contacts.
 - .8 Ambient Temperature: 0°C - 40°C.
 - .9 Ambient Humidity: 0 - 93%.
 - .10 Complete with lamicaid identification on cover identifying address and device controlled.

2.6 ADDRESSABLE DETECTOR BASES

- .1 Addressable detector bases to meet or exceed following technical requirements:
 - .1 Compatible with main fire alarm system.
 - .2 Field programmable.
 - .3 Supervised, including removal of specified plug-in detector devices.
 - .4 Designed to accept ionization, photo-electric smoke detectors and electronic heat detectors.
 - .5 Designed for remote LED output and base mounted LED.
 - .6 Operation on system data loop.
 - .7 Ambient temperature 0 to 90°C.
 - .8 Ambient humidity: 0 - 93%.
 - .9 Provide space for future relay in patient care locations (nurse call interface).
- .2 Provide a dry contact module in the base of all detectors in patient care rooms under the supervision of a Nurses station. The dry contacts will be used by the (existing or future) Nurse Call systems for signalling.

2.7 ADDRESSABLE MANUAL FIRE ALARM STATIONS

- .1 Manual Fire Alarm Stations: to ULC-S528 and as follows:
 - .1 Type: Addressable.
 - .2 Construction: Metal or Lexan.
 - .3 Square pattern, pull lever type
 - .4 Mounting: Flush in all finished areas (surface acceptable in Equipment Rooms).
 - .5 Features: Glass rod.
 - .6 Operation:
 - .1 First Stage: Manual lever.
 - .2 Second State: Key operated.

- .7 Ambient temperature: 0°C to 40°C.
- .8 Ambient humidity: 0 - 93%
- .9 Provide weatherproof design in exterior locations.
- .2 Replace existing "Pull Station" back boxes to provide a flush installation as required.
- .3 Provide protective guards with local alarm in Physc Ward patient areas.
- .4 Mount manual stations in recesses in walls in gymnasiums and activity rooms so that front of station is flush with wall line. Maintain 50mm [2"] clear space around manual stations and recess for reset mechanism. Provide necessary recess in wall. Frame around opening as required to provide a neat and finished appearance.

2.8 THERMAL DETECTORS

- .1 Thermal Detectors: Addressable to ULC-S530 and as follows:
 - .1 Construction: metal.
 - .2 Mounting: Addressable base and plug-in head.
 - .3 Contacts: rated at 3 A from 6 to 125 V AC, 1 A from 6 to 28 V DC.
- .2 Ambient temperature 0°C to 40°C.
- .3 Ambient Humidity - 10% to 95% R.H.
- .4 Operation:
 - .1 Projecting centre disk shall indicate when alarmed.
 - .2 Fixed Temperature Type: Resettable, shall operate at 58°C.
 - .3 Fixed Temperature Type: Non-Resettable shall operate at 88°C.
- .5 Thermal detectors to operate on the dual themistor principle.
- .6 Built-in LED for alarm indication.
- .7 Shielded electronics to limit noise interference.

2.9 MULTISENSOR PRODUCTS-OF-COMBUSTION DETECTORS (SMOKE DETECTORS)

- .1 Multisensor technology utilizing photo-electronic and heat sensors complete with addressable base shall be provided in all areas except electrical rooms where ionization type detectors are to be utilized. Units to be unaffected by changes in environmental temperature, humidity and pressure. Surface mounted, screw connection separate field wiring base, indicator lamp, provision for remote mounting, design and function based on dual chamber principle.
- .2 POC sensors shall communicate actual chamber values to system control panel. Sensors shall not have a self contained sensitivity setting, sensitivity setting to be determined at control panel. In all areas initially, alarm set point will be set at 1% obscurity during evening hours, and 3.7% obscurity during daytime hours.
- .3 The control panel shall be programmed to automatically compensate for environmental changes at the remote sensors. Even if the smoke detector chamber is contaminated with dust, or other particles, the control panel will still alarm at the prescribed alarm set point. The POC shall report ambient conditions to the control panel.
- .4 The POC sensor shall be stable even withstanding air-gusts up to 10 m/sec velocity. The detector shall have a 30 mesh insect screen and have a completely sealed back to prevent entry of dust, moisture and air turbulence. The electronics of the unit shall be totally shielded to protect against false alarms due to EMI and RFI. The detector head

shall be easily disassembled to facilitate cleaning. All wiring to the smoke detector shall be wired to the base only, thus when removing the head for maintenance or cleaning no wiring is disturbed. The detector head shall contain an LED which shall glow continuously to indicate alarm, or a sensor trouble condition. The detector head shall contain a locking screw to prevent unauthorized removal of the head from the base.

- .5 Ceiling units to be attractive design, easy to clean, chamber accessible without special tools, chamber to be provided with anti-static protection, overall tapered geometry with no flare-outs to collect dust. Chamber port open 360°.
- .6 Where units are mounted in the ceiling space, provide remote pilot lamp complete with lamicoïd identification.
- .7 Provide terminals and output for individual annunciation as required.
- .8 Duct mounting POC detectors to be complete with addressable module, duct casting, sampling tubes for installation in air systems and pilot lamp. Duct detectors to be complete with remote alarm LED as well as remote keyed test switches on a single gang plate located near the duct detector at an accessible location.
- .9 Detectors to meet ULC-S529.
- .10 Provide 2 spare smoke detectors and bases. Allow for 20m [60'] of wiring, installation and verification. Locate as directed on site. Any spare material not used to be handed over to Owner.

2.10 ALARM BELLS

- .1 Alarm bells to be heavy duty, die cast, aluminium base with steel or aluminum red dome. 250mm [10"] diameter, 24V DC low current (330ma). Mount in locations as shown on the drawings.
- .2 Surface mount bells on flush mounted outlet boxes. Use manufacturer's recommended outlet box and/or adapter plates.
- .3 Provide 1 additional bells c/w 30m [100 feet] of wiring for each. Make allowance for installation in exact location as determined on site.

2.11 PIEZOELECTRIC HORNS:

- .1 Provide 24V.DC. piezoelectric horns in locations as shown on the drawings.
- .2 Surface mount (vertically) on flush mounted outlet boxes. Use manufacturer's recommended outlet boxes and/or adapter plates.

2.12 VISUAL SIGNAL APPLIANCES (STROBE LIGHTS)

- .1 Visual signal appliances: to ULC S527 and as follows:
 - .1 Voltage: 24V DC.
 - .2 Mounting: designed for ceiling or wall mounted on flush boxes in finished areas. Provide matching red surface mounting boxes in unfinished areas and service rooms
 - .3 Construction:
 - .1 High intensity Xenon flasher.
 - .2 Rated Candela - 15.
 - .3 Pyramid shaped.
 - .4 Polycarbonate lens with red print reading "FIRE".

- .4 Connect visual signal appliances to dedicated supervised output circuit(s) in the fire alarm control panel and synchronize at minimum 20 flashes per minute.

2.13 PROTECTIVE GUARDS

- .1 Provide heavy duty wire or cast guards to completely enclose bells and automatic detectors in areas of possible physical interference (eg: gymnasiums, low ceiling storage areas, etc). Bell guards if cast shall have same colour finish as bell or if made of rod shall have hot dip galvanized or chrome plated finish. Open cages of thin wire rod will not be acceptable.
- .2 Mount guards securely to the wall or ceiling surrounding the device and not to the actual device.
- .3 Submit samples of guards at time of shop drawing submission when requested.

2.14 MAGNETIC LOCKS, SECURITY SYSTEMS AND DOORHOLDERS

- .1 Coordinate with door hardware.

2.15 COMBINATION MOTORIZED FIRE/SMOKE DAMPERS

- .1 Coordinate and connect Motorized Fire/Smoke Damper systems if present.
- .2 Refer to mechanical drawings for damper locations.

2.16 MECHANICAL SYSTEM CONTROL

- .1 Provide control of mechanical system air handling equipment during an alarm condition, as indicated on the drawings and specified under the Mechanical Division.
- .2 Provide the following:
 - .1 BMS interface to send the Fire Alarm status and commands as indicated.
 - .2 All wiring, connections, relay modules, etc. as required.
 - .3 Dual voltage relays as required.
 - .4 Separate relay for each system as indicated in motor schedule.
 - .5 Minimum one set of Form "C" contacts for each system accessed via clearly labeled terminal strip located adjacent to MCC or starter. Provide general purpose enclosure or use spare (barriered) section of MCC.
 - .6 Fan shutdown shall be achieved by wiring fan starter control circuit through appropriate alarm operated contacts located in the fire alarm panel. Use interposing relays and do not run 120V or higher motor feeder voltages through fire alarm system cabinets.

2.17 SPRINKLER SYSTEM CONNECTIONS

- .1 Connect all sprinkler (fire protection) system pressure, flow, and tamper switches. Coordinate with the Fire Protection Division for exact device locations, grouping and zoning.
- .2 Provide the following zoning to monitor the sprinkler (fire protection) system:
 - .1 Separate alarm zone for each floor area.
 - .2 Separate alarm zone for each wet or dry system alarm switch.
 - .3 Separate trouble zone for each wet or dry system low pressure alarm.

- .4 Separate trouble indication for each tamper protected gate valve. Only where gate valves are located in immediate proximity may they be grouped together as one trouble alarm.
- .5 Provide separate address for each device even though they may be grouped or loop fed.

2.18 REMOTE SIGNAL TRANSMISSION

- .1 Existing

2.19 END-OF-LINE DEVICES

- .1 Provide end-of-line devices wall mounted in separate boxes at 1800mm [72"] above the finished floor level in accordance with ULC S524.
- .2 Flush mount devices in finished areas.
- .3 Provide finished stainless steel or anodized aluminum coverplates.
- .4 Provide permanent lamicaid labels on plates to indicate the related circuits.
- .5 Clearly locate and identify the end-of-line devices on record drawings.

2.20 ISOLATORS

- .1 Addressable loop isolators shall be provided in each circuit per zone area, and for each stairway such that a fault on any device in that zone shall not affect any other zone.
- .2 Short circuit isolation shall be installed per floor and for every 25 devices within the floor where Class A loops are utilized.

2.21 SYSTEM POWER SUPPLIES

- .1 Power Supply to ULC S527 and as follows:
 - .1 Rectifier and Battery Charger:
 - .1 Designed to automatically maintain battery bank fully charged.
 - .2 Sized to recharge batteries in 24 hours minimum.
 - .3 Designed to operate system when batteries are disconnected.
 - .4 Temperature compensated.
 - .5 Provide battery connection supervision.
 - .2 Battery Bank: Gel-cell type.
 - .3 Capacity: Designed to operate system under supervisory load condition for 24 hours and then have sufficient power to provide 30 minutes of continuous voice and visual communication without recharging.
 - .4 Mounting integral with each panel or as detailed.

2.22 FREEZE PROTECTION THERMOSTATIC SWITCHES

- .1 Provide Freeze Protection Thermostatic Switches to monitor unheated wet sprinkler fire protection locations where indicated.
- .2 Switches to be complete with concealed set point and cover.
- .3 Switches not to be adjustable below 4 degrees C. Switch contacts to change status when fire protection equipment air temperature drops below 4 degrees C, causing supervisory signal on fire alarm system.

- .4 Removal of the switch from circuit to cause trouble signal in its respective zone.
- .5 Mount switch with centerline 1500mm [5'] above finished floor unless otherwise indicated.
- .6 Provide with insulating sub-base when mounting on exterior wall.

2.23 EXCESS PRESSURE PUMPS

- .1 Provide power connections for excess pressure pump(s) supplied by Fire Protection Division. Provide 15A-1P breakers in the nearest (essential power where available) panelboards. Clearly label breakers.
- .2 Connect pressure switches and provide manual starters suitable for fractional horsepower motor.

2.24 COMPRESSORS

- .1 Provide power connections for compressors supplied by the Fire Protection Division. Provide breakers in nearest (essential power where available) panelboards. Clearly label breakers.
- .2 Connect pressure switch(es) and provide starters suitable for the compressor drives.

2.25 WIRE AND CABLE

- .1 Conductors: Copper, to CSA C22.2 and as follows:
 - .1 Refer to riser drawing for particular wiring specifications and as follows:
 - .2 Conductor Insulation: Minimum rating 300 volts. Single conductor RW90XLPE (X-link).
 - .3 Multi-conductor cables 105°C with outer PVC jacket, colour coded, FAS rated.
 - .4 Conductor sizes as follows:
 - .1 Minimum conductor size for alarm initiating circuits shall be #18 AWG.
 - .2 Minimum conductor size for signal circuits shall be #16 AWG.
 - .3 Minimum conductor size for AC circuits shall be #12 AWG.
 - .4 Minimum conductor size for visual signal appliance circuits shall be #14 AWG.
 - .5 Size all fire alarm wiring for maximum 3% voltage drop at maximum load at last device in run.
 - .5 Main data risers and loops between fire separations to be approved fire rated cables either Mineral Insulated or equal to 'Vitalink' (RW90 cables with "RHW" silicon coated insulation) cabling installed in EMT in accordance with the manufacturers rated system requirements.
 - .6 Selection of the type of cable to be at discretion of fire alarm installer but the system shall meet all code requirements, when complete. All wiring to be terminated in terminal panels, junction boxes, etc. on suitable identified terminal strips or blocks, and to be neatly installed, laced and tagged where required. All terminals in terminal panels and junction boxes to be made with solderless connectors to terminal blocks with separate terminal for each conductor.
 - .7 All wiring to be tag identified at the points of connection.
 - .8 Provide a ground conductor with all system wiring and bond all metal parts including device boxes.

Part 3 Execution

3.1 INSTALLATION

- .1 System installation shall conform to the latest CAN/ULC-S524 Standard for the Installation of Fire Alarm Systems.
- .2 Mount all end-of-line resistors immediately beyond the last device in separate backbox.
- .3 Flush mount all field control and monitor modules in separate backboxes in ceiling or wall. Do not conceal modules in ceiling spaces unless indicated.
- .4 External AC Power Supply:
 - .1 Existing power supply to remain. Provide new only as required.

3.2 AUTOMATIC DETECTORS

- .1 Locate automatic smoke and thermal detectors in locations as shown indicated and in accordance with CAN/ULC-S524.
- .2 Generally, locate ceiling mounted detectors centrally in rooms and corridors unless lights and/or mechanical devices interfere. Coordinate with other trades before proceeding.
- .3 Provide flush mounted devices in finished areas unless wiring is surface mounted in which case surface mounted devices shall be provided. Provide mounting base for surface mounted detectors
- .4 Maintain minimum 450mm [18"] clear to mechanical air diffusers and registers.
- .5 Typically maintain minimum 450mm [18"] clear in all directions around detectors. Note that the CAN/ULC-S524 has exceptions for narrow spaces and minor ceiling obstructions not exceeding 100mm [6"] projections down from ceiling.
- .6 Mount detectors out of line of direct heat and minimum 3m [10'-0"] from unit heaters.
- .7 Mount smoke detectors associated with smoke control doors, on the ceiling on either side of the doors; typically 1200mm [4'-0"] from door. Do not mount detectors closer than 900mm [3'-0"] or farther than 1500mm [5'-0"] from the doors.
- .8 Mount detectors shown in crawl spaces which have solid type joists or beams at the level of the underside of the joist or beam.
- .9 Install duct smoke detectors on the supply air side, and downstream of any filters of air handling units deemed to be shut down in a related fire alarm event.

3.3 WIRING

- .1 Make conductor terminations on fixed terminal strips with separate terminal for each conductor. No loose wiring connections allowed.
- .2 Fire alarm wiring splices to be minimal. Line splices are not acceptable.
- .3 Neatly install wiring clamped with nylon cable straps or laced with jute cord.
- .4 Number identify all wiring terminations and terminal strips as indicated on shop drawings.
- .5 Attach wiring diagram to inside of panel doors.
- .6 All cables crossing fire zones to be protected by 1-hour fire rating.
- .7 Provide separate fire alarm zone (and indicated at the graphic annunciators) for each duct mounted products-of-combustion detector for mechanical pressurization and recirculation units.

- .8 Coordinate duct detector location and accessibility. Provide remote LED's for locations not readily viewable by maintenance personnel.
- .9 Visual signal appliances to be wired independent from audible devices on the system.
- .10 All backboxes in exposed installations to be as provided by system manufacturer.

3.4 CONNECTION OF MISCELLANEOUS SYSTEMS

- .1 Provide outputs for control of the following auxiliary equipment, if equipment is installed.
 - .1 Door hardware:
 - .2 Pressurization, supply and return air fan control.
 - .3 Smoke control: switch 120 volt emergency power circuit through dual voltage relays.

3.5 PROGRAMMING

- .1 Provide a list of all devices and the related LCD messaging and Audio readouts for review by Consultant and Owner: Submit as part of shop drawings.
- .2 This contract to include up to three (3) software re-programs for all the equipment installed under this Contract.

3.6 PROTECTION OF COMPLETED WORK

- .1 Protect equipment in areas of construction to prevent the entry of dust, paint and any other foreign matter into the devices or panels.

3.7 SYSTEM INSPECTION

- .1 Carry out a complete inspection and test of system on completion of the installation to ensure the following:
 - .1 System is complete and functional in accordance with the contract documents and regulatory requirements.
 - .2 System is installed in accordance with the manufacturer's recommendations.
 - .3 Fire suppression detection devices are connected into the system and are functioning.
 - .4 Smoke control equipment has been installed, connected and functioning.
 - .5 All auxiliary equipment has been connected and functioning.
 - .6 On completion of inspection deliver three (3) final sets of maintenance and operating instructions manuals to the Consultant.

3.8 PERFORMANCE VERIFICATION

- .1 The Electrical Division Contractor shall be responsible for directing performance verification of the fire alarm system in accordance with the latest CAN-S537, Standard for Verification of Fire Alarm System Installations.
- .2 Provide interim partial verifications to suit the progress of the work and any staged occupancy. All new work to be tested and verified directly following the installation.
- .3 Submit all verification reports to the Consultant. Provide an unconditional Appendix C and written test reports from the equipment manufacturer showing that the ENTIRE system has been tested, verified and commissioned by him in accordance with the latest edition of ULC S-537 "Standard for Verification of Fire Alarm System Installations" and that the Fire Alarm system complies with all points of the specifications. Include the

verification worksheets identifying every device and its status (i.e. smoke detector - room xx, verified for operation and supervision).

- .4 The qualified Fire Alarm verification agency shall be independent of the installing company.
- .5 Prior to requesting the final performance verification ensure that fire alarm system is fully operable and that subsequent work to be performed on system will not invalidate examinations and tests performed during verification procedure.
- .6 The Electrical Division Contractor and fire alarm system manufacturer's representative shall be present at all times during the verification procedure and shall undertake the following:
 - .1 Provide all required testing equipment and tools.
 - .2 Disassemble and reassemble system components.
 - .3 Disconnect and reconnect wiring.
 - .4 Perform required field adjustments.
 - .5 Repair defective work and replace defective components.
 - .6 Perform all other work on the system required by verification procedure.
 - .7 Provide four portable communication devices during entire verification.
- .7 Include all costs for fire alarm system verifications, including the Fire Alarm System Manufacturer's representative's costs. Take into account that the system may have to be commissioned and verified after normal working hours.
- .8 Provide a minimum of ten working days written notice ahead of the verification process to the Owners Representatives and the Consultant.

3.9 FIRE DEPARTMENT DEMONSTRATION

- .1 Arrange, attend and carry out a Fire Department demonstration of the completed system after the final unconditional verification.
- .2 Activate alarms and demonstrate all controls as requested.

3.10 SPARE MATERIAL

- .1 In addition to all required devices indicated on the drawings and specified above, provide the following spare components:
 - .1 2 monitor modules
 - .2 2 control modules
 - .3 1 breakglass station
 - .4 2 Multisensor POC (smoke detectors)
 - .5 1 bell

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation for fence framework, fabric, and accessories.
- .2 Manual gates and related hardware.

1.2 RELATED SECTIONS

- .1 Division 3 – Cast-in-Place Concrete

1.3 MEASUREMENT PROCEDURES

- .1 Measurement for chain link security fence shall be made in metres following the contour of the ground of the actual length of fence erected and shall include the length of brace panels.
- .2 Measurement for end, corner, and straining posts shall be made for east post erected but not line posts.

1.4 REFERENCES

- .1 The versions of the standards referenced in this section are those listed in the BC Building Code, current edition at the time of the application for Building Permit; or if they are not referenced in the specified code, they are the latest version of the standard in effect at the time of the application for Building Permit.
- .2 ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- .3 ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- .4 ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength. Low-Alloy with Improved Formability, and Ultra-High Strength
- .5 ASTM F567 - Standard Practice for Installation of Chain-Link Fence.
- .6 ASTM F668 - Standard Specification for Polyvinyl Chloride (PVC) and Other Organic Polymer-Coated Steel Chain-Link Fence Fabric.
- .7 ASTM F1043 - Standard Specification for Strength and Protective Coatings on Steel Industrial Chain Link Fence Framework.
- .8 CLFMI (Chain Link Fence Manufacturers Institute) - Product Manual.
- .9 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB-138.1 Fabric for Chain Link Fence.
 - .2 CAN/CGSB-138.2 Steel Framework for Chain Link Fence.
 - .3 CAN/CGSB-138.3 Installation of Chain Link Fence.
 - .4 CAN/CGSB-138.4 Gates for Chain Link Fence.
 - .5 CAN/CGSB-1.181 Ready-Mixed Organic Zinc-Rich Coating.

1.5 SYSTEM DESCRIPTION

- .1 Fence Height: 2.4 metres
- .2 Line Post Spacing: At intervals not exceeding 2.4 metres.
- .3 Fence Post and Rail Strength: Conform to CLFMI Standard Industrial quality.

1.6 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Provide data on fabric, posts, accessories, fittings and hardware.
- .3 Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, elevations of gates, and schedule of components.

1.7 QUALITY ASSURANCE

- .1 Products of This Section: Manufactured to ISO 9000 certification requirements.
- .2 Perform Work in accordance with CLFMI - Product Manual.
- .3 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience.
- .4 Installer Qualifications: Company specializing in performing the work of this section with minimum three (3) years documented experience and approved by the manufacturer.

1.8 DELIVERY, STORAGE AND DISPOSAL

- .1 Material can be stored on site.

Part 2 Products

2.1 CHAIN LINK FENCE FABRIC

- .1 General: Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist according to "CLFMI Product Manual" and requirements indicated below:
 - .1 Steel Wire for Fabric: Wire diameter of 0.148 inch
 - .1 Mesh Size: 1-3/4 inches.
 - .2 Black Vinyl Coated finish, according to ASTM F934, Grade 2
 - .3 Coat selvage ends of metallic-coated fabric before the weaving process.
- .2 Selvage: Twisted top and knuckled bottom.

2.2 FENCE FRAMEWORK

- .1 Posts and Rails ASTM F1043 for framework, including rails, braces, and line; terminal; and corner posts. Provide members with minimum dimensions and wall thickness according to ASTM F1043 based on the following:
 - .1 Fence Height: 2400mm.

- .2 Horizontal Framework Members: Intermediate, top, and bottom rails according to ASTM F1043.
- .3 Metallic Coating for Steel Framework:
 - .1 Type A: Not less than minimum 2.0-oz./sq. ft. average zinc coating according to ASTM A123/A123M or 4.0-oz./sq. ft. zinc coating according to ASTM A653/A653M.

2.3 SWING GATES

- .1 General: ASTM F900 for gate posts and single swing gate types.
 - .1 Gate Leaf Width and Height: 1200mm wide x 2000mm high.
- .2 Pipe and Tubing:
 - .1 Zinc-Coated Steel: ASTM F1043 and ASTM F1083; protective coating and finish to match fence framework.
 - .2 Gate Posts: Round tubular steel.
 - .3 Gate Frames and Bracing: Match gate posts shape.
- .3 Frame Corner Construction: Welded.
- .4 Hardware:
 - .1 Hinges: 180-degree outward swing.
 - .2 Latch: Permitting operation from both sides of gate.
 - .3 Lock: Manufacturer's standard padlock device.

2.4 FITTINGS

- .1 Provide fittings according to ASTM F626.
- .2 Post Caps: Provide for each post.
 - .1 Provide line post caps with loop to receive tension wire or top rail.
- .3 Rail and Brace Ends: For each gate, corner, pull, and end post.
- .4 Rail Fittings: Provide the following:
 - .1 Top Rail Sleeves: Pressed-steel or round-steel tubing not less than 6 inches long.
 - .2 Rail Clamps: Line and corner boulevard clamps for connecting intermediate, and bottom rails to posts.
- .5 Tie Wires, Clips, and Fasteners: According to ASTM F626.
 - .1 Standard Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, according to the following:
 - .1 Hot-Dip Galvanized Steel: 0.148-inch-diameter wire; galvanized coating thickness matching coating thickness of chain-link fence fabric.
- .6 Concrete mixes and materials: in accordance with Division 3 – Cast-in-Place Concrete.
 - .1 Nominal coarse aggregate size: 20-5 mm.
 - .2 Compressive strength: 20 MPa minimum at 28 days.
- .7 Fittings and hardware: to CAN/CGSB-138.2, black vinyl coated galvanized steel.
 - .1 Tension bar bands: minimum of three (3) per tension bar, 500 mm spacing and secure with nuts and bolts.

- .2 Post caps to provide waterproof fit, to fasten securely over posts and to carry top rail.
- .3 Overhang tops to provide waterproof fit, to hold top rails.
- .4 Turnbuckles to be drop forged.
- .8 Bottom Base Plates; 200 x 200 x 6mm, c/w anchor bolt holes, galvanized. These base plates only required where posts are required to be anchored to the concrete pad.
- .9 Grounding rod: 16 mm diameter copper well rod, 3 m long.

2.5 FINISHES

- .1 Vinyl coating:
 - .1 0.380 mm dry film thickness for chain link fabric
 - .2 All posts, rails, braces, fabric and fittings of fences and gates to be electrostatically painted with two coats of black carboxyl modified vinyl chloride/vinyl acetate UCAR paint.

Part 3 Execution

3.1 GRADING

- .1 Remove debris and correct ground undulations along fence line to obtain smooth uniform gradient between posts.
 - .1 Provide clearance between bottom of fence and ground surface of 30 mm to 50 mm.

3.2 ERECTION OF FENCE

- .1 Erect fence along lines as indicated and to CAN/CGSB-138.3.
- .2 Excavate post holes to dimensions indicated.
- .3 Space line posts 24000 mm apart, measured parallel to ground surface.
- .4 Space straining posts at equal intervals not to exceed 150 m if distance between end or corner posts on straight continuous lengths of fence over reasonably smooth grade, is greater than 150 m.
- .5 Install additional straining posts at sharp changes in grade and where directed by the Engineer.
- .6 Install corner post where change in alignment exceeds 10 degrees.
- .7 Install end posts at end of fence.
- .8 Place concrete in post holes then embed posts into concrete to depths indicated.
 - .1 Extend concrete 50mm above ground level and slope to drain away from posts.
 - .2 Brace to hold posts in plumb position and true to alignment and elevation until concrete has set.
- .9 Do not install fence fabric until concrete has cured minimum of 5 days.
- .10 Install brace between end and gate posts and nearest line post, placed in centre of panel and parallel to ground surface.
 - .1 Install braces on both sides of corner and straining posts in similar manner.

- .11 Install overhang tops and caps.
- .12 Install top rail between posts and fasten securely to posts and secure waterproof caps and overhang tops.
- .13 Install bottom tension wire, stretch tightly and fasten securely to end, corner, gate and straining posts with turnbuckles and tension bar bands.
- .14 Lay out fence fabric. Stretch tightly to tension recommended by manufacturer and fasten to end, corner, gate and straining posts with tension bar secured to post with tension bar bands spaced at 500 mm intervals.
 - .1 Knuckled selvedge at bottom.
 - .2 Twisted selvedge at top.
- .15 Secure fabric to top rails, line posts and bottom tension wire with tie wires at 500 mm intervals.
 - .1 Give tie wires minimum two twists.
- .16 Install grounding rods as indicated.

3.3 GATE INSTALLATION

- .1 Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation.

3.4 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.

3.5 CLEANING

- .1 Clean and trim areas disturbed by operations.
 - .1 Dispose of surplus material and soil by the contractor at the contractor's expense.

END OF SECTION