

RIDDELL KURCZABA ARCHITECTURE ENGINEERING INTERIOR DESIGN LTD

PROJECT MANUAL

PARKS CANADA AGENCY

329 Marten Street, Staff housing

BANFF NATIONAL PARK

ISSUED FOR TENDER / BP

July 19, 2019

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END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Definitions

- .1 Information Documents means information of any type and in any form, related to the Project and identified in this Section as such and do not include the Contract Documents.

1.2 STATUS OF INFORMATION DOCUMENTS

- .1 Information Documents, or any part thereof, are not part of the Contract unless specifically incorporated into Contract Documents by means of copying, transcribing or referencing.

1.3 USE OF AND RELIANCE UPON INFORMATION DOCUMENTS

- .1 Information Documents are made available to Bidder by Departmental Representative for the purpose of providing Bidder with access to information available to Departmental Representative.
- .2 Information Documents shall not be considered a representation or warranty that information contained therein is accurate, complete or appropriate, and do not form a part of the Contract Documents.
- .3 Bidder shall interpret and draw its own conclusions about Information Documents and is encouraged to obtain specialist advice with respect thereto. Prime Consultant assumes no responsibility for such interpretations and conclusions.
- .4 Information contained in Information Documents may be time sensitive and dates shall be considered when interpreting Information Documents.
- .5 Bidder may rely upon the data contained in Information Documents, or parts thereof, which are specifically incorporated into Contract Documents by means of copying, transcribing or referencing, but shall draw his own conclusions from such data and shall not rely on opinions or interpretations contained therein.

1.4 INFORMATION DOCUMENTS

- .1 Information Documents, in whole or in part, consist of the following:
- .1 Appendix D - Lone Pine Geotechnical Investigations
- .2 Appendix E - Supplemental Ph 2 Environmental Site Assessment

And consisting of subsurface conditions, recommendations, foundation types, concrete, and pavement design is attached to this section for information only.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 WORK COVERED BY CONTRACT DOCUMENTS

- .1 Work of this Bid Package comprises the work specified and furnishing of all labour, materials, equipment, and supervision required for the Staff Housing project located at 329 Marten Street, Banff, Alberta.
- .2 Perform Work in accordance with National Building Code of Canada (NBC) including amendments up to tender closing date and other codes of provincial or local application provided that in case of conflict or discrepancy, more stringent requirements apply.
- .3 Perform Work in accordance with National Parks Act when projects are located within boundaries of National Park.

1.2 CONTRACT METHOD

- .1 Construct Work under single stipulated price contract with unit prices as indicated on bid form.

1.3 WORK SCHEDULE

- .1 Initiate work of this project as soon as letter of acceptance is received.
- .2 Complete Building Envelope Work by March 31, 2020.
- .3 Complete remaining work by September 30, 2020.
- .4 No compensation will be provided to Contractor for cold weather work or other weather related costs.

1.4 SURVEY OF EXISTING PROPERTY CONDITIONS

- .1 Submission of tender is deemed to be confirmation that the Contractor has inspected the site and is conversant with all conditions affecting execution and completion of work. Review environmental spec for quantity validation survey requirements.
- .2 The Contractor shall regularly monitor the condition of the Work Site and of property on and adjoining the Work Site throughout the construction period, and shall immediately notify the Departmental Representative if any deterioration in condition is detected. Such monitoring shall cover all pertinent features and property including, but not limited to, buildings, structures, roads, walls, fences, slopes, sewers, culverts and landscaped areas.

1.5 WORK BY OTHERS

- .1 Co-operate with other Contractors in carrying out their respective works and carry out instructions from Departmental Representative.
- .2 Co-ordinate work with that of other Contractors. If any part of work under this Contract depends for its proper execution or result upon work of another Contractor, report promptly to Departmental Representative, in writing, any defects which may interfere with proper execution of Work.

1.6 CONTRACTOR USE OF PREMISES

- .1 Unrestricted use of site until Substantial Performance.

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

1.7 ITEMS PURCHASED OUTSIDE THIS CONTRACT

- .1 Departmental Representative Responsibilities:
 - .1 Arrange for delivery of shop drawings, product data, samples, manufacturer's instructions, and certificates to Contractor.
 - .2 Deliver supplier's bill of materials to Contractor
 - .3 Arrange and pay for delivery to site in accordance with Progress Schedule.
 - .4 Inspect deliveries jointly with Contractor.
 - .5 Submit claims for transportation damage.
 - .6 Arrange for replacement of damaged, defective or missing items.
 - .7 Arrange for manufacturer's field services; arrange for and deliver manufacturer's warranties and bonds to Contractor.
- .2 Contractor Responsibilities:
 - .1 Designate submittals and delivery date for each product in progress schedule.
 - .2 Review shop drawings, product data, samples, and other submittals. Submit to Departmental Representative notification of observed discrepancies or problems anticipated due to non-conformance with Contract Documents.
 - .3 Receive and unload products at site.
 - .4 Inspect deliveries jointly with Departmental Representative; record shortages, and damaged or defective items.
 - .5 Handle products at site, including uncrating and storage.
 - .6 Protect products from damage, and from exposure to elements.
 - .7 Assemble, install, connect, adjust, and finish products.
 - .8 Provide installation inspections required by public authorities.
 - .9 Repair or replace items damaged by Contractor or subcontractor on site (under his control).

1.8 DOCUMENTS REQUIRED

- .1 Maintain at job site, one copy each document as follows:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Reviewed Shop Drawings.
 - .5 List of Outstanding Shop Drawings.
 - .6 Change Orders.
 - .7 Other Modifications to Contract.
 - .8 Field Test Reports.
 - .9 Permits
 - .10 Copy of Approved Work Schedule.

- .11 Health and Safety Plan and Other Safety Related Documents.
- .12 Other documents as specified.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 INTENT

- .1 The Work shall be designed, constructed, and commissioned in a manner which is compliant with the Canada National Parks Act and Parks Canada Agency Regulations, Directives, and Guidelines.
- .2 Submit applications and documents, obtain and pay for building permit from independent permit agency and obtain inspections and approvals from this agency for boiler, electrical, plumbing, gas, and other systems required by the agency for the Project.
- .3 Contractors and Sub-contractors shall obtain and pay for business license from the Parks Canada Administration office.

1.2 ACCESS AND EGRESS

- .1 Design, construct and maintain temporary "access to" and "egress from" work areas, including stairs, runways, ramps or ladders and scaffolding, independent of finished surfaces and in accordance with relevant municipal, provincial and other regulations.
- .2 Limit laydown area to an area agreed with by Departmental Representative.

1.3 USE OF SITE AND FACILITIES

- .1 Execute work with least possible interference or disturbance to normal use of premises. Make arrangements with Departmental Representative to facilitate work as stated.
- .2 Maintain existing services to building and provide for personnel and vehicle access.
- .3 Where security is reduced by work provide temporary means to maintain security.
- .4 Provide sanitary facilities for use by Contractor's personnel. Keep facilities clean.
- .5 Closures: protect work temporarily until permanent enclosures are completed.
- .6 Set up office-tool trailer on site.
- .7 Keep Site clean and free from accumulation of waste materials and rubbish regardless of source. Remove snow as necessary and at Contractors cost for the performance and inspection of the Work.
- .8 Repair damage to the Work Site caused by the Contractor at Contractors expense.
- .9 Hours of Work: Monday to Friday, 7.30am – 9.00pm, Saturday, 10.00am – 10.00pm.

1.4 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING

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

1.5 EXISTING SERVICES

- .1 Notify Departmental Representative and utility companies of intended interruption of services and obtain required permission.
- .2 Where Work involves breaking into or connecting to existing services, give Departmental Representative 48 hours of notice for necessary interruption of mechanical or electrical service throughout course of work. Minimize duration of interruptions. Carry out work at times as directed by governing authorities with minimum disturbance to pedestrian, vehicular traffic and tenant operations.
- .3 Provide alternative routes for personnel, pedestrian, and vehicular traffic as required.
- .4 Establish location and extent of service lines in area of work before starting Work. Notify Departmental Representative of findings.
- .5 Submit schedule to and obtain approval from Departmental Representative for any shut-down or closure of active service or facility including power and communications services. Adhere to approved schedule and provide notice to affected parties.
- .6 Provide temporary services when directed by Departmental Representative to maintain critical building and tenant systems.
- .7 Where unknown services are encountered, immediately advise Departmental Representative and confirm findings in writing.
- .8 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in manner approved by authorities having jurisdiction.
- .9 Record locations of maintained, re-routed and abandoned service lines.
- .10 Construct barriers in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

1.6 SPECIAL REQUIREMENTS

- .1 Submit schedule in accordance with Section 01 32 16 – Construction Schedule.
- .2 Ensure that Contractor personnel employed on site become familiar with and obey regulations including safety, fire, traffic and security regulations.
- .3 Keep within limits of work and avenues of ingress and egress.
- .4 Coordinate times for delivery of materials with Departmental Representative.

1.7 BUILDING SMOKING ENVIRONMENT

- .1 Smoking is not allowed on Site.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 APPLICATIONS FOR PROGRESS PAYMENT

- .1 Refer to Construction Contract.
- .2 Make applications for payment on account as provided in Agreement as Work progresses.
- .3 Date applications for payment last day of agreed monthly payment period and ensure amount claimed is for value, proportionate to amount of Contract, of Work performed and Products delivered to Place of Work at that date.
- .4 Submit to Departmental Representative, at least 14 days before first application for payment. Schedule of values for parts of Work, aggregating total amount of Contract Price, to facilitate evaluation of applications for payment.

1.2 SCHEDULE OF VALUES

- .1 Provide schedule of values supported by evidence as Departmental Representative may reasonably direct and when accepted by Departmental Representative, be used as basis for applications for payment.
- .2 Include statement based on schedule of values with each application for payment.
- .3 Support claims for products delivered to Place of Work but not yet incorporated into Work by such evidence as Departmental Representative may reasonably require to establish value and delivery of products.

1.3 PROGRESS PAYMENT

- .1 Departmental Representative will issue, 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 Departmental Representative determines to be due. If Departmental Representative amends application, Departmental Representative will give notification in writing giving reasons for amendment.
- .2 The Departmental Representative may withhold or nullify the whole or a part of any application for payment represented by the Contractor's estimate, or a Certificate for Payment to such extent as may be necessary to protect the Departmental Representative from loss because of unsatisfactory assemblies and procedures by the Contractor and/or the Subcontractors.

1.4 SUBSTANTIAL PERFORMANCE OF WORK

- .1 Prepare and submit to Departmental Representative comprehensive list of items to be completed or corrected and apply for a review by Departmental Representative to establish Substantial Performance of Work or substantial performance of designated portion of Work when Work is substantially performed if permitted by lien legislation applicable to Place of Work designated portion which Departmental Representative agrees to accept separately is substantially performed. 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, Departmental Representative will review Work to verify validity of application, and no later than

7 days after completing review, will notify Contractor if Work or designated portion of Work is substantially performed.

- .3 Departmental Representative: state date of Substantial Performance of Work or designated portion of Work in certificate.
- .4 Immediately following issuance of certificate of Substantial Performance of Work, in consultation with Departmental Representative, establish reasonable date for finishing Work.

1.5 PAYMENT OF HOLDBACK UPON SUBSTANTIAL PERFORMANCE OF WORK

- .1 After issuance of certificate of Substantial Performance 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 Departmental Representative 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, Departmental Representative will issue certificate for payment of holdback amount.
- .3 Where holdback amount has not been placed in a separate holdback account, Departmental Representative 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 Departmental Representative 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. Departmental Representative 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 Departmental Representative.

1.6 PROGRESSIVE RELEASE OF HOLDBACK

- .1 Where legislation permits, if Departmental Representative has certified that Work of subcontractor or supplier has been performed prior to Substantial Performance of Work, Departmental Representative 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.

1.7 FINAL PAYMENT

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

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS SPECIFIED ELSEWHERE

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

1.2 APPOINTMENT AND PAYMENT

- .1 Departmental Representative will appoint and pay for services of testing laboratory except follows:
 - .1 Inspection and testing required by laws, ordinances, rules, regulations or orders of public authorities.
 - .2 Inspection and testing performed exclusively for Contractor's convenience.
 - .3 Testing, adjustment and balancing of mechanical and electrical equipment and systems.
 - .4 Mill tests and certificates of compliance.
 - .5 Tests specified to be carried out by Contractor under the supervision of Departmental Representative.
 - .6 Additional tests specified as required.
- .2 Where tests or inspections by designated testing laboratory reveal Work not in accordance with contract requirements, pay costs for additional tests or inspections as required by Departmental Representative to verify acceptability of corrected work.

1.3 CONTRACTOR'S RESPONSIBILITIES

- .1 Provide labour, equipment and facilities to:
 - .1 Provide access to Work for inspection and testing.
 - .2 Facilitate inspections and tests.
 - .3 Make good Work disturbed by inspection and test.
 - .4 Provide storage on site for laboratory's exclusive use to store equipment and cure test samples.
- .2 Notify Departmental Representative sufficiently in advance of operations to allow for assignment of laboratory personnel and scheduling of test.
- .3 Where materials are specified to be tested, deliver representative samples in required quantity to testing laboratory.
- .4 Pay costs for uncovering and making good Work that is covered before required inspection or testing is completed and approved by Departmental Representative.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Coordinate between mechanical and electrical work, and work of other affected Sections in accordance with the requirements of this Section and other affected sections.

1.2 MECHANICAL-ELECTRICAL WORK COORDINATOR

- .1 Contractor shall be responsible for providing a person technically qualified and experienced in field coordination for the type of mechanical and electrical work required for this Project, for duration of construction work.
- .2 Mechanical and Electrical Coordination shall be performed by a dedicated person other than the Contractor's Project Manager; who shall have extensive experience with coordinating complex mechanical and electrical work and shall be acceptable to the Departmental Representative.

1.3 SUBMITTALS

- .1 Provide required coordination documents before submitting shop drawings, product data and samples; provide information required by this Section in accordance with Section 01 33 00.
- .2 Preparation of Mechanical and Electrical Coordination specified in this Section form a part of the Contractor's Submission requirements as follows:
 - .1 Mechanical and Electrical Subcontractors shall allow for full assistance and cooperation with the General Contractor in the provision of all required information for the assembly of Coordination Drawings.
 - .2 Mechanical and Electrical Coordination Drawings described in this Section form a part of the General Contractor's Scope-of-Work.
- .3 Submit name, qualifications, and related experience of proposed Mechanical-Electrical Coordinator to the Departmental Representative before any Work starts on site; Departmental Representative reserves the right to reject any candidate that does not appear suitable for this Project.
- .4 Submit field coordination drawings for mechanical and electrical work above ceilings for all floor levels, including penthouse and mechanical and electrical rooms, supplemented with building cross sections indicating mechanical and electrical systems fully coordinated with structural drawings and details, and coordinated with architectural finish components such as ceilings, bulkheads, furring, casework and equipment, indicating ductwork, piping, conduit, and equipment in their intended locations, coordinated with all other parts of the Work and highlighting potential interference between systems and building components.

Part 2 Products

2.1 COORDINATION DOCUMENTS

- .1 Prepare Field Coordination Plan and Section Drawings indicating coordination for the following:
 - .1 Installation of subgrade plumbing work.
 - .2 Installation of above ceiling mechanical and electrical work coordinated with the structure and architectural ceiling heights for efficient use of available space, for proper sequence of installation, and to resolve interferences.
 - .3 Scale:
 - .1 Plans: Not less than 1:50 metric.
 - .2 Sections: Not less than 1:20 metric.
 - .3 Details: Not less than 1:10 metric.
 - .4 Clearly indicate changes to the location, direction, route or grade of mechanical and electrical work shown in the Contract Documents that are required or necessary arising from the coordination of the Work.
 - .5 Reproduce and distribute copies at Coordination Meeting to each concerned party in accordance with Section 01 31 19.
 - .6 Update and revise as necessary after each Coordination Meeting.
- .2 Maintain coordination documents throughout construction period, recording changes arising from modifications and adjustments; submit finalized coordination documents after completion of Project in accordance with Section 01 78 00.

Part 3 Execution

3.1 MECHANICAL AND ELECTRICAL COORDINATION

- .1 Coordinate work.
- .2 Coordinate progress schedules, including dates for submittals and for delivery of products.
- .3 Conduct conferences between Subcontractors, other contractors and other concerned entities as necessary to establish and maintain coordination and schedules and to resolve matters identified by coordination activities.
- .4 Participate in Progress and Coordination Meetings; report on work requiring adjustment under coordination requirements, and any needed changes in schedules or in the work to resolve interferences between components of the Work.
- .5 Transmit minutes of coordination to all attendees and concerned individuals in accordance with Section 01 31 19.

- .6 Implementation of changes required as a result of coordination activities shall be performed as follows:
 - .1 Work Considered as No Change to Contract: Changes that **do not** materially increase or decrease the Scope-of-Work of the Contract, shall not be considered as additional work under Contract.
 - .2 Work Considered as Change to Contract: Changes that **do** materially increase or decrease the Scope-of-Work of the Contract, will be administered as a Change to the Contract in accordance with General Conditions of Contract.

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE

- .1 Schedule and administer project meetings throughout the progress of the work as requested by the Departmental Representative.
- .2 Departmental Representative shall prepare agenda for meetings.
- .3 Departmental Representative shall distribute written notice of each meeting four days in advance of meeting date to all parties.
- .4 Contractor to provide physical space and make arrangements for meetings in coordination with Departmental Representative.
- .5 Departmental Representative to preside at meetings.
- .6 Departmental Representative shall record the meeting minutes and include significant proceedings and decisions with identification of actions by parties.
- .7 Departmental Representative shall reproduce and distribute copies of minutes within three days after meetings and transmit to meeting participants and, affected parties not in attendance.
- .8 Representative of Departmental Representative, Contractor, Subcontractor and suppliers attending meetings will be qualified and authorized to act on behalf of party each represents.

1.2 PRECONSTRUCTION MEETING

- .1 Within 15 days after award of Contract, request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.
- .2 Senior representatives of Departmental Representatives, Contractor, major Subcontractors, field inspectors and supervisors will be in attendance.
- .3 Establish time and location of meeting and notify parties concerned minimum 5 days before meeting.
- .4 Incorporate mutually agreed variations to Contract Documents into Agreement, prior to signing.
- .5 Agenda to include:
 - .1 Introduction
 - .2 Project Control – names, authority, responsibility
 - .3 Chain of Command
 - .4 Work Schedule
 - .5 Dewatering
 - .6 Available Utilities – Telephone, Hydro, etc.
 - .7 Contractor's and Department's Field Offices

- .8 Schedule of submission of shop drawings, samples, colour chips. Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .9 Township and Park – cooperation and contacts
- .10 Town of Banff shallow and deep water utilities plan requirements.
- .11 Public Utilities – cooperation, investigations, contacts
- .12 Project Sign
- .13 Surveys – responsibilities
- .14 Extra plans and specifications
- .15 Record Drawings
- .16 As-Built Drawings
- .17 Subtrades and Contractors
- .18 Access
- .19 Correspondence
- .20 Testing
- .21 Contractor to supply information or alternates prior to ordering
- .22 Project Boundary
- .23 Restoration of Damaged Areas
- .24 Work by Others
- .25 Park Responsibilities
- .26 Inform Workers of Park Rules – garbage, wildlife
- .27 Washroom Facilities
- .28 Site Meetings – schedules, minutes
- .29 Contract Forms
- .30 Request for Payment – Procedures
- .31 Dump Site
- .32 Permits
- .33 Bonds and Insurance
- .34 Soils Reports
- .35 O & M Manuals
- .36 Guarantees
- .37 Daily Clean up
- .38 Department of Labour re: safety
- .39 Salvage and Store Existing Parks Equipment
- .40 Specific Questions re: units of contract

1.3 PROGRESS MEETINGS

- .1 During course of Work and 2 weeks prior to project completion, schedule progress meetings every two weeks.
- .2 Contractor, major Subcontractors involved in Work and Departmental Representative are to be in attendance.
- .3 Notify parties minimum 7 days prior to meetings.

- .4 Departmental Representative to record minutes of meetings and circulate to attending parties and affected parties not in attendance within three (3) days after meeting.
- .5 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 regain projected schedule.
 - .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 Review health and safety issues.
 - .13 Review environmental issues.
 - .14 Other business.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 DEFINITIONS

- .1 Activity: element of Work performed during course of Project. Activity normally has expected duration, and 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 Saturday, inclusive, will provide five day work week and define schedule calendar working days as part of Bar (GANTT) Chart submission.
- .5 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.
- .6 Master Plan: summary-level schedule that identifies major activities and key milestones.
- .7 Milestone: significant event in project, usually completion of major deliverable.
- .8 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.
- .9 Project Planning, Monitoring and Control System: overall system operated by Departmental Representative to enable monitoring of project work in relation to established milestones.

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.
- .3 Limit activity durations to maximum of approximately 10 working days, to allow for progress reporting.

- .4 Ensure that it is understood that Award of Contract or time of beginning, rate of progress, Interim Certificate and Final 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 Departmental Representative within 15 working days of Award of Contract Bar (GANTT) Chart as Master Plan for planning, monitoring and reporting of project progress.

1.4 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 Site Services
 - .6 Excavation.
 - .7 Backfill.
 - .8 Building footings.
 - .9 Slab on grade.
 - .10 Structural Steel.
 - .11 Siding and Roofing.
 - .12 Building Close In
 - .13 Interior Architecture (Walls, Floors and Ceiling).
 - .14 Plumbing.
 - .15 Lighting.
 - .16 Electrical.
 - .17 Piping.
 - .18 Controls.
 - .19 Heating, Ventilating, and Air Conditioning.
 - .20 Millwork.
 - .21 Interior finishes
 - .22 Fire Systems.
 - .23 Exterior sitework and landscaping
 - .24 Testing and Commissioning.
 - .25 Building Flushout (IAQ)
 - .26 Supplied equipment long delivery items.
 - .27 Engineer supplied equipment required dates.

.28 Other items as required.

1.5 PROJECT SCHEDULE REPORTING

- .1 Update Project Schedule every two weeks reflecting activity changes and completions, as well as activities in progress.
- .2 Include as part of Project Schedule, narrative report identifying Work status to date, comparing current progress to baseline, presenting current forecasts, defining problem areas, anticipated delays and impact with possible mitigation.

1.6 PROJECT MEETINGS

- .1 Discuss Project Schedule at regular site meetings, identify activities that are behind schedule and provide measures to regain slippage. Activities considered behind schedule are those with projected start or completion dates later than current approved dates shown on baseline schedule.
- .2 Weather related delays with their remedial measures will be discussed.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE

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

1.2 REQUIRED CONTRACTOR SUBMITTALS

- .1 General
 - .1 This Clause identifies the plans, programs, and documentation required prior to mobilization on site and during the construction phase.
- .2 Pre-Mobilization Submittals:
 - .1 The Contractor shall not begin any site Work until the Departmental Representative has authorized acceptance of submittals. Submit the following plans and programs to the Departmental Representative for review prior to mobilization to the project site:
 - .1 Schedule
 - .2 Environmental Protection Plan
 - .3 Dewatering Plan

- .4 Quality Management Program (QMP)
 - .5 Traffic Accommodation
 - .6 Health and Safety plan
 - .7 Emergency Response Plan
 - .8 Chain of Command
 - .9 Project schedule:
 - .10 List of subcontractors, suppliers and consultants, their role and their key personnel, including names and positions, addresses, telephone and cellular telephone numbers, as requested by Departmental Representative.
 - .11 Plan describing methods the Contractor will have to meet his responsibilities as the Prime Contractor for Traffic Control in the Work zones.
 - .12 Contractor Chain of Command, listing key Contractor personnel, including for each name, position, qualification, experience, telephone, cellular telephone and numbers. The list shall include the names and telephone/cellular telephone numbers for contact persons who are available on a 24-hour basis in the event of emergencies.
 - .13 Contractor shall develop an "Emergency Procedures Protocol" in consultation with Parks Canada.
- .3 Construction Phase Submittals
- .1 Progress Reports that outline the detailed Work (Contractor, subcontractors, suppliers, consultants) completed to date as well as the anticipated Work to be performed for the following week. Also, alternate Work to be identified if Work or a portion of, proposed cannot be done due to weather, equipment breakdown, delays in delivery, etc.
 - .1 Progress
 - .2 Quality Control Inspection Reports
 - .2 Submit copies of reports or directions issued by Federal and Provincial health and safety inspectors.
 - .3 Submit copies of incident and accident reports.
 - .4 The Contractor shall not construe the Departmental Representative's authorization of the submittals to imply approval of any particular method or sequence for conducting the Work, or for addressing health and safety concerns. Authorization of the programs shall not relieve the Contractor from the responsibility to conduct the Work in strict accordance with the requirements of Federal or Provincial regulations, this specification, or to adequately protect the health and safety of all workers involved in the project and any members of the public who may be affected by the project. The Contractor shall remain solely responsible for the adequacy and completeness of the programs and work practices, and adherence to them.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.
- .2 Submit shop drawings bearing stamp and signature of qualified professional engineer registered or licensed in Province of Alberta, 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 co-ordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
- .4 Allow 6 working days for Departmental Representative's review of each submission.
- .5 Details of appropriate portion of Work as required in each technical section and 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 Weights
 - .8 Wiring Diagrams
 - .9 Single Line and Schematic Diagrams
 - .10 Relationship to adjacent work
- .6 Adjustments made on shop drawings by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.
- .7 Make changes in shop drawings as Departmental Representative may require, consistent with Contract Documents. When resubmitting, notify Departmental Representative in writing of revisions other than those requested.
- .8 Accompany submissions with transmittal letter containing:
 - .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Identification and quantity of each shop drawing, product data and sample.
 - .5 Other pertinent data.

- .9 Submissions include:
 - .1 Date and revision dates.
 - .2 Project title and number.
 - .3 Name and address of:
 - .1 Subcontractor.
 - .2 Supplier.
 - .3 Manufacturer.
 - .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
- .10 After Departmental Representative's review, distribute copies.
- .11 Submit electronic copy of shop drawings for each requirement requested in specification Sections and as Departmental Representative may reasonably request.
- .12 Submit electronic copies of product data sheets or brochures for requirements requested in specification Sections and as requested by Departmental Representative where shop drawings will not be prepared due to standardized manufacture of product.
- .13 Submit electronic copies of test reports for requirements requested in specification Sections and as requested by Departmental Representative.
 - .1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.
 - .2 Testing must have been within 3 years of date of contract award for project.
- .14 Submit electronic copies of certificates for requirements requested in specification Sections and as requested by Departmental Representative.
 - .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.
- .15 Submit electronic copies of manufacturers instructions for requirements requested in specification Sections and as requested by Departmental Representative.
 - .1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.
- .16 Submit electronic copies of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Departmental Representative.

- .1 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
- .17 Submit electronic copies of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Departmental Representative.
- .18 Delete information not applicable to project.
- .19 Supplement standard information to provide details applicable to project.
- .20 If upon review by Departmental Representative, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.
- .21 The review of shop drawings by Departmental Representative is for sole purpose of ascertaining conformance with general concept.
 - .1 This review shall not mean that Departmental Representative approves detail design inherent in shop drawings, responsibility for which shall remain with Contractor submitting same, and such review shall not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting requirements of construction and Contract Documents.
 - .2 Without restricting generality of foregoing, Contractor is responsible for dimensions to be confirmed and correlated at job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of Work of sub-trades.

1.4 SAMPLES

- .1 Submit for review samples in duplicate or as requested in respective specification Sections. Label samples with origin and intended use.
- .2 Deliver samples to Departmental Representative at site meetings or by Courier.
- .3 Notify Departmental Representative in writing, at time of submission of deviations in samples from requirements of Contract Documents.
- .4 Where colour, pattern or texture is criterion, submit full range of samples.
- .5 Adjustments made on samples by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.
- .6 Make changes in samples which Departmental Representative may require, consistent with Contract Documents.
- .7 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

1.5 PHOTOGRAPHS: DIGITAL FORMAT

.1 Progress Photographs

- .1 Sizes: minimum 2 mega pixel image file size, jpeg image file.
- .2 Format: CD or DVD (*.jpg).
- .3 Viewpoints: A minimum of four (4) photographs from three (3) different viewpoints will be required.
- .4 Number of photo sets: one (1) set per week.
- .5 Identification: referenced to photo file with name, location, purpose, and number of project and date of exposure.
- .6 Viewpoints: interior and exterior locations: viewpoints determined by Departmental Representative.
- .7 Frequency: at completion of each phase of the construction and services before concealment and at completion of each discrete phase of construction.
- .8 Distribution: post photographs to folder as indicated by Departmental Representative.

1.6 CERTIFICATES AND TRANSCRIPTS

- .1 Immediately after award of Contract, submit Workers' Compensation Board status.
- .2 Submit transcription of insurance immediately after award of Contract.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 INTENT

- .1 The intent of Delegated Design Submittals required by this section is to account for professional engineering responsibility for design, review and acceptance of components of Work forming a part of permanent Work in accordance with Building Code, and that has been assigned to a design entity other than Departmental Representative including, but not limited to, the following:
 - .1 Design requiring structural analysis of load bearing components and connections.
 - .2 Design requiring compliance with fire safety regulations.
 - .3 Design requiring compliance with life or health safety regulations.
- .2 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 specification sections.
- .3 Delegated Design Submittals are not required for components of Work requiring engineering for temporary Work (i.e.: crane hoisting, engineered lifts, false Work, shoring, concrete formwork) that would normally form a part of Contractor's scope of Work.
- .4 The requirements of this section are in general conformance with recommended Responsibilities for Engineering Services for Building Projects published by Association of Professional Engineers, Geologists and Geophysicists of Alberta (APPEGA), with regards to duties of specialty professionals appointed during construction period.
- .5 The requirements of this section do not diminish responsibilities of Consultant's role as Registered Professional of Record; submittals will be used by Consultant to establish that Work is substantially performed in accordance with Building Code.

1.2 RELATED REQUIREMENTS

- .1 Structural Drawings, Cast-In-Place Concrete: Concrete mix design
- .2 Section 04 22 00 – Unit Masonry
- .3 Section 05 51 29 - Metal Stairs and Ladders: Design of steel stairs, landings and handrails, and other load supporting elements.
- .4 Section 07 84 00 - Firestopping and Smoke seals
- .5 Divisions 23 and 26 Coordinate with disciplines for items requiring delegated design submittals.
 - .1 Fire Suppression Standpipe Systems: Hose and nozzles, reels, cabinets and valves.
 - .2 Fire Suppression Sprinkler Systems
 - .3 Dry Agent Fire Suppression Systems
 - .4 Integrated Automation Facility Controls: Building automation and controls.
 - .5 Packaged Engine Driven Generator Assemblies

- .6 Coordinate additional items 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 services or certification required, submit a written request for additional information to Departmental Representative.
- .3 Delegated design will be required for elements designed by a specialty professional, which may include:
 - .1 Elements normally fabricated off-site
 - .2 Elements that require specialized fabrication equipment or a proprietary fabrication process not usually available at job site (i.e.: open web steel joists, wood trusses, combination wood and metal or plywood joists, prefabricated wood or metal buildings, noise and vibration isolation devices, elevators).
 - .3 Elements requiring civil engineering, not normally a part of scope of services performed by architectural; structural; mechanical; electrical; or geotechnical disciplines of Consultant.

Part 2 Products

2.1 LETTER OF COMMITMENT

- .1 Submit a signed and sealed Letter of Commitment on company letterhead addressed to Consultant in accordance with format in Letter of Commitment attached to the end of this Section prior to starting Work requiring design and seal of a professional engineer.

2.2 LETTER OF COMPLIANCE

- .1 Submit a signed and sealed Letter of Compliance on company letterhead addressed to Consultant in accordance with format in Letter of Compliance attached to the end of this Section on completion of Work requiring design and seal of a professional engineer.

Part 3 Execution

3.1 IMPLEMENTATION

- .1 Include summary of Work described in technical specification section as a part of the required Letter of Commitment.
- .2 Prepare required submittals and present to Consultant within sufficient time to allow for Consultant's detailed review and acceptance.

- .3 In lieu of Items 2.1 and 2.2, Alberta Building Code Compliance Schedules A, B, and C will be accepted.

END OF SECTION

LETTER OF COMMITMENT

Submit a signed and sealed letter of commitment on company letterhead in the form as follows:

[Date]

[Consultant]

[Consultant's Address]

Attention: [Consultant's Registered Professional of Record]

Re: Letter of Commitment for Delegated Design of [System of Component of Work]
[Name of Project]
[Project Number]
[City, Province]

As the retained registered professional engineer for design and field review of the above named component of Work and project, I hereby give assurance I am qualified to perform the following Work as required by Contract Documents:

1. [List appropriate design services for System or Component of Work];
2. Preparation of shop and erection documents;
3. Review fabrication of [structural] [fire rated] [life and health safety] components;
4. Review erection of [structural] [fire rated] [life and health safety] components.
5. [Modify list to suit System of Component of Work.]

I hereby give assurance that I will be responsible for above noted Work as described in Section [?????] – [Name of Section] of Project Manual, including requirements of addenda, change orders and change directives.

I also undertake to be responsible for field review of fabrication and erection of [structural] [fire rated] [life and health safety] components as required to ascertain substantial compliance with the Building Code and Contract Documents.

I will notify you in writing if my responsibility is terminated at any time during the course of Work covered by this Letter of Commitment.

Retained Professional Engineer

Signature

Date

(Apply seal)

LETTER OF COMPLIANCE

[Date]

[Consultant]

[Consultant's Address]

Attention: [Consultant's Registered Professional of Record]

Re: Letter of Compliance for Delegated Design of [System of Component of Work]

[Name of Project]

[Project Number]

[City, Province]

I hereby give assurance that I have fulfilled my obligations for field review as outlined by previously submitted Letter of Commitment.

I hereby give assurance that aspects of [structural] [life and health safety] Work as defined by previously submitted Letter of Commitment substantially comply with Contract Documents and Building Code.

Retained Professional Engineer

Signature

Date

(Apply seal)

Part 1 General

1.1 REFERENCES

- .1 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .3 Province of Alberta
 - .1 Occupational Health and Safety Regulations, Act and Code 2018.

1.2 SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit site-specific Health and Safety Plan: Within 7 days after date of Notice to Proceed and prior to commencement of Work. Health and Safety Plan must include:
 - .1 Results of site specific safety hazard assessment.
 - .2 Results of safety and health risk or hazard analysis for site tasks and operation found in work plan.
- .3 Submit 2 copies of Contractor's authorized representative's work site health and safety inspection reports to Departmental Representative and authority having jurisdiction, weekly.
- .4 Submit copies of reports or directions issued by Federal and Provincial health and safety inspectors.
- .5 Submit copies of incident and accident reports.
- .6 Submit WHMIS MSDS - Material Safety Data Sheets.
- .7 Departmental Representative will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within 7 days after receipt of plan. Revise plan as appropriate and resubmit plan to Departmental Representative within 7 days after receipt of comments from Departmental Representative.
- .8 Departmental Representative's review of Contractor's final Health and Safety plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.
- .9 Medical Surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of Work, and submit additional certifications for any new site personnel to Departmental Representative
- .10 On-site Contingency and Emergency Response Plan: address standard operating procedures to be implemented during emergency situations.

1.3 PROTECTION OF PERSONS AND PROPERTY

- .1 Comply with all applicable safety regulations of the Workers' Compensation Board of Alberta (WCB) including, but not limited to, WCB's Industrial Health and

Safety Regulations, Industrial First Aid Regulations, and Workplace Hazardous Materials Information System Regulations.

- .2 The Contractor shall take all necessary precautions and measures to prevent injury or damage to persons and property on or near the Work Site.
- .3 The Contractor shall promptly take such measures as are required to repair, replace or compensate for any loss or damage caused by the Contractor to any property or, if Parks Canada so directs, shall promptly reimburse to Parks Canada the costs resulting from such loss or damage.

1.4 FILING OF NOTICE

- .1 File Notice of Project with Provincial authorities prior to beginning of Work.

1.5 SAFETY ASSESSMENT

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

1.6 MEETINGS

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

1.7 GENERAL REQUIREMENTS

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

1.8 RESPONSIBILITY

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

1.9 COMPLIANCE REQUIREMENTS

- .1 Comply with Occupational Health and Safety Act of Alberta.

1.10 UNFORSEEN HAZARDS

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

1.11 PRIME CONTRACTOR

- .1 Responsibility for Work Site Safety - This Contractor Is "Prime Contractor":

- .1 The Contractor shall, for the purposes of the Occupational Health and Safety Act (Alberta), and for the duration of the Work of this Contract:
 - .1 Be the "Prime Contractor" for the "Work Site", and
 - .2 Meet all requirements of the Occupational Health and Safety Act and Regulations, Workers Compensation Board legislation, the Fire Code legislation and all other applicable laws that govern work place safety.
- .2 The Contractor shall direct all Subcontractors, sub-subcontractors, Other Contractors, employees, suppliers, workers and any other persons at the "Work Site" on safety related matters, to the extent required to fulfill its "Prime Contractor" responsibilities pursuant to the Act, regardless of:
 - .1 Whether or not any contractual relationship exists between the Contractor and any of these entities, and
 - .2 Whether or not such entities have been specifically identified in this Contract.
- .3 Safety Certification: Safety certification is a condition of contract award; Contractor is required to maintain a valid Certificate of Recognition (COR) for the duration of the Work of this Contract.

1.12 POSTING OF DOCUMENTS

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

1.13 CORRECTION OF NON-COMPLIANCE

- .1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by Departmental Representative.
- .2 Provide Departmental Representative with written report of action taken to correct non-compliance of health and safety issues identified.
- .3 Departmental Representative may stop Work if non-compliance of health and safety regulations is not corrected.

1.14 POWDER ACTUATED DEVICES

- .1 Use powder actuated devices only after receipt of written permission from Departmental Representative.

1.15 WORK STOPPAGE

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

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 DEFINITIONS

- .1 Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavourably alter ecological balances of importance to human life; affect other species of importance to humankind; or degrade environment aesthetically, culturally and/or historically.
- .2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction. Control of environmental pollution and damage requires consideration of land, water, and air; biological and cultural resources; and includes management of visual aesthetics; noise; solid, chemical, gaseous, and liquid waste; radiant energy and radioactive material as well as other pollutants.

1.2 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Prior to commencing construction activities or delivery of materials to site, submit Environmental Protection Plan for review and approval by Departmental Representative. Environmental Protection Plan is to present comprehensive overview of known or potential environmental issues which must be addressed during construction.
- .3 Address topics at level of detail commensurate with environmental issue and required construction tasks.
- .4 Environmental protection plan shall include:
 - .1 Names of persons responsible for ensuring adherence to Environmental Protection Plan.
 - .2 Names and qualifications of persons responsible for manifesting hazardous waste to be removed from site.
 - .3 Names and qualifications of persons responsible for training site personnel.
 - .4 Descriptions of environmental protection personnel training program.
 - .5 Spill Control Plan: including procedures, instructions, and reports to be used in event of unforeseen spill of regulated substance.
 - .6 Non-Hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris.
 - .7 Air pollution control plan detailing provisions to assure that dust, debris, materials, and trash, do not become air borne and travel off project site.
 - .8 Contaminant prevention plan that: identifies potentially hazardous substances to be used on job site; identifies intended actions to prevent introduction of such materials into air, water, or ground; and details provisions for compliance with Federal, Provincial, and Municipal laws and regulations for storage and handling of these materials.

- .9 Waste water management plan that identifies methods and procedures for management and/or discharge of waste waters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfection water, hydrostatic test water, and water used in flushing of lines.
- .10 Include an equipment access plan.

1.3 FIRE PREVENTION AND CONTROL

- .1 Carry fire extinguisher for use on each machine and at locations as required in the event of fire. Basic fire fighting equipment recommended includes three shovels, two pulaskis, and two five gallon backpack pumps) shall be maintained at the construction site at a location known and easily accessible to Contractors' staff. Contractor's staff shall receive basic training in early response to wildfire events during the "environmental briefing".
- .2 A water truck may be necessary and will depend on the timing of the contract (e.g. - not required during winter or snow covered conditions).
- .3 Construction equipment shall be operated in a manner and with all original manufacturer's safety devices to prevent ignition of flammable materials in the area.
- .4 Care shall be taken while smoking on the construction site to ensure that the accidental ignition of any flammable material is prevented.
- .5 In case of fire, the Contractor or worker shall take immediate action to extinguish the fire provided it is safe to do so and call 911. The ESO and the Departmental Representative shall be notified of any fire immediately. If not available, Banff Dispatch shall be contacted at (403) 762-4506.
- .6 Fires and burning of rubbish on site not permitted.

1.4 DRAINAGE

- .1 Develop and submit erosion and Sediment Control Plan (ESC) identifying type and location of erosion and sediment controls provided. Plan to include monitoring and reporting requirements to assure that control measures are in compliance with erosion and sediment control plan, Federal, Provincial, and Municipal laws and regulations.
- .2 Storm Water Pollution Prevention Plan (SWPPP) to be substituted for erosion and sediment control plan.
- .3 Provide temporary drainage and pumping required to keep excavations and site free from water.
- .4 Ensure pumped water into waterways, sewer or drainage systems is free of suspended materials.
- .5 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements.

1.5 SITE CLEARING AND PLANT PROTECTION

- .1 Protect trees and plants on site and adjacent properties as indicated.
- .2 Protect trees and shrubs adjacent to construction work, storage areas and trucking lanes, and encase with protective wood framework from grade level to height of 2 m minimum.
- .3 Protect roots of designated trees to dripline during excavation and site grading to prevent disturbance or damage.
 - .1 Avoid unnecessary traffic, dumping and storage of materials over root zones.
- .4 Minimize stripping of topsoil and vegetation.
- .5 Restrict tree removal to areas designated by Departmental Representative.

1.6 DISPOSAL OF WASTES

- .1 All garbage must be stored and handled in conformance with the National Parks Garbage Regulations.
- .2 All surplus and waste materials shall be removed from the job site to approved sites outside of the National Parks. Disposal of all wastes shall be in compliance with the Environmental Contaminants Act and applicable provincial regulations while observing the Code of Good Practice for Management of Hazardous and Toxic Wastes at Federal Establishments.
- .3 Contractor shall remove all demolition, construction, and trade waste from the site and dispose of materials at designated site on a regular basis or when directed by Departmental Representative. All users and vehicles must report to the transfer scales prior to the disposal of any material. Various rate schedules apply for unsorted waste, scrap metal, asphalt shingles, appliances, and painted wood.
- .4 No food, domestic garbage or hazardous wastes may be deposited in the trade waste site. Obtain bear proof garbage containers on-site for domestic garbage generated on-site by Contractor's personnel.
- .5 Dispose of all hazardous wastes in conformance with the Environmental Contaminants Act and applicable provincial regulations and Section 02 50 13 while observing the Code of Good Practice for Management of Hazardous and Toxic Wastes at Federal Establishments.
- .6 Maintain the site in a tidy condition, free from the accumulation of waste products, debris and litter.
- .7 Do not dispose of waste or volatile materials, such as mineral spirits, oil or paint thinner into waterways, storm or sanitary sewers.
- .8 No separate payment will be made for waste disposal. Costs of this work shall be considered incidental to the contract.

- .9 Remove all demolition, construction, and trade waste from the site and dispose outside of Parks land to a provincial approved landfill. Other salvaged or dispose materials to location as directed herewithin this document.

1.7 NATIONAL PARKS REGULATIONS

- .1 The Contractor and all sub-contractors shall ensure that all work is performed in accordance with the ordinances, laws, rules and regulations set out in the Canada National Parks Act and Regulations.
- .2 The Contractor and all sub-Contractors, each, shall obtain a business license from the Parks Canada Administration Office prior to commencement of the contract.
- .3 Contractor and all sub-contractors shall comply with all laws and government regulations applicable to work under this contract.
- .4 Contractor's business and private vehicles are required to obtain a vehicle work pass from Parks Canada. These permits may be obtained free of charge at Parks Administration Office.
- .5 Contractor to equip all service and supervisory vehicles with Emergency Spill Kit DOT-E-10102 or equivalent.
- .6 Contractor is responsible to ensure all sub-contractors comply with the National Park Regulations.

1.8 CANADIAN ENVIRONMENTAL ASSESSMENT ACT

- .1 Execution of the work is subject to the provisions within the Canadian Environmental Assessment Act Guidelines Order of 2012 and subsequent amendments.
- .2 Failure to comply with or observe environmental protection measures as identified in these specifications may result in the work being suspended pending rectification of the problem.

1.9 WILDLIFE

- .1 Avoid or terminate activities on-site that attract, disturb or harass wildlife and vacate the area and stay away from the immediate location if wildlife display aggressive behaviour or persistent intrusion.
- .2 Notify the Departmental Representative and Parks Environmental Surveillance Officer (ESO) immediately of wildlife encounters on or around the site. Other wildlife encounters should be reported within 24 hours.
- .3 During the Environmental Briefing all personnel shall be instructed by the ESO on procedures to follow in the event of wildlife appearance near or within the work site and any other wildlife concerns.
- .4 Pets will not be permitted on site.

1.10 HISTORICAL/ARCHAEOLOGICAL CONTROL

- .1 Provide historical, archaeological, cultural resources, biological resources, and wetlands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources and wetlands known to be on project site: and identifies procedures to be followed if historical archaeological, cultural resources, biological resources and wetlands not previously known to be onsite or in area are discovered during construction.
- .2 Plan: include methods to assure protection of known or discovered resources and identify lines of communication between Contractor personnel and Departmental Representative.

1.11 CONTRACTOR'S START UP EMPLOYEE AND ENVIRONMENTAL BRIEFING

- .1 Conduct briefing sessions for all employees and subcontractor employees highlighting the requirements of this section, including operation of equipment strictly.
- .2 An initial site meeting with Contractor, Departmental Representative, Park Project Manager, and Park Surveillance Officer will take place prior to construction commencing.
- .3 Parks Surveillance Officer will conduct approximately 40 minute briefing sessions for all employees and sub-contractor employees highlighting the requirements of this specification section, and other requirements of the Parks Surveillance Officer including operations of equipment strictly within confines of the site; harassment or attraction of wildlife; pollution and garbage management; vehicle access and parking; and care of the environment in the work area.
- .4 All staff employed at the construction site shall attend an orientation before beginning work at the site, conducted by the Contractor regarding their individual and collective responsibilities, to ensure avoidable adverse environmental impact does not arise from their activities and personal choices. Each employee, having received the environmental briefing, will be issued a certification sticker to be displayed on their protective head gear. Employees of other service and materials providers who attend the site must be apprised of their duty not to cause adverse environmental impact.
- .5 Parks Canada will have an ESO attending the site to monitor the construction activity for conformance with the EPP. The ESO or alternate designated Parks Canada staff member will be present for the environmental briefing.

1.12 CONTRACTOR'S OPERATIONS

- .1 The contract documents have been developed in accordance with Park Canada's policy for application of Canadian Environmental Assessment Act (2012). Construction methods which are directly affected by this policy and CEAA will be reviewed at the initial site meeting. The Contractor will be expected to comply with and ensure his construction practice meets the Parks Canada standards. Failure to comply may lead to cessation of work.

- .2 Confine all operations to the work limits as staked or designated by the Departmental Representative. No activities of any kind may be carried out beyond these work limits without Departmental Representative's written approval.
- .3 The Contractor shall prepare an EPP which details how the work limits will be marked and what procedures will be employed to ensure protection or trespass outside these limits does not occur, to the satisfaction of the Departmental Representative and ESO.
- .4 Do not store or stockpile construction materials in the trees bordering or being preserved on-site. Do not unreasonably encumber the site with products.
- .5 Storage areas shall be located within the project boundaries on disturbed or hardened areas. Storage locations to be approved by Departmental Representative.
- .6 Storage locations shall be completely cleaned up and returned to original condition prior to Contractor de-mobilization and finishing the project.
- .7 Equipment maintenance shall only be carried out in designated areas or as approved by the Departmental Representative and Park Surveillance Officer. The use of on-site areas for equipment oil changes and other servicing will not be permitted.
- .8 Obtain permit from Park Surveillance Officer for on-site storage of fuel or other inflammable liquids. Observe all restrictions and conditions imposed by the permit regarding special protection and berming to control spills and tank damage, fire protection considerations, provisions for the disposal of fouled material and used petroleum products.
- .9 Conduct operations at all times in such a manner as to preserve the natural features and vegetation in the area. Cut and fill slopes shall be blended with adjoining topography. Material from fill slopes will not be permitted to sluff or roll into surrounding tree cover or to bury any plant material designated to be retained.
- .10 When, in the opinion of the Departmental Representative, negligence on the part of the Contractor results in damage or destruction of vegetation, or other environmental or aesthetic features beyond the staked or designated work area, the Contractor shall be responsible, at his expense, for complete restoration including the replacement of trees, shrubs, topsoil, grass, etc., to the satisfaction of the Departmental Representative.
- .11 Failure to comply with or observe environmental protection measures as identified in these specifications and the environmental assessment report may result in work being suspended pending rectification of the problems and operators of equipment being charged under the National Park Act.
- .12 As no non-native vegetation is allowed in Park, all construction equipment shall be thoroughly washed before entering Banff National Park.

- .13 All wash from equipment and tools from concrete pour operations such as tools, concrete pumper and delivery trucks to be contained in such a manner not to dispose debris, cement and fines onto a hard surface or other surfaces that would allowed it to eventually enter the storm system, sanitary system, body of water or water course.
- .14 Review construction access requirements with the Departmental Representative both at start-up and an ongoing bases.
- .15 The contractor shall ensure that the environment beyond the work limits is not negatively impacted or damaged by worker's vehicles or machinery and shall instruct workers so that the 'footprint' of the project is kept within defined boundaries. Areas around buildings requiring excavator or equipment access in natural areas should confine access as close to the edge of the walls as possible. Access requirements, once approved, will be flagged by the Environmental Surveillance Officer.

1.13 EQUIPMENT MAINTENANCE, FUELING, AND OPERATION

- .1 Provide, operate, and maintain equipment as indicated in Environmental Assessment Amendment, as indicated in Appendix A of this Project Manual and as follows:
- .2 The Contractor shall ensure that all soil, seeds and any debris attached to construction equipment to be used on the project site shall be removed (e.g. power washing) outside the Kootenay National Park before delivery to the work site.
- .3 Equipment fuelling sites will be identified by the Contractor and approved by the Departmental Representative and the ESO. Except for chain saws, any fuelling closer than 100 metres to any streams, wetlands, water bodies or waterways shall require the authorization and oversight of the Departmental Representative.
- .4 Diesel and gasoline delivery vehicles, including bulk tankers shall be parked more than 100 metres from any streams, wetlands, water bodies or watercourses. Gravity fed fuel systems are not allowed. Manual or electric pump delivery systems shall be used. Fuelling personnel shall maintain presence at and immediate attention to the fuelling operation.
- .5 Mobile fuel containers (e.g. slip tanks, small fuel carboys) shall remain in the service vehicle at all times.
- .6 Equipment used on the project shall be fuelled with E10, and low sulphur diesel fuels and shall conform to local emission requirements. The Contractor is to ensure that unnecessary idling of vehicles is avoided.
- .7 Oil changes, lubricant changes, greasing and machinery repairs shall be performed at locations approved by the ESO or the Departmental Representative. Waste lubrication products (e.g. oil filters, used containers, used oil, etc.) shall be secured in spill-proof containers and properly recycled or disposed of at an approved facility. No waste petroleum, lubricant products or related materials are to be discarded, buried or disposed of in borrow pits, turnouts, picnic areas, viewpoints, etc anywhere within Kootenay National Park.
- .8 The Contractor shall ensure that all equipment is inspected daily for fluid/fuel leaks and maintained in good working order.

- .9 Fuel containers and lubricant products shall be stored only in secure locations specified by the Departmental Representative. Fuel tanks or other potentially deleterious substance containers shall be secured to ensure they are tamperproof and cannot be drained by vandals when left overnight in Kootenay National Park.

1.14 NOISE AND VIBRATION CONTROL

- .1 Low impact demolition equipment and methodologies shall be employed that do not generate significant noise or vibration levels in proximity to the thermal springs, hot pools or sensitive wildlife habitat. Ensure there is no impact to subsurface thermal springs or damage to the Hot Pools heritage building.
- .2 Demolition activities shall take place with the use of low noise and low ground vibration inducing equipment and techniques for the project site and in particular in close proximity to the sensitive thermal springs, snake habitat and Hot Pools. Particularly sensitive sites include bus shelter, elevator shafts and other structures within a 100 meters radius of the Hot Pools. For example, equipment could include but is not limited to a processor or pulverizer attached to an excavator.
- .3 High impact equipment known to cause higher noise levels and potential for higher ground vibrations shall be prohibited. Blasting, portable rock crushers and large jackhammers are not permitted.
- .4 Contractor to submit for review a written procedure for concrete demolition at least 2 weeks prior to commencement of site work. Written procedure shall include descriptions of equipment, methods, and tools.

1.15 POLLUTION CONTROL

- .1 Maintain temporary erosion and pollution control features installed under this contract.
- .2 Control emissions from equipment and plant to local authorities' emission requirements.
- .3 The Contractor shall prevent any deleterious and objectionable materials from entering streams, rivers, wetlands, water bodies or watercourses that would result in damage to aquatic and riparian habitat. Hazardous or toxic products shall be stored no closer than 100 metres from any watercourse.
- .4 A Spill Response Plan will be prepared as part of the EPP and shall detail the containment and storage, security, handling, use and disposal of empty containers, surplus product or waste generated in the application of these products, to the satisfaction of the Departmental Representative and the ESO and in accordance with all applicable federal and provincial legislation. The EPP shall include a list of products and materials to be used or brought to the construction site that are considered or defined as hazardous or toxic to the environment.
- .5 Equip all service and supervisory vehicles with Emergency Spill Kit DOT-E-10102 or equivalent.

- .6 The containment, storage, security, handling, use, unique spill response requirements and disposal of empty containers, surplus product or waste generated in the use of any hazardous or toxic products shall be in accordance with all applicable federal and provincial legislation. Hazardous products shall be stored no closer than 100 metres from any watercourse.
- .7 Timely and effective action shall be taken to stop, contain and clean-up all spills as long as the site is safe to enter. The Departmental Representative and the ESO shall be notified immediately of any spill. If not available, Banff Dispatch will be contacted at (403) 762-4506. Spill response cards will be distributed during the initial Environmental Briefing with basic instructions and phone numbers.
- .8 In the event of a major spill, all other work shall be stopped and all personnel devoted to spill containment and clean-up.
 - .1 The costs involved in a spill incident (the control, clean up, disposal of contaminants and site remediation to pre-spill conditions), shall be the responsibility of the Contractor. The site will be inspected to ensure completion to the expected standard and to the satisfaction of the Departmental Representative and ESO.

1.16 NOTIFICATION

- .1 Departmental Representative will notify Contractor in writing of observed noncompliance with Federal, Provincial or Municipal environmental laws or regulations, permits, and other elements of Contractor's Environmental Protection plan.
- .2 Contractor: after receipt of such notice, inform Departmental Representative of proposed corrective action and take such action for approval by Departmental Representative.
- .3 Departmental Representative will issue stop order of work until satisfactory corrective action has been taken.
- .4 No time extensions granted or equitable adjustments allowed to Contractor for such suspensions.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 INSPECTION

- .1 Allow Departmental Representative 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 Departmental Representative instructions, or law of Place of Work.
- .3 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.
- .4 Departmental Representative will order part of Work to be examined if Work is suspected to be not in accordance with Contract Documents. If, upon examination such work is found not in accordance with Contract Documents, correct such Work and pay cost of examination and correction. If such Work is found in accordance with Contract Documents, Departmental Representative shall pay cost of examination and replacement.

1.2 INDEPENDENT INSPECTION AGENCIES

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

1.3 ACCESS TO WORK

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

1.4 PROCEDURES

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

1.6 REPORTS

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

1.7 MOCK-UPS

- .1 Submit mock-ups as indicated in technical specification sections.

1.8 TEST & MIX DESIGNS

- .1 Submit test and mix designs as indicated in technical specification sections.

1.9 MILL TESTS

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

1.10 EQUIPMENT AND SYSTEMS

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

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

1.2 INSTALLATION AND REMOVAL

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

1.3 DEWATERING

- .1 Provide temporary drainage and pumping facilities to keep site free from standing water as indicated in Section 31 23 19.

1.4 WATER SUPPLY

- .1 Provide continuous supply of potable water for construction use.

1.5 TEMPORARY HEATING AND VENTILATION

- .1 Provide temporary heating required during construction period, including attendance, maintenance and fuel.
- .2 Construction heaters used inside building must be vented to outside or be flameless type. Solid fuel salamanders are not permitted.
- .3 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.
- .4 Maintain temperatures of minimum 10 degrees C or as otherwise specified in other Sections of Work areas where construction is in progress.
- .5 Ventilating:
 - .1 Prevent accumulations of dust, fumes, mists, vapours or gases in areas occupied during construction.
 - .2 Provide local exhaust ventilation to prevent harmful accumulation 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.
- .6 Permanent heating system of building, to be used when available. Be responsible for damage to heating system if use is permitted.
- .7 On completion of Work for which permanent heating system is used, replace filters.
- .8 Pay costs for maintaining temporary heat, when using permanent heating system.
- .9 Maintain strict supervision of operation of temporary heating and ventilating equipment to:
 - .1 Conform 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.
- .10 Be responsible for damage to Work due to failure in providing adequate heat and protection during construction.

1.6 TEMPORARY POWER AND LIGHT

- .1 Provide and pay for temporary power and lighting as required.
- .2 Pay costs for installation, maintenance, and removal.
- .3 Provide and maintain temporary lighting while on site. Ensure level of illumination on all floors and stairs is not less than 162 lx.

1.7 TEMPORARY COMMUNICATION FACILITIES

- .1 Provide and pay for temporary cell phone and data device lines necessary for own use.

1.8 FIRE PROTECTION

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

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB 1.189-00, Exterior Alkyd Primer for Wood.
 - .2 CGSB 1.59-97, Alkyd Exterior Gloss Enamel.
- .2 Canadian Standards Association (CSA International)
 - .1 CSA-A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CSA-0121-08, Douglas Fir Plywood.
 - .3 CAN/CSA-S269.2-M1987(R2003), Access Scaffolding for Construction Purposes.
 - .4 CAN/CSA-Z321-96(R2001), Signs and Symbols for the Occupational Environment.
- .3 U.S. Environmental Protection Agency (EPA) / Office of Water
 - .1 EPA 832R92005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

1.2 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

1.3 INSTALLATION AND REMOVAL

- .1 Prepare site plan indicating proposed location and dimensions of area to be fenced and used by Contractor, number of trailers to be used, avenues of ingress/egress to fenced area and details of fence installation.
- .2 Identify areas which have to be gravelled to prevent tracking of mud.
- .3 Indicate use of supplemental or other staging area.
- .4 Provide construction facilities in order to execute work expeditiously.
- .5 Remove from site all such work after use.

1.4 SCAFFOLDING

- .1 Scaffolding in accordance with CAN/CSA-S269.2.
- .2 Provide and maintain scaffolding, ramps, ladders, swing staging, and platforms.

1.5 HOISTING

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

1.6 SITE STORAGE/LOADING

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

1.7 CONSTRUCTION PARKING

- .1 Limited parking will be permitted on site provided it does not disrupt performance of Work.
- .2 Provide and maintain adequate access to project site for authorized personnel.
- .3 Follow vehicle parking limitations and permit requirements when within the park.
- .4 Personal vehicles shall not be parked on any natural or undisturbed areas. Parking will be confined to parking lots and roads or as approved by the Town of Banff.
- .5 Obtain and pay for permits for any street use as required by the Town of Banff.

1.8 SECURITY

- .1 Provide and pay for responsible security personnel to guard site and contents of site after working hours and during holidays.
- .2 Provide fencing and additional security as deemed necessary.

1.9 OFFICES

- .1 A construction office is anticipated for the work. The construction office may be located at the site area, actual location subject to approval of the Departmental Representative and the ESO. It is anticipated the construction office may comprise the Contractors main office and a materials testing trailer.
- .2 Provide office heated to 22 degrees C, lighted 750 lx and ventilated, of sufficient size to accommodate site meetings and furnished with drawing laydown table.
- .3 Provide marked and fully stocked first-aid case in a readily available location.
- .4 Subcontractors to provide their own offices as necessary. Direct location of these offices.

1.10 EQUIPMENT, TOOL 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 required to be stored in weatherproof sheds on site in manner to cause least interference with work activities.

1.11 SANITARY FACILITIES

- .1 Provide portable sanitary facilities for work force in accordance with governing regulations and ordinances.
- .2 Post notices and take precautions as required by local health authorities. Keep area and premises in sanitary condition.

1.12 CONSTRUCTION SIGNAGE

- .1 No 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 duration of project, and dispose of off site on completion of project or earlier if directed by Departmental Representative.
- .4 Company signage is allowed on trailers or vehicles, not elsewhere on site.

1.13 PROTECTION AND MAINTENANCE OF TRAFFIC

- .1 Provide access and temporary relocated roads as indicated on the Site use plan and traffic accommodation plan to maintain traffic.
- .2 Maintain and protect traffic on affected roads during construction period except as otherwise specifically directed by Departmental Representative.
- .3 Provide measures for protection and diversion of traffic, including provision of watch-persons and flag-persons, erection of barricades, placing of lights around and in front of equipment and work, and erection and maintenance of 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 allowable load limit on these roads. Contractor: responsible for repair of damage to roads caused by construction operations.
- .7 Provide necessary lighting, signs, barricades, and distinctive markings for safe movement of traffic.
- .8 Dust control: adequate to ensure safe operation at all times.
- .9 Lighting: to assure full and clear visibility for full width of haul road and work areas during night work operations.
- .10 Snow Removal. Contractor is responsible for snow clearing within their work site including parking lots, sidewalks, etc as shown in the drawings 'Limit of Work'.

1.14 CLEAN-UP

- .1 Remove construction debris, waste materials, packaging material from work site daily.
- .2 Clean dirt or mud tracked onto paved or surfaced roadways.
- .3 Store materials resulting from demolition activities that are salvageable.
- .4 Stack stored new or salvaged material not in construction facilities.
- .5 Vacuum out all roof drains and locations where debris may have gathered during construction daily.

1.15 FIRE PROTECTION FACILITIES

- .1 Provide fire extinguisher and other equipment on site and maintain emergency vehicle access at all times.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canadian General Standards Board (CGSB)
 - .1 CGSB 1.59-97, Alkyd Exterior Gloss Enamel.
 - .2 CAN/CGSB 1.189-00, Exterior Alkyd Primer for Wood.
- .2 Canadian Standards Association (CSA International)
 - .1 CSA-O121-08 (R2013), Douglas Fir Plywood.
- .3 Town of Banff bylaws

1.2 INSTALLATION AND REMOVAL

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

1.3 GUARD RAILS AND BARRICADES

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

1.4 WEATHER ENCLOSURES

- .1 Provide weather tight closures to unfinished door and window openings, tops of shafts and other openings in floors and roofs.
- .2 Close off floor areas where walls are not finished; seal off other openings; enclose building interior work for temporary heat.
- .3 Design enclosures to withstand wind pressure and snow loading.

1.5 ACCESS TO SITE

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

1.6 PUBLIC TRAFFIC FLOW

- .1 Provide and maintain competent signal flag operators, traffic signals, barricades and flares, lights, or lanterns as required to perform Work and protect public.

1.7 FIRE ROUTES

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

1.8 PROTECTION FOR OFF-SITE AND PUBLIC PROPERTY

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

1.9 PROTECTION OF BUILDING FINISHES

- .1 Provide protection for finished and partially finished building finishes and equipment during performance of Work.
- .2 Provide necessary screens, covers, and hoardings.
- .3 Confirm with Departmental Representative locations and installation schedule 3 days prior to installation.
- .4 Be responsible for damage incurred due to lack of or improper protection.

1.10 WASTE MANAGEMENT AND DISPOSAL

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

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Within text of each specifications section, reference may be made to reference standards.
- .2 Conform to these reference standards, in whole or in part as specifically requested in specifications.
- .3 If there is question as to whether products or systems are in conformance with applicable standards, Departmental Representative reserves right to have such products or systems tested to prove or disprove conformance.
- .4 Cost for such testing will be borne by Departmental Representative in event of conformance with Contract Documents or by Contractor in event of non-conformance.

1.2 QUALITY

- .1 Products, materials, equipment and articles incorporated in Work shall be new, not damaged or defective, and of best quality for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.
- .2 Procurement policy is to acquire, in cost effective manner, items containing highest percentage of recycled and recovered materials practicable consistent with maintaining satisfactory levels of competition. Make reasonable efforts to use recycled and recovered materials and in otherwise utilizing recycled and recovered materials in execution of work.
- .3 Defective products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.
- .4 Should disputes arise as to quality or fitness of products, decision rests strictly with Departmental Representative based upon requirements of Contract Documents.
- .5 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.
- .6 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

1.3 AVAILABILITY

- .1 Immediately upon signing Contract, review project delivery requirements and anticipate foreseeable supply delays for items. If delays in supply of products are foreseeable, notify Departmental Representative of such, in order that

substitutions or other remedial action may be authorized in ample time to prevent delay in performance of Work.

- .2 In event of failure to notify Departmental Representative at commencement of Work and should it subsequently appear that Work may be delayed for such reason, Departmental Representative reserves right to substitute more readily available products of similar character, at no increase in Contract Price or Contract Time.

1.4 STORAGE, HANDLING AND PROTECTION

- .1 Handle and store products in manner to prevent damage, deterioration and soiling and in accordance with manufacturer's instructions when applicable.
- .2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.
- .3 Store products subject to damage from weather in weatherproof enclosures.
- .4 Store cementitious products clear of earth or concrete floors, and away from walls.
- .5 Store sheet materials, lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.
- .6 Store products as indicated in the technical specification or as required by the manufacturer.
- .7 Remove and replace damaged products at own expense and to satisfaction of Departmental Representative.
- .8 Touch-up damaged factory finished surfaces to Departmental Representative's satisfaction. Use touch-up materials to match original. Do not paint over name plates.
- .9 Store products as indicated in the technical specification or as required by the manufacturer.

1.5 TRANSPORTATION

- .1 Pay costs of transportation of products 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 Departmental Representative in writing, of conflicts between specifications and manufacturer's instructions.

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

1.7 QUALITY OF WORK

- .1 Ensure Quality of Work is of highest standard, executed by licensed or qualified workers experienced and skilled in respective duties for which they are employed. Immediately notify Departmental Representative if required Work is such as to make it impractical to produce required results.
- .2 Do not employ anyone unskilled in their required duties. Departmental Representative reserves right to require dismissal from site, workers deemed incompetent or careless.
- .3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with Departmental Representative whose decision is final.

1.8 CO-ORDINATION

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

1.9 CONCEALMENT

- .1 In finished areas conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.
- .2 Before installation inform Departmental Representative if there is interference. Install as directed by Departmental Representative.

1.10 REMEDIAL WORK

- .1 Refer to Section 01 73 00 - Execution Requirements.
- .2 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Co-ordinate adjacent affected Work as required.
- .3 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.

1.11 LOCATION OF FIXTURES

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

1.12 FASTENINGS

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

1.13 FASTENINGS - EQUIPMENT

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

1.14 PROTECTION OF WORK IN PROGRESS

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

1.15 EXISTING UTILITIES

- .1 When breaking into or connecting to existing services or utilities, execute Work at times directed by local governing authorities including Parks owned utilities, with minimum of disturbance to Work, and/or building occupants and pedestrian and vehicular traffic. Make arrangements with Departmental Representative.
- .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.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 QUALITY ASSURANCE

- .1 Qualifications of Surveyor
 - .1 Qualified registered land surveyor, licensed to practice in Place of Work, acceptable to Departmental Representative.

1.2 SURVEY REFERENCE POINTS

- .1 Existing base horizontal and vertical control points are designated on drawings.
- .2 Locate, confirm and protect control points prior to starting site work. Preserve permanent reference points during construction.
- .3 Make no changes or relocations without prior written notice to Departmental Representative.
- .4 Report to Departmental Representative when reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.
- .5 Require surveyor to replace control points in accordance with original survey control.

1.3 SURVEY REQUIREMENTS

- .1 Establish two permanent bench marks on site, referenced to established bench marks by survey control points. Record locations, with horizontal and vertical data in Project Record Documents.
- .2 Establish lines and levels, locate and lay out, by instrumentation.
- .3 Stake for grading, fill and topsoil placement and landscaping features.
- .4 Stake slopes and berms.
- .5 Establish pipe invert elevations.
- .6 Stake batter boards for foundations.
- .7 Establish foundation column locations and floor elevations.
- .8 Establish lines and levels for mechanical and electrical work.

1.4 EXISTING SERVICES

- .1 Before commencing work, arrange and pay to establish location and extent of service lines in area of Work and notify Departmental Representative of findings.
- .2 Remove abandoned service lines within 2 m of structures. Cap or otherwise seal lines at cut-off points as directed by Departmental Representative.

1.5 LOCATION OF EQUIPMENT AND FIXTURES

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

1.6 SUBSURFACE CONDITIONS

- .1 Promptly notify Departmental Representative in writing if subsurface conditions at Place of Work differ materially from those indicated in Contract Documents, or a reasonable assumption of probable conditions based thereon.
- .2 After prompt investigation, should Departmental Representative determine that conditions do differ materially, instructions will be issued for changes in Work as provided in Changes and Change Orders.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit written request in advance of cutting or alteration which affects:
 - .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 Work of Departmental Representative or separate contractor.
- .3 Include in request:
 - .1 Identification of project.
 - .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 Departmental Representative or separate contractor.
 - .7 Written permission of affected separate contractor.
 - .8 Date and time work will be executed.

1.2 MATERIALS

- .1 Required for original installation.
- .2 Change in Materials: Submit request for substitution in accordance with Section 01 33 00 - Submittal Procedures.

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 of cutting or patching means acceptance of existing conditions.
- .4 Provide supports to assure structural integrity of surroundings; provide devices and methods to protect other portions of project from damage.
- .5 Provide protection from elements for areas which 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 Employ original installer to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.
- .9 Cut rigid materials using masonry saw or core drill. Pneumatic or impact tools not allowed on masonry work without prior approval.
- .10 Restore work with new products in accordance with requirements of Contract Documents.
- .11 Fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- .12 At penetration of fire rated wall, ceiling, or floor construction, completely seal voids with firestopping material, full thickness of the construction element.
- .13 Refinish surfaces to match adjacent finishes: Refinish continuous surfaces to nearest intersection. Refinish assemblies by refinishing entire unit.
- .14 Conceal pipes, ducts and wiring in floor, wall and ceiling construction of finished areas except where indicated otherwise.

1.5 WASTE MANAGEMENT AND DISPOSAL

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

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

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 Departmental Representative.
- .2 Remove waste materials from site at daily regularly scheduled times or dispose of outside of National Park. Do not burn waste materials on site.
- .3 Clear snow and ice from access to building including parking lot and sidewalks, bank/pile snow in designated areas only as directed by Departmental Representative.
- .4 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .5 Provide on-site containers for collection of waste materials and debris.
- .6 Provide and use marked separate bins for recycling. Refer to Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .7 Store volatile waste in covered metal containers, and remove from premises at end of each working day.
- .8 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.
- .9 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
- .10 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

1.2 FINAL CLEANING

- .1 Clean work prior to final review by Departmental Representative.
- .2 When Work is Substantially Performed remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.
- .3 Remove waste in accordance with Section 01 74 21 – Waste Management and Disposal.
- .4 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.
- .5 Prior to final review remove surplus products, tools, construction machinery and equipment.

- .6 Remove waste products and debris including that caused by Departmental Representative or other Contractors.
- .7 Remove waste materials from site at regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials on site, unless approved by Departmental Representative.
- .8 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .9 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, and mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.
- .10 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, and floors.
- .11 Clean lighting reflectors, lenses, and other lighting surfaces.
- .12 Vacuum clean and dust building interiors, behind grilles, louvres and screens.
- .13 Wax, seal, shampoo or prepare floor finishes, as recommended by manufacturer.
- .14 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.
- .15 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.
- .16 Remove dirt and other disfiguration from exterior surfaces.
- .17 Clean and sweep roofs, gutters, areaways, and sunken wells.
- .18 Sweep and wash clean paved areas.
- .19 Clean equipment and fixtures to sanitary condition.
- .20 Clean mechanical equipment including replacement of filters.
- .21 Clean roofs, downspouts, and drainage systems.
- .22 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.
- .23 Remove snow and ice from access to building.

1.3 WASTE MANAGEMENT AND DISPOSAL

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

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 WASTE MANAGEMENT GOALS

- .1 Recycle metals and any other items that are accepted at recycling facility. Provide way bills to Departmental Representative.
- .2 Prior to start of Work conduct meeting with Departmental Representative to review and discuss Waste Management Plan and Goals and prepare a waste management plan.
- .3 Waste Management Goal: as much as possible of total Project Waste to be diverted from landfill sites. Provide Departmental Representative documentation certifying that waste management, recycling, reuse of recyclable and reusable materials have been extensively practiced.

1.2 DEFINITIONS

- .1 Class III: non-hazardous waste - construction renovation and demolition waste.
- .2 Inert Fill: inert waste - exclusively asphalt and concrete.
- .3 Recyclable: ability of product or material to be recovered at end of its life cycle and re-manufactured into new product for reuse.
- .4 Recycle: process by which waste and recyclable materials are transformed or collected for purpose of being transferred into new products.
- .5 Recycling: process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for purpose of using in altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- .6 Separate Condition: refers to waste sorted into individual types.
- .7 Source Separation: acts of keeping different types of waste materials separate beginning from first time they became waste.

1.3 STORAGE, HANDLING AND PROTECTION

- .1 Store, materials to recycled and salvaged are to be removed from site to recycling facility without storing on site. Materials to be recycled on site are to be placed in final location with minimum of rehandling. Stockpiles of concrete in areas other than final buried location will not be permitted.
- .2 Unless specified otherwise, materials for removal become Contractor's property.
- .3 Separate recyclable materials from salvaged items. Transport and deliver non-salvageable items to licensed disposal facility. Transport and deliver recyclable items to recycling facilities.
- .4 Protect surface drainage, mechanical and electrical from damage and blockage.

- .5 Separate and store materials produced during dismantling of structures in designated areas.
- .6 Prevent contamination of materials to be salvaged and recycled and handle materials in accordance with requirements for acceptance by designated facilities.
 - .1 On-site source separation is recommended.
 - .2 Remove co-mingled materials to off-site processing facility for separation.

1.4 DISPOSAL OF WASTES

- .1 Do not bury rubbish or waste materials.
- .2 Do not dispose of waste, volatile materials, mineral spirits, oil, and paint thinner into waterways, storm, or sanitary sewers.
- .3 Remove materials from deconstruction as deconstruction/disassembly Work progresses.

1.5 USE OF SITE AND FACILITIES

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

1.6 SCHEDULING

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

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 appropriate regulations and codes.

3.2 CLEANING

- .1 Remove tools and waste materials on completion of Work, and leave work area in clean and orderly condition.
- .2 Clean-up work area as work progresses.
- .3 Source separate materials to be reused/recycled into specified sort areas.

3.3 DIVERSION OF MATERIALS

- .1 On-site sale of recyclable materials is not permitted.

3.4 CANADIAN GOVERNMENTAL DEPARTMENTS CHIEF RESPONSIBILITY FOR THE ENVIRONMENT

- .1 Schedule E - Government Chief Responsibility for the Environment:

Alberta	Alberta Environmental Protection Petroleum Plaza, South Tower 9915 - 108 th Street Edmonton AB T5K 2G8	780-427-2739	
	Alberta Special Waste Management Corporation Pacific Plaza, Suite 610 10909 Jasper Avenue NW Edmonton AB T5J 3L9	780-422-5029	780-428-9627

END OF SECTION

Part 1 General

1.1 INTENT

- .1 A facility start-up process shall be used to bring the facility to a fully operational state, free of deficiencies, in the most efficient and timely manner achievable.
- .2 Contractor shall be responsible for testing, adjusting and balancing of all:
 - .1 Piped, ducted, wired and wireless services and systems, including all components and equipment forming part thereof, and
 - .2 Manually and mechanically operated systems including all components and equipment forming part thereof.
- .3 Perform starting of each system and each item of equipment in accordance with the general requirements specified in this section and is specific to facility start-up and commissioning of the facility.
- .4 This section specifies additional requirements to those required for normal Contractor's start-up of equipment and systems as contained in the General Requirements of the Contract, and as follows:
 - .1 Perform and record tests to confirm proper performance and compliance with requirements of Contract Documents; take corrective action as necessary.
 - .2 Perform adjustments to ensure proper, efficient and safe operation.
 - .3 Perform balancing to ensure that the various parts of system are in a proper state of equilibrium.
- .5 Performance Testing will begin after declaration of Substantial Performance as described in Section 01 77 00 – Closeout Procedures and will lead to Fine Tuning of equipment and systems.
- .6 Fine Tuning will occur after declaration of Substantial Performance as described in Section 01 77 00 – Closeout Procedures and will lead to Final Acceptance of the Work.
- .7 A Commissioning Authority will be employed by the Departmental Representative to act on the behalf of the Departmental Representative will oversee the starting, testing, adjusting and balancing operations, and verify that equipment and systems are working as specified and within manufacturer's operating tolerances.

1.2 RELATED REQUIREMENTS

- .1 Section 01 77 00 – Closeout Procedures
- .2 Section 01 79 00 – Demonstration and Training

1.3 QUALITY ASSURANCE

- .1 Contractor shall perform testing, adjusting and balancing with Contractor's qualified personnel, or employ and pay for a qualified organization to perform such services.
- .2 Perform testing, adjusting and balancing after starting of equipment and systems.
- .3 Provide personnel, operate systems at designated times, and under conditions required for proper testing, adjusting, and balancing.

- .4 Report to Departmental Representative any deficiencies or defects noted during testing, adjusting and balancing, which cannot be promptly corrected.

Part 2 Products

2.1 MANUFACTURER'S SITE SERVICES

- .1 Provide manufacturers authorized representative when specified, or when requested by the Departmental Representative at site to do the following:
 - .1 Inspect, check and approve equipment and systems installation before starting.
 - .2 Supervise placing equipment and systems in operation.
- .2 Manufacturers' authorized representative shall provide a written report verifying that equipment:
 - .1 Is properly installed and lubricated;
 - .2 Is in accurate alignment;
 - .3 Is free from any undue stress imposed by connecting lines or anchor bolts; and,
 - .4 Is being satisfactorily operated under load conditions.

Part 3 Execution

3.1 PREPARATION

- .1 Have Contract Documents, shop drawings, product data, and operation and maintenance data at hand during starting process.
- .2 Coordinate sequence for starting of various equipment and systems.
- .3 Prepare each system and item of equipment for testing, adjusting and balancing.
- .4 Verify that each systems and equipment installation is complete and in continuous operation.
- .5 Verify ambient conditions.

3.2 FIELD QUALITY CONTROL

- .1 Testing, Adjusting and Balancing
 - .1 Testing: Perform tests to confirm compliance with requirements of Contract Documents. Take corrective action as necessary.
 - .2 Adjusting: Perform adjustments to ensure proper, efficient and safe operation.
 - .3 Balancing: Perform balancing to ensure that the various parts of system are in a proper state of equilibrium.
 - .4 Provide testing, adjusting and balancing of all:
 - .1 Piped, ducted, wired and wireless services and systems, including all components and equipment forming part thereof as identified in technical sections, and

- .2 Manually and mechanically operated systems including all components and equipment forming part thereof.
- .3 Comply with the requirements of all CSA, ASTM, ASHRAE, IEEE and other standards affecting their portion of the work to ensure that systems installed will meet the Departmental Representative's testing criteria.
- .4 Copies of required standards shall be kept on site during installation and be available for viewing by the Contractor, the Departmental Representative.
- .5 Perform testing, adjusting and balancing after starting of equipment and systems.
- .2 Fine Tuning
 - .1 Fine tuning shall include, but not be limited to, the following:
 - .1 Air Balancing: final balancing.
 - .2 Water Balancing: final balancing.
 - .3 Fire Protection Systems: Verification of fire alarm system.
 - .4 Electrical Equipment and Systems: Testing of safety systems and devices.
 - .5 Other systems and equipment as identified in the technical sections.
 - .2 Fine tuning shall commence upon Departmental Representative's acceptance of Performance Testing results.
 - .3 Coordinate and cooperate with the Departmental Representative.
 - .4 Make necessary adjustments to comply with standards established by the Specifications ready for Departmental Representative's formalized verification and commissioning process.
 - .5 Contractor shall do the following during Fine Tuning:
 - .1 Correct all Contract Deficiencies previously outstanding and those identified during Fine Tuning.
 - .2 Execute Change Orders issued by Departmental Representative.
 - .3 Perform all other work and activities required for fulfillment of prerequisites to Final Acceptance of the Work as specified in Section 01 77 00.
 - .6 Departmental Representative will do the following during Fine Tuning:
 - .1 Conduct user surveys and take environmental measurements as necessary to identify existing and potential problems.
 - .2 Initiate Change Orders as required.
 - .3 Perform other activities related to Final Acceptance of the Work as specified in Section 01 77 00.

3.3 FACILITY START-UP

- .1 Contractor shall do the following during Facility Start-Up, not necessarily in order listed:
 - .1 Start equipment and systems as specified below.
 - .2 Test, adjust and balance equipment and systems as specified below.

- .3 Demonstrate equipment and systems as specified in Section 01 79 00 – Demonstration and Training.
- .4 Complete and submit Facility Start-Up report forms including:
 - .1 Contractor's system and equipment start-up reports.
 - .2 Testing, adjusting and balancing reports.
 - .3 Manufacturers' equipment start-up reports.
- .5 Review Contract Documents and inspect the Work to ensure completeness of the Work and compliance with requirements of Contract Documents.
- .6 Correct Contract Deficiencies identified as a result of the foregoing and as may be identified by the Departmental Representative.
- .7 Execute Change Orders issued by the Departmental Representative.
- .8 Perform all other work and activities required for fulfillment of prerequisites to Substantial Performance of the Work as specified in Section 01 77 00.

3.4 STARTING

- .1 Verify that each item of equipment has been checked for proper lubrication; drive rotation, belt tension, control sequence, and other conditions affecting starting and operation; take corrective action as necessary.
- .2 Execute starting under supervision of Contractor's personnel and, when specified or requested by Departmental Representative, manufacturer's authorized representative.
- .3 Place equipment and systems in operation in proper sequence and in accordance with approved Contractor's Start-Up sub-schedule.
- .4 Take corrective action as necessary.

3.5 SEASONAL CONSTRAINTS

- .1 Notwithstanding all-inclusive requirements specified in this Section, additional separate cycles of Facility Start-Up, Performance Testing and Fine Tuning may be necessitated at a later time on equipment and systems whose full operation is dependent on seasonal conditions.
- .2 Contractor's responsibilities with respect to such later Facility Start-Up activities shall be as specified in this Section.

3.6 PARTIAL UTILIZATION OF WORK

- .1 Applicable requirements specified in this Section shall apply to the parts of the Work being utilized when partial utilization of the Work is required.

END OF SECTION

Part 1 General

1.1 INSPECTION AND DECLARATION

- .1 Contractor's Inspection: Contractor and Subcontractors: conduct inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.
 - .1 Notify Departmental Representative in writing of satisfactory completion of Contractor's Inspection and that corrections have been made.
 - .2 Request Departmental Representative Inspection.
- .2 Departmental Representative Inspection: Departmental Representative and Contractor will perform inspection of Work to identify obvious defects or deficiencies. Contractor to 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, adjusted and balanced and are fully operational.
 - .4 Certificates required by Boiler Inspection Branch, Fire Commissioner and Utility companies have been submitted.
 - .5 Operation of systems have been demonstrated to Departmental Representative's personnel.
 - .6 Work is complete and ready for final inspection.
- .4 Final Inspection: when items noted above are completed, request final inspection of Work by Departmental Representative, and Contractor. If Work is deemed incomplete by Departmental Representative, complete outstanding items and request reinspection.
- .5 Substantial Performance: in accordance with Construction Contract.
- .6 Lien and Warranty Requirements: in accordance with Construction Contract.
- .7 Final and Holdback Payments: as indicated in Construction Contract.

1.2 CLEANING

- .1 In accordance with Section 01 74 11 - Cleaning.
- .2 Remove waste and surplus materials, rubbish and construction facilities from the site in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Prepare instructions and data using personnel experienced in maintenance and operation of described products.
- .3 Copy will be returned after final inspection, with Departmental Representative's comments.
- .4 Revise content of documents as required prior to final submittal.
- .5 Two weeks prior to Substantial Performance of the Work, submit to the Departmental Representative four final hard copies and pdf version format of operating and maintenance manuals in English on a flash drive.
- .6 Furnish evidence, if requested, for type, source and quality of products provided.
- .7 Defective products will be rejected, regardless of previous inspections. Replace products at own expense.
- .8 Pay costs of transportation.

1.2 FORMAT

- .1 Format below is for paper copies, provide pdf version of electronic copies:
 - .1 Organize data as instructional manual.
 - .2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 219 x 279 mm with spine and face pockets.
 - .3 When multiple binders are used correlate data into related consistent groupings. Identify contents of each binder on spine.
 - .4 Cover: identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.
 - .5 Arrange content by systems, process flow, under Section numbers and sequence of Table of Contents.
 - .6 Provide tabbed fly leaf for each separate product and system, with typed description of product.
 - .7 Text: manufacturer's printed data, or typewritten data.
 - .8 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
 - .9 Provide marked up red-line drawings to the Departmental Representative for them to update the drawings, 1:1 scaled CAD files in dwg format on CD.

1.3 CONTENTS - EACH VOLUME

- .1 Table of Contents: provide title of project;
 - .1 Date of submission; names.

- .2 Addresses, and telephone numbers of Departmental Representative and Contractor with name of responsible parties.
- .3 Schedule of products and systems, indexed to content of volume.
- .2 For each product or system:
 - .1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
- .3 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.
- .4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- .5 Typewritten Text: as required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00 - Quality Control.
- .6 Training: refer to Section 01 79 00 - Demonstration and Training.

1.4 AS-BUILTS AND SAMPLES

- .1 Maintain, in addition to requirements in General Conditions, at site for Departmental Representative 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 Departmental Representative.

1.5 RECORDING ACTUAL SITE CONDITIONS

- .1 Record information in red on set of blue line opaque drawings, and in copy of Project Manual, provided by Departmental Representative.

- .2 Provide felt tip marking pens, maintaining separate colours for each major system, for recording information.
- .3 Record information concurrently with construction progress. Do not conceal Work until required information is recorded.
- .4 Contract 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.

1.6 FINAL SURVEY

- .1 Submit final site survey certificate in accordance with Section 01 71 00 - Examination and Preparation, certifying that elevations and locations of completed Work are in conformance, or non-conformance with Contract Documents.

1.7 REAL PROPERTY CERTIFICATE

- .1 Supply to the Departmental Representative, as soon as construction of foundations and basic ground floor levels are completed, a survey plan from a registered Alberta Land Surveyor.
- .2 Plan shall show dimensioned building plan at ground level, distance from property lines, and elevation of the floor used as datum.
- .3 This includes all buildings in Contract.

1.8 EQUIPMENT AND SYSTEMS

- .1 Each Item of Equipment and Each System: include description of unit or system, and component parts. Give 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 Include installed colour coded wiring diagrams.
 - .4 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.
 - .5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
 - .6 Provide servicing and lubrication schedule, and list of lubricants required.
 - .7 Include manufacturer's printed operation and maintenance instructions.
 - .8 Include sequence of operation by controls manufacturer.
 - .9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
 - .10 Provide installed control diagrams by controls manufacturer.
 - .11 Provide Contractor's co-ordination drawings, with installed colour coded piping diagrams.
 - .12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
 - .13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
 - .14 Include test and balancing reports as specified in Section 01 45 00 - Quality Control and 01 91 13 - General Commissioning (Cx) Requirements.
 - .15 Additional requirements: as specified in individual specification sections.

1.9 MATERIALS AND FINISHES

- .1 Building Products, Applied Materials, and Finishes: include product data, with catalogue number, size, composition, and colour and texture designations. Provide information for re-ordering custom manufactured products.
- .2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

- .3 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.
- .4 Additional Requirements: as specified in individual specifications sections.

1.10 SPARE PARTS

- .1 Provide spare parts, in quantities specified in individual specification sections.
- .2 Provide items of same manufacture and quality as items in Work.
- .3 Deliver to site, location as directed; place and store.
- .4 Receive and catalogue items. Submit inventory listing to Departmental Representative. Include approved listings in Maintenance Manual.
- .5 Obtain receipt for delivered products and submit prior to final payment.

1.11 EXITING SIGNAGE

- .1 Provide computer generated signage for emergency passage exiting of building. Provide minimum 305 x 305 mm size signs to include at locations as required by Authority having Jurisdiction for building exiting.

1.12 MAINTENANCE MATERIALS

- .1 Provide maintenance and extra materials, in quantities specified in individual specification sections.
- .2 Provide items of same manufacture and quality as items in Work.
- .3 Deliver to location as directed; place and store.
- .4 Receive and catalogue items. Submit inventory listing to Departmental Representative. Include approved listings in Maintenance Manual.
- .5 Obtain receipt for delivered products and submit prior to final payment.

1.13 SPECIAL TOOLS

- .1 Provide special tools, in quantities specified in individual specification section.
- .2 Provide items with tags identifying their associated function and equipment.
- .3 Deliver to site, location as directed; place and store.
- .4 Receive and catalogue items. Submit inventory listing to Departmental Representative. Include approved listings in Maintenance Manual.

1.14 STORAGE, HANDLING AND PROTECTION

- .1 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.
- .2 Store in original and undamaged condition with manufacturer's seal and labels intact.
- .3 Store components subject to damage from weather in weatherproof enclosures.
- .4 Remove and replace damaged products at own expense and to satisfaction of Departmental Representative.

1.15 WARRANTIES AND BONDS

- .1 Develop warranty management plan to contain information relevant to Warranties.
- .2 Submit warranty management plan, 30 days before planned pre-warranty conference, to Departmental Representative approval.
- .3 Warranty management plan to include required actions and documents to assure that Departmental Representative receives warranties to which it is entitled.
- .4 Provide plan in narrative form and contain sufficient detail to make it suitable for use by future maintenance and repair personnel.
- .5 Submit, warranty information made available during construction phase, to Departmental Representative for approval prior to each monthly pay estimate.
- .6 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 Co-execute submittals when required.
 - .6 Retain warranties and bonds until time specified for submittal.
- .7 Except for items put into use with Departmental Representative's permission, leave date of beginning of time of warranty until Date of Substantial Performance is determined.
- .8 Conduct 10 month warranty inspection, measured from time of acceptance, by Departmental Representative.
- .9 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 Listing and status of delivery of Certificates of Warranty for extended warranty items, to include roofs, HVAC balancing, pumps, motors, transformers, and commissioned systems such as fire protection, alarm systems, and lightning protection systems.
- .3 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.
- .4 Contractor's plans for attendance at 10 month post-construction warranty inspections.
- .5 Procedure and status of tagging of equipment covered by extended warranties.
- .6 Post copies of instructions near selected pieces of equipment where operation is critical for warranty and/or safety reasons.
- .10 Respond in a timely manner to oral or written notification of required construction warranty repair work.
- .11 Written verification will follow oral instructions. Failure to respond will be cause for the Departmental Representative to proceed with action against Contractor.

1.16 PRE-WARRANTY CONFERENCE

- .1 Meet with Departmental Representative, to develop understanding of requirements of this section. Schedule meeting prior to contract completion, and at time designated by Departmental Representative.
- .2 Departmental Representative will establish communication procedures for:

- .1 Notification of construction warranty defects.
- .2 Determine priorities for type of defect.
- .3 Determine reasonable time for response.
- .3 Provide name, telephone number and address of licensed and bonded company that is authorized to initiate and pursue construction warranty work action.
- .4 Ensure contact is located within local service area of warranted construction, is continuously available, and is responsive to inquiries for warranty work action.

1.17 WARRANTY TAGS

- .1 Tag, at time of installation, each warranted item. Provide durable, oil and water resistant tag approved by Departmental Representative.
- .2 Attach tags with copper wire and spray with waterproof silicone coating.
- .3 Leave date of acceptance until project is accepted for occupancy.
- .4 Indicate following information on tag:
 - .1 Type of product/material.
 - .2 Model number.
 - .3 Serial number.
 - .4 Contract number.
 - .5 Warranty period.
 - .6 Inspector's signature.
 - .7 Construction Contractor.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 DESCRIPTION

- .1 Demonstrate scheduled operation and maintenance of equipment and systems to Departmental Representative's personnel two weeks prior to date of substantial performance.
- .2 Departmental Representative will provide list of personnel to receive instructions, and will co-ordinate their attendance at agreed-upon times.

1.2 QUALITY CONTROL

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

1.3 INFORMATION SUBMITTALS / ACTION SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit schedule of time and date for demonstration of each item of equipment and each system two weeks prior to designated dates, for Departmental Representative's approval.
- .3 Submit reports within one week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.
- .4 Give time and date of each demonstration, with list of persons present.

1.4 CONDITIONS FOR DEMONSTRATIONS

- .1 Equipment has been inspected and put into operation.
- .2 Testing, adjusting, and balancing has been performed in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements and equipment and systems are fully operational.
- .3 Provide copies of completed operation and maintenance manuals for use in demonstrations and instructions.

1.5 PREPARATION

- .1 Verify that conditions for demonstration and instructions comply with requirements.
- .2 Verify that designated personnel are present.

1.6 DEMONSTRATION AND INSTRUCTIONS

- .1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment at agreed upon times, at the designated location.
- .2 Instruct personnel in phases of operation and maintenance using operation and maintenance manuals as basis of instruction.
- .3 Review contents of manual in detail to explain aspects of operation and maintenance.

- .4 Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instructions.

1.7 TIME ALLOCATED FOR INSTRUCTIONS

- .1 Ensure amount of time required for instruction of each item of equipment or system as follows:
 - .1 Heating Plant: as required.
 - .2 Cooling and Ventilation System: as required.
 - .3 Control System: as required.
 - .4 Plumbing System: as required.
 - .5 Electrical System: as required.
 - .6 Overhead Doors: as required.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 General requirements relating to commissioning of project's components and systems, specifying general requirements to Performance Verification of components, equipment, sub-systems, systems, and integrated systems.
- .2 Acronyms:
 - .1 BMM - Building Management Manual.
 - .2 Cx - Commissioning.
 - .3 ICA – Independent Commissioning Agent
 - .4 EMCS - Energy Monitoring and Control Systems.
 - .5 O&M - Operation and Maintenance.
 - .6 PI - Product Information.
 - .7 PV - Performance Verification.
 - .8 TAB - Testing, Adjusting and Balancing.

1.2 GENERAL

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

1.3 COMMISSIONING OVERVIEW

- .1 Cx activities supplement field quality and testing procedures described in relevant technical sections.

- .2 Cx is conducted in concert with activities performed during project delivery. Cx identifies issues in Planning and Design stages which are addressed during Construction and Cx stages to ensure the built facility is constructed and proven to operate satisfactorily under weather, environmental and occupancy conditions to meet functional and operational requirements. Cx activities includes transfer of critical knowledge to facility operational personnel.
- .3 Consultant will issue Interim Acceptance Certificate when:
 - .1 Completed Cx documentation has been received, reviewed for suitability and approved by Consultant
 - .2 Equipment, components and systems have been commissioned.
 - .3 O&M training has been completed.

1.4 NON-CONFORMANCE TO PERFORMANCE VERIFICATION REQUIREMENTS

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

1.5 PRE-CX REVIEW

- .1 Before Construction:
 - .1 Review contract documents, confirm by writing Consultant.
 - .1 Adequacy of provisions for Cx.
 - .2 Aspects of design and installation pertinent to success of Cx.
- .2 During Construction:
 - .1 Co-ordinate provision, location and installation of provisions for Cx.
- .3 Before start of Cx:
 - .1 Work with Independent Commissioning Agent to create a commissioning schedule.
 - .2 Ensure installation of related components, equipment, sub-systems and systems is complete.
 - .3 Fully understand Cx requirements and procedures.
 - .4 Have Cx documentation shelf-ready.
 - .5 Understand completely design criteria and intent and special features.
 - .6 Submit complete start-up documentation to ICA.
 - .7 Have Cx schedules up-to-date.
 - .8 Ensure systems have been cleaned thoroughly.
 - .9 Complete TAB procedures on systems, submit TAB reports to Consultant for review and approval. Submit TAB reports to ICA for review.
 - .10 Ensure "As-Built" system schematics are available.

- .4 Inform Consultant in writing of discrepancies and deficiencies on finished works.

1.6 CONFLICTS

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

1.7 COMMISSIONING DOCUMENTATION

- .1 Commissioning Checksheets will be provided by the Independent Commissioning Agent and completed by the Contractor.
- .2 These sheets will be reviewed for completeness by the Independent Commissioning Agent during Construction Commissioning Reviews.
- .3 Provide completed and approved Cx documentation to the Independent Commissioning Agent.

1.8 COMMISSIONING SCHEDULE

- .1 Provide adequate time for Cx activities prescribed in technical sections and commissioning sections including:
 - .1 Approval of Cx reports.
 - .2 Verification of reported results.
 - .3 Repairs, retesting, re-commissioning, re-verification.
 - .4 Training.

1.9 COMMISSIONING MEETINGS

- .1 Attend Cx meetings following project meetings. Meetings will be organized by General Contractor. Agenda and Minutes will be recorded by the Independent Commissioning Agent.
- .2 Purpose: to resolve issues, monitor progress, identify deficiencies, relating to Cx.
- .3 Continue Cx meetings on regular basis until commissioning deliverables have been addressed.
- .4 At 60% construction completion stage of each phase call a separate Cx scope meeting to review progress, discuss schedule of equipment start-up activities and prepare for Cx. Issues at meeting to include:
 - .1 Review duties and responsibilities of Contractor and subcontractors, addressing delays and potential problems.
 - .2 Determine the degree of involvement of trades and manufacturer's representatives in the commissioning process.
- .5 Thereafter Cx meetings to be held until project completion and as required during equipment start-up and functional testing period.

- .6 Meeting will be chaired by Independent Commissioning Agent who will record and distribute minutes.
- .7 Ensure subcontractors and relevant manufacturer representatives are present at 60% and subsequent Cx meetings and as required.

1.10 STARTING AND TESTING

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

1.11 WITNESSING OF STARTING AND TESTING

- .1 Provide 7 days notice prior to commencement.
- .2 Independent Commissioning Agent to witness of start-up and testing as deemed necessary by the ICA.

1.12 MANUFACTURER'S INVOLVEMENT

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

1.13 PROCEDURES

- .1 Verify that equipment and systems are complete, clean, and operating in normal and safe manner prior to conducting start-up, testing and Cx.
- .2 Conduct start-up and testing in following distinct phases:
 - .1 Included in delivery and installation:

- .1 Verification of conformity to specification, approved shop drawings and completion of PI report forms.
- .2 Visual inspection of quality of installation.
- .2 Start-up: follow accepted start-up procedures.
- .3 Operational testing: document equipment performance.
- .4 System PV: include repetition of tests after correcting deficiencies.
- .5 Post-substantial performance verification: to include fine-tuning.
- .3 Correct deficiencies and obtain approval from Consultant after distinct phases have been completed and before commencing next phase.
- .4 Document require tests on PV forms provided by Independent Commissioning Agent.

1.14 START-UP DOCUMENTATION

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

1.15 OPERATION AND MAINTENANCE OF EQUIPMENT AND SYSTEMS

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

1.16 TEST RESULTS

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

1.17 START OF COMMISSIONING

- .1 Notify Independent Commissioning Authority at least 21 days prior to start of Cx.

- .2 Start Cx after elements of building affecting start-up and performance verification of systems have been completed.

1.18 COMMISSIONING PERFORMANCE VERIFICATION

- .1 Carry out Cx:
 - .1 Under actual or accepted simulated operating conditions, over entire operating range, in all modes.
 - .2 On independent systems and interacting systems.
- .2 Cx procedures to be repeatable and reported results are to be verifiable.
- .3 Follow equipment manufacturer's operating instructions.
- .4 EMCS trending to be available as supporting documentation for performance verification.

1.19 WITNESSING COMMISSIONING

- .1 Independent Commissioning Agent to witness activities and verify results.

1.20 AUTHORITIES HAVING JURISDICTION

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

1.21 COMMISSIONING CONSTRAINTS

- .1 Since access into secure or sensitive areas will be very difficult after occupancy it is necessary to complete Cx of occupancy, weather, and seasonal sensitive equipment and systems in these areas.

1.22 EXTRAPOLATION OF RESULTS

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

1.23 EXTENT OF VERIFICATION

- .1 Conduct tests repeated during verification under same conditions as original tests, using same test equipment, instrumentation.

- .2 Review and repeat commissioning of systems if inconsistencies found in more than 20% of reported results.
- .3 Perform additional commissioning until results are acceptable to ICA.

1.24 SUNDRY CHECKS AND ADJUSTMENTS

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

1.25 DEFICIENCIES, FAULTS, DEFECTS

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

1.26 COMPLETION OF COMMISSIONING

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

1.27 ACTIVITIES UPON COMPLETION OF COMMISSIONING

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

1.28 TRAINING

- .1 As noted in specification in applicable sections.

1.29 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS

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

1.30 OCCUPANCY

- .1 Cooperate fully with Departmental Representative during stages of acceptance and occupancy of facility.

1.31 PERFORMANCE VERIFICATION TOLERANCES

- .1 Application tolerances:

- .1 Specified range of acceptable deviations of measured values from specified values or specified design criteria. Except for special areas, to be within +/- 10% of specified values.
- .2 Instrument accuracy tolerances:
 - .1 To be of higher order of magnitude than equipment or system being tested.
- .3 Measurement tolerances during verification:
 - .1 Unless otherwise specified actual values to be within +/- 2% of recorded values.

1.32 PERFORMANCE TESTING

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

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

PART 1 – GENERAL

1.1 Description

- .1 Section Includes
 - .1 Furnishing of all labour, materials, services and equipment for the supply and installation of concrete accessories as indicated and specified herein.
 - .2 These specifications shall form part of and be read in conjunction with the structural notes contained in the drawings.
- .2 Related Sections
 - .1 Section 01 56 00 – Temporary Barriers and Enclosures
 - .2 Section 03 10 00 – Concrete Formwork
 - .3 Section 03 20 00 – Concrete Reinforcement
 - .4 Section 03 30 00 – Cast-In-Place Concrete
 - .5 Section 03 32 20 – Cast-In-Place Concrete Parking Decks (Reinforced)

1.2 Reference Standards

- .1 Unless specifically noted otherwise, all work performed under this Contract shall comply with the current adopted editions of the list of codes and standards below.
 - .1 Alberta Building Code 2014
 - .2 CSA Standard S23.1 - Concrete materials and methods of concrete construction
 - .3 CSA Standard S23.1 - Test methods and standard practices for concrete
 - .4 CSA Standard S413 – Parking Structures
 - .5 Portland Cement conforming to CSA Standard A3001 - Cementitious Materials Compendium
 - .6 Supplementary materials shall conform to CSA Standard A3001 - Cementitious Materials Compendium
 - .7 Flyash shall conform to the requirements of a Type F or CI pozzolanic mineral admixture as specified in CSA Standard A3001 - Cementitious Materials Compendium
 - .8 CSA Standard A283 - Qualification Code for Concrete Testing Laboratories
 - .9 A copy of CSA Standard S23.1 shall be obtained by the Contractor and kept at the job site
 - .10 WorkSafe Alberta – Occupational Health and Safety Regulations
- .2 The requirements of this section shall be considered as supplemental to the above standards, however, these specifications shall in no way reduce the minimum requirements of the above-mentioned reference standards.

PART 2 PRODUCTS

2.1 Materials

- .1 Waterstop Gasket and Waterstop Sealant: expanding strip waterstop.
 - .1 Acceptable Materials:
 - .1 RX-101 and compatible Cetseal adhesive, Cetco
 - .2 Kyrtonite Swelling Waterstop and Krytonite Adhesive, Kryton.
 - .2 Grout Waterstops
 - .1 Refer to architectural specifications
 - .3 Polyethylene Damproof Membrane: To CAN/CGSB-51.34 - Vapour Barrier, Polyethylene Sheet for Use in Building Construction - 0.15 mm thick
 - .4 Kraft/Polyethylene Damproof Membrane
 - .1 Lamination 0.10 mm polyethylene film asphalt bonded both sides to 2.44 kg/m asphalt treated kraft.
 - .2 Reinforcement: 13×13 mm glass fibre cross directional scrim embedded in asphalt laminate.
 - .3 Performance: to CAN/CGSB-51.33 - Vapour Barrier Sheet, Excluding Polyethylene, for Use in Building Construction
 - .5 Membrane Adhesive: as recommended by Membrane Manufacturer.

PART 3 EXECUTION

3.1 Joint Fillers

- .1 Locate heat and form isolation joints as indicated. Install joint filler to Manufacturer's instructions.

3.2 Anchor Slots

- .1 Nail a single, continuous vertical anchor slot to forms where masonry intersects concrete walls or columns.
- .2 Install continuous vertical anchor slots where concrete walls are masonry faced.

3.3 Damproof Membrane

- .1 Install damproof membrane under concrete slabs-on-grade inside building.

End of Section

Part 1 General

1.1 Description

- .1 Section Includes
 - .1 Furnish all labour, materials, tools and equipment necessary and required to design and complete all concrete formwork required by Section 03 30 00 Cast-In-Place Concrete and Section 03 32 20 – Cast-In-Place Concrete Parking Decks (Reinforced), including the following:
 - .1 Design, supply and erection of all formwork components required to confine concrete and shape it to the required dimensions.
 - .2 Installation of all sleeves, ties, anchor bolts, blockouts, reglets and other embedded items supplied under other sections.
 - .3 Adequate strength to resist damage from removal operations.
 - .4 Reshoring as required to safely distribute the weight of newly placed concrete, forms and construction live loads to the support floors or ground.
 - .5 These specifications shall form part of and be read in conjunction with the structural notes contained in the drawings.
 - .2 The foregoing describes major items or work which come under the provisions of this section but which shall not be interpreted as being all inclusive.
- .2 Related Sections
 - .1 Section 03 05 00 – Concrete Accessories
 - .2 Section 01 56 00 – Temporary Barriers and Enclosure
 - .3 Section 03 20 00 – Concrete Reinforcement
 - .4 Section 03 30 00 – Cast-In-Place Concrete
 - .5 Section 03 32 20 – Cast-In-Place Concrete Parking Decks (Reinforced)

1.2 Referenced Standards

- .3 Unless specifically noted otherwise, all work performed under this Contract shall comply with the current adopted editions of the list of codes and standards below.
 - .1 Alberta Building Code 2014
 - .2 CSA Standard A23.1 2009 - Concrete materials and methods of concrete construction
 - .3 CSA Standard A23.1 2009 - Test methods and standard practices for concrete

- .4 A copy of CSA STANDARD A23.1 2009 shall be obtained by the Contractor and kept at the job site
- .5 CSA Standard S269.1 - Falsework for Construction Purposes
- .6 WorkSafe Alberta – Occupational Health and Safety Regulations
- .7 The requirements of this section shall be considered as supplemental to the above standards, however, these specifications shall in no way reduce the minimum requirements of the above-mentioned reference standards.

1.3 Design

- .1 The design and engineering of all formwork is the responsibility of the Contractor.
- .2 Engage the services of a Registered Professional Engineer to design and inspect all concrete forms, falsework, shoring and reshoring.
- .3 Design formwork to safely carry the vertical and lateral loads specified by CSA Standard S269.1. Provide forms with sufficient strength and rigidity to withstand pressures resulting from placement and vibration of concrete and to maintain specified tolerances.
- .4 Product erection drawings detailed in accordance with CSA Standard S269.1. Specify size, type, grade and location of all components together with construction tolerances and design loadings. Drawings shall indicate all requirements for removal of forms, shoring and reshoring sequences and shall bear the seal and signature of the Designer.
- .5 Submit formwork drawings for review by the Consultant upon request.
- .6 Design column forms to accurately limit the height of concrete columns to the underside of the concrete slab.
- .7 Design slab forms to include construction loads to suit construction methods and procedures.

1.4 Quality Assurance

- .1 Provide at least one person who shall be present at all times during execution of this portion of the Work and who shall be thoroughly familiar with the type of materials being installed, the referenced standards and the requirements of this Work, and who shall direct all Work performed under this Section.

1.5 Approvals

- .1 Approvals of materials, methods or drawings shall in no way relieve the Contractor of his responsibility to make all Work complete, accurate and to remove and replace all defective Work at his own expense whenever such defects are discovered.

1.6 Product Handling

- .1 Obtain delivery of all materials supplied under other Sections and to be installed under this Section. Obtain latest revisions of approved setting drawings, instructions and template.

1.7 Protection

- .1 Use all means necessary to protect Cast-In-Place Concrete materials before, during and after installation and to protect the installed Work and materials of all other trades.
- .2 In the event of damage, immediately make all repairs and replacements necessary to the approval of the Consultant and at no additional cost to the Departmental Representative.

PART 2 PRODUCTS

2.1 Materials

- .1 Formwork Materials
 - .1 Architectural Concrete Finish: Exposed exterior and interior surfaces above grade: Refer to architectural specification and Section 03 34 50 Concrete Finishes.
 - .2 Smooth-Form Finish: Exposed interior concrete surfaces below grade level: use precoated form ply sheets – “Plyguard” as manufactured by McMillan Bloedel or approved alternative.
 - .3 Rough-Form Finish: Non exposed concrete – plywood to CSA 0151 or 0121, board form minimum 20mm G1S or steel panels may be used.
- .2 Form Oil
 - .1 Non-staining colourless mineral oil free from kerosene, and as recommended by Form Ply Manufacturer.
- .3 Form Ties
 - .1 Exposed concrete surfaces – use metal snap ties equipped with 25mm diameter by 25mm deep plastic spreader cones. Refer also to Architectural Specification section 03 33 00.
 - .2 Non-exposed concrete surfaces – removable or snap-off metal ties equipped with integral spreaders.

2.2 Alternate Forming Systems

- .1 Alternate forming systems maybe used subject to the advance approval of the Consultant.

.1 Other Materials

- .1 All other materials, not specifically described but required for proper completion of concrete formwork, shall be as selected by the Contractor subject to the advance review by the Consultant.

PART 3 EXECUTION

3.1 Preparation

- .1 Verify lines, levels and column centres before proceeding with formwork. Ensure that dimensions agree with drawings. Report any discrepancies to the Consultant before proceeding.
- .2 Carefully examine the drawings, all shop drawings and the specifications and consult with other trades to determine requirements for provision of blockouts, sleeves, chases and embedded items.
- .3 Provide temporary openings at bottom of wall and column forms and at other locations required to permit cleaning and observation prior to pouring.
- .4 Terminate internal tie systems not closer than two (2) diameters or twice the minimum dimension of the tie from the formed faces of concrete to be permanently exposed to view, except that in no case shall this distance be less than 19mm.
- .5 Use form ties so that ends can be removed without appreciable concrete spalling. Grout all holes.
- .6 Coat all form surfaces with approved form release agent prior to placing reinforcing steel and concrete.
- .7 Provide cambered formwork to suit cambers as indicated on the drawings and in the general notes shown on the structural drawings.
- .8 Provide details of camber procedures for review by the Consultant.
- .9 Clean forms and embedded items free from accumulated mortar or grout from previous concreting and from all foreign matter.

3.2 Exposed Concrete Surfaces

- .1 Ensure jointing of facing panels and locations of ties is orderly in arrangement. Location of joints and ties is subject to approval by the Consultant, minimum spacing of form ties – 600mm o/c each way.
- .2 Use new forms for this project. Do not reuse any forms if there is evidence of any defects which would impair the quality of the surface.
- .3 Thoroughly clean and properly coat forms as recommended by the Manufacturer before each reuse.
- .4 Continuously observe formwork while concrete is being placed and check that no deviation from the desired alignment, elevation, plumb or camber occurs. If such deviation occurs or a weakness develops stop the work,

repair all damage and strengthen formwork. Remove and replace permanently damaged construction.

3.3 Inserts

- .1 Set reglets, ties, anchor bolts and other inserts, blockouts, chases and sleeves in concrete walls, as required by other trades.
- .2 No sleeves, ducts, pipes or other openings shall pass through beams or walls except where detailed on structural drawings.
- .3 Check all sleeves, openings, etc shown on structural drawings with the Architectural and mechanical drawings. Sleeves, openings, etc not shown on the structural drawings must be approved by the Consultant.

3.4 Tolerances

- .1 Construct forms of sufficient strengths and rigidity in order to prevent leakage of mortar and to ensure that movements and deflections are limited to an amount such as the finished product complies with the following tolerances: refer to structural drawings.

3.5 Inspection

- .1 Obtain inspection and approval of formwork by the Designer immediately prior to pouring.
- .2 Continuously inspect formwork during and after pouring. Adjust shores to take up all settlement during concreting operations.

3.6 Removal of Forms

- .1 Obtain the Structural Engineer's approval before removing formwork.

3.7 Completion

- .1 On completion of Work make good all damage to Work and adjoining Work. Remove from site all surplus materials, debris, tools, plant and equipment and leave site in a condition satisfactory to the Consultant.

End of Section

PART 1 GENERAL

1.1 Description

- .1 Section Includes
 - .1 The Work of this Section consists of furnishing all materials, labour, accessories, support bars, tools, plant and equipment necessary to complete the supply and placing of reinforcing steel as indicated and as hereinafter specified.
 - .2 The specifications shall form part of and be read in conjunction with the structural notes contained in the drawings.
 - .3 The Work shall include, but shall not necessarily be limited to the following principal items:
 - .1 Supply and fabrication of reinforcing steel.
 - .2 Preparation of bending schedules and placing information for reinforcing steel.
 - .3 Placing, securing and supporting of reinforcing steel.
 - .4 Supply and placing of all accessories required for the Work.
 - .5 Supply of reinforcing steel for reinforced masonry Work.
 - .6 Supply and placing of reinforcing mesh.
 - .7 Supply and placing of stud rails
- .2 Related Sections
 - .1 Section 01 56 00 – Temporary Barriers and Enclosures
 - .2 Section 03 05 00 – Concrete Accessories
 - .3 Section 03 30 00 – Cast-In-Place Concrete
 - .4 Section 03 32 20 – Cast-In-Place Concrete Parking Decks (Reinforced)
 - .5 Section 04 22 00 – Unit Masonry

1.2 Reference Standards

- .1 Unless specifically noted otherwise, all work performed under this Contract shall comply with the current adopted editions of the list of codes and standards below.
 - .1 Alberta Building Code 2014
 - .2 CSA Standard A23.1 2009 - Concrete materials and methods of concrete construction
 - .3 CSA Standard A23.1 2009 - Test methods and standard practices for concrete
 - .4 CSA Standard W59 - Welded Steel Construction (Metal Arc Welding)

- .5 A copy of CSA STANDARD A23.1 2009 shall be obtained by the Contractor and kept at the job site
- .6 WorkSafe Alberta – Occupational Health and Safety Regulations
- .2 The requirements of this section shall be considered as supplemental to the above standards, however, these specifications shall in no way reduce the minimum requirements of the above-mentioned reference standards.

1.3 Inspection

- .1 The Contractor shall give the Engineer or his Authorized Representative at least twenty-four (24) hours notice for the inspection of the reinforcing. If the reinforcing or other subtrades affecting the concrete work are not complete and approved a further inspection will be made with twenty-four (24) hours notice of correction of defects. Concrete shall not be placed before the Engineer or his Authorized Representative has inspected and passed the reinforcement in place.
- .2 Any concrete placed without approval from the Engineer shall be replaced at no cost to the Departmental Representative.
- .3 Cost of second inspections will be to the Contractor's account.

1.4 Bending Schedules

- .1 Submit bending schedules for review by the Engineer upon request.

1.5 Concrete Reinforcement

- .1 Reinforcing bars to be of the following material grades unless approved otherwise:
 - .1 10M and larger: 400MPa
 - .2 Welded wire fabric: 450MPa
 - .3 Stud rails are Low Carbon Steel, C1015 to C1018 with 350MPa yield strength and 450MPa tensile strength.
- .2 Shear Reinforcement at slab column connection as shown on the design drawings and details shall be Studrails® as manufactured by Decon® or approved equivalent.
- .3 All reinforcement shall be chaired or otherwise supported and tied in its final position to prevent displacement during concrete pouring.
- .4 Placement of reinforcement shall be in accordance with ACI detailing practice and Clause 12 of CSA STANDARD A23.1 2009
- .5 Rebar must be clean and free of all material which could reduce concrete bond or accelerate corrosion.
- .6 Concrete clear cover to principal longitudinal reinforcement, unless otherwise shown on the drawings, to be:
 - .1 Footings and surfaces cast against earth 75 mm
 - .2 Formed surfaces exposed to earth or weather 50 mm

.3	Beams U/N	38 mm
.4	Slabs U/N	19 mm
.5	Walls U/N	19 mm
.6	Columns U/N	38 mm

Beams and slabs which require greater than one hour fire rating to have cover as indicated on drawings.

Columns require the same fire rating as the assembly they support. Cover to ties to be 50mm U/N for two hour rating. Column cover for fire rating greater than two hour to be as shown on the drawings.

- .7 Not more than fifty percent (50%) of tension reinforcement may be lapped or spliced at any point unless shown on the drawings or approved by the Engineer before construction.
- .8 Dowels from footings to walls or columns to match vertical reinforcing and extend lap length into the footing with 90° bend or as shown on the drawings.
- .9 Wall reinforcing: refer to structural drawings.
- .10 Horizontal wall reinforcing to bend 90° at corners or be lapped to corner bars.
- .11 Openings in walls or slabs to have two (2) 15M extra extending 600mm past the corners plus one 15M – 1200mm long diagonal at each corner.
- .12 Holes in slabs for mechanical must be more than 450 mm from column faces or the face of drop panels unless approved by the Engineer prior to construction.
- .13 Provide tension laps of all reinforcement except as shown on the drawings, except column vertical reinforcing as shown on the General Notes of the Structural Drawings.
- .14 Stud rails are to be welded in accordance with CSA Standard W59 - Welded Steel Construction (Metal Arc Welding).
- .15 The overall height of the stud rail is dependent on the slab thickness and the required concrete cover. The area of the stud head and the base rail profile shall be as per the design drawings.

End of Section

PART 1 GENERAL

1.1 Description

- .1 Section includes
 - .1 The Work described under this Section includes the supply and installation of the following, as indicated on the drawings and as specified therein. These specifications shall form part of and be read in conjunction with the structural notes contained in the drawings.
 - .2 The Work on this Section includes the furnishing of all labour, materials, equipment and all else necessary to complete the cast-in-place concrete work.
 - .1 Concrete in structure as indicated on the structural drawings, and Architectural concrete as indicated on the Architectural drawings.
 - .2 Provision of waterseals and waterstops as required by the Consultant.
 - .3 Setting of anchor bolts and steel anchor plates for steel work complete with pockets as called for on the drawings.
 - .4 Provision of all keys and dowels in construction joints.
 - .5 Supply and application of curing compounds, sealers and hardeners.
 - .6 Architectural concrete including, but not limited to sidewalks, topping, curbs, etc.
 - .7 Installation of prefabricated inserts provided by others.
 - .3 Related Work Under Other Sections:
 - .1 Section 01 56 00 – Temporary Barriers and Enclosures
 - .2 Section 03 05 00 – Concrete Accessories
 - .3 Section 03 10 00 – Concrete Formwork
 - .4 Section 03 20 00 – Concrete Reinforcement
 - .5 Section 03 32 20 – Cast-in-Place Concrete Parking Decks (Reinforced)

1.2 Reference Standards

- .1 Unless specifically noted otherwise, all work performed under this Contract shall comply with the current adopted editions of the list of codes and standards below.
 - .1 Alberta Building Code 2014
 - .2 CSA Standard A23.1 2009 - Concrete materials and methods of concrete construction
 - .3 CSA Standard A23.1 2009 - Test methods and standard practices for concrete
 - .4 CSA Standard S413 - Parking Structures
 - .5 Portland Cement conforming to CSA Standard A3001
 - .6 Supplementary materials shall conform to CSA Standard A3001
 - .7 CSA Standard S413 – Parking Structures

- .8 Flyash shall conform to the requirements of a Type F or CI pozzolanic mineral admixture as specified in CSA A3001
- .9 CSA Standard A283 - Qualification Code for Concrete Testing Laboratories
- .10 ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
- .11 CSA Standard A283 - Qualification Code for Concrete Testing Laboratories
- .12 CSA Standard G30.18 - Carbon steel bars for concrete reinforcement
- .13 A copy of CSA STANDARD A23.1 2009 shall be obtained by the Contractor and kept at the job site
- .14 WorkSafe Alberta – Occupational Health and Safety Regulations
- .2 The requirements of this section shall be considered as supplemental to the above standards, however, these specifications shall in no way reduce the minimum requirements of the above-mentioned reference standards.
- .3 Furnish such notification and reports and pay all fees to these authorities as required.

1.3 Testing

- .1 The Departmental Representative will appoint and pay for an independent testing laboratory. The testing agency shall review and approve concrete mixes prior to commencing construction. The testing agency shall have full authority in regard to acceptance or rejection of concrete delivered to the site. The testing agency shall reject all non-conforming concrete and notify the Engineer immediately by telephone of any low-strength test results.
 - .1 Prepare and test concrete cylinders for compressive strength.
 - .2 Establish slump and percentage of entrained air.
 - .3 Perform tensile and bending tests on reinforcing steel as required by the Engineer.
 - .4 Submit copies of the test results directly to the Departmental Representative, Consultant, Engineer and Contractor.
 - .5 Should work not meet specifications, all subsequent testing costs will be charged to the Contractor.
- .2 Testing procedures for concrete shall conform to the following requirements:
 - .1 Compressive tests on concrete shall be carried out in accordance with CSA STANDARD A23.1 2009, except that a strength test shall consist of seven (7) days and the remaining two at an age of twenty-eight (28) days for control of design strength of concrete.
 - .2 Slump and air entrainment test shall be conducted at the time of sampling concrete for compressive tests and shall be conducted in conformity with CSA STANDARD A23.1 2009
 - .3 Frequency of testing to comply with CSA STANDARD A23.1 2009, Section 17.2.
- .3 Testing procedures for reinforcing steel shall comply with requirements of CSA-G30.18 which shall form the basis of acceptance or rejection.
- .4 Provide at no additional cost to the Departmental Representative:
 - .1 Samples of all material required for testing.

- .2 Cooperation in the execution of concrete testing which shall include protection against injury or loss of cylinders.
- .3 Access to the Departmental Representative and his Representatives to test and/or inspect materials.
- .4 Site storage facilities meeting the requirements of CSA Standard A23.1 2009 for concrete test cylinders prior to removal to the laboratory.
- .5 The Contractor shall give the Engineer or his Authorized Representative at least twenty-four (24) hours notice for the inspection of the reinforcing. If the reinforcing or other subtrades affecting the concrete work are not complete and approved a further inspection will be made with twenty-four (24) hours notice of correction of defects. Concrete shall not be placed before the Engineer or his Authorized Representative has inspected and passed the reinforcement in place.
- .6 Any concrete placed without approval from the Engineer shall be replaced at no cost to the Departmental Representative.
- .7 Cost of second inspections will be to the Contractor's account.
- .8 The Contractor shall cooperate fully with the testing laboratory, and shall give the testing laboratory at least twenty-four (24) hours prior notice of a concrete placement.

1.4 Coordination

- .1 Cooperate with other trades to permit proper execution of the Work.
- .2 Consult with other trades to ensure exact location and extent of items supplied and work required by other trades which are to be incorporated in the concrete work.

1.5 Product Delivery

- .1 Concrete shall be delivered from a plant approved by the Engineer. If there is any problem of delivery or quality control of the concrete, the Engineer shall have the right to require a change to another supplier.

1.6 Job Conditions

- .1 Meet the requirements of CSA STANDARD A23.1 2009, Clause 21, for protection including hot weather protection, cold weather protection and preparation and cooling after protection.
- .2 Meet requirements of CSA STANDARD A23.1 2009, Clause 28, Architectural concrete for exposed concrete.
- .3 Meet requirements of CSA-S413 – Parking Structures

1.7 Construction Joints

- .1 Construction joints shall comply with the requirements of CSA STANDARD A23.1 2009, Clause 20.
- .2 Location of construction joints to be approved by the Engineer and shall be coordinated with reinforcing steel detailing.

1.8 Submittals

- .1 The following information shall be submitted to the Engineer at least twenty-one (21) days before concrete construction of the pertinent component commences on site.
 - .1 Certification of compliance with specification for all materials to be used.

- .2 Proposed concrete mix designs, indicating all pertinent aspects of the mix design to ensure conformance to exposure classes of the Standards.
- .3 Certified test results for strength, density, slump and air content of the proposed mixes. For each design mix test results from at least three (3) separate tests shall be submitted. Each test shall have been from a separate batch of concrete.
- .4 Manufacturer's name and specifications for all admixtures, concrete bonding agents, curing compounds, etc proposed for use on the contract.
- .5 Laboratory test certificates for both fine and coarse aggregates, indicating specification compliance for:
 - .1 Chloride content
 - .2 Limits on organic impurities and deleterious substances
 - .3 Soundness
 - .4 Abrasion resistance
 - .5 Alkali-aggregate reaction: expansion due to alkali-aggregate reaction when tested according to CSA A23.2-09-14A 'Alkali-aggregate Reaction' shall not exceed 0.02 percent at three months.
- .2 Formwork
 - .1 Design, engineering and construction of formwork and reshoring shall be the responsibility of the Contractor. Submit for review to the Engineer drawings of formwork and reshoring.

PART 2 PRODUCTS

2.1 Materials

- .1 All concrete shall be supplied in accordance with CSA STANDARD A23.1 2009. The Contractor shall be responsible for the preparation of all mix designs in accordance with CSA STANDARD A23.1 2009. Clause 14.8 Alternate 1 to provide the following properties unless otherwise noted:
 - .1 Minimum 20 MPa strength at twenty-eight (28) days, higher where noted on the drawings;
 - .2 Meet the requirements of CSA STANDARD A23.1 2009 Table 11 for exposure class;
 - .3 Nominal course aggregate size 20mm;
 - .4 Slump at discharge 75 ± 13 mm;
 - .5 Air content: see drawings, $5\% \pm 1\%$ U/N except five percent (5%) to eight percent (8%) for Class A;
 - .6 For concrete in floors of parking areas, minimum cement content shall be 320kg/m. If pozzolanic material is used in the mix, then for purposes of this clause, $\frac{2}{3}$ of the pozzolan by weight shall be considered as equivalent to cement.
 - .7 Water cement ratio shall be 0.45 maximum for all parking areas.
- .2 Concrete Strengths
 - .1 Refer to structural drawings.
- .3 Mix Designs: to be designed by suppliers to suit specifications.

- .1 Concrete mixes shall be proportioned by the supplier in accordance with CSA STANDARD A23.1 2009 to meet the requirements specified herein and on the drawings. All concrete shall be normal weight unless noted otherwise. The property requirements are as shown on the structural drawings and herein.
- .2 The mix designs shall take advantage of supplementary cementing materials (SCM's) such as fly ash, silica fume and blast furnace slag to reduce the cement content of the concrete to the maximum extent possible consistent with strength and durability requirements.
- .3 Fly ash shall conform to the standard. The following information shall be submitted in a letter signed by the concrete supplier / manufacturer or designated professional engineer :
- .4 The reduction in Portland Cement from Base Mix to Actual SCM Mix (as a percentage) where base mix design is defined as 100kg cement per 10MPa for air entrained concrete and 100kg per 12MPa for non-air entrained concrete.
- .5 The following cement reduction percentages by element shall be used as a minimum on this project (mixes may require adjustment for cold weather placing). The percentage reductions in cement should be achieved without affecting the cost or schedule of the project.

<i>Element</i>	<i>Winter</i>	<i>Summer</i>
Footings	30%	40%
Slab-on-grade	15%	25%
Columns, Walls	15%	25%
Suspended Slabs	15%	25%
Toppings	15%	25%

- .1 In order to take advantage of SCM's, 56 day strength testing will be acceptable for certain elements as shown on the drawings.
- .2 Concrete with high volumes of supplementary cementing materials shall comply with CSA STANDARD A23.1 2009, Clause 8.8.
- .6 All materials for concrete shall conform to the requirements of CSA STANDARD A23.1 2009. Calcium chloride or admixtures containing chlorides, fluorides or nitrates shall not be used.
- .7 Curing Compounds
 - .1 Where permitted or specified, shall be a liquid, membrane forming, curing compound containing a fugitive dye and meeting the requirements of ASTM C309, applied at the rate recommended by the Manufacturer. Sternson's Florseal or other preapproved types may be used.
- .8 Waterproofing admixture for concrete core footing and blind side foundation walls shall be Krystal KIM waterproof concrete mixture, as manufactured by Kryton International Ltd. KIM admixture shall be added to the concrete mix in accordance with manufacturer's printed application instructions.

PART 3 EXECUTION

3.1 Tolerances

- .1 Variation from level or grade as indicated on the drawings for slab surfaces, beam soffits, lintels, sills, horizontal grooves, parapets and other conspicuous lines to be 6mm in 6m or 9mm in any bay.

- .2 Variation from plumb in surfaces of columns, walls, pilasters, beams, vertical joints or grooves, or other conspicuous lines to be 6mm in the greater of 3m or one storey height, and 13mm in total height.
- .3 Variation from cross-section dimension as indicated on the drawings of columns, beams, slabs, and walls to be minus 6mm to plus 9mm.
- .4 Variation of building lines in plan and position of columns and walls to be 13mm in any bay or 6m maximum. Surfaces adjacent property lines must not project beyond property lines. Lines of vertical elements above and below any floor level shall align within 6mm.
- .5 Variation in steps of stairs to be 3mm for risers and 6mm for treads, otherwise as indicated.
- .6 In addition, tolerances for concrete work shall conform to CSA STANDARD A23.1 2009 Clause 10.

3.2 Placing of Concrete

- .1 Placing of concrete shall comply with CSA STANDARD A23.1 2009, Clause 19.
- .2 Special provisions for shrinkage are required for walls longer than 7620mm cast monolithically. Refer to structural drawings for details.
- .3 Unless specified by the Mix Designer, no concrete shall be placed later than thirty (30) minutes after leaving the transit mixer and no concrete shall be used from trucks more than ninety (90) minutes after leaving the mixing plant. Comply with CSA A23.1-09 18.4.3.
- .4 The addition of water to the concrete after leaving the plant shall be done only upon authorization of the Mix Designer and Concrete Supplier. The addition of such water shall be noted on the delivery slip and reported to the testing agency. Comply with CSA STANDARD A23.1 2009 18.4.3.
- .5 The placement of concrete shall be such that embedded materials, formwork or accessories are not damaged or displaced.

3.3 Reshoring

- .1 Procedures for reshoring concrete work shall be submitted to the Engineer for review prior to construction. Load in excess of the structure design loads indicated on the structural drawings shall be indicated and reviewed by the Structural Engineer.

3.4 Construction Joints

- .1 Joints not shown on the drawings shall be approved by the Consultant and Engineer and shall be made and located as to least impair the strength and appearance of the structure.
- .2 A key shall be provided at all vertical construction joints. Horizontal joints shall be cleaned and roughened. Shearwall construction joints shall be roughened to a full amplitude of 12mm minimum.
- .3 All reinforcing steel shall be continuous across joints unless otherwise noted.
- .4 The surface of the concrete at all joints shall be thoroughly cleaned and all laitance removed.
- .5 Provide waterstop as indicated at construction joints.

3.5 Patching

- .1 Immediately after the removal of forms, all bolts, ties, nails or other metal not specifically required for construction purposes shall be removed or cut back to a depth of 25mm from the surface of the concrete.
- .2 Structural repairs shall be accomplished under the direction and supervision of the Consultant.
- .3 All areas requiring patching shall be saturated with water. The surface shall be scrubbed with a neat cement paste and repaired by filling with cement mortar of the same general composition as that used in the concrete. The mortar shall be well pressed or packed into the depression so as to completely fill the cavity and then finished to match the adjacent surface.
- .4 Areas which have been patched shall be cured in accordance with the requirements outlined elsewhere in this Section.

3.6 Finishing of Formed Surfaces

- .1 Refer to Section 03 34 50 – Concrete Finishes

3.7 Floor Finishing

- .1 Finishing of concrete slabs shall comply with CSA STANDARD A23.1 2009, Clause 22 and with tolerances indicated for Class A and Section 03 34 50 – Concrete Finishes. Due care shall be taken to prevent excessive build-up in elevation of slab concrete at column locations.
- .2 General
 - .1 Sprinkling of dry cement or a mixture of dry cement and sand on the surface of fresh concrete to absorb water or to stiffen the mix shall not be permitted during any stage of floor construction.
- .3 When finishes are to be applied to a concrete floor slab, the surface finish of the slab shall meet the requirements of the Subtrade responsible for the applied floor finish.
- .4 Do not continue to trowel a concrete slab which has been heavily rained upon.

3.8 Slab On Grade

- .1 Place slabs on grade on compacted granular fill as per General Notes of Structural Drawings for the project.
- .2 Slab on grade to be placed in panelized sections not exceeding 6m by 6m. Allow adequate curing time before casting adjacent sections as recommended by the materials consultant.
- .3 Full time supervision of the placing and curing procedures is required by the materials consultant. The materials consultant is to specify the appropriate curing requirement to minimize cracking within the slab on grade. Failure to notify the consultant prior to placing the slab on grade may result in remedial Work at the Contractor's expense.

3.9 Openings Through Structural Work

- .1 If, after any part of the structural Work has been completed, it is required that additional openings be made through the structure, the Engineer shall be so informed. No opening shall be made through completed Work without authorization in writing by the Engineer.

3.10 Rejection of Defective Work

- .1 In the event that concrete tests do not conform to the requirements of this specification, or when conditions are such to cause doubt about the safety of the structure, test any portion of the structure in accordance with CSA STANDARD A23.1 2009 -14C. Such test shall be made at the expense of the Contractor.
- .2 Where, in the opinion of the Engineer, material or workmanship fails to meet the requirements of the specification, such Work may be rejected. Work rejected shall be replaced or repaired to the approval of the Engineer and at no additional cost to the Departmental Representative.
- .3 Acceptance criteria shall be 100% of the design strength of the concrete in situ. Alternative testing methods shall be evaluated by the Materials Consultant who shall indicate anticipated twenty-eight (28) day and long term strength. The Engineer shall evaluate suitability of low concrete strength and indicate those which are not acceptable.
 - .1 If the Contractor is, in any way, dissatisfied with the decision of the Engineer, he shall, without delay, make his proposal for alternative rectification.
- .4 Equipment Bases
 - .1 Provide all concrete bases for mechanical and electrical equipment.

3.11 Camber

- .1 The top surface of concrete elements shall be cambered to accommodate immediate and long term deflections due to self weight and applied loads.

3.12 Inserts and Openings

- .1 Install all embedded steel connections, anchorages, inserts, anchor bolts, angles, sleeves, expansion joint covers, reglets and other embedded items shown or called for on the drawings, specified, shown or required for other sections.
- .2 Install all blockouts and pockets shown or called for on the drawings.

3.13 General

- .1 The proposed mix designs shall be submitted for review and acceptance to a concrete testing laboratory certified to the CSA-A283 as a Category 1 or Category 2 laboratory.

End of Section

PART 1 GENERAL

1.1 Description

- .1 Section includes
 - .1 The Work described under this Section includes the furnishing of all labour, materials, equipment and all else necessary to complete the cast-in-place concrete work for parking decks.
 - .2 These specifications shall form part of and be read in conjunction with the structural notes contained in the drawings.
- .2 Related Work Under Other Sections:
 - .1 Section 01 56 00 – Temporary Barriers and Enclosures
 - .2 Section 03 05 00 – Concrete Accessories
 - .3 Section 03 10 00 – Concrete Formwork
 - .4 Section 03 20 00 – Concrete Reinforcement
 - .5 Section 03 30 00 – Cast-In-Place Concrete

1.2 Reference Standards

- .1 Unless specifically noted otherwise, all Work performed under this Contract shall comply with the current adopted editions of the following codes and standards. The latest version of all referenced standards shall apply:
 - .1 Alberta Building Code 2014
 - .2 CSA Standard A23.1 2009 - Concrete materials and methods of concrete construction
 - .3 CSA Standard A23.1 2009 - Test methods and standard practices for concrete
 - .4 CSA Standard S269.1 – Falsework for Construction Purposes
 - .5 CSA S413 – Parking Structures
 - .6 Portland Cement conforming to CSA Standard A3001
 - .7 Supplementary materials shall conform to CSA Standard A3001
 - .8 Flyash shall conform to the requirements of a Type F or CI pozzolanic mineral admixture as specified in CSA A3001
 - .9 CSA Standard A283 - Qualification Code for Concrete Testing Laboratories
 - .10 A copy of CSA STANDARD A23.1 2009 shall be obtained by the Contractor and kept at the job site.
 - .11 WorkSafe BC – Occupational Health and Safety Regulations.
- .2 The requirements of this Section shall be considered as supplemental to the above standards, however, these specifications shall in no way reduce the minimum requirements of the above mentioned reference standards.

1.3 Submittals

- .1 The following information shall be submitted to the Engineer at least twenty-one (21) days before concrete construction of the pertinent component commences on site.
 - .1 Certification of compliance with specification for all materials to be used.
 - .2 Proposed concrete mix designs, indicating all pertinent aspects of the mix design to ensure conformance to exposure classes of the Standards.
 - .3 Certified test results for strength, density, slump and air content of the proposed mixes. For each design mix test results from at least three (3) separate tests shall be submitted. Each test shall have been from a separate batch of concrete.
 - .4 Manufacturer's name and specifications for all admixtures, concrete bonding agents, curing compounds, etc proposed for use on the contract.
 - .5 Laboratory test certificates for both fine and coarse aggregates, indicating specification compliance for:
 - .1 Chloride content
 - .2 Limits on organic impurities and deleterious substances
 - .3 Soundness
 - .4 Abrasion resistance
 - .5 Alkali-aggregate reaction: expansion due to alkali-aggregate reaction when tested according to CSA A23.2-09-14A 'Alkali-aggregate Reaction' shall not exceed 0.02 percent at three months.

PART 2 PRODUCTS

2.1 Cement

- .1 Portland Cement conforming to CSA A3001

2.2 Flyash

- .1 Flyash shall conform to the requirements of a Type F or CI pozzolanic mineral admixture as specified in CSA A3001

2.3 Water

- .1 Water for use in Portland Cement concrete, and for curing shall be of potable quality, clear and free from injurious amounts of oil, acid, alkali, organic matter, sediment, chlorides or any other deleterious substances.

2.4 Aggregates

- .1 All fine and coarse aggregates shall meet the requirements of Clauses 5.3 and 5.4 respectively of CSA STANDARD A23.1 2009.
- .2 The maximum size of aggregate shall not exceed $\frac{3}{4}$ of the minimum specified cover.
- .3 Lightweight aggregate, or aggregate larger than 37mm shall not be used without written authorization from the engineer.
- .4 The Engineer may, independent of conformance to any or all of the specified test requirements, accept or reject aggregate on the basis of:

- .1 In-service performance of similar aggregate from the same source in concrete of comparable properties.
- .2 Performance of concrete of comparable properties when subjected to one or more of the following standard tests.
- .3 ASTM C666 - Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing
- .4 ASTM C672 - Standard Test Method for Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals
- .5 Admixtures
 - .1 Admixtures shall conform to CSA STANDARD A23.1 2009 Section 6.
 - .2 No admixture shall be added to the concrete, except as specified herein or as authorized in writing by the Engineer.
 - .3 Admixtures containing chlorides, fluorides or nitrates shall not be used.
 - .4 Superplasticizers and accelerators may be used, provided they conform with CSA STANDARD A23.1 2009, Section 6.
- .6 Concrete Mix Proportions
 - .1 Concrete mixes shall be proportioned by the supplier in accordance with CSA STANDARD A23.1 2009 to meet the requirements specified herein and on the drawings. All concrete shall be normal weight unless noted otherwise. The property requirements are as shown on the structural drawings and herein.
 - .2 Minimum compressive strength levels at twenty-eight (28) days shall be indicated on drawings.
 - .3 Concrete shall be proportioned to meet the particular requirements of the various exposure classes as follows: Location Class Maximum Water Cement Ratio Air Content Retaining walls, foundations columns and beams not subject to de-icing chemicals C4 0.55 4% – 7% for 20mm coarse aggregate floor slabs, ramps, walkways curbs, sumps, columns and beams potentially subject to de-icing C2 0.45 5% – 8% for 20mm coarse aggregate.
 - .4 Concrete shall be batched and delivered so that the slump at point of discharge shall be 80 mm (+20) for foundation walls, footing, slabs on grade, columns, except as otherwise indicated on the drawings.
 - .5 For concrete in parking floors, minimum cement content shall be 2400kg/m³. If pozzolanic material is used in the mix, then for purposes of this clause, 2/3 of the pozzolan by weight shall be considered as equivalent to cement.
 - .6 The mix designs shall take advantage of supplementary cementing materials (SCM's) such as fly ash, silica fume and blast furnace slag to reduce the cement content of the concrete to the maximum extent possible consistent with strength and durability requirements.
 - .1 Fly ash shall conform to the standard. The following information shall be submitted in a letter signed by the concrete supplier / manufacture or designated professional engineer :
 - .2 The reduction in Portland Cement from Base Mix to Actual SCM Mix (as a percentage) where base mix design is defined as 100kg cement per 10MPa for air entrained concrete and 100kg per 12MPa for non-air entrained concrete.
 - .3 The following cement reduction percentages by element shall be used as a minimum on this project (mixes may require adjustment for cold weather placing). The percentage reductions in cement

should be achieved without affecting the cost or schedule of the project.

Element	Winter	Summer
Footings	30%	40%
Slab-on-grade	15%	25%
Columns, Walls	15%	25%
Suspended Slabs	15%	25%
Toppings	15%	25%

- .4 In order to take advantage of SCM's, 56 day strength testing will be acceptable for certain elements as shown on the drawings.
- .5 Concrete with high volumes of supplementary cementing materials shall comply with CSA STANDARD A23.1 2009, Clause 8.8.
- .7 All materials for concrete shall conform to the requirements of CSA STANDARD S23.1 2009. Calcium chloride or admixtures containing chlorides, fluorides or nitrates shall not be used.
- .8 Curing Compounds
 - .1 Where permitted or specified, shall be a liquid, membrane forming, curing compound containing a fugitive dye and meeting the requirements of ASTM C309, applied at the rate recommended by the Manufacturer. Sternson's Florseal or other preapproved types may be used.
- .9 Waterproofing admixture for concrete core footing shall be Krystal KIM waterproof concrete mixture, as manufactured by Kryton International Ltd. (refer to Detail No. 0-D1.35). KIM admixture shall be added to the concrete mix in accordance with manufacturer's printed application instructions.
- .10 The Concrete Supplier shall assume responsibility for the concrete mix proportions for all locations, in accordance with the requirements of CSA STANDARD A23.1 2009, Alternative 1.

PART 3 EXECUTION

3.1 General

- .1 All batching, transporting, testing, placing, finishing and curing of concrete shall conform to the requirements of CSA STANDARD A23.1 2009
- .2 The proposed mix designs shall be submitted for review and acceptance to a concrete testing laboratory certified to the CSA-A283 as a Category 1 or Category 2 laboratory.
- .3 Acceptance of the proposed concrete mix designs by the certified concrete laboratory does not relieve the Concrete Supplier of his responsibilities under CSA STANDARD A23.1 2009, Alternative 1.
- .4 The cost of such mix design review shall be paid as described in other sections of this specification.

3.2 Quality Control

- .1 An independent testing agency shall be appointed to inspect and test the concrete in the field for conformance to the project specifications. The cost of such inspection shall be paid by the Departmental Representative.
- .2 The testing agency employed shall be certified by the CSA in accordance with the requirements of the CSA A283 - Qualification Code for Concrete Testing Laboratories.

- .3 The Contractor shall allow the testing agency unhindered access to the Work for the purpose of inspection and selection of samples and shall supply, without charge, the concrete and other materials required for quality control purposes.
- .4 The Contractor shall notify the testing agency at least twenty-four (24) hours prior to the placement of any concrete requiring testing.

3.3 Frequency and Number of Tests

- .1 One strength test shall be made for each 100 cubic meter of three of concrete placed and at least one strength test shall be made for each class of concrete or separate type of structural component placed on any one (1) day unless more frequent tests are stipulated in other specifications.
- .2 The Engineer may specify a higher frequency of testing in high strength concrete or critical structural elements.
- .3 Three standard 150mm × 300mm cylinders shall be made for each strength test. One cylinder shall be tested at seven (7) days after casting and two (2) cylinders at twenty-eight (28) days after castings.
- .4 A slump test and air content determination shall be made with load of concrete at the point of discharge.
- .5 If any concrete test result is not in accordance with the drawings and specifications, procedures described in CSA STANDARD A23.1 2009 shall be undertaken at the Contractor's expense.

3.4 Workmanship

- .1 Obtain an Engineer's review before placing concrete. At least twenty-four (24) hours notice must be given.
- .2 No concrete placed until reinforcing steel and/or tendon placement is complete.

End of Section

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 03 30 00 - Cast-in-Place Concrete.
- .2 Section 09 30 13 – Tiling
- .3 Section 09 65 00 – Resilient Flooring.

1.2 REFERENCES

- .1 American Concrete Institute (ACI):
 - .1 ACI 117-10 (R2015), ACI Manual of Practice: Specifications for Tolerances for Concrete Construction and Materials, (ACI 117-10) and Commentary.
 - .2 ACI 301-16, Specification for Structural Concrete.
 - .3 ACI 302.1R-15, ACI Manual of Practice: Guide for Floor and Slab Construction.
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM D1751-04(2013)e1, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
 - .2 ASTM D1752-04a(2013), Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-25.20-95, Surface Sealer for Floors.
- .4 Canadian Standards Association (CSA)
 - .1 CSA-A23.1- 05/A23.2-14, Concrete Materials and Methods of Concrete Construction/Testing Methods and Standard Practices for Concrete, Includes Update No. 1 (2015).
- .5 International Concrete Repair Institute (ICRI)
 - .1 ICRI 310.2R-2013, Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings and Polymer Overlays and Concrete Repair – Guide Only
- .6 South Coast Air Quality Management District (SCAQMD), California State
 - .1 SCAQMD Rule 1113-16, Architectural Coatings.

1.3 PERFORMANCE REQUIREMENTS

- .1 Product quality and quality of work in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Submit written declaration that components used are compatible and will not adversely affect finished flooring products and their installation adhesives.

1.4 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 – Submittal Procedures.
 - .1 Submit manufacturer's printed product literature, specifications and data sheet for each product specified.
 - .2 Submit WHMIS MSDS - Material Safety Data Sheets. WHMIS MSDS acceptable to Labour Canada and Health and Welfare Canada for concrete floor treatment materials. Indicate VOC content.
 - .3 Include application instructions for concrete floor treatments.
- .2 Submit closeout data in accordance with Section 01 78 00 – Closeout Submittals.
 - .1 Provide manufacturer's printed recommendations for general maintenance, including cleaning instructions and submit a complete list of floor care products that will be required for on-going maintenance.

1.5 WASTE MANAGEMENT AND DISPOSAL

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

1.6 ENVIRONMENTAL REQUIREMENTS

- .1 Temporary lighting:
 - .1 Minimum 1200 W light source, placed 2.5 m above floor surface, for each 40 sq m of floor being treated.
- .2 Electrical power:
 - .1 Provide sufficient electrical power to operate equipment normally used during construction.
- .3 Work area:
 - .1 Make the work area water tight protected against rain and detrimental weather conditions.
- .4 Temperature:
 - .1 Maintain ambient temperature of not less than 10 degree C from 7 days before installation to at least 48 hours after completion of work and maintain relative humidity not higher than 40% during same period.
- .5 Moisture:
 - .1 Ensure concrete substrate is within moisture limits prescribed by flooring manufacturer.
- .6 Safety:
 - .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials.
- .7 Ventilation:
 - .1 Arrange for ventilation system to be operated during installation of concrete floor treatment materials by use of approved portable supply and exhaust fans.

- .2 Ventilate enclosed spaces in accordance with Section 01 51 00 - Temporary Utilities.
- .3 Provide continuous ventilation during and after coating application.

Part 2 Products

2.1 PERFORMANCE/DESIGN CRITERIA

- .1 F1-Finishing: Floors having a straightedge value of ± 8 mm over 3050 mm; similar to CSA A23.1 Class A Slab Finishing.
- .2 F2-Finishing: Floors having a straightedge value of ± 6 mm over 3050 mm; similar to CSA A23.1 Class B Slab Finishing.
- .3 F3-Finishing: Floors having a straightedge value of ± 5 mm over 3050 mm; similar to CSA A23.1 Class C Slab Finishing.
- .4 F4-Finishing: Floors having a straightedge value of ± 4 mm over 3050 mm; no similar CSA A23.1 Slab Finishing.

2.2 LEVELLING MATERIALS

- .1 Underlayment: Cementitious, self levelling, single component, polymer modified underlayment and manufacturer's low VOC recommended primer, for application thicknesses to a minimum feather edge to 13 mm; acceptable materials as follows:
 - .1 CustomTech TechLevel150, Custom Building Products
 - .2 Eucofloor SL160, by Euclid Chemical.
 - .3 Novoplan 2 Plus, MAPEI Inc.
 - .4 Sikafloor Level 125, Sika Canada Ltd.
 - .5 Sure-Flo ST, Gemite.
- .2 Overlayment: Cementitious, self levelling, single component, polymer modified overlayment, for application thicknesses to a minimum of 13 mm to 25 mm; acceptable materials as follows:
 - .1 CustomTech TechLevel150, Custom Building Products
 - .2 Sikafloor Level 25, Sika Canada Ltd.
 - .3 Sure-Flo FT 100, Gemite.
 - .4 Ultraplan 1 Plus, MAPEI Inc.
- .3 Patching and Flash Patching Materials: Cementitious based, polymer modified, fine aggregate, single component, rapid curing, early strength floor patching compounds having high adhesion with manufacturer's recommended primer and surface profile; for application in thicknesses to a minimum of 4 mm to 25 mm, and as follows:
 - .1 Acceptable Materials:
 - .1 GenPatch, Custom Building Products
 - .2 NXT Patch, Laticrete
 - .3 Planitop 18 ES, MAPEI Inc.
 - .4 SD-P, Ardex

- .5 SikaQuick 1000, Sika
- .6 Sealtight Meadow-Crete H, W.R. Meadows

2.3 CRACK REPAIR MATERIALS

- .1 Crack repair and filler: two-component, nonshrink, 100% solids, moisture-insensitive, VOC free, and meeting the requirements of ASTM C881.
 - .1 Basis-of-Design:
 - .1 Planibond EBA, MAPEI Canada Inc.

2.4 HARDENERS

- .1 Type: 1, Sodium silicate, permanent penetrating sealer and hardener
 - .1 Liquid applied, water based, chemically reactive.
 - .2 Non-toxic, non-flammable, and anti-dusting have low or no VOC.
 - .3 Colour: colourless
 - .4 Acceptable Materials:
 - .1 Ashford Formula, Curecrete
 - .2 Euco Diamond Hard, Euclid Chemical Company
 - .3 Mapecrete Hard SB, Mapei Inc.
 - .4 Seal Hard, L&M Construction Company
 - .5 Sealtight Liqui-Hard, W.R. Meadows
 - .6 Sikafloor 3S, Sika Canada
- .2 Water: potable.

2.5 SEALING COMPOUNDS

- .1 Surface sealer: to CAN/CGSB-25.20, Type 1 - solvent-based, colour.
 - .1 Surface sealers manufactured or formulated with aromatic solvents, formaldehyde, halogenated solvents, mercury, lead, hexavalent chromium and their compounds are not acceptable.
 - .2 Surface sealer shall be compatible with the hardener and shall be manufactured by hardener manufacturer.
 - .3 Surface sealer shall have less than 100g/l of VOC in accordance with SCAQMD Rule #1113.
- .2 Wax: acrylic carnuba wax, colour.

2.6 CURING COMPOUNDS

- .1 Select low VOC, water-based, organic-solvent free curing compounds.
 - .1 Concrete Curing Compounds: maximum VOC limit 100 g/L in accordance with SCAQMD Rule #1113.

2.7 MIXES

- .1 Mixing, ratios and application in accordance with manufacturers instructions.

2.8 ACCESSORIES

- .1 Joint Filler Strips:

- .1 Floor Isolation Joints: ASTM D1751, bituminous impregnated fibreboard, or ASTM D1752, cork or self-expanding cork, 13 mm thick minimum.
- .2 Edge Joint Filler: ASTM D1751, bituminous impregnated fibreboard, 13 mm thick minimum.
- .2 Control Joint Filler:
 - .1 Two component, epoxy-urethane, load bearing, self levelling sealant.
 - .1 Acceptable Materials:
 - .1 Euco Qwikjoint UVR, by Euclid Chemical
 - .2 Loadflex, Sika Canada
 - .3 Planiseal Rapid Joint 15, MAPEI Inc.
 - .4 Rezi-Weld Flex, WR Meadows
 - .3 Waterstop Gasket and Waterstop Sealant: expanding strip waterstop.
 - .1 Acceptable Materials:
 - .1 RX-101 and compatible Cetseal adhesive, Cetco
 - .2 Kyrtonite Swelling Waterstop and Krytonite Adhesive, Kryton.

Part 3 Execution

3.1 EXAMINATION

- .1 Prepare floor surface in accordance with CSA A23.1.
- .2 Verify that slab surfaces are ready to receive work and elevations are as instructed by manufacturer.

3.2 REPAIRS

- .1 Inspect surfaces for defects immediately after removal of forms. Repair or patch defects within 48 hours of removal of forms with cure repairs same as new concrete with Departmental Representatives permission.
- .2 Defective Areas: where patches are allowed, repair and patch areas to match surrounding areas in texture and colour.

3.3 FINISHING FORMED SURFACES

- .1 Requirements listed below apply to normal structural concrete; refer to Section 03 30 00 for additional requirements for formed exposed architectural concrete.
- .2 Unspecified Finish: Provide following finishes as applicable when finish of formed surfaces is not specifically indicated:
 - .1 Unexposed Surfaces:
 - .1 Rough form finish for concrete not exposed to view.
 - .2 Smooth form finish for concrete to receive membrane waterproofing.
 - .2 Exposed Surfaces:
 - .1 Smooth form finish for concrete surfaces exposed to view.
- .3 Rough Form Finish: Leave surfaces with texture imparted by forms; patch tie holes and defects; remove fins longer than 6 mm high.

- .4 Smooth Form Finish: Coordinate as necessary to secure form construction using smooth, hard, uniform surfaces with number of seams kept to a minimum, uniformly spaced in an orderly pattern; patch tie holes and defects; completely remove fins.
- .5 Sack Rubbed Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes; add white hydraulic cement in amounts determined by trial patches so colour of dry grout will match adjacent surfaces; rub surfaces with clean burlap and keep damp by fog spray for a minimum of 36 hours after grout whitens.
- .6 Related Unformed Finish: Strike-off concrete smooth and finish with using texture matching adjacent formed surfaces at tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces; continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces.
- .7 Penetrating Sealer Finish: Apply penetrating sealer to vertical surfaces after any patching, joint sealing or caulking is completed in accordance with manufacturer's written instructions.

3.4 FINISHING FLOORS AND SLABS

- .1 Finish floors and slabs in accordance with CSA A23.1 and ACI 302.1R recommendations for screeding, re-straightening, and finishing operations for concrete surfaces; do not wet concrete surfaces.
- .2 Trowel (Final) Finishing:
 - .1 Commence trowel finishing after all bleed water has disappeared and when the concrete has stiffened sufficiently to prevent the working of excess mortar to the surface.
 - .2 Apply first trowelling and consolidate concrete by hand or power-driven trowel after applying float finishing; continue trowelling passes and re-straighten until surface is free of trowel marks and uniform in texture and appearance; repair or smooth any surface defects that would telegraph through applied coatings or floor covering.
 - .3 Apply a trowel finishing to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
 - .4 Finish surfaces to the tolerances indicated above.
- .3 Trowel and Fine Broom Finishing:
 - .1 Apply trowel finishing to surfaces where ceramic or quarry tile is scheduled for installation by either thickset or thin-set method.
 - .2 Slightly scarify surface with a fine broom While concrete is still plastic.
 - .3 Finish surfaces to the tolerances indicated above.
- .4 Broom Finishing:
 - .1 Apply a broom finishing to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.
 - .2 Slightly roughen trafficked surface by brooming with fibre bristle broom perpendicular to main traffic route immediately after float finishing.
 - .3 Coordinate required final finishing with Departmental Representative before application.

- .5 Sandblast Finishing:
 - .1 Use abrasive grit, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces to provide levels of finish as follows:
 - .1 Brush Blast Finish: Removes surface dirt and stains to give the surface a uniform appearance.
 - .2 Light Blast Finish: Exposes some of the fine aggregate as well as removing surface dirt and stains; depth of cut shall not exceed 1.5 mm.
 - .3 Medium Blast Finish: Exposes the top faces of the coarse aggregate faces near the surface; depth of cut shall not exceed 5 mm.

3.5 APPLICATION: GENERAL

- .1 After floor treatment is dry, seal control joints and joints at junction with vertical surfaces with sealant.
- .2 Apply floor treatment in accordance with Sealer manufacturer's written instructions.
- .3 Clean overspray. Clean sealant from adjacent surfaces.
- .4 Cure concrete in accordance with manufacturers recommended procedures.

3.6 APPLICATION: LIQUID APPLIED FLOOR HARDENER

- .1 Apply liquid floor hardener in accordance with manufacturer's written instructions after initial floating.
- .2 Cure concrete in accordance with manufacturer's recommended instructions.
- .3 Apply hardener to horizontal and vertical exposed concrete to remain unfinished.

3.7 APPLICATION: WATERSTOPS

- .1 Install in accordance with manufacturer's written instructions at exterior construction joints.
- .2 Ensure concrete is free of voids, honeycombing, segregation of the mix, or any conditions which leads to concrete permeability.
- .3 Install in all applicable exterior vertical and horizontal cast-in-place concrete constructions joints, around applicable penetration and structural members. Leaving a minimum of 75mm of concrete cover to the exterior.
- .4 Tightly butt coil ends together to form continuous waterstop.
- .5 Protect installed waterstop from prehydration prior to concrete placement and product encapsulation.

3.8 PROTECTION

- .1 Protect finished installation in accordance with manufacturer's instructions.

3.9 MAINTENANCE

- .1 Provide training to Departmental Representative based on written manufacturers instructions as indicated in Section 01 78 00 – Closeout Submittals.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation for precast concrete splashpads.

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM C109/C109M-16a, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 in. or 50 mm Cube Specimens).
 - .2 ASTM C260/C260M-10a (2016), Standard Specification for Air-Entraining Admixtures for Concrete.
 - .3 ASTM C330/C330M-17A, Standard Specification for Lightweight Aggregates for Structural Concrete.
 - .4 ASTM C494/C494M-17, Standard Specification for Chemical Admixtures for Concrete.
 - .5 ASTM C827/C827M-16, Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures.
 - .6 ASTM C939C939M-16a Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method).
- .2 Canadian Standards Association (CSA) International
 - .1 CAN/CSA-A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete, Includes Updates No. 1 (2011).
 - .2 CAN/CSA-A23.4-16, Precast Concrete - Materials and Construction, Includes Update No. 1 (July 2010).
 - .3 CSA-A3000-13, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005), Includes Update No. 1 (2014), Update No. 2 (2014), Update No. 3 (2014), Update No. 4 (2016), Update No. 5 (2017)
 - .4 CAN/CSA-G30.18-09 (R2014), Carbon Steel Bars for Concrete Reinforcement, Includes Update No. 1 (2012).

Part 2 Products

2.1 MATERIALS

- .1 Portland cement [with 40% Fly ash replacement]: to CAN/CSA-A5, Type GU.
- .2 Water: to CAN/CSA-A23.1/A23.2.
- .3 Aggregates: to CAN/CSA-A23.1/A23.2.
 - .1 Coarse aggregates to be normal density.
 - .2 Low density aggregate for lightweight concrete: to ASTM C330/C330M.
- .4 Air entraining admixture: to ASTM C260/C260M.

- .5 Chemical admixtures: to ASTM C494/C494M. Use of accelerating or set retarding admixtures for cold and hot weather placing to approval of Departmental Representative.
- .6 Supplementary cementing materials: to CAN/CSA-A23.5.
- .7 Shrinkage compensating grout: premixed compound consisting of non-metallic aggregate, portland cement, water reducing and plasticizing agents.
 - .1 Compressive strength: 50 MPa at 28 days.
 - .2 Consistency:
 - .1 Fluid: to ASTM C827/C827M. Time of efflux through flow cone, under 30 seconds in accordance with ASTM C939.
 - .2 Flowable: to ASTM C827/C827M. Flow table, 5 drops in 3 seconds, to ASTM C109/C109M, applicable portion 125 to 145%.
 - .3 Plastic: to ASTM C827/C827M. Flow table, 5 drops in 3 seconds, to ASTM C109/C109M, applicable portions 100 to 125%.
 - .4 Dry pack: to manufacturer's requirements.
 - .3 Net shrinkage at 28 days: maximum 6%.
- .8 Reinforcing Steel: In accordance with CSA G30.18, 400 MPa yield grade deformed billet steel bars.

2.2 CONCRETE MIXES

- .1 Proportion concrete in accordance with CAN/CSA-A23.1/A23.2, Alternative 1, to following requirements:
 - .1 Type GU cement.
 - .2 Minimum compressive strength at 28 days: 32 MPa.
 - .3 Class of exposure: C-2.
 - .4 Maximum Water/Cement Ratio: 0.45
 - .5 Nominal size of coarse aggregate: 10 mm.
 - .6 Slump at time and point of discharge: 60 mm to 80 mm.
 - .7 Air content category: 1.

2.3 FABRICATION

- .1 Fabricate: to CAN/CSA-A23.4/A251, to sizes indicated on Drawings
- .2 Finish: commercial grade.

Part 3 Execution

3.1 INSTALLATION

- .1 Splashpads:
 - .1 Install splashpads at downspouts as indicated on Drawings.
 - .2 Replace damaged and defective units as directed by Departmental Representative.
- .2 Replace damaged and defective units as directed by Departmental Representative.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 05 50 00 – Metal Fabrications
- .2 Section 07 21 13 – Board Insulation
- .3 Section 07 27 13 – Modified Bituminous Air and Vapour Barrier
- .4 Section 07 62 00 – Sheet Metal Flashing and Trim
- .5 Section 07 92 00 – Sealants
- .6 Section 08 50 13 – Aluminum Clad Wood Windows

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A116-11 (2016), Standard Specification for Metallic-Coated, Steel Woven Wire Fence Fabric.
 - .2 ASTM A123/A123M-15, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .3 ASTM A153/A153M-16a, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - .4 ASTM A307-14, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.
 - .5 ASTM A641/A641M-09a (2014), Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
 - .6 ASTM A653/A653M-15e1, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .7 ASTM A1011/A1011M-15, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
 - .8 ASTM C140/C140M-17, Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
 - .9 ASTM C207-06(2011), Standard Specification for Hydrated Lime for Masonry Purposes.
- .2 Canadian Standards Association (CSA International)
 - .1 CSA A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete, Includes Update No.1 (2015).
 - .2 CAN/CSA-A165 Series-14, CSA Standards on Concrete Masonry Units (Consists of A165.1, A165.2, and A165.3)
 - .3 CSA A179-14, Mortar and Grout for Unit Masonry
 - .4 CSA A370-14, Connectors for Masonry.
 - .5 CAN/CSA A371-14, Masonry Construction for Buildings.
 - .6 CSA-A3000-13, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005), Includes Update No. 1 (2014), Update No. 2 (2014), Updated No. 3 (2014), Update No. 4 (2016).

- .7 CSA S304-14, Design of Masonry Structures, include Update No. 1 (2015).

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Coordinate lines, levels and coursing with work of other Sections.
 - .2 Obtain built-in items prior to start of this work.
- .2 Pre-Installation Meetings: convene pre-installation meeting one week prior to beginning work of this Section and on-site installation, with Contractor, Subcontractor, material supplier and Departmental Representative in accordance with Section 01 31 19 – Project Meetings to:
 - .1 Verify project requirements including specification and details for project.
 - .2 Confirm required mortar, grout and concrete testing; review batch control and grouting procedures.
 - .3 Coordinate crack control measures.
 - .4 Review requirements for reinforcement at corners and wall intersections.
 - .5 Review membranes and membrane flashing materials and details used for construction.
 - .6 Confirm trowelled or tooled joints to concealed and exposed masonry faces.
 - .7 Review methods for controlling efflorescence during construction.
 - .8 Review hot and cold weather requirements.

1.4 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 – Submittal Procedures.
 - .1 Provide manufacturer's printed product literature, specifications and data sheet. Indicate masonry types, shapes, sizes, and textures.
 - .2 Cementitious Materials:
 - .1 Include brand, type, and name of manufacturer for site mixed mortar materials.
 - .2 Submit proposed mix proportions and sand analysis reports and compressive strength reports on the proposed mortar mix(es).
- .2 Submit samples in accordance with Section 01 33 00 – Submittals Procedures.
 - .1 Provide 3 concrete masonry units (face only) to show texture and colour variance of finish only.
 - .2 Provide sample of masonry connector, joint reinforcement, flashings, weeps and vent.
 - .3 Obtain review comments from Departmental Representative prior to ordering.

1.5 QUALITY ASSURANCE

- .1 Conform to CAN/CSA A371, except as modified by this specification.

- .2 The masonry Subcontractor shall be a member in good standing with the Masonry Contractors Association of Alberta.
- .3 The masonry Subcontractor shall have a minimum of five (5) years of experience on projects of similar size and magnitude and shall provide continuous active supervision by a journeyman mason while masonry work is in progress.
- .4 Masonry work shall be performed by experienced, qualified journeyman masons under the direct and continual full-time supervision of certified masons.
- .5 Before starting masonry work establish mix proportions based on the limitations set out in Table 2 of CSA A179.
- .6 Test laboratory prepared samples of the proposed mortar(s) for compressive strength in accordance with CSA A179, by a laboratory approved by the Departmental Representative. The Departmental Representative will pay for the initial cost of mortar testing. Any re-testing required as a result of the original test failing will be borne by the Contractor.
- .7 Connectors and joint reinforcement shall conform to CSA A370.
- .8 Miscellaneous masonry accessories, and their use where not otherwise specified but shown or required for proper completion of the Work, shall conform to CSA A371.
- .9 Regulatory Requirements: Provide fire resistance rated materials and construction identical to those of assemblies with fire resistance ratings determined by ULC Listings.

1.6 MOCK-UPS

- .1 Construct mock-up in accordance with Section 01 45 00 – Quality Control.
- .2 Construct a portion of one wall in location agreed upon by Departmental Representative to establish a standard of construction, workmanship, and appearance. Show reinforcement, masonry connectors, flashing, jointing, coursing, mortar, and masonry pattern, unit face alignment, texture, and colour.
- .3 Do not continue with work of this Section until Departmental Representative has reviewed mock-up.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver masonry units on pallets or cubes, suitably protected from road grime and moisture absorption due to exposure to rain or melting snow.
- .2 Unload and store on dry, level areas, without direct contact with the ground.
- .3 Remove plastic wrappings from concrete masonry units and cover with waterproof coverings which will provide protection from the elements but allow for air circulation.
- .4 Deliver cement, lime, and mortar in dry condition with manufacturer's label intact and store under waterproof cover and protected from elements.

1.8 WASTE MANAGEMENT AND DISPOSAL

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

1.9 SITE CONDITIONS

- .1 Ambient Conditions: maintain materials and surrounding air temperature to:
 - .1 Minimum 5 degrees C prior to, during, and 48 hours after completion of masonry work.
 - .2 Maximum 32 degrees C prior to, during, and 48 hours after completion of masonry work.
- .2 Provide adequate bracing for masonry during construction and until permanent lateral supports are in place.

Part 2 Products

2.1 CONCRETE MASONRY UNITS

- .1 Standard Concrete Masonry Units: to CAN/CSA A 165.1 and as follows:
 - .1 Classification: H/15/B/M (standard)
 - .2 Size (Nominal): As indicated on Drawings
 - .3 Special shapes: provide plain end units for exposed corners as indicated on Drawings. Lintels and bond beams are constructed using knock-out lintel units. Provide additional special shapes as indicated.
 - .4 Acceptable Manufacturer:
 - .1 Expocrete, An Oldcastle company.

2.2 MORTAR AND GROUT MATERIALS

- .1 Use same brands of materials and source of aggregate for entire project.
- .2 Cement:
 - .1 Portland Cement: to CAN/CSA-A3000, Type GU - General use hydraulic cement (Type 10) gray colour.
 - .1 Use low VOC products in compliance with SCAQMD Rule 1168.
 - .2 Masonry Cement: to CAN/CSA-A3002 and CAN/CSA A179, Type N.
- .3 Aggregate: supplied by one supplier.
 - .1 Fine Aggregate: to CAN/CSA A179, natural sand or manufactured sand.
 - .2 Course Aggregate: to CAN/CSA A179.
- .4 Water: clean and potable.
- .5 Lime:
 - .1 Quick Lime: to CAN/CSA A179.
- .6 Mortar Mixes
 - .1 Mortar for interior masonry:
 - .1 Loadbearing: type S based on property specifications.
 - .2 Non-Loadbearing: N based on property specifications.
 - .2 Following applies regardless of mortar types and uses specified above:
 - .1 Mortar for grouted reinforced masonry: type S based on property specifications.

- .7 Mortar Mixing:
 - .1 Use pre-blended, pre-coloured mortar prepackaged under controlled factory conditions. Ingredients batching limitations to be within 1% accuracy.
 - .2 Mix mortar ingredients in accordance with CAN/CSA A179 in quantities needed for immediate use.
 - .3 Maintain sand uniformly damp immediately before mixing process.
 - .4 Do not use anti-freeze compounds including calcium chloride or chloride based compounds.
 - .5 Use a batch type mixer in accordance with CAN/CSA A179.
 - .6 Pointing mortar: prehydrate pointing mortar by mixing ingredients dry, then mix again adding just enough water to produce damp unworkable mix that will retain its form when pressed into ball. Allow to stand for not less than 1 hour no more than 2 hours then remix with sufficient water to produce mortar of proper consistency for pointing.
 - .7 Re-temper mortar only within two hours of mixing, when water is lost by evaporation.
 - .8 Use mortar within 2 hours after mixing at temperatures of 32 degrees C, or 2-1/2 hours at temperatures under 5 degrees C.
- .8 Grout Mixes:
 - .1 Bond Beams: grout mix 20 MPa strength at 28 days; 200-250 mm slump; premixed type in accordance with CAN/CSA-A23.1
 - .2 Lintels: grout mix 20 MPa strength at 28 days; 200-250 mm slump; premixed type in accordance with CAN/CSA-A23.1
 - .3 Grout: Minimum compressive strength of 20 MPa at 28 days. Maximum aggregate size and grout slump: CAN/CSA A179.
- .9 Grout Mixing:
 - .1 Mix batched and delivered grout in accordance with CAN/CSA-A23.1 transit mixed.
 - .2 Mix grout ingredients in quantities needed for immediate use in accordance with CAN/CSA A179 fine grout.
 - .3 Add admixtures in accordance with manufacturer's instructions; mix uniformly.
 - .4 Do not use calcium chloride or chloride based admixtures.
- .10 Mix Tests:
 - .1 Testing Mortar Mix:
 - .1 Test mortar to requirements of Section 01 45 00 - Quality Control, and in accordance with CAN/CSA A179, for mortar based on property specification. Test prior to construction and during construction for:
 - .1 Compressive strength.
 - .2 Consistency.
 - .3 Mortar aggregate ratio.
 - .4 Sand/cement ratio.

- .5 Water content and water/cement ratio.
- .6 Air content.
- .7 Splitting tensile strength
- .2 Testing Grout Mix:
 - .1 Test grout to requirements of Section 01 45 00 - Quality Control, and in accordance with CAN/CSA A179, for grout based on property specification. Test prior to construction and during construction for:
 - .1 Compressive strength.
 - .2 Sand/cement ratio.
 - .3 Water content and water/cement ratio.
 - .4 Slump.

2.3 GALVANIZING

- .1 The following galvanizing requirements apply to steel anchors, ties, reinforcing and accessories where requirements are not otherwise specifically listed:
 - .1 Ties and Reinforcing:
 - .1 Mill Galvanized (Interior Use): In accordance with ASTM A116, Class 3.
 - .2 Hot Dip Galvanized (Exterior, including inner wythe of exterior wall construction and High Humidity Use): In accordance with ASTM A153, Class B-2.
 - .2 Hot Dip Hardware and Bolts: In accordance with ASTM A153, Class B-2 regardless of location.
 - .3 Hot Dip Sheet Steel: In accordance with ASTM A653, Coating Designation Z600, regardless of location.
 - .4 Structural Shapes and Pipes: In accordance with ASTM A123, Grade 85, regardless of location.

2.4 REINFORCEMENT

- .1 Bar reinforcement: Steel to CAN/CSA A371 and CAN/CSA G30.18, Grade 400 W stainless steel to ASTM A167.
- .2 Masonry Joint Reinforcement: In accordance with to CSA A371 and ASTM A496, with corrosion protection in accordance with CSA S304 and CSA A370, and as follows:
 - .1 Interior Walls: Hot dip galvanized, carbon steel.
 - .2 Wire Size for Side Rods: W1.7 or 3.8 mm diameter.
 - .3 Wire Size for Cross Rods: W1.7 or 3.8 mm diameter.
 - .4 Spacing of Cross Rods, Tabs, and Cross Ties: At a maximum of 400 mm o/c.
 - .5 Lengths: A minimum of 3000 mm, with prefabricated corner and tee units.
- .3 Connectors: In accordance with to CSA A370 and CSA S304 with hot dip galvanized finish.

- .4 Single Wythe Masonry Joint Reinforcement: Ladder type with single pair of side rods.

2.5 TIES AND ANCHORS

- .1 Ties and anchors specified in this section shall be designed in accordance with CSA A370 for non-conventional masonry connectors as follows:
 - .1 Deflection: Maximum 2 mm, including free play, when acted upon by a lateral load of 0.45 kN, in all possible positions of adjustment.
 - .2 Positive restraint at position of maximum adjustment.
 - .3 Free play of multi-component ties maximum 1.2 mm when assembled in all possible configurations.
 - .4 Anchors shall allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall.
- .2 Lateral Partition Supports (Top of Wall Anchors):
 - .1 Angle Support: Fabricated from 2.657 mm core metal thickness angled steel plate having 75 mm long legs fastened to deck structure to allow vertical movement of masonry assembly; hot dip galvanized; coordinate with Section 07 84 00 for firestopping insulation and smoke seals.
 - .2 Plate Support: Fabricated from 2.657 mm core metal thickness stainless steel plate with 10 mm diameter metal 150 mm long welded to plate having closed end plastic tube fitted over rod that allows rod to move in and out of tube.
- .3 Rigid T-Intersection Anchors: Fabricate from steel bars 38 mm wide x 6 mm thick x 600 mm long with ends turned up 50 mm or with cross pins at installers option; hot dip galvanized.
- .4 Anchor Bolts: Headed or L-shaped steel bolts in accordance with ASTM A307, Grade A; with ASTM A563 hex nuts and, where indicated, flat washers; hot-dip galvanized in accordance with ASTM A153, Class C.
- .5 Post Installed Anchors: Provide chemical or torque controlled expansion anchors, with capability to sustain, without failure, a load equal to six times the load imposed when installed in solid or grouted unit masonry and equal to four times the load imposed when installed in concrete when tested in accordance with ASTM E488 conducted by a qualified independent testing agency, and as follows:
 - .1 Indoor Locations: Carbon-steel components zinc-plated in accordance with ASTM B633, Class Fe/Zn 5.
 - .2 Outdoor and High Humidity Locations: Alloy Group 1 or 2 stainless steel bolts complying with ASTM F593/F738M and nuts complying with ASTM F594/ASTM F836M.
 - .3 Fastening Into Solid Concrete or Solidly Grouted Installation: Two component, injectable adhesive specifically manufactured for use in installing dowels or threaded anchor rods and inserts into new or existing concrete or grout, and as follows:
 - .1 Epoxy Composition: Sealed packaging containing resin, hardener, cement and water; components.

- .2 Curing Time: Rapid set, high strength and stiffness; maximum time 45 minutes at 20°C.
- .3 Basis-of-Design Materials: Hilti Inc., HIT HY150 System, no Substitutions Accepted.
- .4 Fastening Trough Hollow Wall Installation: Two component, injectable adhesive specifically manufactured for use in installing dowels or threaded anchor rods and inserts, with cylindrical mesh screen tube into new or existing masonry cavity wall, and as follows:
 - .1 Epoxy Composition: Sealed packaging containing resin, hardener, cement and water.
 - .2 Curing Time: Rapid set, high strength and stiffness; maximum time 60 minutes at 20°C.
 - .3 Basis-of-Design Materials: Hilti Inc., HIT HY20 System, no Substitutions Accepted.
- .5 Fastening To Hollow Wall Installation: Two component, injectable adhesive specifically manufactured for use in installing dowels or threaded anchor rods and inserts, with cylindrical mesh screen tube into new or existing masonry cavity wall, and as follows:
 - .1 Epoxy Composition: Sealed packaging containing resin, hardener, cement and water.
 - .2 Curing Time: Rapid set, high strength and stiffness; maximum time 60 minutes at 20°C.
 - .3 Basis-of-Design Materials: Hilti Inc., HIT HY20 System, no Substitutions Accepted.
- .6 Toggle Bolts: Tumble wing type, class and style as required for supported construction.

2.6 FLASHING

- .1 Metal Flashing: Provide metal flashing materials in accordance with Section 07 62 00.
- .2 Coordinate supply and installation of flexible flashing materials with Section 07 27 13, provide only materials that are compatible with acceptable materials listed in Section 07 27 13 and that form the basis of the contract.
- .3 Butyl Rubber Base Flashing: minimum 1.2 mm thick butyl sheet rubber strips.
- .4 Sheet Steel Base Flashing: minimum 0.60 mm thick, to ASTM A653, formed as detailed, galvanized with Z275 zinc coating.
- .5 Modified Bitumen Base Flashing: SBS modified sheet membrane, minimum 1.0 mm thick self-adhering type or minimum 3.0 mm thick torch-applied type.

2.7 ACCESSORIES

- .1 Firestopping: As specified under Section 07 84 00.
- .2 Sealants: As specified under Section 07 92 00, and as follows:
 - .1 Vertical Sealant: Colour to match brick
 - .2 Horizontal Sealant: Colour to match mortar

- .3 Clear Unit Masonry Sealer:
 - .1 Clear coating for ground face terrazzo concrete unit masonry.
 - .2 Acceptable materials:
 - .1 Pro-Masonry, Clear Sheen single coat, semi-gloss finish.
 - .2 Fabrikem, Fabrishield 763
 - .3 Application shall be provided under conditions specified in Section 09 91 00 – Painting.
- .4 Joint Filler: Control Joint Fillers: Preformed rubber, neoprene or polyvinylchloride, size and profile to suit intended application and as indicated on drawings.
- .5 Bond Breaker Strips: #15 asphalt saturated, organic roofing felt in accordance with CSA A123.3.

2.8 CLEANING COMPOUNDS

- .1 Use low VOC products in compliance with SCAQMD Rule 1168.
- .2 Compatible with substrate and acceptable to concrete masonry manufacturer for use on products.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify surfaces and conditions are ready to accept work of this Section.
- .2 Examine work of other Sections upon which work of this section is dependent. Should discrepancies be found which affect the proper performance of the work of this section, do not commence work until such discrepancies have been resolved.
- .3 Perform work with minimal cutting and patching.

3.2 PREPARATION

- .1 Protect adjacent finished materials from damage due to masonry work.

3.3 APPLICATION

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

3.4 INSTALLATION: GENERAL

- .1 Construction to conform to CAN/CSA A371.
- .2 Where mortar has started to harden at units requiring repositioning, remove and replace with fresh mortar.
- .3 Masonry horizontal and vertical joints to be 10 mm thick except where adjustments are necessary to maintain the bond pattern or to adjust coursing.

3.5 INSTALLATION: CONCRETE MASONRY UNITS

- .1 Standard concrete block units:
 - .1 Bond: running.
 - .2 Coursing height: 200 mm for one block and one joint.
 - .3 Jointing: flush where exposed or where paint or other finish coating is specified.
- .2 Cull out masonry units, in accordance with CAN/CSA A165 and reviewed range of colour samples, with chips, cracks, broken corners, excessive colour and texture variation.
- .3 Build in miscellaneous items such as bearing plates, steel angles, bolts, anchors, inserts, sleeves and conduits.
- .4 Construct masonry walls using running bond unless otherwise noted.
- .5 Build around frames previously set and braced. Fill behind hollow frames within masonry walls with mortar or grout and embed anchors.
- .6 Fit masonry closely against electrical and plumbing outlets so collars, plates and covers overlap and conceal cuts.
- .7 Install movement joints and keep free of mortar where indicated.
- .8 Hollow Units: spread mortar setting bed from outside edge of face shells. Gauge amount of mortar on top and end of unit to create full joints, equivalent to shell thickness. Avoid excess mortar.
- .9 Solid Units: apply mortar over entire vertical and horizontal surfaces.
- .10 Ensure compacted head joints. Use full or face-shell joint as indicated.
- .11 Tamp units firmly into place.
- .12 Do not adjust masonry units after mortar has set. Where resetting of masonry is required, remove, clean and reset units in new mortar.
- .13 Tool exposed joints concave weathered/raked for interior work; strike concealed joints flush.
- .14 After mortar has achieved initial set up, tool joints.
- .15 Do not interrupt bond below or above openings.

3.6 TOLERANCES

- .1 Tolerances for standard concrete unit masonry tolerances in accordance with CAN/CSA A165.1, supplemented as follows:
 - .1 Maximum variation between units within specific job lot not to exceed 2 mm.
 - .2 No parallel edge length, width or height dimension for individual unit to differ by more than 2 mm.
 - .3 Out of square tolerance not to exceed 2 mm.

3.7 INSTALLATION: CONNECTORS AND REINFORCEMENT

- .1 Supply and install masonry connectors and reinforcement in accordance with CAN/CSA A370, CAN/CSA A371, CAN/CSA-A23.1 and CSA-S304.1 unless indicated otherwise.
- .2 Prior to placing concrete mortar or grout, obtain Departmental Representative's approval of placement of reinforcement and connectors.

3.8 BONDING AND TYING

- .1 Install unit, adjustable, single wythe and multiple wythe joint reinforcement where indicated and in accordance with CAN/CSA A370, CAN/CSA A371, and manufacturer's instructions.
 - .1 Install horizontal joint reinforcement 400 mm on centre.
 - .2 Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 400 mm each side of opening.
 - .3 Place joint reinforcement continuous in first and second joint below top of walls.
 - .4 Lap joint reinforcement ends minimum 200 mm.
 - .5 Connect stack bonded unit joint corners and intersections with strap anchors 400 mm on centre.

3.9 REINFORCED LINTELS AND BOND BEAMS

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

3.10 GROUTING

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

3.11 ANCHORS

- .1 Supply and install metal anchors in accordance with CAN/CSA A370 and CAN/CSA A371 as indicated.

3.12 LATERAL SUPPORT AND ANCHORAGE

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

3.13 CONTROL AND EXPANSION JOINTS

- .1 Install control and expansion joint materials in unit masonry as masonry progresses; do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- .2 Form control joints in concrete masonry consisting of a complete vertical break free from mortar using one of the following methods:

- .1 Break joint reinforcement at control joints, but extend bond beam reinforcing 400 mm into wall across control joint and wrap with 0.15 mm polyethylene bond breaker.
 - .2 Fit bond breaker strips into hollow contour in ends of concrete masonry units on one side of control joint; fill resultant core with grout and rake out joints in exposed faces for application of sealant.
 - .3 Install preformed control joint gaskets designed to fit standard sash block.
 - .4 Install interlocking units designed for control joints; install bond breaker strips at joint; keep head joints free and clear of mortar or rake out joint for application of sealant.
 - .5 Install temporary foam plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.
 - .6 Refer to Drawings for control and expansion joint locations, and vertical reinforcing requirements; confirm location with Departmental Representative before installation; confirm with Departmental Representative where not shown on Drawings.
- .3 Form expansion joints in brick masonry consisting of a complete vertical break free from mortar using one of the following methods:
- .1 Build flanges of metal expansion strips into masonry; lap each joint 100 mm in direction of water flow; seal joints below grade and at junctures with horizontal expansion joints if any.
 - .2 Build flanges of factory fabricated, expansion joint units into masonry.
 - .3 Build in compressible joint filler.
 - .4 Locate joints at 6000 mm o/c maximum and at a minimum of 3600 mm from any corners, any other indication notwithstanding.
 - .5 Refer to Drawings for control and expansion joint locations, and vertical reinforcing requirements; confirm location with Departmental Representative before installation; confirm with Departmental Representative where not shown on Drawings.
- .4 Install a minimum 10 mm high horizontal, pressure relieving joints by either leaving an air space or inserting a compressible filler, sealant and backer rod specified in Section 07 92 00; locate horizontal, pressure relieving joints beneath shelf angles supporting masonry.
- .5 Locate joints at 6000 mm centres maximum and at a maximum of 4000 mm from any corners, any other indication notwithstanding.

3.14 FIELD BENDING

- .1 Do not field bend reinforcement and connectors except where indicated or authorized by Departmental Representative.
- .2 When field bending is authorized, bend without heat, applying a slow and steady pressure.
- .3 Replace bars and connectors which develop cracks or splits.

3.15 INSTALLATION: FLASHINGS

- .1 Build in flashings in masonry in accordance with CAN/CSA A371.

- .1 Install flashings under exterior masonry bearing on foundation walls, slabs, shelf angles, and steel angles over openings, and at base of cavity wall and where cavity is interrupted by horizontal members or supports and as shown on drawings. Install flashings under weep hole courses and as indicated.
- .2 In cavity walls and veneered walls, carry flashings from front edge of exterior masonry, under outer wythe, then up backing not less than 150 mm, and as follows:
 - .1 For masonry backing embed or bond flashing 25 mm in joint.
 - .2 For concrete backing, insert or bond flashing into reglets.
 - .3 For wood frame backing, staple flashing to walls behind water resistive paper, and lap joints.
 - .4 For gypsum board and glass fibre faced sheathing backing, bond to wall using manufacturer's recommended adhesive.
- .3 Lap joints 150 mm and seal with adhesive.
- .2 Form flashing (end dams) at lintels, sills and wall ends to prevent water from travelling horizontally past flashing ends.
- .3 Install vertical flashing where outer veneer returns at window or door jambs, to prevent contact of veneer with inner wall.

3.16 MASONRY COATINGS

- .1 Place safety devices and signs near work areas as indicated and directed; seal or repair openings and joints where there is potential risk of water or chemical infiltration through the wall assembly.
- .2 Cover surfaces not scheduled for masonry coatings; cover and protect surfaces and non-masonry finishes with in areas scheduled for coatings.
- .3 Rinse off masonry until no indications of chemicals are present; rinse from bottom to top and from top to bottom; cleanup work area as work progresses; remove debris and waste from site at end of each work day.

3.17 FIELD QUALITY CONTROL

- .1 Site Tests, Inspection: as follows:
 - .1 Concrete masonry units will be sampled and tested by independent testing agency appointed and paid by Departmental Representative in accordance with CSA S304.1.
 - .2 Notify inspection agency minimum of 24 hours in advance of requirement for tests.

3.18 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
- .2 Concrete Unit Masonry:
 - .1 Progress Cleaning:
 - .1 Standard Concrete Unit Masonry:
 - .1 Allow mortar droppings on masonry to partially dry then remove by means of trowel, followed by rubbing lightly with small piece of block. Clean wall surface with suitable brush or burlap.
- .3 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.
- .4 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 04 22 00 – Unit Masonry
- .2 Section 05 50 00 – Metal Fabrications
- .3 Section 06 10 00 – Rough Carpentry
- .4 Section 07 27 19 – Sheet Membrane Air and Vapour Barrier
- .5 Section 07 24 00 – Exterior Insulation and Finish System

1.2 REFERENCES

- .1 American Society for Testing of Materials (ASTM)
 - .1 ASTM C97/C97M-15, Standard Test Methods for Absorption and Bulk Specific Gravity of Dimension Stone.
 - .2 ASTM C99/C99M-15, Standard Test Method for Modulus of Rupture of Dimension Stone.
 - .3 ASTM C119-16, Standard Terminology Relating to Dimension Stone.
 - .4 ASTM C170/C170M-16, Standard Test Method for Compressive Strength of Dimension Stone.
 - .5 ASTM C207-06(2011), Standard Specification for Hydrated Lime for Masonry Purposes.
 - .6 ASTM C568/C568M-15, Standard Specification for Limestone Dimension Stone.
 - .7 ASTM C847-14a, Specification for Metal Lath.
 - .8 ASTM C933-14, Standard Specification for Welded Wire Lath.
- .2 Canadian Standards Association (CSA)
 - .1 CSA A179-14, Mortar and Grout for Unit Masonry, Includes Update No. 1 (2006), Update No.2 (R2011).
 - .2 CSA A370-14, Connectors for Masonry
 - .3 CSA A371-14, Masonry Construction for Buildings.
 - .4 CSA-A3000-13, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005), Includes Update No. 1 (2014), Update No. 2 (2014).

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Convene pre-installation meeting one week prior to beginning work of this Section, with Contractor, Departmental Representative, installer, manufacturer's representative to:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordination with other building subtrades.
 - .4 Review manufacturer's installation instructions and warranty requirements.

1.4 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 – Submittals:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet.
 - .2 Submit test reports covering conformance of stone to ASTM Standards.
- .2 Submit shop drawings in accordance with Section 01 33 00 – Submittals:
 - .1 Submit complete cutting and setting drawings for all stone work. Show in detail the sizes, sections and dimensions of stone, the arrangement of joints and bonding, anchoring and other necessary details. Indicate an identifying number or mark for each stone. Clearly indicate anchoring, dowelling, and cramping of stone work and detail all connections to the structure.
- .3 Submit samples in accordance with Section 01 33 00 – Submittals:
 - .1 Submit 3 stone veneer units showing the range of colour possible within each type specified.
- .4 Submit laboratory test reports certifying compliance of mortar ingredients with specification requirements.

1.5 QUALITY ASSURANCE

- .1 Installer Qualifications: Engage experienced installer with a minimum of 5 years experience who has completed systems similar in material, design, and extent to that indicated for Project and with record of successful performance and is approved by manufacturer.
- .2 Fabricate stone, detail and fabricate supports, and do masonry work in accordance with CSA A371 except where specified otherwise.
- .3 Do masonry reinforcing and tying in accordance with CSA A370 unless specified otherwise.
- .4 Make and use mortar in accordance with CSA A179 unless specified otherwise.

1.6 MOCK-UPS

- .1 Construct mock-up in accordance with Section 01 45 00 – Quality Control.
- .2 Construct a portion of one exterior wall in location agreed upon by Departmental Representative to establish a standard of construction, workmanship, and appearance.
- .3 Do not continue with work of this Section until Departmental Representative has reviewed mock-up. When accepted, mock-up will demonstrate minimum standard or quality required for work of this Section.

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

- .1 Deliver materials to job site in dry condition.
- .2 Keep materials dry until use.
- .3 Store materials under waterproof cover on pallets or plank platforms held off ground.

1.8 ADVERSE WEATHER REQUIREMENTS

- .1 In cold weather conform to Clause 5.15.2 of CSA A371 and maintain temperature of mortar between 5 degrees C and 50 degrees C until used.
- .2 In hot weather protect freshly laid masonry from drying too rapidly, by means of waterproof, non-staining coverings.

1.9 PROTECTION

- .1 Keep masonry dry using coverings that extend over walls and down sides sufficiently to protect walls from wind driven rain, until masonry work is completed and protected by flashings or other permanent construction.
- .2 Protect masonry and other work from marking and other damage. Protect completed work from mortar droppings. Use non-staining coverings.

Part 2 Products

2.1 MANUFACTURERS

- .1 Acceptable Manufacturers: Subject to compliance with requirements specified in this section and as established by the Basis-of-Design materials, manufacturers offering similar products that may be incorporated into the Work include the following:
 - .1 Boral Stone
 - .2 Cultured Stone
 - .3 Eldorado Stone
 - .4 K2 Stone

2.2 PERFORMANCE/DESIGN CRITERIA

- .1 General: Design, fabricate and install stonework to withstand normal loads from wind, gravity, movement of building structure, and thermally induced movement, as well as to resist deterioration under conditions of normal use including exposure to weather.

2.3 STONE MATERIALS

- .1 Stone:
 - .1 Colour and Texture as indicated on Drawings.
- .2 Provide corner units, caps and other accessories for a complete and finished installation. Accessories to match stone wall material.

2.4 ACCESSORIES

- .1 Building Paper: Asphalt impregnated kraft paper manufactured from virgin cellulose and having a 30 minute moisture resistance rating meeting the requirements of CGSB 51.32.
- .2 Metal Lath: Minimum 2.5 lb (3.4 lb for open stud construction) galvanized expanded metal lath (Diamond mesh) in accordance with ASTM C847
- .3 Sealants: Refer to Section 07 92 00.
- .4 Sealer: Silane based sealer, breathable type as recommended by Manufacturer.

- .5 Mortar: Type S and as follows:
 - .1 Cement: complying with ASTM C270.
 - .2 Lime: ASTM C207.
 - .3 Sand: ASTM C144, natural or manufactured sand.
 - .4 Color Pigment: ASTM C979, mineral oxide pigments.
 - .5 Water: Potable.
 - .6 Pre-Packaged Latex-Portland Cement Mortar: ANSI A118.4.
- .6 Fasteners: Galvanized nails, screws or as approved by stone work manufacturer.
- .7 Flashing: as indicated in Section 07 62 00 – Sheet Metal Flashing and Trim.

Part 3 **Execution**

3.1 EXAMINATION

- .1 Verify conditions of substrate previously installed are acceptable for stone installation in accordance with stone suppliers written instructions.
 - .1 Visually inspect substrate with Departmental Representative present.
 - .2 Inform Departmental Representative of unacceptable conditions upon discovery.
 - .3 Proceed with installation after unacceptable conditions have been remedied.

3.2 INSTALLATION

- .1 Lay Work true to line and level. Accurately space courses, keep bond plumb throughout. Corners and reveals shall be plumb and true. Check Work regularly.
- .2 Do not shift or tap units after mortar has taken initial set. If adjustment is required, remove mortar and use fresh mortar.
- .3 Where fresh stonework abuts or is built upon partially or fully set stonework, clean the exposed surface and dampen to obtain bond.
- .4 Use no toothing of new Work into Work that has set unless approved by Departmental Representative; rake back one-half unit lengths where a stop-off is necessary.
- .5 Open stonework pallets and work from a number of pallets, to mix units; before laying to ensure that an even, consistent colour/texture range is provided without obvious or unsightly colour changes.

3.3 INSTALLATION OF STONE

- .1 Refer to manufacturers written instructions for installation procedures and Drawings for details for manufactured veneer as indicated on Drawings.
- .2 Over sheathing and layers of 30-minute building paper (air barrier), mechanically fasten galvanized expanded metal lath on centres recommended by Manufacturer. Ensure lath is overlapped 406 mm at corners and at no point left butted together.
- .3 Over lath (applied so “the cups” are pointing upwards) apply scratch coat.
- .4 Mix mortar to a firm, moist consistency. Take precautions during dry, hot

weather, or during near freezing conditions. Do not re-temper mortar that has passed initial set.

- .5 Upon completion of scratch coat, tool or groove surface providing for mechanical bond of subsequent stone and mortar. Allow scratch coat to cure.
- .6 To cured scratch coat apply mortar and stone according to manufacturers written instruction, starting from the corners and moving to the centre of any given panel.

3.4 CONCEALED WORK

- .1 All head and bed joints in concealed work are to be mortar filled and compacted with the point of the trowel or rodded.
- .2 Compacted joints are required for improved air and sound sealing.

3.5 CUTTING AND FITTING

- .1 Build in chases, piping, ducts, sleeves, grounds, blocking, inserts, supports, conduit, outlet boxes, recessed fittings, fixtures and access panels as required to complete the Work. Cooperate fully to ensure correct size, shape and location.
- .2 Cut and make good the stonework to accommodate other Work as the Work proceeds.
- .3 Fill all openings or voids left for services, etc. Where exposed, use same material as remainder of wall; elsewhere use brick or other suitable bearing masonry. Neatly cut to exposed contours of the space, using full size units where possible.
- .4 Obtain Departmental Representative's approval before cutting any part or area that may impair appearance or strength.
- .5 Exposed chases requiring patching are not permitted without approval.

3.6 BUILT-IN WORK

- .1 Set loose and miscellaneous items of steel and iron into stonework.
- .2 Fill pressed steel frames in stonework openings with mortar or grout.

3.7 JOINTS FOR SEALANT

- .1 Form concave recessed joints where sealed joints are required.
- .2 Form recessed joints where stonework abuts concrete in exposed locations and where indicated.

3.8 CONTROL JOINTS

- .1 Where a control joint is indicated on the architectural drawings, form a continuous vertical joint in the facing, free of mortar. If none are indicated, contact Departmental Representative for verification of locations.
- .2 Form joints to same width as regular jointing, but not exceeding 13 mm unless otherwise indicated.
- .3 Locate joints at 6000 mm centres maximum and at a maximum of 4000 mm from any corners, any other indication notwithstanding.
- .4 Refer to elevations on Drawings for locations.

3.9 STONework CLEANING

- .1 At completion, brush and clean exposed stonework using clean water.
- .2 Comply with manufacturer's cleaning recommendations. Do not use cleaning compounds, additives, soaps or detergents unless approved in writing by both the stonework manufacturer and the Departmental Representative.
- .3 Use of acids is not allowed.
- .4 Clean the stonework work using methods approved by the manufacturer.
- .5 Do not use wire brushes or metal tools for cleaning - use fibre brushes, nylon brushes or wood paddles.
- .6 Do not wipe-off mortar or grout runs while wet. Wait until dry and then remove.

3.10 SEALING

- .1 Seal stone work in accordance with manufacturers written instruction.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 This Section specifies the requirements for shop-applied powder coatings for metal fabrications, railings, and balustrades.

1.2 RELATED SECTIONS

- .1 Section 05 50 00 – Metal Fabrications
- .2 Section 05 51 29 – Metal Stairs and Ladders

1.3 REFERENCES

- .1 American Architectural Manufacturers Association (AAMA)
 - .1 AAMA 2604-13, Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.
- .2 ASTM International (ASTM)
 - .1 ASTM B117-16, Standard Practice for Operating Salt Spray (Fog) Apparatus.
 - .2 ASTM D1654-08 (2016), Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.
 - .3 ASTM D2244-16, Standard Practice for Calculation of Colour Tolerances and Colour Differences from Instrumentally Measured Colour Coordinates
 - .4 ASTM D2247-15, Standard Practice for Testing Water Resistance of Coatings in 100 % Relative Humidity.
 - .5 ASTM D3363-05(2011)e2, Standard Test Method for Film Hardness by Pencil Test.
 - .6 ASTM D4214-07 (2015), Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films.
 - .7 ASTM D7091-13, Standard Practice for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to Ferrous Metals and Nonmagnetic, Nonconductive Coatings Applied to Non-Ferrous Metals.
 - .8 ASTM E1980-11, Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces.
- .3 Canadian Institute of Steel Construction (CISC):
 - .1 CISC Code of Standard Practice, 8th Edition, 2016.
 - .2 CISC Code of Standard Practice, Appendix I, Architecturally Exposed Structural Steel (AESS).

1.4 SUBMITTALS

- .1 Product Data:
 - .1 Submit powder coat cured physical properties for each type of application indicated.
 - .2 Submit transportation, storage, and handling requirements pertaining to powder coated Products.

- .3 Submit coating maintenance and touch-up guidelines.
- .2 Submit Samples for Initial Section: for each type of powder coat application indicated.
- .3 Submit Samples for Verification: For each type of powder coating application and in each colour and gloss indicated.
 - .1 Submit Samples on substrate materials specified, 200 mm square.
 - .2 Label each sample with Contract number and title, colour name and number, sheen name and gloss values, date, and name of manufacturer.
 - .3 Label each Sample for location and application area.
- .4 Submit Product List: for each substrate indicated, cross-reference products to powder coating finish colour and gloss, and locations of application. Use same designations indicated on Drawings and in schedules.
- .5 Quality Control Submittals:
 - .1 Certificates of Compliance: manufacturer's certification that finishes applied on Project components comply with referenced AAMA standards.
- .6 Submit qualifications for shop-applied coatings applicator.
- .7 Warranty: At completion of Contract, submit powder coating manufacturer's five year coating warranty.

1.5 QUALITY ASSURANCE

- .1 Applicator Qualifications: Coating manufacturer's approved and certified applicator who is equipped, trained and approved for application of coatings required for this project, and is approved to provide the warranty specified in this Section
- .2 Verify accuracy of components, quantities, and sizes prior to application of finishes.
- .3 Work shall be to AAMA 2604, which is the minimum standard of quality and performance acceptable for this project.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Transport, handle, store, and protect products in accordance with the manufacturer's printed guidelines.
- .2 Store products off ground, and protected from direct sunlight.
- .3 Protect products from exposure to harmful weather conditions. Store at temperature and humidity conditions recommended by supplier.
- .4 Remove damaged or deteriorated Products from site.

1.7 COORDINATION

- .1 Coordinate submittal and selection procedures for items to receive shop-applied coatings. Where items are indicated to match coatings selected for other items, adjust formulations as required to achieve match. Submit samples for verification indicating compliance with matching requirements.

1.8 PROJECT CONDITIONS

- .1 Ambient Conditions: Maintain area where Products are being installed at a uniform temperature and humidity for 24 hours prior to, during, and after installation in accordance with supplier's guidelines; provide additional lighting to maintain a minimum of 430 lx on surfaces and areas where work is being installed.

1.9 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for recycling and divert waste from landfill in accordance with Section 01 74 21.

1.10 WARRANTY

- .1 Coating Warranty: coating applicator's warranty in which applicator agrees to repair finish or replace coated items that demonstrate deterioration of shop-applied finishes within warranty period indicated.
 - .1 Exposed coating: deterioration includes but is not limited to:
 - .1 Colour fading in excess of 5 Delta E Hunter units per ASTM D2244.
 - .2 Peeling, checking, or cracking of coating adhesion to metal.
 - .3 Chalking in excess of a No. 8 per ASTM D4214, when tested per Method D659.
 - .4 Corrosion of substrate in excess of a No. 6 on cut edges and a No. 8 on field surfaces, when measured per ASTM D1654.
 - .2 Warranty period: 5 years from date of Substantial Performance.

Part 2 Products

2.1 MATERIALS

- .1 Powder Coating Materials:
 - .1 Super durable or modified polyester based coating (TGIC-Free), to AAMA 2604, three-coat system (primer, intermediate coat, and topcoat), colour and gloss to be selected from manufacturer's full range.
 - .1 Acceptable Materials:
 - .1 Sherwin-Williams POWDURA® Super Durable TGIC-Free Polyester powder coating system.
 - .2 TIGER Drylac® Series 58 TGIC-Free Super Durable Polyester powder coating system.
 - .2 Primer: as recommended by powder coating system manufacturer, suitable for substrates and exposures.
 - .3 Touch-up coating materials: as recommended by powder coating manufacturer for post-installation repairs and touch-ups.

- .2 Finishing:
 - .1 Pre-treatment: mechanically clean and chemically pre-treat fabricated items in accordance with coating manufacturer's requirements and AAMA 2604 requirements for finish indicated.
 - .2 Application: apply primer and finish coats in accordance with coating manufacturer's requirements for finish indicated.
 - .3 Concealed / backer finish: pre-treat substrate and apply coating applicator's standard polyester or epoxy finish in accordance with manufacturers' requirements.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Comply with the following:
 - .1 Powder coating manufacturer's guidelines and data sheets.
 - .2 AAMA 2604 guidelines.
 - .3 Applicable sections of CISC Code of Standard Practice.

3.2 EXAMINATION

- .1 Verify site conditions.
- .2 Examine substrates and conditions for compliance with requirements for conditions affecting performance of work.
- .3 Verify compatibility and suitability of substrates.
- .4 Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
- .5 Coating application indicates acceptance of surfaces and conditions.

3.3 PREPARATION

- .1 Architecturally exposed steel at railings, stairs, and balustrades shall be fabricated to CISC Code of Standard Practice, AESS 4: Showcase Elements.
- .2 Comply with manufacturer's written instructions and recommendations applicable to substrates indicated.
- .3 Remove plates, machined surfaces, and similar items already in place that are not to be powder coated.
 - .1 After completing coating operations, reinstall items that were removed; use workers skilled in the trades involved.
- .4 Clean substrates of substances that could impair bond of powder coating, including dirt, oil, grease, and incompatible paints, primers, and encapsulants.
- .5 Prepare substrates to provide required finished appearance prior to powder coating and in accordance with the powder coating manufacturer's requirements.

3.4 APPLICATION

- .1 Shop-apply powder coating to achieve required finishes and performance criteria.

- .1 Use powder coat formula and method suitable to substrate, location, and finish indicated.
- .2 Powder coat thickness to be as required to meet powder formula cured physical properties from manufacturer's printed data sheets.
- .2 Apply powder coatings to produce a uniform and consistent surface coverage with no seams, layers, lines or other surface imperfections. Produce sharp lines and colour breaks.
- .3 To the extent practical, powder-coat fabrications, otherwise, fabricate using powder coated materials, to Section 05 50 00 – Metal Fabrications, Section 05 51 29 – Metal Stairs and Ladders, drawings, and as required to meet the design intent.

3.5 INSTALLATION

- .1 Prime and paint cut-outs, uncoated edges, ends, faces, undersides, and back sides with compatible coating system in accordance with powder coating manufacturer's guidelines.
- .2 Install products in accordance with the drawings. Refer to individual specifications sections for installation requirements for items receiving shop-applied coatings.

3.6 PROTECTION AND CLEANING

- .1 Protect finished Work.
- .2 Protect work of other trades against damage from Product installation and related site coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by Departmental Representative, and leave in an undamaged condition.
- .3 Remove protective wrap (if used) from coated items at time of installation.
- .4 At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces using touch-up materials recommended by powder coating manufacturer.
- .5 Clean finished surfaces after installation in accordance with finish manufacturer's instructions.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Structural Drawings – Cast-in-Place Concrete
- .2 Section 04 22 00 – Unit Masonry
- .3 Structural Drawings – Structural Steel
- .4 Structural Drawings – Steel Joist Framing
- .5 Structural Drawings – Steel Deck
- .6 Section 05 51 29 – Metal Stairs and Ladders
- .7 Section 06 10 00 – Rough Carpentry
- .8 Section 06 20 00 – Finish Carpentry
- .9 Section 06 40 00 – Architectural Woodwork
- .10 Section 09 21 16 – Gypsum Board Assemblies
- .11 Section 09 91 00 – Painting

1.2 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM A53/A53M-12, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - .2 ASTM A153/A153M-16a, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - .3 ASTM A269/A269M-15a, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
 - .4 ASTM A276/A276M-17, Standard Specification for Stainless Steel Bars and Shapes.
 - .5 ASTM A307-14, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.
 - .6 ASTM A653/A653M-15e1, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .7 ASTM A780/A780M-09(2015), Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
 - .8 ASTM A666-15, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar.
 - .9 ASTM B221-14, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - .10 ASTM B632/B632M-15, Standard Specification for Aluminum-Alloy Rolled Tread Plate.
 - .11 ASTM F593-13ae1, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
 - .12 ASTM F3125/F3125M-15A, Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.

- .2 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .2 CAN/CSA-G164-M92 (R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .3 CSA-S16-14, Design of Steel Structures.
 - .4 CSA W47.1-09 (R2014), Certification of Companies for Fusion Welding of Steel.
 - .5 CSA W48-14, Filler Metals and Allied Materials for Metal Arc Welding.
 - .6 CSA W59-13, Welded Steel Construction (Metal Arc Welding), Includes Update No. 1 (2014), Update No. 3 (2015), Update No. 4 (2015).
- .3 National Association of Architectural Metal Manufacturers (NAAMM)
 - .1 NAAMM AMP 555-92, Code of Standard Practice for the Architectural Metal Industry (Including Miscellaneous Iron).
- .4 The Environmental Choice Program
 - .1 UL 2768, Architectural Surface Coatings.
 - .2 UL 2760, Surface Coatings - Recycled Water-Borne.

1.3 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 – Submittals:
 - .1 Submit manufacturer's printed product literature, specifications and data sheets.
 - .2 Provide two copies of WHMIS MSDS - Material Safety Data Sheets in accordance with WHMIS acceptable to Labour Canada, and Health and Welfare Canada and indicate VOC content for:
 - .1 Finishes, coatings, primers and paints.
- .2 Submit shop drawings in accordance with Section 01 33 00 – Submittals:
 - .1 Indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.
 - .2 For items where design is delegated to fabricator, provide shop drawings signed and sealed by the professional engineer registered in Province of Work, responsible for the design as indicated in Section 01 35 00.

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 Detail and fabricate metal fabrications in accordance with the NAAMM AMP 555.
- .4 Perform Work to the highest standard of modern shop and field practice, by personnel experienced in this Work. Accurately fit joints and intersecting members in true planes with adequate fastening. Build and erect the Work

plumb, true, square, straight, level, accurate to the sizes shown, and free from distortion or defects.

- .5 Fabricator Qualifications: A firm experienced in producing metal fabrications similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- .6 Welding: Qualify procedures and personnel according to the following:
 - .1 Welders shall be qualified by Canadian Welding Bureau for classification of work being performed.
 - .2 The fabricator shall be certified to CSA W47.1, Division 1 or 2.1.
 - .3 Do welding inspection to CSA W178.
 - .4 Resistance welding: to CSA W55.3.
 - .5 Fusion welding: to CSA W59.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Exercise due care in storing, handling and erecting all materials and support all materials properly at all times so that no piece will be bent, twisted or otherwise damage structurally or visibly.
- .2 Correct damaged material and where the Departmental Representative deems damage irreparable, replace the affected items at no additional expense to the Departmental Representative.
- .3 Apply protective covering to face of all exposed finished metalwork before it leaves shop, covering to remain until item installed.
- .4 Fabricate large assemblies so they can be safely and easily transported and handled to their place of installation.

1.6 WASTE MANAGEMENT AND DISPOSAL

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

1.7 JOB CONDITIONS

- .1 Coordinate this Work with the remainder of the Work and exercise the necessary scheduling to ensure that all Work is carried out and all items incorporated during the appropriate construction phase.
- .2 Provide instructions and drawings to other trades for setting bearing plates, anchors bolts, and other members that are built in to work of other trades.
- .3 Protect other Sections of the Work from damage by this Section of the Work.

Part 2 Products

2.1 MATERIALS

- .1 Steel sections and plates: to CAN/CSA-G40.20/G40.21, Grade 350W.
- .2 Hollow Structural Sections: In accordance with CAN/CSA G40.20/G40.21, Grade 350W, Class C.

- .3 Steel pipe: to ASTM A53/A53M, standard weight (Schedule 40), unless another weight is indicated or required by structural loads, galvanized finish.
- .4 Welding materials: to CSA W59.
- .5 Welding electrodes: to CSA W48 Series.
- .6 Fasteners: Bolts, nuts, washers, rivets, lock washers, anchor bolts, machine screws, and machine bolts.
 - .1 Unfinished fasteners: In areas not exposed to public, use unfinished bolts conforming to ASTM A307, Grade A, with hexagon heads and nuts. Supply bolts of lengths required to suit the thickness of the material being joined, but not projecting more than 6 mm beyond nut, without the use of washers.
 - .2 Finished fasteners:
 - .1 In areas exposed to public use, bolts, nuts, washers, rivets, lock washers, anchor bolts, machine screws and machine bolts to be hot dip galvanized in accordance with ASTM A153/A153M or CAN/CSA-G164.
 - .2 For joining stainless steel components use stainless steel fasteners of same type.
- .7 Structural bolts: to ASTM F3125.
- .8 Stainless steel fasteners, washers and nuts: to ASTM F593, 18-8 austenitic stainless steel (Grade 8 - B8/B8A), sized as required for purpose intended, or as otherwise indicated. Cold finished: Condition B, cold worked, per ASTM A276.
- .9 Stainless Steel Sheet, Strip, Plate, and Flat Bars: ASTM A666, Type 304.
- .10 Stainless Steel Bars and Shapes: ASTM A276, Type 304.
- .11 Grout: non-shrink, non-metallic, flowable, 15 MPa at 24 hours.

2.2 FABRICATION

- .1 Fabricate work square, true, straight and accurate to required size, with joints closely fitted and properly secured.
- .2 Use self-tapping shake-proof flat, round, or oval headed screws on items requiring assembly by screws or as indicated.
- .3 Where possible, fit and shop assemble work, ready for erection.
- .4 Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush. Seal exterior steel fabrications to provide corrosion protection in accordance with CAN-S16.
- .5 Welding is to conform to CSA W59 and the fabricator certified to CSA W47.1. Include for welding inspection in the Contract.
- .6 File or grind all exposed welds smooth and flush. Repair or fill all pits, cracks and holes. Grind and polish all handrails to a smooth, even surface. Smooth all inside corners, returns.
- .7 Insulate when necessary to prevent electrolysis due to metal to metal contact or metal to masonry or concrete contact. Use bituminous paint or other approved method.

- .8 Provide fastenings, including anchor bolts, bolts, lag screws, expansion bolts, straps, brackets, etc. required for the fabrication and erection of work of this Section.

2.3 FINISHES

- .1 Prior to priming steel, prepare all surfaces in conformance with SSPC SP-3 – Power Tool Cleaning for non-exposed locations and SSPC SP-5 – White-metal Blast Cleaning for exposed architectural finished locations. Adjust blast grit to suit primer coat thickness specified in Section 09 91 00 – Painting.
- .2 Hot dip galvanizing: galvanize steel, where indicated, to ASTM A123, minimum zinc coating of 600 g/m². (Severe, unprotected exposures)
- .3 Electrolytic galvanizing: galvanize steel, where indicated, to ASTM A591, minimum zinc coating of 180 g/m². (Non-severe, unprotected exposures)
- .4 Wipe coat galvanizing: galvanize steel, where indicated to CSA G189, minimum zinc coating of 75 g/m². (Non-severe, protected exposures)
- .5 Shop Primers: Provide primers that are compatible with paint systems specified.
- .6 Touch up galvanized surfaces with zinc rich coating, to ASTM A780: DOD-P-21035 zinc rich paint, minimum DFT 8 mils.
- .7 Zinc Rich Paint: Conforming to DOD-P-21035 zinc rich paint.
 - .1 Clean metal to equivalent of commercial sand blast SSPC-SP6, remove sandblast in residue.
 - .2 Apply one coat of zinc rich paint to surfaces exposed after assembly to minimum dry film thickness of 60 µm (2.5 mil). Apply coating immediately after cleaning.
- .8 Isolation Coating: Apply an isolation coating to contact surfaces in contact with cementitious materials, wood materials and dissimilar metals except stainless steel.
- .9 Paint: Prepare the Work and paint in accordance with CAN/CSA-S16, primed ready for site finish as specified in Section 09 91 00 – Painting. Leave surfaces to be welded unpainted.
- .10 Urethane Enamel Finish, primed as specified in Section 09 91 00 – Painting, ready for site finish. Leave surfaces to be welded uncoated.
 - .1 Base metal galvanized steel or aluminum, blast clean to SP-6 Commercial, apply Quick Dry primer for specific base metal.
 - .2 Finish with 2 coats Quick Dry Urethane Enamel.
- .11 Chromium plating: chrome on steel with plating sequence of 0.009 mm thickness of copper 0.010 mm thickness of nickel and 0.0025 mm thickness of chromium.

2.4 ROUGH HARDWARE

- .1 Furnish bent or otherwise custom fabricated bolts, plates, anchors, hangers, dowels, and other miscellaneous steel and iron shapes as required. Fabricate items to sizes, shapes, and dimensions required.

2.5 MISCELLANEOUS FABRICATIONS

- .1 Miscellaneous Framing and Supports: Provide steel framing and supports for applications indicated that are not a part of structural steel framework, as required to complete work.
- .2 Fabricate units to sizes, shapes, and profiles indicated and required to receive adjacent other construction retained by framing and supports. Fabricate from structural steel shapes, plates, and steel bars of welded construction using mitred joints for field connection. Cut, drill, and tap units to receive hardware, hangers, and similar items.
- .3 Equip units with integrally welded anchors for casting into concrete or building into masonry. Furnish inserts if units must be installed after concrete is placed.
- .4 Miscellaneous Steel Trim: Provide shapes and sizes indicated for profiles shown. Unless otherwise indicated, fabricate units from structural steel shapes, plates, and steel bars, with continuously welded joints and smooth exposed edges. Use concealed field splices wherever possible. Provide cutouts, fittings, and anchorages as required for coordination for assembly and installation with other work.

2.6 ANGLE LINTELS

- .1 Steel angles: galvanized, sizes indicated for openings. Provide 150 mm minimum bearing at ends.
- .2 Weld or bolt back-to-back angles to profiles as indicated.
- .3 Finish: shop painted where exposed.

2.7 CHANNEL FRAMES

- .1 Fabricate frames from steel, sizes of channel and opening as indicated.
- .2 Weld channels together to form continuous frame for jambs and head of openings, sizes as indicated.
- .3 Weld steel strap anchors to channel jamb frame at centres as required.
- .4 Finish: galvanized or prime coat painted as indicated.

Part 3 Execution

3.1 ERECTION

- .1 Install Work in accordance with manufacturer's/fabricator's written instructions and Contract Documents.
- .2 Do welding work in accordance with CSA W59 unless specified otherwise.
- .3 Supply finished items to be built-in to those trades along with instructions for proper installation.
- .4 Apply architectural metal work using hidden mechanical fasteners. Installation shall be by skilled Architectural metal workers experienced in highest quality work.
- .5 Fasteners to draw adjoining sections together in proper, true alignment, and are capable of field adjustment.

- .6 All fasteners, mountings to be non-loosening and installed so that they will be hidden at completion.
- .7 Install all Work to true, straight lines, accurate to profile, all properly aligned.
- .8 Isolate dissimilar metals in a manner approved by the Departmental Representative to prevent electrolytic action or corrosion.
- .9 Install finish hardware supplied under other Sections required for completion of components of this Section.
- .10 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.
- .11 Provide suitable means of anchorage acceptable to Departmental Representative such as dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.
- .12 Make field connections with high tensile bolts to CSA-S16.1 and weld to prevent loosening.
- .13 Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates.
- .14 Touch-up rivets, field welds, bolts and burnt or scratched surfaces after completion of erection with primer.
- .15 Repair galvanized areas damaged by welding, flame cutting or during handling, transport or erection in accordance with ASTM A780. Touch-up with organic zinc-rich paint to DOD-P-21035 zinc rich paint, minimum DFT 8 mils.

3.2 CHANNEL FRAMES

- .1 Install steel channel frames to openings as indicated.

3.3 MISCELLANEOUS ITEMS

- .1 Provide steel angle frame, hanging rods and bracing for supporting bulkheads and shelving.
- .2 Provide bracket backing supports for vanities.
- .3 Steel angle masonry supports as detailed.
- .4 Supply and install miscellaneous metal items as indicated or specified, or as otherwise required for a complete job, in accordance with the design intent of the project.

3.4 CLEANING

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

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 35 00 – Delegated Design
- .2 Section 03 30 00 – Cast-in-Place Concrete
- .3 Section 05 50 00 – Metal Fabrications
- .4 Section 09 91 00 – Painting

1.2 REFERENCES

- .1 Alberta Occupational Health and Safety Commission (OH&S):
 - .1 Occupational Health and Safety Code, Section 130 – Fixed Ladders
 - .2 Process Industry Practices: Fixed Ladders and Cages
- .2 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM A53/A53M-12, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - .2 ASTM A276/A276M-17, Standard Specification Stainless Steel Bars and Shapes.
 - .3 ASTM A307-14, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.
 - .4 ASTM A312/A312M-17, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
 - .5 ASTM A500/A500M-13, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 - .6 ASTM A653/A653M-15e1, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .7 ASTM A780/A780M-09(2015), Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
 - .8 ASTM B209-14, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - .9 ASTM B221-14, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - .10 ASTM B241/B241M-16, Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.
 - .11 ASTM F3125/F3125M-15A, Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 105 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.
- .3 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-G40.20/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel, Includes Update No. 1 (2014).
 - .2 CAN/CSA-G164-M92 (R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.

- .3 CSA W59-13, Welded Steel Construction (Metal Arc Welding), Includes Update No. 1 (2014), Update No. 3 (2015), Update No. 4 (2015).
- .4 CAN/CSA A3000-13, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005), Includes Update No. 1 (2014), Update No. 2 (2014)
- .4 National Association of Architectural Metal Manufactures (NAAMM)
 - .1 NAAMM AMP 510-92, Metal Stair Manual.
 - .2 NAAMM MBG 531-09, Metal Bar Grating Manual.
 - .3 NAAMM AMP 521-01(R2012), Pipe Railing Systems Manual.
 - .4 NAAMM MBG 533-09, Welding Standards for Fabrication of Steel, Stainless Steel and Aluminum Bar Grating.
- .5 Steel Structures Painting Council (SSPC), Systems and Specifications Manual, Volume 2.

1.3 DEFINITIONS

- .1 Usage Classifications: NAAMM AMP 510 provides four usage classifications for finishing of metal stair and railing systems as follows:
 - .1 Industrial Class: NAAMM Industrial Class stairs are purely functional in character, design for interior or exterior locations for industrial or fire escape applications, primarily for use by building occupants only; not including stairs integral with industrial equipment.
 - .2 Service Class: NAAMM Service Class stairs are intended for use in enclosed stairways and to provide a secondary or emergency means of travel between floors or levels in a multi-storey building, primarily for use by building occupants, tenants and the public.
 - .3 Commercial Class: NAAMM Commercial Class stairs are intended for use in enclosed stairways to provide primary means of travel between floors or levels in a multi-storey institutional or commercial building where appearance and finish are important considerations.

1.4 PRE-INSTALLATION MEETINGS

- .1 Pre-Installation Meetings: convene pre-installation meeting in accordance with Section 01 31 19 – Project Meetings to:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordination with other building subtrades.
 - .4 Review manufacturer's installation instructions.

1.5 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 – Submittals:
 - .1 Submit manufacturer's printed product literature, specifications and data sheets.
 - .2 Provide two copies of WHMIS MSDS - Material Safety Data Sheets in accordance with WHMIS acceptable to Labour Canada, and Health and Welfare Canada and indicate VOC content for:

- .1 Finishes, coatings, primers and paints.
- .2 Submit shop drawings in accordance with Section 01 33 00 – Submittals:
 - .1 Indicate construction details, sizes of steel sections and thickness of steel sheet.
 - .2 Indicate fasteners, welds and connection details between stringers; treads; risers; headers; newels; platforms; struts, columns and hangers; railings; handrails; brackets; reinforcements; anchors; and welded and bolted connections.
 - .3 Submit shop drawing bearing stamp of a qualified professional engineer registered in Province of Alberta.

1.6 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 Qualifications:
 - .1 Use a fabricator experienced in producing metal fabrications similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
 - .2 Welders shall be qualified by Canadian Welding Bureau for classification of Work being performed.
 - .3 Welding of load supporting components shall be performed by companies certified by Canadian Welding Bureau in accordance with CSA W47.1.
- .4 Retain a Professional Engineer, registered in the Province of the work, for the design, fabrication, and erection of the work of this Section in accordance with applicable Building Code and Contract Documents requirements including, but not limited to, the following:
 - .1 Seal and signature to shop drawings and design submittals.
 - .2 Field review of installed components.
 - .3 Completion of Letters or Commitment and Supervision specified in Section 01 35 00.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Store materials in a location and manner to avoid damage; stack materials to prevent bending or applying stress to components; keep handling of materials on-site to a minimum.
- .2 Store components and materials in clean, dry location, away from uncured concrete or masonry; cover with waterproof paper, tarpaulin or polyethylene sheeting in a manner that permits air circulation inside of covering.
- .3 Correct damaged material and where damage is deemed irreparable by the Departmental Representative, replace the affected item at no additional expense to the Departmental Representative.

- .4 Apply protective covering to face of all exposed finished metalwork before it leaves shop, covering to remain until item installed and ready for final finishing.
- .5 Fabricate large assemblies so they can be safely and easily transported and handled to their place of installation.

1.8 WASTE MANAGEMENT AND DISPOSAL

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

Part 2 Products

2.1 PERFORMANCE/DESIGN CRITERIA

- .1 Provide delegated design in accordance with Section 01 35 00.
- .2 Design Requirements:
 - .1 Design metal stair, balustrade and landing construction and connections in accordance with Alberta Building Code for vertical and horizontal live load requirements.
 - .2 Detail and fabricate stairs to NAAMM Metal Stairs Manual.
 - .3 Design grating treads in accordance with NAAMM Metal Bar Grating Manual.
 - .4 Design pipe railings in accordance with NAAMM Pipe Railing Manual.

2.2 MATERIALS

- .1 Carbon Steel:
 - .1 Steel sections and plates: to CAN/CSA-G40.20/G40.21, Grade 300W.
 - .2 Hollow Structural Sections (HSS): In accordance with CAN/CSA G40.20/G40.21, Grade 350W, Class C.
 - .3 Steel plate: to CAN/CSA-G40.20/G40.21, Grade 260 W.
 - .4 Metal bar grating: to ANSI/NAAMM MBG 531, steel, Type W-19-4, with abrasive nosings.
 - .5 Steel pipe: to ASTM A53/A53M, standard weight, schedule 40 seamless black.
 - .6 Steel tubing: to ASTM A500, round, 6 mm wall thickness, sizes and dimensions as indicated.
- .2 Stainless Steel:
 - .1 Pipe: In accordance with ASTM A312, Type 316 having #4 directional satin finish
 - .2 Bars and Shapes: In accordance with ASTM A276, extruded shapes and sizes as indicated on drawings having #4 directional satin finish
 - .3 Acceptable Manufacturer's:
 - .1 C.R. Laurence, Inc.
 - .2 Julius Blum.
- .3 Welding materials: to CSA W59.

- .4 Welding electrodes: to CSA W48 Series.
- .5 Bolts: to ASTM A307.
- .6 High strength bolts: to ASTM F3125.

2.3 PIPE/TUBING BALUSTRADES

- .1 Construct balusters and handrails from stainless steel pipe and steel tubing as detailed on Drawings to commercial class as define by NAAMM AMP 510.
- .2 Cap and weld exposed ends of balusters and handrails.
- .3 Provide texture change within the last 300 mm of the handrail in accordance with accessible guidelines.
- .4 Terminate at abutting wall with end flange.
- .5 Fabricate railings in accordance with NAAMM AMP 521 to finish as follows:
 - .1 Fabrication Tolerance: Fabricate steel to one half the normal tolerance as specified in the CISC/AISC Code of Standard Practice Section 10.
 - .2 Welds Ground Smooth: Fabricator shall grind welds of exposed steel smooth; make groove welds flush to the surfaces each side and be within +1.5 mm, -0 mm of plate thickness.
 - .3 Contour and blend of welds where fillet welds are ground contoured, or blended, oversize welds as required and grind to provide a smooth transition and to match profile on accepted sample.
 - .4 Continuous weld where noted of uniform size and profile.
 - .5 Minimize weld show through at locations where welding on the far side of an exposed connection occurs, grind distortion and marking of the steel to a smooth profile with adjacent material.
 - .6 Maintain a uniform gap of $3 \text{ mm} \pm 0.8 \text{ mm}$ at copes and blocks.
 - .7 Maintain a uniform gap tolerance of $3 \text{ mm} \pm 0.8 \text{ mm}$ at connections.
 - .8 Fabricate exposed steel so that piece marks are fully hidden in the final structure or made with media to permit full removal after erection.
 - .9 Deliver steel with no mill marks (stencilled, stamped, raised) in exposed locations; cut off mill material to appropriate lengths where possible; fill or grind to a surface finish consistent with the accepted sample where cutting is not possible.
 - .10 Grind edges of sheared, punched or flame-cut steel to match accepted sample.
 - .11 Rolled members shall be fully shaped in the shop and tied during shipping to prevent stress relieving; distortion of the web or stem, and of outstanding flanges or legs of angles will be visibly acceptable to the Departmental Representative when viewed from a distance of 6100 mm under any lighting condition; tolerances for the vertical and horizontal walls of rectangular HSS members after rolling shall be $\pm 13 \text{ mm}$.
 - .12 Seal weld open ends of round and rectangular hollow structural section with 10 mm closure plates; provide continuous, sealed welds at angle to gusset plate connections and similar locations where exposed steel is exposed to weather.

- .6 Fabricate work square, true straight and accurate to required size, with joints closely fitted and properly secured.
- .7 Where work of other Sections is attached to work of this section, prepare work by drilling and tapping holes as required facilitating installation of such work.

2.4 ACCESSORIES

- .1 Handrail Wall Brackets: steel 75 mm diameter wall mount with 19 mm bracket and shape formed to hold handrail.
 - .1 Acceptable Material:
 - .1 RB14030, R & B Wagner
 - .2 WMHCMB251U, McNichols
- .2 Sealant: in accordance with Section 07 92 00 – Sealants.

2.5 FINISHES

- .1 Galvanizing: hot dipped galvanizing with zinc coating 600 g/m² to CAN/CSA-G164.
- .2 Shop Primers: Provide primers that are compatible with paint systems specified.
- .3 Touch-up galvanized surfaces with zinc rich coating, to ASTM A780: DOD-P-21035 zinc rich paint, minimum DFT 8 mils.
- .4 Painting: in accordance with Section 09 91 00 – Painting.

2.6 SHOP PAINTING

- .1 Clean surfaces in accordance with Steel Structures Painting Council Manual Volume 2.
- .2 Apply one coat of shop primer except interior surfaces of pans.
- .3 Apply two coats of primer of different colours to parts inaccessible after final assembly.
- .4 Use primer as prepared by manufacturer without thinning or adding admixtures. Paint on dry surfaces, free from rust, scale, and grease. Do not paint when temperature is below 7 degrees C.
- .5 Do not paint surfaces to be field welded.

2.7 FABRICATION

- .1 Fabricate stairs in accordance with NAAMM AMP 510.
- .2 Fabricate railings in accordance with NAAMM AMP 521.
- .3 Fabricate gratings to NAAMM MBG 531.
- .4 Weld connections where possible, otherwise bolt connections. Countersink exposed fastenings, cut off bolts flush with nuts. Make exposed connections of same material, colour and finish as base material on which they occur.
- .5 Accurately form connections with exposed faces flush; mitres and joints tight. Make risers of equal height.
- .6 Grind or file exposed welds and steel sections smooth.

- .7 Shop fabricate stairs in sections as large and complete as practicable.
- .8 Insulate dissimilar materials to prevent electrolysis arising from metal to metal contact or metal to masonry or concrete contact; use bituminous paint or other acceptable method acceptable to Departmental Representative.

Part 3 Execution

3.1 PREPARATION

- .1 Provide anchorage devices and fasteners to other Sections where necessary for securing metal stairs to in place construction; include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- .2 Perform cutting, drilling, and fitting required for installing metal stairs.
- .3 Field check and verify that structural framing, enclosures, weld plates, blocking, and that size and location of pockets are placed in accordance with reviewed shop drawings.
- .4 Report discrepancies to Contractor and Departmental Representative, and recommend corrective action by responsible parties.
- .5 Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- .6 Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates and instructions for installation.

3.2 INSTALLATION OF STAIRS

- .1 Install in accordance with NAAMM, Metal Stair Manual.
- .2 Install grating treads, stringers, landings, hanger assemblies, closures, balustrades, handrails, guards, level, plumb, square, complete, accurately fitted, with tight joints and intersections, in the proper locations and positions, structurally sound, securely fastened, free from defects detrimental. Weld connections between handrails and balusters and in lengths of handrails continuously. Weld balustrades to steel stairs or steel plates as required. Secure wall handrails to walls.
- .3 Install plumb and true in exact locations, using welded connections wherever possible to provide rigid structure. Provide anchor bolts, bolts and plates for connecting stairs to structure.
- .4 Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates.
- .5 Do welding work in accordance with CSA W59 unless specified otherwise.
- .6 Touch up shop primer to bolts, welds, and burned or scratched surfaces at completion of erection.

3.3 INSTALLATION OF GUARDRAILS, RAILING AND HANDRAILS

- .1 Install guardrails, railings, and handrails as indicated, including all sleeves, anchors and connections. Prepare steel, and shop prime exposed components. Field prime as required to maintain cover of exposed steel.

- .2 Install in accordance with NAAMM, Metal Stair Manual.
- .3 Adjust railings prior to anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated, or if not indicated, as required by design loadings. Plumb posts in each direction. Secure posts and railing ends to building construction as follows:
 - .1 Anchor posts in concrete by means of pipe sleeves preset and anchored into concrete. After posts have been inserted into sleeves, fill annular space between post and sleeve solid with non-shrink, non-metallic grout, mixed and placed to comply with anchoring material manufacturer's directions.
 - .2 Anchor posts and rail ends to steel with welded connections, unless otherwise indicated.
 - .3 Anchor posts and rail ends into concrete and masonry with steel round flanges welded to post and rail ends, and anchored into wall construction with expansion shields and bolts.
 - .4 Install removable railing sections where indicated in slip-fit metal sockets cast into concrete. Accurately locate sockets to match post spacing.
- .4 Secure handrails to wall with wall brackets and end fittings. Provide bracket with not less than 40 mm clearance from inside face of handrail and finished wall surface. Locate brackets at spacing not less than 1.5 m o.c., unless otherwise indicated. Secure wall brackets and wall return fittings to building construction as follows:
 - .1 Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.
 - .2 For concrete and solid masonry anchorage, use drilled-in expansion shield and either concealed hanger bolt or exposed lag bolt, as applicable.
 - .3 For hollow masonry anchorage, fasten brackets directly on masonry wall using toggle bolts.
 - .4 For steel framed gypsum board assemblies, fasten brackets to wood blocking using lag bolts or to metal blocking using self-tapping screws, of size and type required to support structural loads.
- .5 Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates.
- .6 Touch up shop primer to bolts, welds, and burned or scratched surfaces at completion of erection.

3.4 CLEANING

- .1 Perform cleaning as soon as possible after installation to remove construction and accumulated environmental dirt.
- .2 Remove protective coverings and clean metal work using cleaning solutions and methods to suit the metal and its finish at completion of work.
- .3 Protect adjacent materials and finishes from damage or discolouring during cleaning.
- .4 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

Part 1 General

1.1 INTENT

- .1 Materials of this section are to be Forest Stewardship Council graded wood.

1.2 RELATED SECTIONS

- .1 Section 07 27 19 - Sheet Membrane Air and Vapour Barrier
- .2 Section 07 62 00 - Sheet Metal Flashing and Trim
- .3 Section 09 91 00 - Painting

1.3 REFERENCES

- .1 Alberta Roofing Contractors' Association, (ARCA):
 - .1 Manual on Good Roofing Practice and Accepted Roofing Systems.
- .2 American National Standards Institute (ANSI)
 - .1 ANSI/NPA A208.1-2009, Particleboard.
 - .2 ANSI A208.2-2009, Medium Density Fibreboard (MDF) for Interior Applications.
- .3 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A307-14, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.
 - .2 ASTM A653/A653M-15e1, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.
 - .3 ASTM C578-16, Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
 - .4 ASTM C954-15, Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness
 - .5 ASTM C1289-16, Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
 - .6 ASTM D1761-12, Standard Test Methods for Mechanical Fasteners in Wood.
 - .7 ASTM D5055-16, Standard Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-Joists.
 - .8 ASTM D5456-17, Standard Specification for Evaluation of Structural Composite Lumber Products.
 - .9 ASTM E1333-14, Standard Test Method for Determining Formaldehyde Concentrations in Air and Emission Rates from Wood Products Using a Large Chamber.
- .4 American Wood Preservers Association (AWPA):
 - .1 AWPA Book of Standards, 2016
- .5 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-51.32-M77, Sheathing, Membrane, Breather Type.

- .2 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
- .6 Canadian Standards Association (CSA International)
 - .1 CSA A123.2-03 (R2013), Asphalt-Coated Roofing Sheets.
 - .2 CAN/CSA-A247-M86 (R1996), Insulating Fiberboard.
 - .3 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.
 - .4 CAN/CSA-G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .5 CAN/CSA O80 Series-15, Wood Preservation
 - .6 CSA O112 Series-M1977 (R2006), CSA Standards for Wood Adhesives.
 - .7 CSA O121-17, Douglas Fir Plywood.
 - .8 CSA O122-16, Structural Glued-Laminated Timber.
 - .9 CSA O141-05 (R2014), Softwood Lumber.
 - .10 CSA O151-17, Canadian Softwood Plywood.
 - .11 CSA O153-13, Poplar Plywood.
 - .12 CAN/CSA-O325-16, Construction Sheathing.
 - .13 CSA O437 Series-93(R2011), Standards on OSB and Waferboard
- .7 National Lumber Grading Association (NLGA):
 - .1 NLGA SPS2-2010, Special Products Standards on Machine Stress-Rated Lumber.
 - .2 Standard Grading Rules for Canadian Lumber 2010.
- .8 South Coast Air Quality Management District (SCAQMD), California State (SCAQMD)
 - .1 SCAQMD Rule 1113-16, Architectural Coatings.
 - .2 SCAQMD Rule 1168-05, Adhesive and Sealant Applications.
- .9 Truss Design and Procedures for Light Metal Connected Wood Trusses, Truss Plate Institute of Canada.
- .10 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S770-15, Standard Test Method for Determination of Long-Term Thermal Resistance of Closed-Cell Thermal Insulating Foams.
 - .2 CAN/ULC-S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.
 - .3 CAN/ULC S102.2-10, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

1.4 DEFINITIONS

- .1 For the purpose of this project the following definitions shall apply:
 - .1 Structural Light Framing: All horizontal and vertical load bearing framing including members indicated as “Studs” on the drawings shall be considered to be No. 2 Grade and better and shall be used throughout unless prior approval is provided by the Departmental Representative.
 - .2 Stud Framing: Vertical framing members of non-load bearing wall systems may be considered as No. 3 or Stud Grade and may only be

used where the Departmental Representative gives prior approval. Use of No. 3 and Stud Grade framing material will not be allowed for any horizontal applications.

1.5 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 – Submittals:
 - .1 Submit manufacturer's printed product literature, specifications and data sheets.
 - .2 Submit MSDS sheets or official manufacturer literature stating no urea-formaldehyde was used in the manufacturing of composite wood.

1.6 QUALITY ASSURANCE

- .1 Lumber shall be graded and stamped by an agency certified by Canadian Lumber Standards Accreditation Board.
- .2 Plywood, particleboard, OSB and wood based composite panels in accordance with CSA and ANSI standards.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver wood products bundled or crated to provide adequate protection during transit. Inspect wood products for damage upon delivery and remove and replace damaged materials.
- .2 Store materials a minimum of 150 mm off the ground on blocking. Keep materials under cover and dry. Provide for air circulation within and around stacks and under temporary coverings.
- .3 Protect sheet materials to prevent breaking of corners and damage to surfaces.

1.8 WASTE MANAGEMENT AND DISPOSAL

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

Part 2 Products

2.1 LUMBER

- .1 Lumber: Stud Grade to CAN/CSA-O141, softwood, S-P-F, S4S, graded and stamped in accordance with National Lumber Grading Association (NLGA) Standard Grading Rules for Canadian Lumber and as follows:
 - .1 Moisture Content: maximum 19% at time of installation.
 - .2 Maximum moisture content when used for attachment of drywall: 16%.
 - .3 Finger jointed lumber is not acceptable.
 - .4 Meeting requirements of the Building Code.
- .2 Lumber: Structural Light Framing and Structural Joists and Planks to CAN/CSA-O141, softwood, S-P-F, S4S, graded and stamped in accordance with National Lumber Grading Association (NLGA) Standard Grading Rules for Canadian Lumber and as follows:
 - .1 Moisture Content: maximum 19% at time of installation.

- .2 Finger jointed lumber is not acceptable.
- .3 Maximum moisture content when used for attachment of drywall: 16%.
- .4 Grade: Select Structural No. 2 or better.
- .5 Meeting requirements of the Building Code.

2.2 ENGINEERED WOOD PRODUCTS

- .1 Provide engineering wood products with the structural capacity that meets or exceeds the requirements shown on drawings and as set forth in the Alberta Building Code. Manufacturers published values shall be determined by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.
- .2 Laminated Veneer Lumber: A composite of wood veneers with the grain primarily parallel to the member length, manufactured with an exterior type adhesive complying with ASTM D2559. The product shall have allowable design values determined in accordance with ASTM D5456.
- .3 Parallel Strand Lumber: A composite of wood strand elements with the grain primarily parallel to the member length, manufactured with an exterior type adhesive complying with ASTM D2559. The product shall have allowable design values determined in accordance with ASTM D5456.
- .4 Wood I-Joists: Prefabricated units complying with depths, load capacity and performance ratings as shown on drawings. The web material shall be either oriented strand board or plywood.

2.3 PANEL MATERIALS

- .1 Sheathing for structural shear wall and diaphragms:
 - .1 Plywood: Douglas Fir (DFP) or Canadian Softwood (CSP), Sheathing Grade, to CSA O121 or O151, thickness as indicated on drawings.
 - .2 OSB: Oriented Strand Board panels to CSA O437, Grade O-2, thickness as indicated on drawings. Grade stamp shall indicate span rating. Grade O-2 material may be used thickness for thickness on the same spans as plywood.
- .2 Other sheathing:
 - .1 Fire Rated Plywood Panels to CSA O325, Class A fire retardant produced under Performance Standard PS-1, certified by the American Plywood Association.
 - .1 Acceptable Materials:
 - .1 Purekor Fire Retardant Plywood.
 - .2 Exterior applications: marine-grade Douglas fir sheathing, Grade B-B; exposure durability rating shall be 'EXTERIOR', and the glue used shall be a fully waterproof structural adhesive
 - .3 Plywood or Oriented Strand Board panels to CSA O325, thickness as indicated on drawings.
 - .4 Interior sheathing shall be ULC labelled fire resistant, provide grade stamp or certification as noted for fire retardant pressure treated lumber.

- .5 All plywood used in sub-flooring assembly shall be T&G Unsanded Sheathing Grade Phenolic Bonded Douglas fir Plywood with staggered joints.
- .3 Underlayment:
 - .1 Plywood to CSA O325, 10 mm thick S1S, with no knot fillers detrimental to areas to receive finish floor products specified in Section 09 65 00 – Resilient Flooring meeting the requirements of ASTM F1482.
 - .2 OSB to CSA O325, 11 mm thick, sanded surface, Grade O-1 with no adhesives detrimental to areas to receive floor products specified in Section 09 65 00 – Resilient Flooring meeting requirements of ASTM F1482.

2.4 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.

2.5 WOOD PRESERVATIVE

- .1 Where lumber or plywood is indicated as preservative treated or is specified to be treated, treated in accordance with CAN/CSA O80.9M and AWWA.
- .2 Wood preservatives containing arsenic or chromium are not permitted.
- .3 Pressure treat above ground items with waterborne preservatives to minimum retention of 4.0 kg/m³. After treatment, kiln-dry lumber and plywood to maximum moisture content of 19% and 15% respectively. Treat indicated items and the following:
 - .1 Wood cants, nailing strips, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapour barriers, and waterproofing.
 - .2 Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry and concrete.
 - .3 Wood framing members less than 460 mm above grade.
 - .4 Wood floor plates installed over concrete slabs directly in contact with earth.
- .4 Pressure treat wood members in contact with ground or freshwater with waterborne preservatives to minimum of 6.4kg/m³
- .5 Fire-Retardant Treatment: to CAN/SCA O80.9M, CAN/CSA O80.20M and CAN/CSA O80.27M, pressure impregnated, and as follows:
 - .1 Flame Spread Classification: FSC 25 maximum.
 - .2 Smoke developed of not more than: 75.

- .6 Complete fabrication of treated items before treatment where possible. If cut after treatment apply field treatment to cut surfaces.
- .7 Wood Preservatives: Maximum allowable VOC limit 350 g/L in accordance with SCAQMD Rule #1113 - Architectural Coatings.

2.6 ACCESSORIES

- .1 Air seal: closed cell polyurethane or polyethylene.
- .2 Sealants: in accordance with Section 07 92 00 – Sealants.
 - .1 Maximum allowable VOC limit 250 g/L in accordance with SCAQMD Rule 1168.
- .3 Subflooring adhesive: to CGSB-71.26, cartridge loaded.
 - .1 Maximum allowable VOC limit 50 g/L in accordance with SCAQMD Rule 1168.
- .4 General purpose adhesive: to CSA O112 Series.
 - .1 Maximum allowable VOC limit 70 g/L in accordance with SCAQMD Rule 1168.
- .5 Nails, spikes and staples: to CSA B111, hot dipped galvanized for exterior work and pressure preservative and fire retardant treated materials.
- .6 Surface Applied Wood Preservative:
 - .1 Containing minimum 5% clear pentachlorophenol in accordance with CAN/CSA-O80 Series-M89.
 - .2 Apply minimum of 2 coats applied in accordance with manufacturers written instructions.
 - .3 Acceptable materials: Osmose-Pentox Inc.
- .7 Rough Hardware (bolts, nuts, washers, etc.): Hot dip galvanized in conformity to CSA G164 or Grade A low carbon steel, conforming to ASTM A307.
- .8 Proprietary fasteners: toggle bolts, expansion shields and lag bolts, screws and lead or inorganic fibre plugs, [explosive actuated fastening devices], recommended for purpose by manufacturer.
- .9 Joist Hangers: U-shaped joist hangers with 50 mm long seat and 32 mm wide nailing flanges at least 85% of joist depth.
- .10 I-Joist Hangers: U-shaped joist hangers with 50 mm long seat and 32 mm wide nailing flanges full depth of joist. Nailing flanges to provide lateral support as the joist top chord.
- .11 Top Flange Hangers: U-shaped joist hangers, full depth of joist, formed from 50 mm wide metal strap with tabs bent to extend over and be fastened to support member.
- .12 Rafter Tie-Downs: 38 mm wide bent strap tie for fastening rafters or roof trusses to wall studs below. Tie fastens to side of rafter or truss, face of top plates and side of stud below.
- .13 Hold-Downs: Brackets for bolting to wall studs and securing to foundation walls with anchor bolts or to other hold-downs with threaded rods, and designed with

the first two bolts placed seven bolt diameters from the reinforced base. Bolt Diameter –19 mm

- .14 Nailing discs: flat caps, minimum 25 mm diameter, minimum 0.4 mm thick, fibre, formed to prevent dishing. Bell or cup shapes not acceptable.
- .15 Roof sheathing H-Clips: formed "H" shape, thickness to suit panel material, extruded 6063-T6 aluminum alloy type approved by Departmental Representative.
- .16 Expanding foam sealant:
 - .1 Acceptable Materials:
 - .1 GREAT STUFF PRO™ by Dow Canada
 - .2 Hilti (Canada) Ltd. CF Filler Foams.
 - .3 Approved alternates.

2.7 FASTENER FINISHES

- .1 Galvanizing: to CAN/CSA-G164, use galvanized fasteners for exterior work, interior highly humid areas, pressure-preservative, and fire-retardant treated lumber.

Part 3 Execution

3.1 INSTALLATION

- .1 Comply with requirements of Building Code supplemented by following paragraphs.
- .2 Install members true to line, levels and elevations, square and plumb.
- .3 Construct continuous members from pieces of longest practical length.
- .4 Install spanning members with "crown-edge" up.
- .5 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.
- .6 Install subflooring and combined subfloor and underlay with panel end-joints located on solid bearing, staggered at least 800 mm.
 - .1 In addition to mechanical fasteners, floor panels secure floor subflooring to floor joists using screws. Place continuous adhesive bead in accordance with manufacturer's instructions, single-bead on each joist and double-bead on joists where panel ends butt.
- .7 Install blocking at locations indicated to support washroom accessories.
- .8 Install wall sheathing in accordance with manufacturer's printed instructions.
- .9 Install roof sheathing in accordance with requirements of ABC.
- .10 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.
- .11 Install furring to support siding applied vertically where there is no blocking and where sheathing is not suitable for direct nailing.

- .1 Align and plumb faces of furring and blocking to tolerance of 1:600.
- .12 Install rough bucks, nailers and linings to rough openings as required to provide backing for frames and other work.
- .13 Install wood cants, fascia backing, nailers, curbs and other wood supports as required and secure using galvanized fasteners.
- .14 Install sleepers as indicated.
- .15 Use dust collectors and high quality respirator masks when cutting or sanding wood panels.

3.2 WOOD FRAME CONSTRUCTION

- .1 Space framing members at 305 mm o/c, or as indicated otherwise on drawings. Construct members of continuous pieces of longest possible length.
- .2 Provide 38 x 89 mm blocking at 610 mm o/c between engineered floor joists for lateral support of wall plates where walls run parallel to joists.
- .3 Make allowance for erection stresses. Securely brace members in place to maintain plumb and true until permanently fixed and held to structure.
- .4 Install fire-blocking as detailed.
- .5 Fabricate wood frame construction to the requirements of the Building Code, Part 9, except where more stringent requirements are indicated on the drawings.
- .6 Minimum sizes and spacing of members, thickness of materials, allowable species and lumber grades, shall meet the requirements of the above noted standards, unless indicated or specified otherwise.
- .7 Minimize cutting of framing members for pipes, etc. by prior consultation with other trades. Cutting limitations in accordance with Part 9 of the Building Code.
- .8 Construct framing as necessary to accommodate the work of other trades.

3.3 ERECTION

- .1 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.
- .2 Countersink bolts where necessary to provide clearance for other work.
- .3 Use nailing disks for soft sheathing as recommended by sheathing manufacturer.

3.4 POWER, TELECOMMUNICATIONS AND DATA PANEL BOARDS

- .1 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 150 mm off of finished floor.

END OF SECTION

Part 1 General

1.1 RELATED WORK SPECIFIED IN OTHER SECTIONS

- .1 Section 01 33 00 - Submittal Procedures
- .2 Section 05 50 00 - Metal Fabrications
- .3 Section 06 10 00 - Rough Carpentry

1.2 REFERENCE DOCUMENTS

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM A36/A36M 09 Carbon Structural Steel
 - .2 ASTM A47/A47M 99 Ferritic Malleable Iron Castings
 (2009)
 - .3 ASTM A307 07b Carbon Steel Bolts and Studs, 60,000 PSI Tensile
 Strength
 - .4 ASTM A653/A653M Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy
 09 Coated (Galvannealed) by the Hot Dip Process
- .4 Canadian Standards Association (CSA):
 - .1 CSA B111-1974 Wire Nails, Spikes and Staples
 (R2003)
 - .2 CSA G40.20/G40.21-04 General Requirements for Rolled or Welded Structural
 (2009) Quality Steel/Structural Quality Steel
 - .3 CAN/CSA-G164-M92 Hot Dip Galvanizing of Irregularly Shaped Articles
 (R2003)
 - .4 CAN/CSA-O80 Wood Preservation
 Series-08
 - .5 CAN/CSA-O86-01 Consolidation(2006), Engineering Design in Wood
 - .6 CSA O112 CSA Standards for Wood Adhesives
 Series-M1977(R2006)
 - .7 CAN/CSA O141-05 Softwood Lumber
 - .8 CAN/CSA-O122-06 Structural Glued-Laminated Timber
 - .9 CAN/CSA-O177-06 Qualification Code for Manufacturer's of Structural
 Glued-Laminated Timber
 - .10 CAN/CSA-S16-01 Limit States Design of Steel Structures
 - .12 CAN/CSA-Z808-08 A Sustainable Forest Management System: Guidance
 Document
- .5 FSC Forest Stewardship Council:
 - .1 FSC-STD-01-001- FSC Principle and Criteria for Forest Stewardship
 2004

- .2 FSC-STD-20-002-2004 Structure and Content of Forest Stewardship Standards V2-1
- .3 FSC Certified Bodies
- .6 National Lumber Grading Authority (NLGA):
 - .1 NLGA-07 Standard Grading Rules for Canadian Lumber

1.3 DESIGN CRITERIA

- .1 Contractor shall be responsible for design of connections not indicated on drawings but necessary for completion of the Work. Design connections in accordance with:
 - .1 CSA O86.1 - Engineering Design in Wood (Limit States Design)
 - .2 CAN/CSA-S16.1 - Limit States Design of Steel Structures

1.4 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheet in accordance with Section 01 33 00 Submittal Procedures.
 - .2 Submit two copies of WHMIS MSDS Material Safety Data Sheets in accordance with Section 01 33 00 Submittal Procedures. Indicate VOC's for:
 - .1 Finishes
 - .2 Adhesives
- .2 Shop Drawings:
 - .1 Submit erection drawings in accordance with CAN/CSA-S16.
 - .2 Indicate stress grade, service grade and appearance grades, shop applied finishes, camber, cuts, ledgers, holes and connection details.
 - .3 Each erection and shop drawing shall bear the stamp and signature of a qualified Professional Engineer registered in the Province of Alberta.
- .3 Certificates:
 - .1 Submit manufacturer's certification by CSA in accordance with CAN/CSA O177.

1.5 QUALITY ASSURANCE

- .1 Regulatory Agency Approvals:
 - .1 Material shall comply with applicable requirements of Alberta Building Code (ABC).

- .2 Lumber shall be graded and stamped by an agency certified by Canadian Lumber Standards Administrative Board.
- .3 Plywood shall be graded and stamped in accordance with applicable CSA standards.
- .4 Panel products shall be marked with a recognized, visible grade stamp.
- .2 Qualifications:
 - .1 Manufacturer:
 - .1 Manufacturer shall be certified by CSA in accordance with CAN/CSA O177, Qualification Code for Manufacturers of Structural Glued-Laminated Timber.
 - .2 Fabricator:
 - .1 Steel fabricator performing welding of steel connections shall be certified in accordance with CSA W47.1, Certification of Companies for Fusion Welding of Steel Structures.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Delivery and Acceptance Requirements:
 - .1 Wrap appearance grade members with an opaque, moisture resistant wrapping prior to leaving plant.
 - .2 Use padded, non-marring slings for handling members.
 - .3 Protect corners with wood blocking.
- .2 Storage and Handling Requirements:
 - .1 Store members supported off the ground and separated with strapping, to allow air to circulate around all faces of members.
 - .2 Maintain protection of members until permanent weather protection is installed, then completely remove protective wrappings.

Part 2 Products

2.1 DESCRIPTION

- .1 Sustainability Characteristics:
 - .1 Provide materials that have been extracted, harvested, recovered and processed within minimum distances required to the final point of manufacture. Provide materials from a manufacturing facility within minimum distance required from Project site and delivered to Project site by acceptable transportation method.

2.2 MATERIALS

- .1 Laminating Stock: Lumber: unless specified otherwise, moisture content 19% (S-dry) or less in accordance with following standards:
 - .1 CSA O141.
 - .2 NLGA Standard Grading Rules for Canadian Lumber.
- .2 Laminating Glue:
 - .1 To CSA O112.7.
 - .2 Grade of service required in accordance with CAN/CSA-O122.
- .3 Sealer for glued-laminated members: penetrating type, clear, non-yellowing liquid.
- .4 Steel For Connections: to CAN/CSA-G40.20/G40.21, Grade 300W.
- .5 Fastenings:
 - .1 Split Ring Connections: hot rolled carbon steel, SAE 1010
 - .2 Shear Plate Connectors: pressed steel, hot-rolled carbon steel, SAE 1010 or malleable iron to ASTM A47M, grade 350.
 - .3 Bolts: to ASTM A307.

2.3 FABRICATION

- .1 Fabricate to stress grade as follows:
 - .1 Bending Members: 20f-E
 - .2 Compression Members: 12c-E
- .3 Fabricate connection hardware to applicable requirements of Section 05 50 00.
- .5 Tag and mark members and connections as identified on shop drawings. Affix grade labels. Locate marks and labels at locations concealed after installation.

2.4 APPEARANCE GRADE

- .1 Structural glued-laminated timber shall be commercial grade.

2.5 FACTORY FINISHING

- .1 Apply two coats of sealer to end grain and one coat to remainder of members.
- .2 Prepare steel connection surfaces to applicable requirements of Section 05 50 00.
- .3 Galvanize connection steel after fabrication.

2.6 PRESERVATIVE TREATMENT

- .1 After fabrication, pressure treat indicated members with preservative in accordance with CAN/CSA-O80 Series.

Part 3 Execution

3.1 INSTALLATION

- .1 Erect members in accordance with reviewed erection drawings.
- .2 Brace and anchor members until permanently secured by structure.
- .3 Fit members closely and accurately to other members and other assemblies.
- .4 Obtain Minister's approval prior to field cutting or altering of members. If approved, apply factory sealer to cut surfaces.

END OF SECTION

Part 1 General

1.1 INTENT

- .1 Materials of this section are to be Forest Stewardship Council graded wood.
- .2 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.
- .3 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, panelling, trim and other trim related products.

1.2 RELATED SECTIONS

- .1 Section 06 10 00 – Rough Carpentry
- .2 Section 06 40 00 – Architectural Woodwork
- .3 Section 09 91 00 - Painting

1.3 REFERENCES

- .1 American National Standards Institute (ANSI)
 - .1 ANSI A208.1-2009, Particleboard.
 - .2 ANSI A208.2-2009, Medium Density Fibreboard (MDF) for Interior Applications.
 - .3 ANSI/HPVA HP-1-2009, Standard for Hardwood and Decorative Plywood.
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM E1333-14, Standard Test Method for Determining Formaldehyde Concentrations in Air and Emissions Rates from Wood Products Using a Large Chamber.
 - .2 ASTM F1667-17, Standard Specification for Driven Fasteners: Nails, Spikes, and Staples.
- .3 Architectural Woodwork Manufacturers Association of Canada (AWMAC) and Architectural Woodwork Institute (AWI)
 - .1 AWMAC Architectural Woodwork Standards, Most Recent Edition.
- .4 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-11.3-M87, Hardboard.
- .5 Canadian Plywood Association (CanPly)
 - .1 The Plywood Handbook 2005.
- .6 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .2 CSA O121-08(R2013), Douglas Fir Plywood, Includes Update No. 1 (2013).
 - .3 CAN/CSA O141-05 (R2014), Softwood Lumber.

- .4 CSA O151-17, Canadian Softwood Plywood.
- .5 CSA O153-13, Poplar Plywood.
- .6 CSA Z760-94 (R2001), Life Cycle Assessment.
- .7 Forest Stewardship Council (FSC)
 - .1 FSC-STD-01-001-V5-2 EN, 2015 FSC Principle and Criteria for Forest Stewardship.
- .8 National Hardwood Lumber Association (NHLA)
 - .1 Rules for the Measurement and Inspection of Hardwood and Cypress 2011.
- .9 National Lumber Grades Authority (NLGA)
 - .1 Standard Grading Rules for Canadian Lumber 2007.
- .10 South Coast Air Quality Management District (SCAQMD), California State (SCAQMD)
 - .1 SCAQMD Rule 1113-16, Architectural Coatings.
 - .2 SCAQMD Rule 1168-05, Adhesive and Sealant Applications.
- .11 Underwriters Laboratories of Canada (ULC)
 - .1 CAN4-S104-10, Standard Method for Fire Tests of Door Assemblies.
 - .2 CAN/ULC 105-09, Standard Specification for Fire Door Frames Meeting the Performance Required by CAN/ULC-S104 (CAN/ULC-s105:2016).

1.4 SUBMITTALS

- .1 Submit shop drawings in accordance with Section 01 33 00 – Submittals
 - .1 Indicate details of construction, profiles, jointing, fastening and other related details.
 - .2 Indicate materials, thicknesses, finishes and hardware.
- .2 Submit samples in accordance with Section 01 33 00 – Submittals.
 - .1 Submit samples, 300 mm x 300 mm of each wood species to receive finish, to the Departmental Representative for review.
 - .2 Submit 250 mm long samples of each type of trim, moulding and handrail.
 - .3 Reviewed samples shall become the standard for the work.
- .3 Closeout Submittals:
 - .1 Provide operations and maintenance data in accordance with Section 01 78 00 – Operation and Maintenance Manuals.

1.5 QUALITY ASSURANCE

- .1 Architectural Woodwork Standards (AWS) published by the Architectural Woodwork Manufacturers Association of Canada, together with authorized additions and amendments will be used as a reference standard and shall form part of this project specification. Where differences occur between the drawings and specifications requirements and the AWS, the more restrictive requirement shall prevail.

- .2 Any reference to Custom or Premium grade in this specification shall be as defined in the AWS.
- .3 Any item not given a specific quality grade shall be Premium grade as defined in the AWS.
- .4 A copy of the AWS shall be made readily available for reference purposes on the job site.
- .5 References in this specification to part and item numbers mean those parts and items contained within the AWS.
- .6 Materials and installation shall be in Metric measurements as specified.

1.6 DELIVERY, STORAGE AND HANDLING

- .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 AWS.
- .3 Delivered materials which are damaged in any way or do not comply with these specifications will be rejected by the Departmental Representative and shall be removed from the job site and replaced with acceptable materials.

1.7 WASTE MANAGEMENT AND DISPOSAL

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

1.8 PROJECT CONDITIONS

- .1 Environmental Conditions: Comply with the AWS Section 2 – Care & Storage for optimum temperature and humidity conditions for woodwork during its storage and installation. Do not install woodwork until these conditions have been attained and stabilized.

1.9 COORDINATION

- .1 Coordinate provision of concealed blocking or supports.
- .2 Ensure that back-priming of finish carpentry surfaces concealed after installation, has been performed as specified in Section 09 91 00 – Painting, prior to installation.

Part 2 Products

2.1 LUMBER MATERIAL

- .1 Softwood lumber: unless specified otherwise, spruce-pine-fir species, S4S, average moisture content of 6% and maximum of 9% for interior work, an average moisture content of 12% and maximum of 15% for exterior work, in accordance with following standards:
 - .1 CAN/CSA-O141.

- .2 NLGA Standard Grading Rules for Canadian Lumber.
- .3 AWS custom grade, moisture content as specified.
- .4 Forest Stewardship Council (FSC) certified.
- .2 Machine stress-rated lumber is acceptable.
- .3 Douglas Fir:
 - .1 Grade: A Clear and Better.
 - .2 Treatment: Heat Treated –thermowood
 - .3 Moisture Content: kiln dried to 5 - 7% moisture content.
 - .4 Density: 350 – 480 kg/m³
 - .5 Board Size: railing and fencing, confirm size as indicated on Drawings.
 - .6 Finish: stained both sides as indicated in Section 09 91 00.
 - .7 Acceptable Material:
 - .1 Thermowood, Finnforest
 - .2 ThermoForest, Superior Thermo Wood

2.2 PANEL MATERIAL

- .1 Hardwood plywood: to CSA O115, of thickness indicated, and maximum size sheets application and as follows:
 - .1 AWS premium grade, for transparent finish.
 - .2 Face Veneer: AA Veneer Grade:
 - .1 Minimum 150 mm flitch width.
 - .2 Continuous across face of panel, no end matching allowed.
 - .3 Wood Species as indicated, flat sliced, quarter cut, single sheet match and symmetry.
 - .4 Minimum veneer thickness, 0.50 mm.
 - .5 Vertical grain direction.
 - .3 Core Construction: Particle board.
 - .4 Back Veneer: #1 Backing Grade.
 - .5 Panel Edge: Blind Edge, matching face veneers, hardwood 12 mm wide x thickness of panel, edge glued to side of panel where edge of panel is exposed.
 - .6 Grade stamp, non-exposed, marked on the edge of each panel, indicating cut, species and grade, and manufacturer's name.
- .2 Poplar plywood (PP): to CSA O153, utility interior moisture resistant type.
 - .1 Forestry Stewardship Council (FSC) certified.
 - .2 Urea-formaldehyde free.
- .3 Medium density fibreboard (MDF): Meeting ASTM D1037 and ANSI A208.2, Premium Grade for interior use, minimum 750 kg/m³ density; formaldehyde emissions shall be 0.30 ppm or less per 0.424m²/m³ of room value.
 - .1 Forestry Stewardship Council (FSC) certified.
 - .2 Urea-formaldehyde free.
 - .3 Acceptable Materials:

- .1 Medex and Medite II MDF, Roseburg
- .2 Flakeboard Premier MDF, Flakeboard.
- .3 Medite MDF FR, Roseburg
- .4 Flakeboard Premier MDF FR, Flakeboard.

2.3 ACCESSORIES

- .1 Fasteners: to suit size and nature of components being fastened.
- .2 Nails and staples: to CSA B111; galvanized to CAN/CSA-G164 for exterior work, interior humid areas and for treated lumber; plain finish elsewhere.
- .3 Wood screws: plain steel, type and size to suit application.
- .4 Splines: wood.
- .5 Adhesive: recommended by manufacturer.
 - .1 Adhesives: maximum VOC limit 30 g/L in accordance with SCAQMD Rule 1168 - Adhesives and Sealants Applications.

2.4 SITE FABRICATION

- .1 Fabricate items rigid, plumb and square, as detailed, with tight, bevelled, hairline joints. Sand work smooth, set all nails and screws.
- .2 Countersink bolts and washers, fill holes with matching wood plugs.
- .3 Fit shelves with hardwood edging.

Part 3 Execution

3.1 EXAMINATION

- .1 Contractor, and Departmental Representative to visit site at 80% completion and note state of Work and finishes in the various areas in which cabinet and millwork to be installed.
- .2 Ensure surfaces are ready to receive Work. All surfaces of other Work to be finished and painted before being built-over or covered in any way or millwork installed.

3.2 INSTALLATION

- .1 Do finish carpentry to Quality Standards of the AWS, except where specified otherwise.
- .2 Scribe and cut as required to fit abutting walls, and surfaces, to fit properly into recesses and to accommodate intersecting or penetrating objects; secure materials and components in place, rigid, plumb and square, with tight, hairline joints to locations indicated on Drawings and in accordance with AWS, and as follows:
 - .1 Form joints to conceal shrinkage
 - .2 Set finishing nails to receive filler
 - .3 Countersink screws in round cleanly cut hole and plug with wood plug matching material being secured

- .4 Match wood pieces end to end for consistent colour and grain appearance; space and centre joints evenly in runs.

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. Where screws are used to secure members, countersink screw in round smooth cut hole and plug with wood plug to match material being secured.
 - .4 Replace items of finish carpentry with damage to wood surfaces including hammer and other bruises.
- .2 Standing and running trim:
 - .1 Butt and cope internal joints of baseboards to make snug, tight, joint. Cut right angle joints of casing and base with mitred joints.
 - .2 Fit backs of baseboards and casing snugly to wall surfaces to eliminate cracks at junction of base and casing with walls.
 - .3 Make joints in baseboard, where necessary using a 45 degrees scarf type joint.
 - .4 Install door and window trim in single lengths without splicing.
- .3 Interior and exterior frames:
 - .1 Set frames with plumb sides, level heads and sills, and secure.
- .4 Panelling:
 - .1 Secure panelling and perimeter trim using adhesive recommended for purpose by manufacturer. Fill nail holes caused by temporary fixing with filler matching wood in colour.
 - .2 Secure panelling and perimeter trim using concealed fasteners.
 - .3 Secure panelling and perimeter trim using counter sunk screws plugged with matching wood plugs.
- .5 Handrails, wall rails and bumper rails.
 - .1 Make joints hair line, dowelled and glued.
 - .2 Support brackets provided under Section 05 50 00 for installation under this Section.
 - .3 Install brackets at ends and at required centre maximum at intermediate spacing.
 - .4 Install metal backing plates between studs at bracket locations to ensure proper support for brackets and bolts or self-tapping screws.
 - .5 Secure using counter sunk screws plugged with matching wood plugs.
- .6 Shelving:
 - .1 Install shelving on ledgers or shelf brackets as indicated.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 The work of this section includes the supply installation of shop manufactured architectural woodwork.
- .2 Cabinet hardware to be supplied by this section.
- .3 Materials of this section are to be Forest Stewardship Council graded wood.

1.2 RELATED SECTIONS

- .1 Section 06 10 00 – Rough Carpentry
- .2 Section 08 14 16 – Flush Wood Doors
- .3 Section 09 21 16 – Gypsum Board Assemblies
- .4 Section 09 65 00 – Resilient Flooring
- .5 Section 09 91 00 – Painting
- .6 Section 10 28 10 – Toilet and Bath Accessories
- .7 Division 22 Mechanical: Sinks in countertops
- .8 Division 26 Electrical
- .9 Division 27 Communications

1.3 REFERENCES

- .1 American National Standards Institute (ANSI)
 - .1 ANSI/NPA A208.1-2009, Particleboard.
 - .2 ANSI A208.2-2009, Medium Density Fiberboard (MDF) for Interior Applications.
 - .3 ANSI/HPVA HP-1-2009, Standard for Hardwood and Decorative Plywood.
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM D2555–16, Standard Practice for Establishing Clear Wood Strength Values.
 - .2 ASTM D2559–12ae1, Standard Specification for Adhesives for Bonded Structural Wood Products for Use Under Exterior Exposure Conditions.
 - .3 ASTM D2832-92(2016), Standard Guide for Determining Volatile and Nonvolatile Content of Paint and Related Coatings.
 - .4 ASTM D3930–08(2015), Standard Specification for Adhesives for Wood-Based Materials for Construction of Manufactured Homes.
 - .5 ASTM D4300-01(2013), Standard Test Methods for Ability of Adhesive Films to Support or Resist the Growth of Fungi.
 - .6 ASTM D5116-10, Standard Guide for Small-Scale Environmental Chamber Determinations of Organic Emissions from Indoor Materials/Products.
 - .7 ASTM E1333-14, Standard Test Method for Determining Formaldehyde Concentrations in Air and Emission Rates from Wood Products Using a Large Chamber.

- .3 Architectural Woodwork Manufacturers Association of Canada (AWMAC) and Architectural Woodwork Institute (AWI)
 - .1 AWMAC Architectural Woodwork Standards, Most Recent Edition
 - .2 Sustainable Architectural Woodwork (SAW) Certification Manual (2012).
- .4 Canadian Standards Association (CSA International)
 - .1 CSA B111-74(R2003), Wire Nails, Spikes and Staples.
 - .2 CSA O112.9-10(R2014), Evaluation of Adhesives for Structural Wood Products (Exterior Exposure), Includes Update No. 1 (2011).
 - .3 CSA O112.10-08 (R2013), Evaluation of Adhesives for Structural Wood Products (Limited Moisture Exposure), Includes Update No. 1 (2010), Update No. 2 (2010).
 - .4 CSA O121-08 (R2013), Douglas Fir Plywood, Includes Update No. 1 (2013).
 - .5 CSA O141-05 (R2014), Softwood Lumber.
 - .6 CSA O151-17, Canadian Softwood Plywood.
 - .7 CSA O153-13, Poplar Plywood.
- .5 International Organization for Standardization (ISO)
 - .1 ISO 14040:2006, Environmental Management-Life Cycle Assessment - Principles and Framework.
 - .2 ISO 14041:1998, Environmental Management-Life Cycle Assessment - Goal and Scope Definition and Inventory Analysis.
- .6 National Electrical Manufacturers Association (NEMA)
 - .1 ANSI/NEMA LD-3-2005, High-Pressure Decorative Laminates (HPDL),
- .7 National Hardwood Lumber Association (NHLA)
 - .1 Rules for the Measurement and Inspection of Hardwood and Cypress 2011.
- .8 National Lumber Grades Authority (NLGA)
 - .1 Standard Grading Rules for Canadian Lumber 2014.
- .9 South Coast Air Quality Management District (SCAQMD), California State (SCAQMD)
 - .1 SCAQMD Rule 1113-16, Architectural Coatings.
 - .2 SCAQMD Rule 1168-05, Adhesive and Sealant Applications.

1.4 SUBMITTALS

- .1 Submit shop drawings in accordance with Section 01 33 00 – Submittals.
 - .1 Show location of each item, dimensioned plans and elevations, large scale details, attachment devices, and other components.
 - .2 Show details of construction, profiles, jointing, fastening and other related details.
 - .3 Show materials, thicknesses, finishes and hardware.

- .4 Show locations and sizes of cut-outs and holes for plumbing fixtures and other items installed in architectural woodwork.
- .2 Submit samples in accordance with Section 01 33 00 – Submittals.
 - .1 Submit two (2) finished samples, 610 mm x 610 mm of each finish to be applied at the factory, to the Departmental Representative for approval. Where materials are being matched, verify that specified materials match existing prior to submitting samples.
 - .2 Alternative cabinet hardware from that specified shall be submitted to the Departmental Representative for approval.
 - .3 Reviewed samples shall become the standard for the work.
- .3 Closeout Submittals:
 - .1 Project Record Sheet: Submit to the Departmental Representative two (2) copies of the project record sheet identifying the project title and address, Departmental Representative, and Architectural Woodwork Subcontractor. Indicate also materials and finishes used for architectural woodwork and whether shop finished or site finished and by whom. Include type and source of all cabinet hardware and any special items used under architectural woodwork.
 - .2 Submit in accordance with Section 01 78 00 – Operations and Maintenance Manuals.

1.5 QUALITY ASSURANCE

- .1 Architectural Woodwork Standards (AWS) and Errata shall be used to establish the minimum level of quality for this project.
- .2 Execute the work of this Section by a member of AWMAC with five years' experience in work of comparable complexity and scope.
- .3 Any reference to Custom or Premium grade in this specification shall be as defined in the AWS.
- .4 Any item not given a specific quality grade shall be Premium grade as defined in the AWS.
- .5 A copy of the AWS shall be made readily available for reference purposes on the job site.
- .6 References in this specification to part and item numbers mean those parts and items contained within the AWS.
- .7 Perform the Work in accordance with the definition of 'Good Workmanship' as defined in the AWS.
- .8 Remove and replace finish carpentry Work which does not conform to the AWS.
- .9 Guarantee and Inspection Service (GIS)
 - .1 Architectural woodwork shall be manufactured and/or installed to the current AWMAC Architectural Woodwork Standards and shall be subject to an inspection at the factory and/or site by an appointed AWMAC Certified Inspector. Inspection costs shall be included in the tender price for this project. (Contact your local AWMAC Chapter for details of inspection costs). Shop drawings shall be submitted to the AWMAC

Chapter office for review before work commences. Work that does not meet the AWMAC Architectural Woodwork Standards, as specified, shall be replaced, reworked and/or refinished by the architectural woodwork contractor, to the approval of AWMAC, at no additional cost to the Departmental Representative.

- .2 If the woodwork contractor is an AWMAC Manufacturer member in good standing, a two (2) year AWMAC Guarantee Certificate will be issued. The AWMAC Guarantee shall cover replacing, reworking and/or refinishing deficient architectural woodwork due to faulty workmanship or defective materials supplied and/or installed by the woodwork contractor, which may appear during a two (2) year period following the date of issuance.
 - .3 If the woodwork contractor is not an AWMAC Manufacturer member they shall provide the Departmental Representative with a two (2) year maintenance bond, in lieu of the AWMAC Guarantee Certificate, to the full value of the architectural woodwork contract.
 - .4 For more information about AWMAC and the GIS Program visit our website at www.awmac.com and contact your local AWMAC Chapter office
- .10 Materials and installation shall be in metric measurements.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store, and handle materials in accordance with the AWS. Control the temperature and humidity in accordance with AWS recommendations, before, during, and after delivery, during storage, and during and after installation as required.
- .2 Provide protective coverings of suitable material for plastic laminate items, taking special precautions to protect corners.
- .3 Do not permit delivery of millwork to the site until the area is sufficiently dry so that woodwork shall not be damaged by excessive changes in ambient humidity

1.7 PROJECT CONDITIONS

- .1 Comply with the AWS requirements for care and storage for optimum temperature and humidity conditions. Maintain a minimum 430 lx (40 f.c.) illumination on surfaces and areas where work is being installed.
- .2 Where work is indicated to be fitted to other construction, check dimensions of other construction by field measurement before fabrication; show recorded field measurements on final Shop Drawings. Coordinate fabrication schedule with construction schedule and progress to avoid delay of Work.
- .3 Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with fabrication without field measurements. Coordinate other construction to ensure that actual dimensions correspond to guaranteed dimensions.

1.8 WASTE MANAGEMENT AND DISPOSAL

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

1.9 WARRANTY

- .1 Provide 2 year AWMAC GIS Guarantee.

Part 2 Products

2.1 MATERIALS

- .1 Use clean stock only and comply with AWS for quality grades specified.
- .2 Panel Materials: Provide panel materials meeting requirements for moisture content and grades in accordance with AWS requirements and as specified below. Panel products must be manufactured with no added urea-formaldehyde.
- .3 Poplar plywood: to CSA O153, utility interior moisture resistant type.
- .4 Medium Density Fibreboard (MDF): Meeting ASTM D1037 and ANSI A208.2, Premium Grade for interior use, minimum 700 kg/m³ density; formaldehyde emissions shall be 0.30 ppm or less per 0.424m²/m³ of room value.
 - .1 Urea-formaldehyde free.
 - .2 Acceptable Materials for high moisture areas (e.g., bathrooms):
 - .1 Medex MDF, Roseburg
 - .2 Flakeboard Premier Plus Moisture Resistant MDF, Flakeboard
 - .3 Acceptable Materials for standard applications:
 - .1 Medite II MDF, Roseburg
 - .2 Flakeboard Premier MDF, Flakeboard.
 - .4 Acceptable Materials for thin paper laminates and thermally fused melamine:
 - .1 Flakeboard Premier Plus MDF, Flakeboard.
- .5 Particleboard: to ANSI A208.1, Grade M-2 or better, minimum 720 kg/m³ density and Grade M-3, minimum 750 kg/m³ particleboard for countertops and shelves; clearly mark panels with grade mark in visible location; extruded particleboard having loose cores with voids will not be permitted; having no added urea formaldehyde.
 - .1 Acceptable Materials:
 - .1 Vesta Particleboard, Flakeboard.
 - .2 Purekor Platinum Particleboard, Panel Source International.
 - .3 Encore SDF Sustainable Particleboard, SierraPine Ltd.
- .6 Lumber:
 - .1 Softwood: to CAN/CSA O141, kiln dried to maximum moisture content of 12%, dressed 4 sides.
- .7 High Pressure Decorative Laminate (HPDL): to ANSI/NEMA LD3; Grades and application in accordance with applicable AWS requirements and as follows:
 - .1 Constructed of multiple layers of phenolic resin-saturated kraft paper in combination with a layer of decorative melamine-saturated paper, all fused together under heat and pressure.

- .2 Horizontal General Purpose Grade (HGS): thickness of 1.2 mm \pm 0.12 mm, used on the following:
 - .1 Horizontal surfaces, unless specified otherwise.
- .3 Vertical General Purpose Grade (VGS): thickness of 0.7 mm \pm 0.10 mm, used on the following:
 - .1 Vertical surfaces, unless specified otherwise.
 - .2 Exposed portions of case bodies, including ends, divisions and bottoms.
 - .3 Exposed shelves.
 - .4 Casework Doors: exposed and semi-exposed surfaces.
 - .5 Drawer Faces: exposed and semi-exposed surfaces.
- .4 Liner Grade (CLS): thickness of 0.5 mm \pm 0.10 mm, used on the following:
 - .1 Semi-exposed shelves.
 - .2 Interior portions of case bodies.
 - .3 All surfaces of drawer boxes.
- .5 Laminate backer grade (BKL): thickness of 0.5 mm \pm 0.10 mm, used on the following:
 - .1 Concealed surface of casework backs.
 - .2 Concealed surfaces, unless specified otherwise.
- .6 Colour basis of design:
- .7 Acceptable Materials:
 - .1 Arborite
 - .2 Formica
 - .3 Lamin-Art
 - .4 Nevamar
 - .5 Pionite
 - .6 Wilsonart
- .8 Low Pressure Decorative Laminate: to ANSI/NEMA LD3, in accordance with applicable AWS requirements, and as follows:
 - .1 Melamine impregnated papers thermally fused under pressure.
 - .2 Thickness: 0.5 mm minimum.
 - .3 Wear Resistance: 400 cycles minimum.
 - .4 Colours: as indicated on Drawings.
- .9 Edging:
 - .1 All edges of door and drawer panels shall be finished the same as face and back (6 sides finished).
 - .2 Edge type shall conform to AWS requirements.
 - .3 High Pressure Decorative Laminate Edging:
 - .1 Horizontal General Purpose Grade (HGS): thickness of 1.2 mm \pm 0.12 mm, colour and finish to match surface finish.
- .10 Adhesive:

- .1 Decorative laminate: polyvinyl acetate or aliphatic resin in accordance with manufacturer's recommendation for curing under pressure for bonding to wood cores, water resistant type.
- .11 Sealant: in accordance with Section 07 92 00 – Sealants

2.2 CABINET WORK

- .1 Work shall conform to applicable AWS requirements.
- .2 HPDL edge banding shall be applied to all four edges.
- .3 Door and Drawer Bumpers: Self-adhesive type approximately 6 mm diameter clear silicone bumpers for all cabinet work doors and drawer faces, two per door and drawer, placed at door top and bottom and drawer top.

2.3 CABINET FABRICATION

- .1 General
 - .1 Flush overlay cabinet doors and drawer fronts as detailed.
 - .2 Fabricate gables and edges meeting walls oversize to allow for scribing to fit on site.
 - .3 Use non-telegraphing grain plywood when laminate is the specified finish.
 - .4 Assemble Work with flush butt hairline corners and joints. Cut-outs for services to be done on site during installation. No hairline cracks will be allowed in the face area of cabinet work modules unless approved in writing by Departmental Representative.
 - .5 Carefully fit, cope or mitre and well glue-up Joints. There shall be no end wood visible on finished surfaces.
 - .6 Set nail heads in finished surfaces. Countersink screws and bolts, except those detailed to be exposed, and fill holes with edge grain wood plugs to match colour and grain.
 - .7 Ensure adjacent part of continuous work match in colour and pattern.
- .2 Construction
 - .1 Minimum core thicknesses as follows:
 - .1 Drawer bottoms, particleboard, 12 mm;
 - .2 Drawer sides and backs, particleboard, 12 mm;
 - .3 Drawer fronts, particleboard, 19 mm;
 - .4 Doors, particleboard, 19 mm;
 - .5 Lower case backs against walls, particleboard, 10 mm;
 - .6 Upper case backs against walls, particleboard, 10 mm;
 - .7 Shelves, fixed and adjustable, particleboard, 19 mm;
 - .8 Counter top cores, Plywood with non-telegraphing grain, 19 mm with 38 mm edge, for wet areas, use marine grade plywood and ensure that all cut-outs are sealed prior to installation of sinks, primer is not considered to be an appropriate sealer;
 - .9 Backsplashes at all locations: Poplar Veneer Plywood, 19 mm; use marine grade plywood at wet areas,
 - .10 All other work Poplar Veneer Plywood, 19 mm.

- .2 Glue, dowel, mortise, lock joint or dado all cabinet work and cabinet work. Do not use staples. Nailing and screws are acceptable. Do not surface nail or screw through countertops.
- .3 Blocking, framing, web frames to be solid lumber.
- .4 Provide solid wood edge strips in all doors and cases to receive hardware. Rebate and pressure glue to core.
- .5 Cut and adapt all Work to receive hardware.
 - .1 Drill and prepare end gables for insert type shelf standards on gables.
 - .2 Install all finishing hardware and fittings in shop.
 - .3 Fittings which may be susceptible to damage during shipping and installation may be installed after millwork installed on site.

2.4 CABINET HARDWARE

- .1 Provide the following cabinet hardware, in quantity required, complete with all screws, bolts, washers for complete installation.
- .2 Non-Exposed Fasteners: fabricators choice consistent with quality level specified.
- .3 Exposed Fasteners: Architectural appearance, material, finish and fastener tool type as selected by Departmental Representative; coordinate sample submittals before ordering materials.
- .4 Draw Bolt Fasteners: Mitre butt joint fastener, adjustable and requiring no special tools for installation, galvanized.
 - .1 Acceptable Materials:
 - .1 K&V 516 by Knape & Vogt Canada.
 - .2 BP5162G by Richelieu
- .5 Spacers: Rigid PVC to size and profile indicated.
- .6 Access Panel Connectors
 - .1 Acceptable Materials:
 - .1 Richelieu Type JCB-A0101C complete with Tee-Nut 261.12.
- .7 Grommets for electrical cords through counter tops, as indicated on drawings.
 - .1 Acceptable Materials:
 - .1 Richelieu 600910140, 70 mm Ø, chrome.
 - .2 Richelieu 76090, 64 mm Ø, black.
- .8 Pulls: Typical drawers and doors: as indicated on Drawings
- .9 Drawer Slides: Following list of drawer slides is provided to indicate general conformance requirements only; notify the Departmental Representative where drawer width, height or intended use differs from that indicated in the general description and the requirements of the manufacturer:
 - .1 Light duty drawer slides: 34 kg capacity, $\frac{3}{4}$ extension:
 - .1 Acceptable materials:
 - .1 Accuride 2132

- .2 Dynaslide 3611
 - .3 Hettich Canada LP KA3432
 - .4 Knape and Vogt 8350
 - .2 Medium duty drawer slides and high height drawers (≥ 150 mm, ≤ 305 mm): 41 kg capacity, full extension:
 - .1 Acceptable materials:
 - .1 Accuride 3834
 - .2 Hettich Canada LP KA5632
 - .3 Knape & Vogt 8400
 - .3 Heavy duty drawer slides: 68 kg capacity, full extension:
 - .1 Acceptable materials:
 - .1 Accuride 4032
 - .2 Hettich Canada LP KA555
 - .3 Knape and Vogt 8500
 - .4 Lateral file drawers, 91 kg capacity, over-travel extension:
 - .1 Acceptable materials:
 - .1 Accuride 3640
 - .2 Hettich Canada LP KA 4620
 - .3 Knape and Vogt 8805
- .10 Hinges:
 - .1 Oversize or High Use Cabinet Doors: Exposed knuckle pivot hinge with 5 mm axle and cover caps; fully adjustable for overlay and height; opening angle of 180°; self-closing feature; nickel plated zinc die cast construction; gable mounting, size and profile to suit cabinet construction:
 - .1 Acceptable Materials:
 - .1 Häfele America Co., Aximat SM Series
 - .2 Hettich Canada LP, Selekt Pro 2000 Series
 - .3 Richelieu MB 8000 Series
 - .2 Typical Cabinet Doors: Concealed, euro-style hinge with cover caps; fully adjustable for overlay, depth, height and closing force; opening angle of 110°; self-closing feature; nickel plated steel construction; overlay and half overlay mounting, size and profile to suit cabinet construction:
 - .1 Acceptable materials:
 - .1 Julius Blum Canada Ltd., Modul and Expando Series
 - .2 Hettich Canada LP, Intermat Soft 9943 Series
 - .3 Häfele America Co., H-Series
 - .3 Typical Cabinet Doors: Exposed knuckle pivot hinge with 5 mm axle and cover caps; fully adjustable for overlay and height; opening angle of 180°; self-closing feature; nickel plated zinc die cast construction; gable mounting, size and profile to suit cabinet construction:
 - .1 Acceptable Materials:
 - .1 Häfele America Co., Aximat SM Series
 - .2 Hettich Canada LP, Selekt Pro 2000 Series

- .3 Richelieu MB 8000 Series
- .4 Piano Hinges: Continuous hinge, nickel finish, 40 mm width x 0.8 mm thickness x length of leaf.
 - .1 Acceptable Materials:
 - .1 Richelieu, 4025180.
- .5 Fold Down Desk: Continuous hinge, nickel finish, 38 mm width x 1 mm thickness x length of leaf:
 - .1 Basis-of-Design Materials: Martin 4025-180.
- .6 Waste Cabinet Doors: Zinc, spring hinges, 50 mm x 45 mm:
 - .1 Basis-of-Design Materials: Richelieu 45XV
- .11 Locks:
 - .1 Typical lockable doors and drawers: Nickel finished, master keyed, keyed alike in groups, cam lock with plate, adjust keying group to suit requirements:
 - .1 Acceptable Materials:
 - .1 Richelieu
 - .2 CompX National
 - .3 Trimline
- .12 Door Latches:
 - .1 Standard Doors: Elbow Latches for inactive leaves of pairs of doors to be locked, standard duty, zinc finish.
 - .1 Basis-of-Design Materials: Richelieu 36752G
 - .2 Magnetic Catch:
 - .1 Basis-of-Design Materials: Richelieu BP504510
 - .3 Elbow Latch:
 - .1 Basis-of-Design Materials: Richelieu 36752G
 - .4 Roller latches for closet doors, heavy duty, double roller type, zinc finish:
 - .1 Basis-of-Design Materials: Richelieu 6032G
 - .5 Gate Latch: Aluminum finish, secret gate latch:
 - .1 Acceptable Materials:
 - .1 Knappe & Vogt 989
 - .2 Rockwood 600
 - .6 Touch Latch: Non-metallic:
 - .1 Basis-of-Design Materials: Amerock Tutch-Latch
 - .7 Narcotics Storage Doors: heavy duty, security spring lock, nickel finish:
 - .1 Basis-of-Design Materials: Richelieu BP10102/03-180
- .13 Shelf Rests:
 - .1 Stainless steel pin rests: 7 mm Ø socket collar inserts for steel pin shelf supports, drill holes in cabinet work to accept collar, chrome or nickel finish:
 - .1 Acceptable Materials:
 - .1 Knappe & Vogt Canada, Series 331/325 grommet

- .2 Richelieu 5829-180/2292-180
- .2 Surface wall mounted pilaster with shelf rests sized for shelf depth, nickel finish.
 - .1 Acceptable Materials:
 - .1 Knape & Vogt.
- .3 Flush mounted pilaster with shelf rests sized for shelf depth, nickel finish.
 - .1 Acceptable Materials:
 - .1 Knape & Vogt.
- .4 Recessed mounted pilaster w/clips: Nickel plated, surface mounted steel standards mounted 150 mm from top & bottom, one support for each 305 mm of standard:
 - .1 Acceptable Materials:
 - .1 Knape & Vogt 255/256
 - .2 Richelieu Richelieu 2552G/CP2562G
 - .3 Hettich Canada LP 00120

2.5 FACTORY FINISHING – CABINET WORK

- .1 Cabinet work for High Pressure Decorative Laminate Finish:
 - .1 AWS Quality Grade Premium.
 - .2 Construction: Cabinet work shall conform to applicable sections of the AWS.
 - .3 Exposed Parts: High pressure decorative laminate, plywood with non-telegraphing grain as indicated.
 - .4 Semi-Exposed Parts: High pressure decorative laminate, plywood with non-telegraphing grain as specified above.
 - .5 Concealed parts: Low pressure decorative laminate backer to balance face materials.
- .2 Laminate Countertops and Backsplashes
 - .1 Countertops shall be self edge type to applicable AWS requirements.
 - .2 Backsplash shall conform to Section 6 of the AWS.
 - .3 Custom counter shall be seamless.

Part 3 Execution

3.1 JOB CONDITIONS

- .1 Job Conditions for installation of architectural woodwork shall be in accordance with applicable AWS requirements.

3.2 INSPECTION

- .1 Verify condition and dimensions of previously installed work upon which this Section depends. Report defects to Departmental Representative. Commencement of Work means acceptance of existing conditions.

3.3 PREPARATION

- .1 Obtain measurements from site.
- .2 Check access to ensure large pieces of work can be safely handled to their place of final installation.
- .3 Protect finished surfaces and materials of other trades from damage.
- .4 Ensure services and roughing-in which affect or are connected to or through this work are complete and acceptable.
- .5 Back prime cabinet work immediately after delivery to site.

3.4 INSTALLATION

- .1 Install work to applicable AWS and Quality Assurance requirements.
- .2 Install cabinet work in its indicated locations, plumb, level, and true.
- .3 Anchor to floor, walls or ceiling using fastening devices and hardware consistent with the building materials encountered. Do not use wood plugs. Do not use plastic plugs for ceilings or walls. Provide wall strapping as required.
- .4 Anchor cabinet work and millwork to building structure. Shim level and set square in relation to adjoining surfaces. Scribe to adjacent Work. Provide allowance for finish flooring installation to base.
- .5 Cabinet work:
 - .1 Fasten to framing using zinc-coated bolts, countersunk and plugged with matching wood plugs.
 - .2 Set cabinetwork in place, on base, anchoring securely to building structure and to adjoining cabinetwork. Use approved connector type fasteners between items of cabinetwork to hold adjoining pieces tightly together.
 - .3 Scribe to smooth snug fit with adjoining surfaces and materials to align work. Mitre corners.
 - .4 Perform cutting, fitting, repairing in woodwork as required by other trades where their work is connected to or part of this work.
 - .5 Cut out openings for mechanical, electrical, and communications fittings and fixtures. Coordinate and cooperate in the connection and installation of mechanical, electrical, and communications work.
 - .6 Apply sealant between countertops and adjoining walls and cabinetwork. Seal edges of cut-out core material before fixtures installed.
 - .7 Install finishing hardware shipped loose.
- .6 Supply and install hardware required for the completion of architectural woodwork, including, without limitations, adjustable shelf supports and cabinet hinges, catches, pulls, drawer accessories, bumpers, drawer slides and closet hanger bars, and similar items. Install millwork hardware in the shop wherever possible. Install millwork hardware secure, plumb, level, true to line, and in accordance with the hardware manufacturers' printed instructions. Cut and fit to millwork for proper installation and operation. Provide smoothly operating units free from binding. Clean and adjust hardware for proper operation.

3.5 ADJUSTING AND CLEANING

- .1 During and after installation adjust all hardware and operating parts as necessary to ensure smooth and proper operation.
- .2 Clean all cabinet, countertops, shelves and fixtures.
- .3 Repair any marks, scratches or marring.
- .4 Remove and replace damaged, marked, or stained finish carpentry.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 05 50 00 – Metal Fabrications
- .2 Section 06 10 00 – Rough Carpentry
- .3 Section 07 92 00 – Sealants
- .4 Section 09 21 16 – Gypsum Assemblies

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM D6109-10, Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastic Lumber and Related Products.
 - .2 ASTM D2394-05(2011), Standard Test Methods for Simulated Service Testing of Wood and Wood-Base Finish Flooring
 - .3 ASTM D4060-10, Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.
 - .4 ASTM D696-08, Standard Test Method for Coefficient of Linear Thermal Expansion of Plastic Between -30°C and 30°C with a Vitreous Silica Dilatometer.
 - .5 ASTM E84-11c, Standard Test Method for Surface Burning Characteristic of Building Materials.
- .2 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC S101-07, Standard Methods of Fire Endurance Tests of Building Construction and Materials.

1.3 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 – Submittal Procedures.
 - .1 Submit manufacturer's printed product literature, specifications and data sheets.
- .2 Submit samples in accordance with Section 01 33 00 – Submittal Procedures.
 - .1 Submit 300 mm long representative samples in texture, thickness and widths of materials specified.
- .3 Closeout Submittals: Submit manufacturer's written instructions for care, repair and cleaning procedures, in accordance with Section 01 78 00 – Closeout Submittals.

1.4 QUALITY ASSURANCE

- .1 Regulatory Requirements: Comply with local Building Code and Authorities Having Jurisdiction for installation requirements.
- .2 Installers: Use experienced installers having experience with projects similar in material, design and extent as required for Work of this Contract and are approved by manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturers instructions.
- .2 Store materials on flat and level surface. Handle materials to prevent damage to edges and corners. Store materials under protective covering.

1.6 WASTE MANAGEMENT AND DISPOSAL

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

Part 2 Products

2.1 MATERIALS

- .1 Plastic Decking: Rice Hull and virgin HDPE Plastic as follows:
 - .1 Size and colour: as indicated on Drawings in Elevation Materials Legend
 - .2 Flame Spread: 40 to ASTM E84
 - .3 Edge: T & G
 - .4 Basis-of-Design
 - .1 I. Dekk (formerly GeoDeck Classic), Green Bay Decking

2.2 ACCESSORIES

- .1 Provide products of material, size, and shape required for application indicated, and with a proven record of compatibility with surfaces contacted in installation, and as required for a complete and functioning assembly.
- .2 Fasteners: Use stainless steel screws designed specifically for composite decking and as recommended by manufacturer.

Part 3 Execution

3.1 INSTALLATION: DECKING

- .1 Install in accordance with manufacturer's written installation instructions and technical product bulletin instructions.
- .2 Fasten materials in straight, aligned lengths with screws as recommended by manufacturer.
- .3 Cut materials with carbide tipped blades designed to cut wood. Avoid fine tooth metal cutting blades.
- .4 Finish edges by sanding, grinding or filing with traditional woodworking tools.
- .5 Glue joints to eliminate joint separation.
- .6 Drilling, milling, and routing can be performed with traditional tools used for lumber.

3.2 CLEANING AND PROTECTION

- .1 Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .2 Wash down exposed surfaces in accordance with manufacturers cleaning instructions.
- .3 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation for asphalt for use as dampproofing.

1.2 RELATED SECTIONS

- .1 Section 03 30 00 – Cast-In-Place Concrete
- .2 Section 07 21 13 – Board Insulation

1.3 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM D1227-13, Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing.
- .2 Canadian General Standards Board (CGSB)
 - .1 CGSB 37-GP-9MA-83, Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing and Waterproofing.
- .3 Canadian Standards Association (CSA International)
 - .1 CSA A123.4-04 (R2013), Asphalt for Construction Built-Up Roof Coverings and Waterproofing Systems.
- .4 National Research Council Canada (NRC)/Institute for Research in Construction (IRC)
 - .1 Canadian Construction Materials Centre (CCMC)
- .5 South Coast Air Quality Management District (SCAQMD), California State
 - .1 SCAQMD Rule 1113-16, Architectural Coatings.
- .6 Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.4 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00 – Submittals:
 - .1 Provide two copies of WHMIS MSDS - Material Safety Data Sheets in accordance with WHMIS acceptable to Labour Canada, and Health and Welfare Canada.
 - .2 Submit product data sheets for bituminous dampproofing products including:
 - .1 Product characteristics.
 - .2 Performance criteria.
 - .3 Application methods.
 - .4 Limitations.
- .2 Manufacturer's Instructions: Submit manufacturer's written installation instructions indicating:
 - .1 Special handling criteria.
 - .2 Installation sequence.

- .3 Surface preparation.
- .4 Environmental restrictions.
- .5 Cleaning procedures.

1.5 QUALITY ASSURANCE

- .1 Obtain primary dampproofing materials from single manufacturer and/or ensure materials ordered and supplied are compatible with one another. Ensure dampproofing materials are compatible with air and vapour retarder specified under Section 07 27 13 – Modified Bituminous Air and Vapour Barrier.
- .2 Obtain secondary materials recommended by manufacturer of, and compatible with primary dampproofing materials.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Provide and maintain dry, off-ground weatherproof storage.
- .2 Store materials on supports to prevent deformation.
- .3 Remove only in quantities required for same day use.
- .4 Store materials in accordance with manufacturer's written instructions.

1.7 WASTE MANAGEMENT AND DISPOSAL

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

1.8 PROJECT/SITE ENVIRONMENTAL REQUIREMENTS

- .1 Temperature, relative humidity, moisture content.
 - .1 Apply dampproofing materials only when surfaces and ambient temperatures are within manufacturers' prescribed limits.
 - .2 Do not proceed with Work when wind chill effect would tend to set bitumen before proper curing takes place.
 - .3 Maintain air temperature and substrate temperature at dampproofing installation area above 5 degrees C for 24 hours before, during and 24 hours after installation.
 - .4 Do not apply dampproofing in wet weather.
- .2 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.
- .3 Ventilation:
 - .1 Arrange for ventilation system to be operated during installation of dampproofing.
 - .2 Ventilate enclosed spaces in accordance with Section 01 51 00 - Temporary Utilities.
 - .3 Provide continuous ventilation during and after dampproofing application. Run ventilation system 24 hours per day during installation; provide continuous ventilation for 7 days after completion of dampproofing installation.

Part 2 Products

2.1 MATERIALS

- .1 Emulsion Type Dampproofing Coating: Asphaltic, water based emulsion dampproofing, asbestos free, designed for application to exterior side of below grade foundations and walls, containing no solvents in accordance with ASTM D1227 and as follows:
 - .1 Application Temperature: 5°C minimum.
 - .2 Grade: Spray - Type III or II, Class 1
 - .3 VOC Content: Maximum 30 g/L (less water and exempt solvents).
 - .4 Acceptable materials:
 - .1 700-01, Henry Company.
 - .1 Dehydratine 75, Euclid Chemical Company.
 - .2 Sealmatic Type I, W.R. Meadows.

2.2 ACCESSORIES

- .1 Protection Board: Asphalt impregnated fibreboard, 13 mm thickness.
- .2 Polypropylene Protection Board, 2mm thick
 - .1 Basis of Design:
 - .1 990-31, Henry Company
- .3 Board Insulation: Plastic foam foundation insulation as specified in Section 07 21 13.
- .4 Drainage board: high-strength drainage panel consisting of polypropylene core and fabric for installation over waterproof membranes with the following characteristics:
 - .1 Thickness: 10 mm
 - .2 Compressive strength: 550 kPa
 - .3 Flow rate: 223 l/min/m.
 - .4 Acceptable materials:
 - .1 DB 2000, Henry.
 - .2 Delta-Drain 6200, Cosella-Dorken
 - .3 Mel-Drain 5035, W.R. Meadows.
 - .4 Sopradrain 10G, Soprema.
- .5 Termination Bar: high strength plastic composite, ultraviolet resistant as recommended by membrane manufacturer.
- .6 Provide drainage board accessories as required for complete installation as recommended by drainage board manufacture.
- .7 Joint Sealing Compound: as recommended by dampproofing manufacturer.
- .8 Primer: as recommended by dampproofing manufacturer.
- .9 Patching Compound: fibred mastic compound as recommended by dampproofing manufacturer.

- .10 Reinforcing Fabric: asphalt coated fabric as recommended by dampproofing manufacture.

Part 3 Execution

3.1 PROTECTION

- .1 Protect adjoining surfaces from soiling during application.

3.2 EXAMINATION

- .1 Examine substrates and verify that surface smoothness, moisture emissions and other conditions affecting performance of materials specified in this Section complies with the dampproofing manufacturer's recommended substrate requirements.

3.3 PREPARATION

- .1 Protect and mask adjoining exposed surfaces from being stained, spotted or coated with dampproofing; prevent dampproofing materials from entering or clogging weep holes, drains and perimeter drainage systems.
- .2 Seal exterior joints between foundation walls and footings, joints between concrete floor slab and foundation and around penetrations through dampproofing with sealing compound and reinforcing fabric before applying dampproofing.
- .3 Clean substrates, remove projections; fill voids and apply bond breakers (if required), and apply primer as recommended by dampproofing manufacturer.

3.4 INSTALLATION

- .1 Apply dampproofing to provide a continuous, uniform coating to entire exterior faces of foundation walls from 50 mm below finish grade level to and including tops of foundation wall footings:
 - .1 Do not permit dampproofing to extend onto surfaces exposed to view in final construction.
 - .2 Reinforce changes in direction greater than 45° at intersections, projecting surfaces, internal and external corners, changes in plane, and across construction joints, cracks and honeycombing; apply additional coat of dampproofing material to embed reinforcing fabric into primary dampproofing membrane; extend reinforcing fabric 200 mm to each side of areas requiring reinforcing.
 - .3 Allow for additional coats to achieve required coating.
 - .4 Provide sufficient drying time between successive coatings.
 - .5 Provide drying time according to manufacturer's recommendations before backfilling. Allow for a range of ambient temperatures and humidity.
- .2 Use cutback asphalt materials at temperatures below 5°C.
- .3 Use either cutback or emulsified asphalt materials, at Contractor's option, when surfaces and ambient air will be minimum 5°C for 72 hours before application, during application and for curing period.

- .4 Seal holes around pipes and other services passing through coating surfaces by using joint sealing compound applied in accordance with manufacturer's directions.

3.5 CLEANING

- .1 Dampproofing materials shall be removed from surfaces not intended to receive dampproofing.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Structural Drawings – Structural Concrete
- .2 Section 03 33 00 – Architectural Concrete
- .3 Section 06 10 00 – Rough Carpentry
- .4 Section 07 21 13 – Board Insulation
- .5 Section 07 27 13 – Modified Bituminous Air and Vapour Barrier
- .6 Section 07 92 00 – Sealants

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM E96/E96M-16, Standard Test Method for Water Vapor Transmission of Materials.
 - .2 ASTM E154/E154M-08a(2013)e1, Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.
 - .3 ASTM C726-17, Standard Specification for Mineral Wool Roof Insulation Board.
 - .4 ASTM C728-17, Standard Specification for Perlite Thermal Insulation Board.
 - .5 ASTM D41/D41M-11(2016), Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.
 - .6 ASTM D412-16, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
 - .7 ASTM D448-12, Standard Classification for Sizes of Aggregate for Road and Bridge Construction.
 - .8 ASTM D449/D449M-03(2014)e1, Standard Specification for Asphalt Used in Dampproofing and Waterproofing.
 - .9 ASTM D5147/D5147M-14, Standard Test Methods for Sampling and Testing Modified Bituminous Sheet Material.
 - .10 ASTM C1325-17, Standard Specification for Non-Asbestos Fiber-Mat Reinforced Cementitious Backer Units.
 - .11 ASTM D2178/D2178M-15a, Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing.
 - .12 ASTM D6162M-16, Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fibre Reinforcements.
 - .13 ASTM D6163M-16, Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fibre Reinforcements.
 - .14 ASTM D6164/D6164M-16, Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Polyester Reinforcements.

- .2 Canadian Roofing Contractors Association (CRCA)
 - .1 CRCA Roofing Specifications Manual.
- .3 Canadian Standards Association (CSA International)
 - .1 CSA-A123.3-05 (R2015), Asphalt Saturated Organic Roofing Felt (Reaffirmed 2010).
 - .2 CSA-A123.4-04 (R2013), Asphalt for Constructing Built-Up Roof Coverings and Waterproofing Systems.
 - .3 CSA A231.1-14/A231.2-14, Precast Concrete Paving Slabs/Precast Concrete Pavers.
- .4 Underwriters Laboratories' of Canada (ULC)
 - .1 CAN/ULC-S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.
 - .2 CAN/ULC-S702.2-15, Mineral Fibre Thermal Insulation for Buildings, Part 2: Application Guidelines.
 - .3 CAN/ULC-S704-11, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.
 - .4 CAN/ULC-S706-09, Standard for Wood Fibre Insulating Boards for Buildings.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Convene pre-installation meeting one week prior to beginning waterproofing Work, with waterproofing contractor's representative, Engineer, Departmental Representative, and Contractor in accordance with Section 01 31 19 – Project Meetings to:
 - .1 Verify project requirements.
 - .2 Co-ordination with other building subtrades.
 - .3 Review installation procedures, including:
 - .1 Substrate requirements for Project acceptance (curing of concrete surface, for release agents, temperature).
 - .2 Waterproofing installation.
 - .3 Phasing and sequencing requirements.
 - .4 Termination, flashing, expansion joint, and penetration requirements.
 - .5 Review inspection, testing, and quality control procedures.
 - .6 Manufacturer's warranty requirements.

1.4 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 – Submittals:
 - .1 Provide two copies of most recent technical waterproofing components data sheets describing materials' physical properties and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit membrane manufacturer's standard details that will be utilized for this project, indicate changes that must be made to make the details project specific for review by the Departmental Representative.

- .3 Provide two copies of WHMIS MSDS - Material Safety Data Sheets in accordance with WHMIS acceptable to Labour Canada, and Health and Welfare Canada and indicate VOC content for:
 - .1 Primers.
 - .2 Asphalt.
 - .3 Sealers.
 - .4 Filter fabric.
- .2 Submit shop drawings in accordance with Section 01 33 00 – Submittals:
 - .1 Indicate flashing, control joints, tapered insulation and penetration details.
 - .2 Layout for tapered insulation.
 - .3 Manufacturer's Certificate: certify that products meet or exceed specified requirements.
 - .4 Test and Evaluation Reports: submit laboratory test reports certifying compliance of bitumens and membrane with specification requirements.
 - .5 Manufacturer's Installation Instructions: indicate special precautions required for seaming the membrane.
 - .6 Manufacturer's field report: in accordance with Section 01 45 00 - Quality Control.
 - .7 Reports: indicate procedures followed, ambient temperatures and wind velocity during application.

1.5 QUALITY ASSURANCE

- .1 Installer Qualifications: Engage experienced installer acceptable to the membrane manufacturer with a minimum of 3 years experience who has completed systems similar in material, design, and extent to that indicated for Project and with record of successful performance.
- .2 Obtain primary waterproofing materials from single manufacturer and/or ensure materials ordered and supplied are compatible with one another. Ensure waterproofing materials are compatible with air and vapour retarder specified under Section 07 27 13 – Modified Bituminous Air and Vapour Barrier.
- .3 Coordination between all installers of each component of membrane is essential to ensure continuity of system and that junctions between the various components are effectively sealed.

1.6 FIRE PROTECTION

- .1 Fire Extinguishers:
 - .1 Maintain a clean site and have one approved ABC fire extinguisher within 6 meters of each roofing torch. Respect all safety measures described in manufacturer's technical data sheets. Do not place torches near combustible or flammable products.
 - .2 ULC labelled for A, B and C class protection.
- .2 Do not apply torch directly to dry or unprotected wood surfaces.
- .3 Use a heat detector gun to spot any smouldering or concealed fire at the end of each work day. Establish a minimum one hour fire watch after torch application.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Provide and maintain dry, off-ground weatherproof storage.
- .2 Store rolls of felt and membrane in upright position.
 - .1 Store membrane rolls with salvage edge up.
- .3 Remove only in quantities required for same day use.
- .4 Place plywood runways over completed Work to enable movement of material and other traffic.
- .5 Store sealants at +5 degrees C minimum.
- .6 Store insulation protected from daylight, weather and deleterious materials.
- .7 Handle waterproofing materials in accordance with manufacturer's written directives, to prevent damage or loss of performance.
- .8 Store and manage hazardous materials in accordance with Section 01 35 29 - Health and Safety Requirements.

1.8 WASTE MANAGEMENT AND DISPOSAL

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

1.9 FIELD CONDITIONS

- .1 Ambient Conditions
 - .1 Do not install waterproofing when temperature remains below -18 degrees C for torch application, or to manufacturers' recommendations.
 - .2 Minimum temperature for solvent-based adhesive is -5 degrees C.
- .2 Install waterproofing on substrate, free of snow and ice, use only dry materials and apply only during weather that will not introduce moisture into waterproofing system.

Part 2 Products

2.1 MANUFACTURERS

- .1 Acceptable manufacturers: Subject to compliance with requirements of this Section, products by the following manufacturers are acceptable. However, it is Contractor's responsibility to provide only products compatible with adjacent materials in assembly.
 - .1 Henry Bakor
 - .2 IKO
 - .3 Soprema.
 - .4 Tremco
 - .5 W.R. Meadows.

2.2 PERFORMANCE CRITERIA

- .1 Compatibility between components of waterproofing system is essential. Provide written declaration to Departmental Representative stating that materials and components, as assembled in system, meet this requirement.

2.3 SELF-ADHESIVE WATERPROOFING SYSTEM MATERIALS

- .1 Primer: water based primer as recommended by membrane manufacturer.
 - .1 Acceptable materials:
 - .1 Aquatac, Henry Bakor
 - .2 Elastocol Stick H2O, Soprema.
 - .3 Water Based Primer, IKO
 - .4 Mel-Prime Water-Base Primer, W.R. Meadows.
 - .2 Primer: to CGSB 37-GP-9Ma, elastomeric bitumen, solvent primer with adhesive enhancing resins to enhance adhesion of self-adhesive membranes at temperatures above -10°C as recommended by membrane manufacturer.
 - .1 Acceptable materials:
 - .1 Blueskin Adhesive, Henry Bakor
 - .2 Elastocol Stick, Soprema.
 - .3 SAM Adhesive, IKO
 - .4 Mel-Prime, W.R. Meadows.
 - .5 Blueskin LVC Adhesive, Henry Bakor.
 - .6 Mel-Prime NE, W.R. Meadows.
- .3 Waterproofing Membrane: SBS modified bitumen self-adhering sheet membrane with cross-laminated polyethylene film, covered by pull-off release sheets and as follows:
 - .1 Minimum total thickness: 1.5 mm
 - .2 Tensile strength (membrane): 4.07 MPa to ASTM D412
 - .3 Tensile strength (film): 40.71 MPa to ASTM D412
 - .4 Ultimate elongation: 455% to ASTM D412
 - .5 Flexibility at cold temperature: minimum -30°C
 - .6 Water vapour permeability: <0.019 perms to ASTM E96
 - .7 Puncture Resistance: 2.98 kN to ASTM E154
 - .8 Acceptable materials:
 - .1 Blueskin WP200, Henry Bakor.
 - .2 Carlisle CCW MiraDRI 860/861
 - .3 Aquabarrier FP, IKO
 - .4 Colphene 3000, Soprema.
 - .5 Mel-Rol, W.R. Meadows.
 - .6 Mel-Rol Low Temperature, W.R. Meadows.
 - .7 Blueskin WP200, Henry Company (minus 12C)

2.4 ACCESSORIES

- .1 Waterproofing Mastic: single component sealing compound to seal exterior, vertical and horizontal terminations as recommended by manufacturer.
- .2 Adhesive for overlay board and insulation: Water-based rubberised liquid coating as recommended by manufacturer.
- .3 Insulation: as specified in Section 07 21 13.
- .4 Protection board: glass mesh cement backer board to ASTM C1325, thickness as indicated on Drawings.
 - .1 Acceptable materials:
 - .1 Durock, CGC.
 - .2 Wonderboard, Custom Building Products.
 - .3 990-31, Henry Bakor.
- .5 Drainage board: high-strength drainage panel consisting of polypropylene core and fabric for installation over waterproof membranes with the following characteristics:
 - .1 Thickness: 10 mm
 - .2 Compressive strength: 550 kPa
 - .3 Flow rate: 223 l/min/m.
 - .4 Acceptable materials:
 - .1 DB 2000, Bakor.
 - .2 Mel-Drain 5035, W.R. Meadows.
 - .3 Nilex WD 15, IKO
 - .4 Sopradrain 10G, Soprema.
 - .5 TremDrain 6000, Tremco
- .6 Protection Board (for all horizontal underslab installations): premanufactured protection board as recommended by the membrane manufacturer for installation under slabs.
- .7 Protection Board (for all vertical applications): 25 mm thick expanded polystyrene foam board or other premanufactured protection board as recommended by the membrane manufacturer.
- .8 Protection board adhesive: fast drying, rubber based cement,
 - .1 Acceptable Materials:
 - .1 Bituthene PBA3000,
 - .2 Airbloc 21 or 230-21 By Henry Bakor
 - .2 Note: protection board adhesive is to be compatible with protection board and with membrane.
- .9 Termination Bar: high strength plastic composite, ultraviolet resistant as recommended by membrane manufacturer.
- .10 Provide drainage board accessories as required for complete installation as recommended by drainage board manufacture.

Part 3 Execution

3.1 EXAMINATION AND PREPARATION OF SURFACES

- .1 Do not proceed with work until conditions are in accordance with manufacturers instructions.
- .2 Ensure surfaces are smooth, dry, clean and free of ice and debris as per manufacturer's recommendations.
- .3 Do not install materials in conditions of snow or rain.
- .4 Cure concrete a minimum of fourteen (14) days, adhesion test is recommended before membrane application.
- .5 Verify the compatibility of membrane components with curing compounds, coatings, or other materials which are already installed on the surfaces to be treated.
- .6 Report cracks over 3 mm wide to Departmental Representative. Fill crack with waterproofing mastic. Apply 150 mm wide strip of membrane centered over crack.

3.2 METHOD OF EXECUTION

- .1 Perform Work on a continuous basis as surface and weather conditions allow.
- .2 Protect adjoining surfaces against damage that could result from the waterproofing installation.

3.3 PRIMER APPLICATION

- .1 Apply primer coating as recommended by manufacturers printed instructions. If not covered the same day, primed surfaces must be re-primed.

3.4 SELF-ADHESIVE WATERPROOFING MEMBRANE INSTALLATION

- .1 Select waterproofing membrane according to temperatures during application. For membrane applications (not primer) at temperature below -10°C, contact membrane manufacturer.
- .2 Apply pre-stripped membrane and seal with waterproofing mastic to all protrusions through waterproofing membrane.
- .3 Align the first roll of membrane to a previously drawn chalk line.
- .4 Pre-strip edges with a 150 mm wide strip of membrane centered on the corner. Membrane to be installed in direct contact with the substrate not leaving any voids under the membrane strip.
- .5 Install membrane onto primed surface by peeling back the paper backing on the underside and adhering the membrane to the surface.
- .6 Install subsequent rolls in the same manner and aligned with the preceding roll with a side lap of at least 75 mm. End laps must be overlapped at least 150 mm.
- .7 Holes and tears in the membrane must be repaired with the appropriate membrane material. The repair must exceed the affected surface area by at least 75 mm. The membrane piece applied for the repair must be sealed around its edges with mastic.

- .8 Use a roller approved by manufacturer to apply pressure over the entire surface of the membrane to ensure perfect adhesion.
- .9 Contractor to verify meticulously the membrane installation at the end of each day of work and before application of membrane protection system and backfilling.
- .10 Seal all inside corner overlaps with a bead of mastic after membrane installation.
- .11 Uppermost edge of membrane is to be mechanically fastened to the concrete substrate using applicable fasteners and termination bars.
- .12 Apply mastic on the top edge of membrane to prevent water infiltration.
- .13 Any waterproofing membrane left exposed after backfilling shall be protected from ultra violet and mechanical damages.

3.5 PROTECTION, INSULATION, AND DRAINAGE BOARD INSTALLATION

- .1 Drape the drainage board and secure without fastening through the waterproofing membrane or tape to the waterproofing membrane.
 - .1 Unroll drainage board with flat core side against the wall or waterproofing membrane.
 - .2 Adhere drainage board with mastic without fastening through the waterproofing membrane.
 - .3 Overlap flat side core lip with second sheet of the drainage board to provide a continuous drainage layer. Ensure excess filter fabric is overlapped with the next sheet.
- .2 Apply adhesive with spots 75 mm in diameter, every 300 mm. Bottom panel should be supported or mechanically fixed. On the top row of insulation, apply a continuous bead of adhesive 25 mm wide to the top leading edge of the panels to be glued. This bead will protect the adhesive spots during initial cure by limiting the flow of moisture behind the insulation in case of rain.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 This Section includes requirements for the supply and installation of vehicular traffic coatings having integral waterproofing membrane on slabs for the following applications:
 - .1 Pedestrian traffic.
 - .2 Vehicular traffic.
 - .3 Pavement markings.
- .2 Supply and install vehicular traffic coatings that:
 - .1 Protect concrete substrates and reinforcement from damage arising from reactions with salts and water.
 - .2 Prevent passage of water and salts through substrates under pressure.
 - .3 Provide non-slip surfaces capable of supporting vehicle traffic.
 - .4 Bridge latent developing cracks in substrate up to and including 1.5 mm in width.

1.2 RELATED SECTIONS

- .1 Section 03 30 00 – Cast-in-Place Concrete
- .2 Section 03 35 00 – Concrete Finishing
- .3 Section 07 92 00 – Joint Sealants: Elastomeric, traffic bearing joint sealants.

1.3 REFERENCES

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM C957M-50, Standard Specification for High-Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane with Integral Wearing Surface
 - .2 ASTM C1127/C1127M-15, Standard Guide for Use of High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane with an Integral Wearing Surface
 - .3 ASTM C1193-16, Standard Guide for Use of Joint Sealants
 - .4 ASTM D4797-12a Standard Test Methods for Chemical and Gravimetric Analysis of White and Yellow Thermoplastic Traffic Marking Containing Lead Chromate and Titanium Dioxide
- .2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB 1.5-M91, Low Flash Petroleum Spirits Thinner
- .3 International Concrete Repair Institute (ICRI):
 - .1 Guideline 03732-1997, Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings and Polymer Overlays

- .4 The Master Painters Institute (MPI):
 - .1 Architectural Painting Specification Manual

1.4 SUBMITTALS

- .1 Provide required information in accordance with Section 01 33 00 – Submittals.
- .2 Submit product data for each product specified.
- .3 Submit shop drawings indicating extent of each traffic coating including details for treating substrate joints and cracks, flashings, deck penetrations, and other termination conditions and pavement marking layout.
- .4 Submit stepped samples of each type of traffic coating required, prepared on rigid backing and of same thickness and material specified for the Work; make samples large enough to illustrate build-up of traffic coatings.
- .5 Submit statement of material compatibility indicating that primers; base, intermediate, and topcoats; and miscellaneous materials are compatible with one another and with substrate under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

1.5 PROJECT CLOSEOUT SUBMISSIONS

- .1 Provide operations and maintenance information in accordance with Section 01 11 00 – General Requirements, Operations and Maintenance Data.
- .2 Submit maintenance data for traffic coatings for inclusion in maintenance manuals including, but not limited to, the following:
 - .1 Identify substrates and types of traffic coatings applied.
 - .2 Include recommendations for periodic inspections, cleaning, care, maintenance, and repair of traffic coatings.

1.6 QUALITY ASSURANCE

- .1 Use installer trained by traffic coating manufacturer and who is approved for installation of traffic coatings required for this Project, having a minimum of three (3) years of experience with projects of similar scope and complexity.
- .2 Obtain primary traffic coating primers and coatings from single manufacturer; obtain secondary materials such as aggregates, flashings, sealants and repair materials from source recommended in writing by primary material manufacturer; with total sum of components meeting or exceeding requirements of ASTM C957.
- .3 Provide traffic coating materials with fire test response characteristics required by testing identical products using independent testing and inspecting agency that is acceptable to Authorities Having Jurisdiction.

1.7 MOCK-UPS

- .1 Provide required Sample Installation in accordance with Section 01 45 00 –, Quality Control.
- .2 Mock-ups will set quality standards for materials and execution as follows:

- .1 Departmental Representative will select one representative surface for each traffic coating and each substrate to receive traffic coatings.
- .2 Apply each coating to a minimum 10 m² area of each substrate to demonstrate surface preparation, joint and crack treatment, thickness, texture, color, and standard of workmanship.
- .3 Acceptable mock-ups may become part of the completed Work if undisturbed at time of Substantial Performance for the Project.

1.8 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver materials in original packages and containers with seals unbroken and bearing manufacturer's labels showing the following information:
 - .1 Manufacturer's brand name.
 - .2 Type of material.
 - .3 Directions for storage.
 - .4 Date of manufacture and shelf life.
 - .5 Lot or batch number.
 - .6 Mixing and application instructions.
 - .7 Colour.
- .2 Store materials in a clean, dry location protected from exposure to direct sunlight.
- .3 Maintain environmental conditions in storage areas within range recommended in writing by manufacturer.

1.9 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 – Waste Management and Disposal.

1.10 PROJECT CONDITIONS

- .1 Apply traffic coatings within range of ambient and substrate temperatures recommended in writing by manufacturer.
- .2 Apply traffic coatings to clean and dry substrates, when temperatures are above 5°C and a minimum of 3°C above dew point, and when relative humidity is below 85%.
- .3 Apply traffic coatings when substrates are frost free throughout depth of substrate, and when potential for snow, rain, fog, mist, or similar weather conditions are not imminent during the application and curing period.
- .4 Apply traffic coating after items penetrating membrane have been installed.

1.11 WARRANTY

- .1 Provide manufacturer's standard form of warranty indicating that manufacturer agrees to repair or replace traffic coatings that deteriorate during the specified warranty period.
- .2 It is understood that warranty does not include deterioration or failure of traffic coating due to unusual weather phenomena, failure of prepared and treated

substrate, formation of new substrate cracks exceeding 1.5 mm in width, fire, vandalism, or damage arising from snow plough, maintenance equipment, and truck traffic.

- .3 Deterioration of traffic coatings includes, but is not limited to, the following:
 - .1 Adhesive or cohesive failures.
 - .2 Abrasion or tearing failures.
 - .3 Surface crazing or spalling.
 - .4 Intrusion of water, oils, gasoline, grease, salt, de-icing chemicals, or acids into deck substrate.
 - .5 Warranty Period: Five (5) years from date of Substantial Performance.

1.12 MAINTENANCE SERVICE

- .1 Submit detailed maintenance proposal for consideration by Departmental Representative indicating inspection services and costs of providing the services; include current price structure and projected escalation factors that will be applied during the term of the maintenance contract.
- .2 Carefully inspect the work of this Section twice yearly during warranty period, and submit typewritten reports to Departmental Representative indicating condition of work and defects found, if any.
- .3 Make good all defects covered by warranty at no cost to Departmental Representative.

Part 2 Products

2.1 MANUFACTURERS

- .1 Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - .1 Advanced Polymer Technology Corp., Qualideck
 - .2 Duochem Inc., Duodeck
 - .3 Neogard, Autogard FC
 - .4 BASF Building Systems, Sonneborn, Sonoguard
 - .5 Stoncor Group
 - .6 Technical Barrier Systems Inc., Kelmar FWC III
 - .7 MAPEI Inc., Mapefloor, Parking Deck System

2.2 MATERIALS

- .1 Primer: Manufacturer's standard factory formulated primer recommended for substrate and conditions indicated.
- .2 Base and Intermediate Coats: Single or multi-component liquid urethane or epoxy elastomeric membrane forming part of manufacturer's standard vehicular traffic deck as required to meet traffic exposure requirements listed in this Section.

- .3 Topcoat: Single or multi-component liquid urethane or epoxy elastomeric membrane top coat with UV light inhibitors for exterior applications forming part of manufacturer's standard vehicular traffic deck as required to meet traffic exposure requirements listed in this Section; colour as selected by Departmental Representative from manufacturer's full range.
- .4 Aggregate: Uniformly graded, washed quartz sand having particle sizes and shapes in sufficient quantities required to achieve slip resistance and service conditions as recommended by coating manufacturer and as scheduled.

2.3 ACCESSORY MATERIALS

- .1 Joint Sealants: Refer to Section 07 92 00, of type compatible with traffic coating materials.
- .2 Sheet Flashing: Non-staining elastomeric preformed membrane forming a part of traffic coating system, having a minimum 1.5 mm thickness in widths necessary to adequately bridge cracks and gaps.
- .3 Liquid Flashing: Non-staining liquid applied elastomeric membrane compatible with sheet flashing and traffic coating materials.
- .4 Adhesive: Contact adhesive compatible with traffic coating materials.
- .5 Reinforcing Strip: Fibreglass mesh forming a part of traffic coating system, compatible with liquid flashing and traffic coating materials.

2.4 PAVEMENT MARKINGS

- .1 Paint: Alkyd traffic paint meeting requirements of ASTM D4797, colour as directed by Departmental Representative to ASTM E1360, and in accordance with MPI Architectural Painting Specification Manual "Approved Product" listing MPI #32, Alkyd Traffic Paint.
- .2 Thinner: In accordance with CAN/CGSB 1.5.

Part 3 Execution

3.1 EXAMINATION

- .1 Examine substrates and notify Contractor in writing verifying that substrates are compatible, and are free from moisture or other conditions detrimental to performance of traffic coating system.
- .2 Start coating application after minimum concrete curing and drying period recommended by traffic coating manufacturer and after unsatisfactory conditions have been corrected.
- .3 Application of traffic coating will indicate acceptance of surfaces and conditions.

3.2 PREPARATION

- .1 Clean and prepare substrates in accordance with ASTM C1127 and manufacturer's written recommendations to produce clean, dust free, dry substrate for traffic coating application.

- .2 Mask adjoining surfaces not receiving traffic coatings, deck drains, and other deck substrate penetrations to prevent spillage, leaking, and migration of coatings.
- .3 Mechanically abrade concrete surfaces to achieve a minimum ICRI CSP3 to 4 uniform profile, and as follows:
 - .1 Acid etching of surfaces will not be considered as acceptable surface preparation.
 - .2 Remove grease, oil, paints, and other penetrating contaminants from concrete.
 - .3 Remove concrete fins, ridges, and other projections.
 - .4 Remove laitance, glaze, efflorescence, curing compounds, concrete hardeners, form release agents, and other incompatible materials that might affect coating adhesion.
 - .5 Remove remaining loose material to provide a sound surface, and clean surfaces.

3.3 TERMINATIONS AND PENETRATIONS

- .1 Prepare vertical and horizontal surfaces at terminations and penetrations through traffic coatings and at expansion joints, drains, and sleeves in accordance with ASTM C1127 and manufacturer's written recommendations.
- .2 Provide sealant cants at penetrations, and at reinforced and non-reinforced deck-to-wall butt joints.
- .3 Terminate edges of deck-to-deck expansion joints with preparatory base coat strip.
- .4 Install sheet flashings at deck-to-wall expansion and dynamic joints, and bond to deck and wall substrates in accordance with manufacturer's written recommendations.

3.4 JOINT AND CRACK TREATMENT

- .1 Prepare, treat, rout, and fill joints and cracks in substrates in accordance with ASTM C1127 and manufacturer's written recommendations, remove dust and dirt from joints and cracks before applying joint treatment materials.
- .2 Seal control joints and bridge using preformed or liquid applied membrane flashing materials in accordance with manufacturers written instructions.
- .3 Apply sealants in accordance with ASTM C1193.

3.5 TRAFFIC COATING APPLICATION

- .1 Apply traffic coating material in accordance with ASTM C1127 and manufacturer's written recommendations.
- .2 Verify thickness of wet film for each component coat is in accordance with manufacturer's requirements once every 10 m2.
- .3 Apply traffic coatings to prepared wall terminations and vertical surfaces to a minimum height of 150 mm; omit aggregate on vertical surfaces.

- .4 Cure traffic coatings in accordance with manufacturer's written instructions; prevent contamination and damage during application and curing stages.

3.6 PAVEMENT MARKINGS

- .1 Apply traffic paint for striping and other markings after traffic coating has cured in accordance with manufacturer's written recommendations.
- .2 Apply traffic paint for striping and other markings using mechanical equipment to produce uniform straight edges at application rates recommended by paint manufacturer to achieve minimum wet film thickness.

3.7 FIELD QUALITY CONTROL

- .1 Departmental Representative will engage a qualified testing agency to perform the following field tests and inspections:
 - .1 Take samples of material delivered to site, identified, sealed, and certified in presence of Departmental Representative and Contractor.
 - .2 Confirm compliance with specified standards.
 - .3 Verify thickness of coatings during traffic coating application.
 - .4 Remove non-complying materials, prepare surfaces, and reapply traffic coatings where test results show traffic coating materials do not comply with requirements.
 - .5 Repair cuts and patches taken for inspection and testing purposes to same standard as remaining areas of installation.
 - .6 Submit test reports indicating condition and any repairs made to traffic coating system.
- .2 Arrange for traffic coating manufacturer's technical personnel to inspect membrane installation on completion ready for issuance of warranty and statement of material compatibility.
- .3 Additional testing and inspecting may be performed to determine compliance of replaced or additional work with specified requirements.

3.8 PROTECTING AND CLEANING

- .1 Clean spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.
- .2 Remove surface blemishes from coatings using cleaners and procedures recommended by traffic topping manufacturer.
- .3 Protect traffic coatings from damage and wear during remainder of construction period.

3.9 TRAFFIC COATING SCHEDULE

- .1 Traffic Exposure Classification, as follows:

Mark	Traffic Exposure Classification	Description
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1	Light Duty	Parking stalls, pedestrian areas and other areas exposed to light traffic using single broadcast quartz sand texturing.
2	Medium Duty	Level traffic lanes and gradually sloping ramps, and for parking stalls in high traffic areas using single broadcast using single broadcast quartz sand texturing.
3	Heavy Duty	Steep or helix ramps, high torque turning areas and areas adjacent to ticket dispensers, entrances and cashiers using double broadcast quartz sand texturing.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 03 30 00 – Cast-in-Place Concrete
- .2 Section 04 22 00 – Unit Masonry
- .3 Section 07 21 16 – Fibrous Insulation
- .4 Section 07 27 13 – Modified Bituminous Air and Vapour Barrier
- .5 Section 07 27 19 – Sheet Membrane Air and Vapour Barrier
- .6 Section 09 21 16 – Gypsum Board Assemblies

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A653/A653M-15e1, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .2 ASTM C208-12, Specification for Cellulosic Fiber Insulating Board.
 - .3 ASTM C591-16, Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
 - .4 ASTM C612-14, Standard Specification for Mineral Fibre Block and Board Thermal Insulation.
 - .5 ASTM C726-17, Standard Specification for Mineral Wool Roof Insulation Board.
 - .6 ASTM C728-17, Standard Specification for Perlite Thermal Insulation Board.
 - .7 ASTM C1126-15, Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation.
 - .8 ASTM C1289-16, Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
 - .9 ASTM D1621-16, Standard Test Methods for Compressive Properties of Rigid Cellular Plastics.
 - .10 ASTM D2842-12, Standard Test Methods for Water Absorption of Rigid Cellular Plastics.
 - .11 ASTM E96/E96M-16, Standard Test Methods for Water Vapour Transmission of Materials.
- .2 American Society of Heating Refrigeration and Air-Conditioning (ASHRAE)
 - .1 ASHRAE 90.1-2013, Energy Standard for Buildings Except Low-rise Residential Buildings.
- .3 Canadian Gas Association (CGA)
 - .1 CAN/CGA-B149.1-15, Natural Gas and Propane Installation Code, Includes Update No.1 (2010).
 - .2 CAN/CGA-B149.2-15, Propane Storage and Handling Code.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

- .5 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-11, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S114-05, Test for Determination of Non-Combustibility in Building Materials.
 - .3 CAN/ULC-S604-M91, Standard for Factory-Built Type A Chimneys.
 - .4 CAN/ULC-S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Coverings.
 - .5 CAN/ULC-S702-.2-15, Mineral Fibre Thermal Insulation for Buildings, Part 2: Application Guidelines.
 - .6 CAN/ULC-S704-11, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.

1.3 PRE-INSTALLATION MEETINGS

- .1 Pre-Installation Meetings: convene pre-installation meeting one week prior to beginning work of this Section and on-site installation, with contractor's representative and Departmental Representative in accordance with Section 01 31 19 – Project Meetings to:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordination with other building subtrades.
 - .4 Review manufacturer's installation instructions.

1.4 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 – Submittals:
 - .1 Submit manufacturer's printed product literature, specifications and data sheet.
 - .2 Provide two copies of WHMIS MSDS - Material Safety Data Sheets in accordance with WHMIS acceptable to Labour Canada, and Health and Welfare Canada. Indicate VOC's insulation products and adhesives.
- .2 Manufacturer's Instructions:
 - .1 Submit manufacturer's installation instructions.

1.5 QUALITY ASSURANCE

- .1 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
- .2 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .3 Health and Safety Requirements: in accordance with Section 01 35 29 - Health and Safety Requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Storage and Handling Requirements:

- .1 Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- .2 Protect plastic insulation as follows:
 - .1 Do not expose to sunlight, except to extent necessary for period of installation and concealment.
 - .2 Protect against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.
 - .3 Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

1.7 WASTE MANAGEMENT AND DISPOSAL

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

Part 2 Products

2.1 MANUFACTURERS

- .1 Acceptable Manufacturers: Subject to compliance with requirements specified in this section and as established by the Basis-of-Design materials, manufacturers offering similar products that may be incorporated into the Work include the following:
 - .1 Beaver Plastics
 - .2 Dow Canada
 - .3 Fibrex Insulations, Inc.
 - .4 Johns Manville
 - .5 Owens-Corning Canada
 - .6 Rockwool Inc.

2.2 INSULATION MATERIALS

- .1 Foundation Wall Insulation: Extruded polystyrene (XPS) to CAN/ULC S701 and as follows:
 - .1 Type: 4
 - .2 Thermal Resistance: RSI 0.87/25 mm minimum.
 - .3 Edges: square
 - .4 Size: 610 mm x 2440 mm x thickness as indicated on Drawings.
 - .5 Compressive Strength: minimum 200 kPa at 10% deformation in accordance with ASTM D1621.
 - .6 Water Absorption: maximum 0.7% (% by volume) in conformance with ASTM D2842.
 - .7 Acceptable Materials:
 - .1 Dow Styrofoam SM
 - .2 Owens-Corning Canada LP Foamular C-300

- .2 Perimeter Insulation: Premanufactured concrete faced polystyrene, extruded type, in accordance with CAN/ULC S701 and as follows:
 - .1 Type: 4
 - .2 Thermal Resistance: RSI 0.87/25 mm minimum.
 - .3 Edges: tongue and groove.
 - .4 Size: 610 mm x 1220 mm x thickness as indicated on Drawings with 8 mm concrete topping.
 - .5 Compressive Strength: minimum 200 kPa at 10% deformation in accordance with ASTM D1621.
 - .6 Water Absorption: maximum 0.7% (% by volume) in conformance with ASTM D2842.
 - .7 Acceptable Materials:
 - .1 Tech-Crete Processors Ltd., CFI Wall Panels.
 - .2 T-Clear Corp., CFI Wall Panels
- .3 Load Bearing Insulation: Extruded Polystyrene (XPS), high density extruded type in accordance with CAN/ULC S701 and as follows:
 - .1 Type: 4
 - .2 Thermal Resistance: RSI 0.87/25 mm minimum.
 - .3 Edges: square
 - .4 Size: 610 mm x 2440 mm x thickness as indicated on Drawings.
 - .5 Compressive Strength: minimum 690 kPa at 5% deformation in accordance with ASTM D1621.
 - .6 Water Absorption: maximum 1% (% by volume) in conformance with ASTM D2842.
 - .7 Acceptable Materials:
 - .1 Beaver Plastics. TerraFoam EPS HS- 100
 - .2 Dow Styrofoam, Hiload 100
 - .3 Owen-Corning Canada LP, Foamular 1000

2.3 ACCESSORIES

- .1 Adhesive (for polystyrene): trowel consistency, synthetic rubber based insulation adhesive compatible with polystyrene insulation to CGSB 71-GP-24; suitable for application in temperature down to -12°C.
 - .1 Basis of Design:
 - .1 230-21 or Airbloc 21 Rigid Insulation Adhesive, Bakor
 - .2 Alternatives will be considered for this material.
- .2 Thermal Spacers: low-conductivity, fibreglass thermal spacers as follows:
 - .1 Depth: 150 mm and as indicated on Drawings.
 - .2 Spacing: as indicated on Drawings or as required to suit conditions.
 - .3 Fasteners: as recommended by manufacturer in length to suit wall construction.
 - .4 Acceptable Materials:
 - .1 Cascadia Clip, by Cascadia Windows Ltd.

- .2 ISO Clip, Northern Facades
- .3 Insulation Fasteners
 - .1 Mechanical Fasteners: High quality, impact resistant plastic fastener system specifically designed for installation of board insulation materials; 38 mm diameter, shaft length to suit insulation thickness and hot dipped galvanized fastener to suit substrate, and as follows:
 - .1 Basis-of-Design Materials:
 - .1 Ucan Fastening Systems, Insulation Fasteners
 - .2 Insulation Clips: Impale type, perforated 50 mm x 50 mm cold rolled carbon steel 0.912 mm core metal thickness, adhesive back; 2.657 mm diameter annealed steel wire spindle, length to suit insulation, 25 mm diameter self locking washers, and as follows:
 - .1 Basis-of-Design Materials: [Gemco Insulation Fasteners](#), Insulation Hanger; substitutions will be considered for this material.
 - .3 Concrete Faced Insulation Fasteners: Concrete faced insulation manufacturer's standard concealed fasteners with groove mounting plate and fastening spline.
 - .4 Perimeter Insulation Flashings: Coordinate supply of end closures and flashings for perimeter insulation system with Section 07 62 00.
 - .5 Drainage board: high-strength drainage panel consisting of polypropylene core and fabric for installation over waterproof membranes with the following characteristics:
 - .1 Thickness: 10 mm
 - .2 Compressive strength: 550 kPa
 - .3 Flow rate: 223 l/min/m.
 - .4 Acceptable materials:
 - .1 DB 2000, Bakor.
 - .2 Mel-Drain 5035, W.R. Meadows.
 - .3 Sopradrain 10G, Soprema.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 EXAMINATION

- .1 Examine substrates and immediately inform Departmental Representative in writing of defects.
- .2 Prior to commencement of work ensure:
 - .1 Substrates are firm, straight, smooth, dry, free of snow, ice or frost, and clean of dust and debris.

3.3 WORKMANSHIP

- .1 Install insulation after building substrate materials are dry.
- .2 Install insulation to maintain continuity of thermal protection to building elements and spaces.
- .3 Fit insulation tight around electrical boxes, plumbing and heating pipes and ducts, around exterior doors and windows and other protrusions.
- .4 Keep insulation minimum 75 mm from heat emitting devices such as recessed light fixtures, and minimum 50 mm from sidewalls of CAN4-S604 type A chimneys and CAN/CGA-B149.1 and CAN/CGA-B149.2 type B and L vents.
- .5 Use only insulation boards free from chipped or broken edges that is dry, and unsoiled and that has not been left exposed at any time to ice and snow.
- .6 Use largest possible dimensions to reduce number of joints.
- .7 Offset both vertical and horizontal joints in multiple layer applications.
- .8 Do not enclose insulation until it has been reviewed by Departmental Representative.

3.4 INSTALLATION: GENERAL

- .1 Install rigid insulation to maintain continuous thermal insulation, vapour barrier and air tightness for building spaces and elements.
- .2 Saw-cut and trim insulation neatly to fit spaces. Butt edges and ends tight. Fit insulation tight against mechanical, electrical and other items protruding plane of insulation. Fill voids with foamed-in-place insulation compatible with installed insulation; refer to Section 07 21 19.
- .3 Follow the instructions for use of materials of insulation and accessory manufacturers.
- .4 Install insulation horizontally. Offset vertical joints minimum 300 mm.
- .5 Leave insulation joints unbonded over line of expansion and control joints; bond a continuous 150 mm wide strip of primary vapour membrane over expansion and control joints using compatible adhesive.

3.5 INSTALLATION: PERIMETER INSULATION

- .1 Install board insulation to vertical surfaces with adhesive applied in accordance with manufacturer's written instructions, and as follows:
 - .1 Interior Application: Extend boards as indicated on Drawings, installed on inside face of perimeter foundation walls.
 - .2 Exterior Application: Extend boards as indicated on Drawings, installed on exterior face of perimeter foundation wall.
 - .3 Apply adhesive to the substrate by the "dab" method not less than 10 mm x 20 mm size at 150 mm centres; bed the insulation in the adhesive before the adhesive loses its tack or skins over.
- .2 Concrete Faced Perimeter Insulation: Install in accordance with manufacturer's written instructions, and as follows:
 - .1 Fasten board insulation using manufacturer recommended fastening system.

- .2 Cover exposed insulation at corners and top of perimeter insulation with prefinished flashing as specified in Section 07 62 00.
- .3 Install boards vertically in accordance with manufacturers written instructions.

3.6 INSTALLATION: UNDERSLAB INSULATION

- .1 Extend boards as indicated on Drawings, and as follows:
 - .1 Lay boards on level compacted fill.
 - .2 Protect top surface of horizontal insulation from damage during concrete work by applying protection board.
 - .3 Insulate structural slabs at entrances with insulation placed horizontally underneath the concrete, and insulate surrounding slabs on grade in the same way for a distance of 1200 mm in every direction from the perimeter of the structural slab; omit perimeter insulation on adjacent foundations for the width of the structural slab.
- .2 Load Bearing Insulation: Install in accordance with manufacturer's written instructions, and as follows:
 - .1 Load Bearing Insulation: Install board insulation horizontally having a minimum compressive strength of 690 kPa on level compacted fill to locations indicated on Drawings.

3.7 INSTALLATION: CAVITY WALL INSULATION

- .1 Cavity Wall Insulation: Fit courses of insulation between wall ties and other confining obstructions in cavity; butt edges tightly in vertical and horizontal directions and as follows:
 - .1 Install cavity insulation with a tight fit to substrate materials, provide adhesive and additional fasteners where uneven substrates cause air spaces behind insulation; apply adhesive to substrate in a continuous film not less than 3 mm thick when wet and bed the insulation into adhesive before adhesive loses its tack or skins-over.
 - .2 Apply insulation fasteners using a minimum of six (6) fasteners in two rows located near the centre of the board along the narrow dimension and near the third points along the long dimension; secure boards with two clips at the centre where both dimensions are less than 600 mm.
 - .3 Coordinate application of cavity wall insulation with installation of masonry ties and anchors specified in Section 04 22 00.
 - .4 Apply sheet membrane vapour retarder behind Z-bars prior to installation of insulation between Z-bars supporting preformed metal cladding.
 - .5 Install insulation clips to walls before sheet membrane vapour retarders are applied.

3.8 CLEANING AND PROTECTION

- .1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.
- .2 Protect installed board insulation from damage due to harmful weather exposures, physical abuse, and other causes.

- .3 Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 06 10 00 – Rough Carpentry
- .2 Section 07 21 13 – Board Insulation
- .3 Section 07 27 13 – Modified Bituminous Air and Vapour Barrier
- .4 Section 07 27 19 – Sheet Membrane Air and Vapour Barrier
- .5 Section 09 21 16 – Gypsum Board Assemblies

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM C167-15, Standard Test Methods for Thickness and Density of Blanket or Batt Thermal Insulations.
 - .2 ASTM C553-13, Specification for Mineral Fibre Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .3 ASTM C665-12, Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
 - .4 ASTM C1320-10 (2016), Standard Practice for Installation of Mineral Fiber Batt and Blanket Thermal Insulation for Light Frame Construction.
 - .5 ASTM C520-15, Standard Test for Density of Granular Loose Fill Insulations.
 - .6 ASTM C1015-17, Standard Practice for Installation of Cellulosic and Mineral Fiber Loose-Fill Thermal Insulation.
 - .7 ASTM C1630-11 (2016), Standard Guide for Development of Coverage charts for Loose-Fill Thermal Building Insulations.
 - .8 ASTM F1667-17, Standard Specification for Driven Fasteners: Nails, Spikes, and Staples.
- .2 Canadian Gas Association (CGA)
 - .1 CAN/CSA-B149.1-15, Natural Gas and Propane Installation Code, Includes Update No. 1 (2010).
 - .2 CAN/CGA-B149.2-15, Propane Storage and Handling Code.
- .3 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-11, Standard Method of Test For Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S114-05, Standard Method of Test for Determination of Non-Combustibility in Building Materials.
 - .3 CAN/ULC-S604-2016, Standard for Factory Built Type A Chimneys.
 - .4 CAN/ULC-S702.2-15, Mineral Fibre Thermal Insulation for Buildings, Part 2: Application Guidelines.

1.3 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 – Submittals:
 - .1 Submit manufacturer's printed product literature, specifications and data sheet.

- .2 Submit WHMIS MSDS - Material Safety Data Sheets. WHMIS MSDS acceptable to Labour Canada and Health and Welfare Canada for sealants. Indicate VOC content.
- .2 Manufacturer's Instructions:
 - .1 Submit manufacturer's installation instructions.
- 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.
- 1.5 DELIVERY, STORAGE AND HANDLING**
 - .1 Deliver insulation and accessories in original unopened packaging or cartons bearing manufacturer's seals and labels.
 - .2 Store materials under cover on raised platforms, away from moisture. Keep dry at all times.
- 1.6 WASTE MANAGEMENT AND DISPOSAL**
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Waste Management and Disposal.
- Part 2 Products**
 - 2.1 MANUFACTURERS**
 - .1 Acceptable Manufacturers: Subject to compliance with requirements specified in this section and as established by the Basis-of-Design materials, manufacturers offering similar products that may be incorporated into the Work include the following:
 - .1 CertainTeed Corporation
 - .2 Johns-Manville Corporation
 - .3 Knauf Insulation
 - .4 Owens-Corning Canada LP.
 - .5 Rockwool Inc.
 - 2.2 BATT INSULATION**
 - .1 Fibrous Mineral Wool Insulation: non-combustible, stone wool batt insulation to CAN/ULC S702 and as follows:
 - .1 Type: 1
 - .2 Fire performance:
 - .1 Non-combustibility: To CAN/ULC S114.
 - .1 Flame spread: 0.
 - .2 Smoke developed: 5.

- .2 Surface Burning Characteristics: To CAN/ULC S102.
 - .1 Flame spread: 0.
 - .2 Smoke developed: 0.
- .3 Density: 32 kg/m³ to ASTM C167
- .4 Thermal Resistance: nominal RSI of 0.71/25 mm
- .5 Thickness: as required to fill insulated spaces.
- .6 Basis-of-Design:
 - .1 Rockwool Inc., ComfortBatt
- .2 Mineral Fibre Insulation For Fire and Smoke Rated Assemblies: Un-faced preformed GreenGuard™ or formaldehyde free binder fibrous insulation meeting the requirements of ULC S702; having maximum flame spread and smoke developed of 20/20 in accordance with CAN/ULC S102 and being non-combustible in accordance with CAN/ULC S114 and as follows:
 - .1 Type: 1.
 - .2 Width: to friction fit in stud spaces.
 - .3 Thickness: minimum 89 mm to fill a minimum of 90% of the cavity thickness.
 - .4 STC Ratings: as indicated on Drawings.
 - .5 Acceptable materials:
 - .1 Owens-Corning Canada LP., Ecotouch Quietzone Pink FiberGlas Acoustic Insulation.
 - .2 Rockwool Inc., Roxul AFB Acoustical Fire Batt.
- .3 Refer to Section 09 21 16 – Gypsum Board Assemblies for insulation in interior partitions.

2.3 ACCESSORIES

- .1 Insulation clips:
 - .1 Impale type, perforated 50 x 50 mm cold rolled carbon steel 0.8 mm thick, adhesive back, spindle of 2.5 mm diameter annealed steel, length to suit insulation, 25 mm diameter washers of self locking type.
- .2 Attic Rafter Vents: extruded polystyrene foam vent, moisture and rot resistance and as follows:
 - .1 Size: 572 mm x 1220 mm
 - .2 Air channel depth: 37.5 mm
 - .3 Acceptable Materials:
 - .1 ADO, Durovent
 - .2 Owens-Corning Canada LP., Raft-R-Mate
- .3 Eave Ventilation: Preformed, rigid fibreboard or plastic sheets designed and sized to fit between roof framing members, and to provide cross ventilation between insulated attic spaces and vented eaves.
- .4 Nails: galvanized steel, length to suit insulation plus 25 mm, to ASTM F1667.
- .5 Staples: 12 mm minimum leg.
- .6 Tape: as recommended by manufacturer.

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 PREPARATION

- .1 Verify all in-wall construction is complete before beginning installation.
- .2 Install insulation after building substrate materials are dry.
- .3 Ensure substrate materials are properly installed and complete before beginning installation.

3.3 INSTALLATION

- .1 Install batts between framing members, structural components and other items snug and tight.
- .2 Cut and trim batts neatly to fit spaces. Use batts free from ripped or damaged back and edges.
- .3 Do not compress insulation to fit into spaces.
- .4 Install batt insulation where indicated with continuous vapour retarder on the warm side of the insulation in accordance with ASTM C1320.
- .5 Fit insulation closely around electrical boxes, pipes, ducts, frames and other objects in or passing through insulation.
- .6 Keep insulation minimum 75 mm from heat emitting devices such as recessed light fixtures, and minimum 50 mm from sidewalls of CAN/ULC-S604 Type A chimneys and CAN/CGA-B149.1 and CAN/CGA-B149.2 Type B and L vents.
- .7 Fill stud space of exterior framed walls with insulation full depth of stud only where no insulation/vapour retardant indicated on exterior face of stud walls.
- .8 Hold insulation in position with clips, wires or as recommended by manufacturer when insulation is installed in horizontal locations.
- .9 Do not enclose insulation until it has been reviewed by Departmental Representative.
- .10 Installation of Attic Rafter Vents:
 - .1 Install in accordance with manufacturer's written instructions.
 - .2 Install in each rafter or truss space beginning at soffit area and continue up the cavity to the ridge vent or to a common air space.

3.4 CLEANING

- .1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

Part 1 General

1.1 INTENT

- .1 Foam-in-place insulation to exterior hollow steel door frames, aluminum door frames and window frames.
- .2 Foam-in-place insulation around protrusions through the exterior wall envelope and juncture of different cladding materials.

1.2 RELATED SECTIONS

- .1 Section 07 21 13 – Board Insulation
- .2 Section 07 21 16 – Fibrous Insulation
- .3 Section 07 27 13 – Modified Bituminous Air and Vapour Barrier
- .4 Section 07 92 00 – Sealants
- .5 Section 08 11 13 – Steel Doors and Frames
- .6 Section 08 50 13 – Aluminum Clad Wood Windows

1.3 REFERENCES

- .1 Canadian Urethane Foam Contractors' Association Inc. (CUFCA)
- .2 Green Seal Environmental Standards
 - .1 Standard GC-03-97, Anti-Corrosive Paints.
 - .2 Standard GS-11-10, Paints and Coatings.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .4 South Coast Air Quality Management District (SCAQMD), California State SCAQMD Rule 1113-06, Architectural Coatings.
- .5 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S101-07, Standard Methods of Fire Endurance Tests of Building Construction and Materials.
 - .2 CAN/ULC-S102-11, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
 - .3 CAN/ULC-S705.1-15, Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density,-Material –Specification.
 - .4 CAN/ULC-S705.2-05, Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density, Application.

1.4 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 – Submittals:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Provide two copies of WHMIS MSDS - Material Safety Data Sheets in accordance with WHMIS acceptable to Labour Canada, and Health and Welfare Canada.

- .2 Quality assurance submittals: submit following in accordance with Section 01 45 00 - Quality Control.
 - .1 Test reports: submit certified test reports for insulation from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
 - .2 Submit test reports in accordance with CAN/ULC-S101 for fire endurance and CAN/ULC-S102 for surface burning characteristics.
 - .3 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, and cleaning procedures.

1.5 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installers: Use companies that are members and licensed CUFCA having trained and certified installers in accordance with CAN/ULC S705.2 and CUFCA requirements.
 - .2 Manufacturer: Obtain air and vapour seal materials from a single manufacturer regularly engaged in manufacturing the products specified in this Section.
- .2 Cooperate and coordinate with the requirements of other units of work specified in other sections.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.7 WASTE MANAGEMENT AND DISPOSAL

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

1.8 SITE CONDITIONS

- .1 Protect adjacent surfaces and equipment from damage by overspray, fall-out, and dusting of insulation materials.
- .2 Apply insulation only when surfaces and ambient temperatures are within manufacturers' prescribed limits.
- .3 Ensure temperature is maintained throughout the curing period.

Part 2 Products

2.1 MATERIALS

- .1 Insulation: Closed cell, two pound density, one component rigid urethane foam.
 - .1 Acceptable Materials:

- .1 CF128-CW, Hilti (Canada) Ltd.
 - .2 EnerFoam, Abisko Manufacturing Inc.
 - .3 Froth Pak, Dow Chemical Co.
 - .4 Handi-seal Window & Door Sealant, Fomo Products Inc.
 - .5 RHH Foam Systems Inc.
- .2 Thermal Barrier: spray applied fire retardant overcoat meeting applicable requirements of the Building Code for thermal barrier of foamed plastic.
 - .1 Acceptable Material:
 - .1 A/D Thermal Barrier, AD Fire Protection Systems.
 - .2 CafcoBlaze-Shield II, Isolatek International
 - .3 Monokote Z-3306, WR Grace & Co.

Part 3 Execution

3.1 SURFACE PREPARATION/EXISTING CONDITIONS

- .1 Clean spaces that are to receive insulation, of dirt, dust, grease, loose material or other foreign matter that may inhibit adhesion.
- .2 Provide sufficient ventilation during and until insulation has cured, to ensure safe working conditions. Introduce fresh air and exhaust air continuously during the 24 hour period after application.
- .3 Protect adjacent surfaces from overspray and dusting.
- .4 Prior to application, slightly moisten surfaces to which foam in place insulation is being applied, to accelerate curing.
- .5 Temporarily brace frames as may be required to prevent possible bowing of frames due to over expansion of the foam-in-place insulation.

3.2 INSTALLATION/AIR SEAL AROUND EXTERIOR WINDOW AND DOOR FRAMES

- .1 Fill exterior hollow steel door frames 75% full with foam-in-place insulation prior to installation of frames. Fill the remainder of the frame after installation, through the gap between the frame and the wall construction.
- .2 Install foam-in-place insulation around all exterior window frames to maintain continuity of the thermal barrier, after air barrier has been installed and sealed to windows as specified.
- .3 Ensure that foam completely fills spaces, without voids, and that foam is continuous at corners.

3.3 INSTALLATION/AROUND PROTRUSIONS THROUGH AIR SEAL

- .1 Install foam-in-place insulation around all protrusions through the exterior building envelope to achieve and maintain continuity of air/vapour seal.

3.4 CLEANING

- .1 Cut back excess foam-in-place insulation once cured, flush with surrounding surfaces, or recess back for application of sealant as specified in Section 07 92 00.
- .2 Upon completion of foam-in-place insulation work, clean adjacent surfaces of overspray and dusting to the satisfaction of the Departmental Representative.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 04 22 00 – Unit Masonry
- .2 Section 06 10 00 – Rough Carpentry
- .3 Section 07 62 00 – Sheet Metal Flashing and Trim
- .4 Section 07 92 00 – Sealants
- .5 Section 09 21 16 – Gypsum Board Assemblies
- .6 Section 09 91 00 – Painting

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM B117-16, Standard Practice for Operating Salt Spray (Fog) Apparatus.
 - .2 ASTM C144-11, Standard Specification for Aggregate for Masonry Mortar.
 - .3 ASTM C297/C297M-16, Standard Test Method for Flatwise Tensile Strength of Sandwich Construction.
 - .4 ASTM C1002-16, Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
 - .5 ASTM D968-16, Standard Test Methods for Abrasion Resistance of Organic Coatings by the Falling Abrasive.
 - .6 ASTM D2247-15, Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.
 - .7 ASTM E72-15, Standard Test Methods of Conducting Strength Tests of Panels for Building Construction.
 - .8 ASTM E96/E96M-16, Standard Test Methods for Water Vapor Transmission of Materials.
 - .9 ASTM E2098/E2098M-13, Standard Test Method for Determining Tensile Breaking Strength of Glass Fiber Reinforcing Mesh for Use in Class PB Exterior Insulation and Finish Systems (EIFS), after Exposure to a Sodium Hydroxide Solution.
 - .10 ASTM E2134/E2134M-14, Standard Test Method for Evaluating the Tensile-Adhesion Performance of an Exterior Insulation and Finish System (EIFS).
 - .11 ASTM E2273-03(2011), Standard Test Method for Determining the Drainage Efficiency of Exterior Insulation and Finish Systems (EIFS) Clad Wall Assemblies
 - .12 ASTM E2321-03(2011), Standard Practice for Use of Test Methods E 96 for Determining the Water Vapor Transmission (WVT) of Exterior Insulation and Finish Systems (EIFS).
 - .13 ASTM E2430/E2430M-13, Standard Specification For Expanded Polystyrene (EPS) Thermal Insulation Boards For Use In Exterior Insulation and Finish Systems (EIFS).

- .14 ASTM E2485/E2485M-13, Standard Test Method for Freeze/Thaw Resistance of Exterior Insulation and Finish Systems (EIFS) and Water Resistive Barrier Coatings
- .15 ASTM E2486/E2486M-13, Standard Test Method for Impact Resistance of Class PB and PI Exterior Insulation and Finish Systems (EIFS)
- .16 ASTM G154-16, Standard Practice for Operating Fluorescent Light Apparatus UV Exposure of Nonmetallic Materials.
- .2 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-A3000-13, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005), Includes Update No. 1 (2014), Update No. 2 (2014).
- .3 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S101-14, Standard Methods of Fire Endurance Tests of Building Construction and Materials
 - .2 CAN/ULC-S114-05, Standard Method of Test for Determination of Non-Combustibility in Building Materials.
 - .3 CAN/ULC-S134-13, Standard Method of Fire Test of Exterior Wall Assemblies.
 - .4 CAN/ULC-S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.
 - .5 CAN/ULC-S702-14, Standard for Thermal Insulation Mineral Fibre for Buildings, Includes Amendment 1 (January 2012).
 - .6 CAN/ULC-S716.1-12, Standard for Exterior Insulation and Finish Systems (EIFS) – Materials and Systems
 - .7 CAN/ULC S716.2-12, Standard for Exterior Insulation and Finish Systems (EIFS) – Installation.

1.3 DEFINITIONS

- .1 Aesthetic joint: joint for appearance or installation ease. Also known as aesthetic reveals, grooves and reglets used to provide starting and stopping points during application of finish coat.
- .2 Back wrapping: at edges (termination) of EIFS where the reinforcing mesh and base coat extend from the back side of the insulation around the termination edge and onto the front of the insulation.
- .3 Base coat adhesive: adhesive used in base coat. Polymer modified, polymer based or cementitious material, typically mixed with Portland cement.
- .4 Base coat: base coat consists of 2 components; base coat adhesive and reinforcing mesh.
- .5 Finish coat: acrylic-based, decorative and protective coating applied to outside surface of base coat.
- .6 Lamina: base coat, reinforcing mesh and finish.
- .7 Reinforcing mesh: woven glass fibre reinforcement to base coat providing impact resistance.

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Convene pre-installation meetings: one week prior to beginning work of this Section.
 - .1 Verify project requirements.
 - .2 Review installation conditions.
 - .3 Co-ordinate with other building subtrades.
 - .4 Review manufacturer's instructions and warranty requirements.

1.5 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 – Submittals:
 - .1 Submit WHMIS MSDS - Material Safety Data Sheets acceptable to Labour Canada, and Health and Welfare Canada for exterior finish - direct applied materials. Indicate VOC content.
 - .2 Submit product data sheets for system materials. Include product characteristics, performance criteria, limitations and colours.
- .2 Submit shop drawings in accordance with Section 01 33 00 – Submittals:
 - .1 Indicate wall layout, details, connections, expansion joints, finish system, installation sequence, including interface with doors, windows, air barriers, vapour retarders and other components.
- .3 Submit samples in accordance with Section 01 33 00 – Submittals:
 - .1 Submit one 300 x 300 mm sample of each colour of system prior to fabrication of mock-up.
- .4 Manufacturer's Instructions: provide to indicate special handling criteria, installation sequence, and cleaning procedures.
- .5 Informational Submittals: Upon request of Departmental Representative, submit copy of system manufacturer's approval certification indicating that installer is an acceptable installer for materials specified in this Section.
- .6 Manufacturers' Field Reports: submit copies of manufacturers field reports, within 3 days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.
- .7 Closeout Submittals: Provide maintenance data including instructions for repair and cleaning procedures for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.6 QUALITY ASSURANCE

- .1 Installer Qualifications: Engage experienced installer with a minimum of 5 years experience who has successfully completed systems similar in material, design, and extent to that indicated for Project and who is approved or certified by manufacturer to install system materials.
- .2 Manufacturer and distributor to be a member in good standing of the EIFS Council of Canada.
- .3 Submit certification to Departmental Representative prior to commencement of work.

- .4 Single-Source Responsibility: Obtain materials for system from one source and by single manufacturer, or by manufacturers approved by system manufacturer as compatible with other system components.
- .5 Compatibility Requirements: System manufacturer shall certify that system is suitable for use with substrates indicated herein and in Contract documents.

1.7 MOCK-UPS

- .1 Construct mock-up in accordance with Section 01 45 00 - Quality Control.
- .2 Construct mock up of complete EIFS system on typical exterior wall 3000 mm long x 3000 mm wide incorporating:
 - .1 Window and frame to demonstrate back wrap and reinforcement at corners.
 - .2 Door and frame to demonstrate back wrap and reinforcement at corners.
 - .3 Wrappings and terminations: back wrapping and edge wrapping.
 - .4 Joints to demonstrate aesthetic, control and expansion joint construction.
 - .5 Construction at changes in substrate.
 - .6 Construction at corner stop.
 - .7 Construction at sill of wall, windows and doors.
 - .8 Construction at grade and below grade.
 - .9 Construction at parapets and soffits.
 - .10 Construction at both large and small penetrations.
 - .11 Construction at surface mounted objects and foam shapes.
 - .12 Adhesive and mechanical fastening systems.
 - .13 Colour, texture and finish.
- .3 Construct mock-up where directed.
- .4 Allow 24 hours for review of mock-up by Departmental Representative before proceeding with work.
- .5 When accepted, mock-up will demonstrate minimum standard for work, and may remain as part of finished work.

1.8 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, handle, store and protect materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver and store materials in accordance with manufacturer's instructions.
- .3 Protect base finish materials from freezing.
- .4 Safety: Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of insulation, adhesive and caulking materials.

1.9 WASTE MANAGEMENT AND DISPOSAL

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

1.10 AMBIENT CONDITIONS

- .1 Temperature, relative humidity, moisture content.
 - .1 Apply exterior finish system components at temperatures, relative humidity, and substrate moisture content and substrate temperature in accordance with manufacturer's written instructions
 - .2 Maintain ambient temperature above 4 degrees C during adhesive application and until cured minimum 24 hours.
 - .3 Maintain ambient temperature above 4 degrees C during basecoat application and until cured minimum 24 hours.
 - .4 Maintain ambient temperature above 4 degrees C during finish coat application and until cured minimum 24 hours.
- .2 Partially completed work or work not fully cured that is exposed to the elements in excess of manufacturer's recommendations may be rejected.
- .3 Ventilation:
 - .1 Ventilate area of work as directed by Departmental Representative by use of approved portable supply and exhaust fans.
 - .2 Ventilate enclosed spaces in accordance with Section 01 51 00 - Temporary Utilities.
 - .3 Provide continuous ventilation during and after insulation application. Run ventilation system 24 hours per day during installation; provide continuous ventilation for 7 days after completion of insulation installation.

1.11 WARRANTY

- .1 Contractor warrants that exterior insulation and finish system will not leak or delaminate for 24 months.

Part 2 Products

2.1 MANUFACTURERS

- .1 Manufacturers: Subject to compliance with requirements of this Section, products by the following manufacturers are acceptable. However, it is Contractor's responsibility to provide only products compatible with adjacent materials in assembly.
 - .1 ADEX Systems Inc.
 - .2 BASF Senergy Wall Systems
 - .3 Dryvit Systems, Inc.
 - .4 Durabond Products Ltd.
 - .5 DuRock Alfacing International Ltd.
 - .6 Sto Corporation

2.2 PERFORMANCE/DESIGN CRITERIA

- .1 System, materials and installation shall meet or exceed the requirements of CAN/ULC S716.1 and CAN/ULC S716.2.

- .2 Installed modified polymer coat wall system to have following performance properties:
 - .1 Comply with CAN/ULC-S134.
 - .2 Finish-abrasion resistance: falling sand method to ASTM D968, no deleterious effects after 500 litres (132 gal) of sand.
 - .3 Finish-salt spray resistance: to ASTM B117, after 300 hours' exposure to 5% salt spray solution - no effects.
 - .4 Finish-moisture resistance: to ASTM D2247 (U.S. Federal Test Standard 141A Method 6201), after 14 days exposure - no deleterious effects.
 - .5 Accelerated weathering: to CAN/CGSB-1.162 and ASTM G154, 2000 hours - no effect.
 - .6 Freeze/Thaw Resistant: to ASTM E2485, no deleterious effects at 10 cycles when viewed under 5x magnification.
 - .7 Impact resistance: to ASTM E 72, only slight dents observed up to 108.465J Level 1, 3-6 joules.
 - .8 Bond strength: to ASTM C 297, dry, wet-2 hour dry, wet-7 day dry, minimum 1 MPa.
 - .9 Permeability: to ASTM E96, 5.93 perms

2.3 SUBSTRATE

- .1 Plywood or Oriented strand board sheathing as indicated.

2.4 AIR AND VAPOUR BARRIER SYSTEM

- .1 All components of the air and vapour barrier system, including transition membrane, sealants, primers, mastics, reinforcement and adhesives shall be supplied by one manufacturer.
- .2 Reinforcement tape: Open weave mesh as recommended by EIFS manufacturer. 100 mm wide roll, self-adhering glass fiber mesh
- .3 Transition membrane primer: Synthetic rubber based adhesive type quick setting primer or water-based surface conditioner supplied or recommended by EIFS manufacturer.
- .4 Water Resistive Air Barrier/Vapour Membrane: Manufacturers standard trowel applied vapour membrane system designed specifically as a primary building envelope component for non-insulated substrate wall assemblies
- .5 Transition membrane: Manufacturer's recommended composite self adhering membrane comprised of rubberized asphalt or SBS modified bitumen membrane or fleece-faced membrane backed with a high density polyethylene film. Minimum thickness 1.5 mm. Width and length to suit application.
- .6 Transition membrane sealant: recommended by EIFS manufacturer.

2.5 ADHESIVES

- .1 Adhesive: Manufacturer's standard polymer modified cementitious adhesive system forming a part of water drainage and venting component of EIFS coating.

2.6 INSULATION

- .1 Extruded polystyrene (XPS): to CAN/ULC-S701, Type 3, RSI and thickness as indicated.

2.7 MECHANICAL FASTENERS

- .1 Mechanical fasteners: as recommended by EIFS manufacturer.
- .2 Steel screw or impact-type fastener with corrosion resistant finish stainless steel of type and size to suit substrate complete with high density polypropylene or polyethylene plastic washers at least 50 mm in diameter with nib to encapsulate screw-head.
- .3 Solid high density polypropylene or polyethylene fasteners for masonry and concrete substrates, requiring pre-drilling with a hammer drill, then installed with mallets until flush.
- .4 Insulation clips: impale type, perforated 50 x 50 mm cold rolled carbon steel 0.8 mm thick, adhesive back, 2.5 mm annealed steel spindle, length to suit insulation, 25 mm diameter self locking washers.

2.8 REINFORCING MESH

- .1 Reinforcing Mesh: Manufacturer's recommended glass fibre mesh meeting requirements of ASTM E2098, conditions of installation, and as follows:
 - .1 Heavy Duty Mesh: Nominal 4.5 to 6.4 kg/m²
 - .2 Intermediate Duty: Nominal 2.7 to 3.7 kg/m²
 - .3 Standard Duty: Nominal 1.3 to 1.8 kg/m²
- .2 Speciality mesh:
 - .1 Corner mesh: pre-creased, non-woven glass fibre fabric made from twisted multi-end strands, treated, alkali resistant, compatible with chemical bonding system base coat and finish coat, weight 212 g/m².

2.9 BASECOAT

- .1 Base Coat: Provide manufacturer's standard materials in dry or wet mix, consisting of the following, mixed strictly to manufacturer's instructions:
 - .1 Polymer: acrylic.
 - .2 Cement: Type 10 (Normal) Portland, to CAN/CSA-A3000.
 - .3 Cement Content: maximum 50% by weight polymer/cement mix.
 - .4 Water: clear and potable.
 - .5 Colour: tinted to match finish coat

2.10 FINISH COAT

- .1 Finish Coat: Provide factory-mixed, 100% acrylic emulsion with integral colour and aggregate, proportioned and prepared in strict accordance with manufacturer's instructions, to provide the following appearance characteristics:
 - .1 Texture: Fine.
 - .2 Pattern: sand float

- .3 Aggregate Size: as required to provide specified texture and pattern, but not greater than 1 mm diameter.
- .4 Finish Coat Colours: As indicated on Drawings.
- .2 Sealer: provide manufacturers recommended sealer to prevent fading.

2.11 PRIMER

- .1 Finish Coat Primer: Tinted primer compatible with base and finish coats as recommended by EIFS manufacturer, closely coloured to match finish coat colour.

2.12 ACCESSORIES

- .1 Accessories: galvanized or PVC corner beads, casing beads, stop beads, starter strips and accessories, as recommended by exterior insulated wall system manufacturer to suit system components.

2.13 EXPANSION JOINTS

- .1 Expansion joints and Fire Control Breaks: PVC or galvanized
- .2 Ensure expansion joints are back wrapped.
- .3 Joint Cleaner: non-corrosive and non-staining type, compatible with joint forming materials and sealant recommended by sealant manufacturer.
- .4 Sealant primer: as recommended by sealant manufacturer.
- .5 Joint filler: extruded polyethylene, closed cell, Shore A hardness 20, tensile strength 140 - 200 kPa, oversized 30 to 50%.
- .6 Sealant: in accordance with Section 07 92 00 - Sealants
 - .1 Weather seals: multi-component, chemical curing to CAN/CGSB-19.24, Type 2, Class B].
 - .2 Panel joints: multi-component, chemical curing to CAN/CGSB-19.24, Type 2, Class B.

2.14 MIXES

- .1 General:
 - .1 Mixer: high speed, clean and rust free.
 - .2 Mixing pail: clean and rust free.
 - .3 Mixes: additive free.
- .2 Conditioner: mix in accordance with manufacturer's written instructions.
- .3 Leveller: mixed to uniform consistency in accordance with manufacturer's written instructions.
- .4 Adhesive: mixed in accordance with manufacturer's written instructions.
- .5 Basecoat: mixed to uniform consistency in accordance with manufacturer's written instructions.
- .6 Finish coat: mixed to uniform consistency in accordance with manufacturer's written instructions.

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 Inspect and verify condition of existing substrate surfaces for contamination, surface absorption, chalkiness, cracks, damage, deterioration, moisture content, moisture damage, and tolerances.
 - .1 Substrate tolerance not greater than 6 mm in 2500 mm
- .2 Report deviations from specified requirements or other conditions that might adversely affect EIFS installation in writing to Departmental Representative.
- .3 Proceed with Work only after receipt of written approval from Departmental Representative.

3.3 PREPARATION

- .1 Protection:
 - .1 Protect adjacent surfaces from damage resulting from Work of this Section.
 - .2 Protect finished Work from water penetration at end of each day or on completion of each section of Work.
 - .3 Protect installation from moisture for 48 hours minimum after completion of each portion of Work.
- .2 Surface preparation:
 - .1 Ensure environmental and site conditions are suitable for installation of system.
 - .2 Prepare new surfaces in accordance with manufacturer's written instructions.

3.4 INSTALLATION

- .1 Install system in accordance with CAN/ULC-S134 and EIFS manufacturer's written instructions.
- .2 Air and vapour barrier system:
 - .1 Apply reinforcing tape on all vertical and horizontal sheathing board joints, exposed edges at terminations, inside and outside corners. Centre reinforcing tape on the board joint, corners edges, etc., with the pressure sensitive adhesive backing in contact with the substrate surface.
 - .2 Install transition membrane at all movement joints, junctures to windows fenestration, junctures with roofing membranes. Transition membrane shall be of sufficient width to lap both sides of joint, crack, or transition a minimum of 50 mm.
 - .3 Roll the transition membrane immediately after placement to ensure continuous adhesion.

- .4 Ensure the continuity of transition membrane is maintained at all penetrations and terminations. Apply transition membrane sealant as requires to fill inaccessible gaps.
- .5 Mix, prepare, and apply the water restrictive barrier in accordance with manufacturer's application instructions. The product shall be applied to all surfaces of the substrate where EIFS is to be installed. Ensure the coating is continuous with no voids.
- .6 Allow water resistive barrier to cure/dry before the installation of the insulation.
- .3 Insulation anchors: install insulation anchors to spacing and pattern recommended by EIFS manufacturer. Maintain continuity of air barrier system.
- .4 Adhesives application and installation of insulation board:
 - .1 Apply uniform ribbons of adhesive to back of and parallel to long dimension of insulation board, using recommended notched trowel.
 - .2 Offset insulation joints.
 - .3 Immediately place insulation boards in running bond pattern on walls with long dimension horizontal, starting from level base line. Apply firm pressure over entire surface of board to ensure full contact. Determine location and pattern of sheathing joints. Bridge sheathing joints by minimum of 200 mm.
 - .4 Butt vertical and horizontal joints tightly together. Ensure joints between boards are free of adhesive.
 - .5 Cut insulation board in L-shaped pattern to fit around openings. Ensure all cut edges and terminations of the insulation board are backwrapped with reinforcing mesh and base coat. Do not align joints with corners of openings.
 - .6 Remove individual boards periodically when adhesive is still wet to check for satisfactory contact with substrate and back of insulation board.
- .5 Backwrapping:
 - .1 Ensure edge of insulation board is wrapped with base coat prior to installation to substrate.
 - .2 Apply strip of detail mesh with adhesive to substrate at level base line and at terminations.
 - .3 Ensure width of detail mesh is adequate to adhere 100 mm of mesh onto substrate and to wrap around insulation board edge with minimum 64 mm coverage on outside of insulation board.
 - .4 After adhering detail mesh to substrate ensure, mesh ends hang free for completion of backwrapping procedure after insulation application.
- .6 Accessories:
 - .1 Install all required accessories as detailed and as required by EIFS manufacturer and in accordance with CAN/ULC-S134.
- .7 Preparation of Insulation Board surface:
 - .1 Fill open joints in insulation board with slivers of insulation or spray foam as recommended by manufacturer's written instructions.

- .2 Rasp surface to achieve smooth, level, even surface after insulation boards have firmly adhered to substrate. Remove ultraviolet ray damage. Rasp smooth any irregularities in insulation board greater than 1.6 mm. Ensure insulation board tolerance not greater than 6 mm in 2500 mm in accordance with manufacturer's written instructions.
- .8 Joints:
 - .1 Reveals and Aesthetic Grooves:
 - .1 Cut reveals and aesthetic grooves with appropriate tool in locations indicated.
 - .2 Offset reveals minimum 75 mm from insulation joints.
 - .3 Maintain minimum 19 mm insulation board thickness at bottom of groove after cutting.
 - .4 Install deep V control joints to divide wall area into maximum 14 m² panels with maximum 5.5 linear meters in any direction at floor lines, at dissimilar substrates, at masonry wall joints. Confirm pattern with Departmental Representative prior to application
 - .5 Install shallow V surface mount control joints at colour separations, window corners, door corners, drip grooves, to sub-divide panels into 1200 x 1200 mm areas or as indicated by Departmental Representative.
 - .2 Expansion joints:
 - .1 Install expansion joints in locations indicated and to manufacturers written instructions.
 - .2 Install fire control breaks in accordance with manufacturer's written requirements and as needed to meet intent of Building Code and Authorities Having Jurisdiction.
 - .3 Install expansion joints at isolation joints in substrate and at locations where movement is expected].
- .9 Backwrapping completion:
 - .1 Complete backwrapping procedure by applying base coat to exposed edges of insulation board and 100 mm onto face of insulation board.
 - .2 Pull mesh tight around board and embed it in base coat with trowel.
 - .3 Use corner trowel for clean, straight lines.
 - .4 Smooth wrinkles or gaps in mesh.
- .10 Mesh and Base Coat Application:
 - .1 Apply 225 x 300 mm diagonal strips of detail mesh at corners of windows, doors and penetrations through insulation. Embed strips in wet base coat and trowel from centre to mesh edge to avoid wrinkles.
 - .2 Apply detail mesh at reveals. Embed mesh in wet base coat and trowel from base of reveal to mesh edges.
 - .3 Apply corner mesh at inside and outside corners. Embed mesh in wet base coat and trowel from corner of mesh edges.
 - .4 High impact mesh application: Apply base coat over insulation board to uniform thickness of approximately 3 mm. Work horizontally or vertically in 1000 mm strips, and immediately embed mesh into wet base coat by

trowelling from centre to edge of mesh. Butt mesh at seams. Allow base coat to dry.

.5 Standard mesh application:

- .1 Apply base coat over insulation board, including areas with high impact mesh to uniform thickness of approximately 3 mm.
- .2 Work horizontally or vertically in 1000 mm strips, and immediately embed mesh into wet base coat by trowelling from centre to mesh edge.
- .3 Overlap mesh 64 mm minimum at mesh seams and overlaps of detail mesh.
- .4 Feather seams and edges.
- .5 Double wrap inside and outside corners with minimum 64 mm overlap in each direction. Embed corner mat in wet base coat, allow to dry, then overlap up to corner with standard reinforcing mesh embedded in base coat.
- .6 Avoid wrinkles in mesh.
- .7 Fully embed mesh so that no mesh colour shows through base coat when dry.
- .8 Ensure minimum base coat thickness 1.6 mm when dry. Re-skim base coat if 1.6 mm thickness not achieved during initial application. Allow base coat to thoroughly dry before applying primer or finish coat.

.11 Finish Coat Application:

- .1 Apply finish coat in accordance with manufacturer's writing installation instructions.
- .2 Prime dry base coat and allow to dry thoroughly before applying finish coat.
- .3 Apply finish coat directly over base coat, or primed base coat, only after base coat or primer has thoroughly dried.
- .4 Apply finish by spray or trowel as recommended by manufacturer.
- .5 Apply finish in continuous application, and work towards wet edge.
- .6 Do not install separate batches of finish coat side by side.
- .7 Do not apply finish into or over sealant joints. Apply finish to outside of wall only.
- .8 Do not apply finish over irregular or unprepared surfaces.
- .9 Apply textured or aggregate finishes to wall areas as indicated and in accordance with manufacturer's written instructions.

3.5 SILLS AND HORIZONTAL PROJECTION

.1 Base Coat Application:

.1 Standard mesh application:

- .1 Apply base coat over insulation board, including areas with high impact mesh to uniform thickness of approximately 3 mm.

- .2 Work horizontally or vertically in strips of 1000 mm, and immediately embed mesh into wet base coat by troweling from centre to mesh edge.
 - .3 Overlap mesh not less than 64 mm at mesh seams and at overlaps of detail mesh.
 - .4 Feather seams and edges.
 - .5 Double wrap inside and outside corners with minimum 64 mm overlap in each direction. Embed corner mat in wet base coat, allow to dry, then overlap up to corner with standard reinforcing mesh embedded in base coat.
 - .6 Avoid wrinkles in mesh.
 - .7 Fully embed mesh so that no mesh colour shows through base coat when dry.
 - .8 Ensure minimum base coat thickness of 1.6 mm when dry. Re-skim base coat if 1.6 mm thickness not achieved during initial application. Allow base coat to thoroughly dry before applying primer or finish coat.
 - .9 Apply waterproof base coat and mesh over dry standard application base coat and mesh on sloped surface and immediately above and below grade.
- .2 Finish Coat Application:
- .1 Apply finish coat in accordance with manufacturer's written installation instructions.
 - .2 Prime dry base coat and allow to dry thoroughly before applying finish coat.
 - .3 Apply finish directly over base coat, or primed base coat, only after base coat or primer has thoroughly dried.
 - .4 Apply finish by spray or trowel as recommended by manufacturer.
 - .5 Apply finish in continuous application, and work towards wet edge.
 - .6 Do not apply separate batches of finish coat side by side.
 - .7 Do not apply finish into or over sealant joints. Apply finish to outside of wall only.
 - .8 Do not apply finish over irregular or unprepared surfaces.
 - .9 Apply textured or aggregate finishes to wall areas as indicated and in accordance with manufacturer's written instructions.

3.6 FIELD QUALITY CONTROL

- .1 Manufacturers' Field Services:
- .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 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 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.
- .4 Obtain reports within three days of review and submit.

3.7 CLEANING

- .1 Upon completion of installation, remove excess materials, droppings and debris, tools and equipment barriers.
- .2 Clean surface and adjacent work area of foreign materials resulting from installation procedures.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 03 30 00 – Cast-In-Place Concrete
- .2 Section 07 21 13 – Board Insulation
- .3 Section 07 21 16 – Fibrous Insulation
- .4 Section 07 21 19 – Foam-In-Place Insulation
- .5 Section 07 31 13 – Asphalt Shingles
- .6 Section 07 92 00 – Sealants
- .7 Section 08 11 14 – Steel Doors and Frames
- .8 Section 08 11 16 – Aluminum Doors and Frames
- .9 Section 09 21 16 – Gypsum Board Assemblies

1.2 REFERENCES

- .1 American Society for Testing of Materials (ASTM)
 - .1 ASTM D93-16a, Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester.
 - .2 ASTM D146/D146M-04 (2012) e1, Standard Test Methods for Sampling and Testing Bitumen-Saturated Felts and Woven Fabrics for Roofing and Waterproofing.
 - .3 ASTM D412-16, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension.
 - .4 ASTM D1970-16, Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
 - .5 ASTM E96/E96M-16, Standard Test Methods for Water Vapor Transmission of Materials.
 - .6 ASTM E283-04 (2012), Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
 - .7 ASTM E2178-13, Standard Test Method for Air Permeance of Building Materials.
 - .8 ASTM E2357-11, Standard Test Method for Determining Air Leakage of Air Barrier Assemblies.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Select products to be compatible with adjoining membranes previously installed under related Sections

- .2 Select products from a single manufacturer, or products which are compatible from different manufacturers.
- .3 Coordination between all installers of each component of vapour and air retarder system is essential to ensure continuity of system and that junctions between the various components are effectively sealed.
- .4 Verify with manufacturers and all tradesmen involved with installation procedures of building products incorporated into air barrier elements including, but not limited to, various membranes, coating and sealants as well as continuity with roofing membrane.
- .2 Pre-installation Meeting:
 - .1 Convene one (1) week before commencing Work of this Section.
 - .2 Arrange for manufacturer's factory-trained agent to be on site at beginning of installation to provide training and supervision of personnel who will install membrane. Agent shall also provide frequent inspection visits thereafter to assure quality and competence of membrane installations.
- .3 Sequencing:
 - .1 Sequence work in accordance with Construction Progress Schedule.
 - .2 Sequence work to permit installation of materials in conjunction with related materials and seals.

1.4 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 – Submittals Procedures.
 - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit WHMIS MSDS - Material Safety Data.
 - .3 Submit statement from manufacturer(s), indicating products supplied under this Section are compatible with one another and with products previously installed under the work of related Sections.
- .2 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Provide duplicate 200 mm x 200 mm samples of membrane adhered to all project substrates, including adjoining membranes specified in other Sections.
- .3 Quality Assurance Submittals: submit following in accordance with Section 01 45 00 - Quality Control.
 - .1 Existing Substrate Condition: report deviations, as described in PART 3 - EXAMINATION in writing to Departmental Representative.
 - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .3 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures.

1.5 QUALITY ASSURANCE

- .1 Applicator: company specializing in performing work of this section with minimum 3 years documented experience with installation of air/vapour barrier systems.
 - .1 Completed installation must be approved by the material manufacturer.
- .2 Applicator: company:
 - .1 Currently licensed by National Air Barrier Association certifying organization.
 - .2 Must maintain their license throughout the duration of the project.
- .3 Single-Source Responsibility: obtain primary air and vapour materials from a single manufacturer regularly engaged in the manufacturing and supply of the specified products and meeting or exceeding the material properties and performance characteristics of the materials and manufacturers named in this Section.

1.6 MOCK-UP

- .1 Construct mock-up in accordance with Section 01 45 00 - Quality Control.
- .2 Construct typical exterior wall panel, 3 m long by 4 m wide, incorporating window and frame and sill, insulation, building corner condition, and junction with roof system; illustrating materials interface and seals.
- .3 Locate where directed.
- .4 Mock-up may remain as part of finished work.
- .5 Allow review of mock-up by Departmental Representative before proceeding with air/vapour barrier Work. Accepted mock-up will demonstrate minimum standard of quality required for this project.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.8 WASTE MANAGEMENT AND DISPOSAL

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

1.9 AMBIENT CONDITIONS

- .1 Install solvent curing sealants and vapour release adhesive materials in open spaces with ventilation.
- .2 Ventilate enclosed spaces in accordance with Section 01 51 00 - Temporary Utilities.
- .3 Maintain temperature and humidity recommended by materials manufacturer before, during and after installation.

- .4 Apply air/vapour barrier membrane to gypsum board surfaces which are dry, when temperature is 4 degrees C or higher or as per manufacturers recommendations.
- .5 Apply air/vapour barrier membrane to cast-in-place concrete, precast concrete, masonry (strike masonry joints flush) which are smooth, clean, dry, and in good condition. Moisture, grease, machine oil or other foreign material must be removed. Concrete must be cured, minimum 7 days, and dry before application, and when temperature is 5 degrees C or higher or as per manufacturers recommendations.

1.10 WARRANTY

- .1 Manufacturer's Warranty: issue and written and signed warranty in the name of the Departmental Representative, certifying the product will meet the physical characteristics published by the manufacturer for a period of 5 years starting from the completion date of installation of membranes.
- .2 Installer's Warranty: Submit installers warranty stating that air and vapour membranes and accessories are installed in accordance with manufacturer's recommendation and that membrane, transitions and through-wall flashing membranes, primers, mastics, adhesives and sealants are sourced from one manufacturer.

Part 2 Products

2.1 MANUFACTURERS

- .1 Acceptable Manufacturers: Subject to compliance with requirements specified in this section and as established by the Basis-of-Design materials, manufacturers offering similar products that may be incorporated into the Work include the following:
 - .1 Bakor Inc. (Henry Canada)
 - .2 Grace Construction Materials
 - .3 IKO Industries Ltd.
 - .4 Protecto Wrap
 - .5 Soprema Canada
 - .6 Tremco Commercial Sealants and Waterproofing
 - .7 W.R. Meadows Inc.

2.2 SELF-ADHESIVE AIR AND VAPOUR BARRIER SYSTEM MATERIALS

- .1 Primer: SBS synthetic rubbers, adhesive resins and solvents used to prime porous substrates to enhance adhesion of self-adhesive membranes at temperatures above -10°C.
 - .1 Specific gravity at 20°C (kg/l): 0.79 to 1.0 kg/l
 - .2 Solids by weight: 24% to 53%
 - .3 Flash point: -30°C to ASTM D93
 - .4 Acceptable materials:
 - .1 Elastocol Stick, Soprema

- .2 SAM Adhesive, IKO
- .3 Mel-Prime WB, W.R. Meadows
- .4 Aquatac Primer, Henry Bakor
- .2 Air/Vapour Barrier Membrane (winter application): to CAN/CGSB 37.56 or ASTM D1970; SBS modified bitumen, self-adhering sheet membrane with polyethylene facer, for application temperatures between -10°C and 10°C and as follows:
 - .1 Thickness: 1 mm to 1.5 mm
 - .2 Tensile strength: 11.3 kN/m to 15.4 kN/m to ASTM D5147.
 - .3 Ultimate elongation: 25% to 40%
 - .4 Flexibility at cold temperature: minimum -30°C
 - .5 Air permeability: <0.0003 L/sec. m²
 - .6 Water vapour permeability: <0.05 perm
 - .7 Static puncture: minimum 178 N
 - .8 Lap adhesion: 800 N/m
 - .9 Acceptable materials:
 - .1 Blueskin SALT, Henry Bakor
 - .2 CCW-705LT, Carlisle
 - .1 Perm-A-Barrier Wall Membrane LT, GCP Applied Technologies
 - .2 Sopraseal Stick 1100 T, Soprema.
 - .3 AVB LT, IKO
 - .4 Exoair 110 LT, Tremco Inc.
 - .5 Air Shield LT, W.R. Meadows.
- .3 Air/Vapour Barrier Membrane (summer application): to CAN/CGSB 37.56 or ASTM D1970; SBS modified bitumen, self-adhering sheet membrane with polyethylene facer, for application temperature above 5°C, and as follows:
 - .1 Thickness: 1 mm to 1.5 mm
 - .2 Tensile strength: minimum 6 kN/m
 - .3 Ultimate elongation: 25% to 40%
 - .4 Flexibility at cold temperature: minimum -17°C
 - .5 Air permeability: <0.0003 L/sec. m²
 - .6 Water vapour permeability: <0.05 perm
 - .7 Static puncture: 400 N
 - .8 Lap adhesion: minimum 1750 N/m
 - .9 Acceptable materials:
 - .1 Blueskin SA, Bakor.
 - .2 Perm-A-Barrier Wall Membrane, GCP Applied Technologies
 - .3 AquaBarrier AVB, IKO.
 - .4 Sopraseal Stick 1100, Soprema.
 - .5 AVB LT, IKO
 - .6 Exoair 110, Tremco Inc.
 - .7 Air Shield, W.R. Meadows.

2.3 MASTICS AND ADHESIVES

- .1 Waterproofing Mastic: solvent-based mastic containing SBS modified bitumen, fibres and mineral fillers, used to seal around penetrations and extrusions.
 - .1 Compatibility: With air/vapour barrier membrane, substrate and insulation.
 - .2 Specific gravity at 20°C: 1.0 kg/l to 1.12 kg/l
 - .3 Application Temperature: -10°C to +35°C
 - .4 Solids by Weight: 70% to 83 %
 - .5 Acceptable materials:
 - .1 Bituthene Mastic, GCP Applied Technologies
 - .2 Air-Bloc 21 or Air-Bloc 230-21 Adhesive, Henry Bakor.
 - .3 570-05 Polybitume Henry Bakor
 - .4 925 BES Sealant Henry Bakor
 - .5 Exoair Termination Mastic, Tremco Inc.
 - .6 Roofcraft AquaBarrier Mastic, IKO.
 - .7 Sopreamastic, Soprema.
 - .8 Pointing Mastic, W.R. Meadows.

2.4 ACCESSORIES

- .1 Thinner and cleaner for Butyl or Neoprene Sheet: as recommended by sheet material manufacturer.
- .2 Attachments: galvanized steel bars and anchors.
- .3 Roof-to-Wall Transition Membranes: Manufacturer's recommended reinforced self adhesive, compatible with roofing air and vapour membranes and wall materials specified in this Section.
 - .1 Acceptable Materials:
 - .1 Henry Blueskin Butyl Flash for transition with EPDM, PVC and TPO Membranes.
- .4 Through Wall Membranes: Manufacturer's recommended reinforced self adhesive, compatible with air and vapour membrane and that will not become plastic and extrude onto finished surfaces when exposed to high wall temperatures.
 - .1 Acceptable Materials:
 - .1 Blueskin TWF, Henry Bakor
 - .2 TWF, IKO
 - .3 Sopraseal WFM, Soprema
- .5 Masonry Flashing Membrane: self-adhesive membrane as recommended by membrane manufacturer and composed of thermoplastic polymer modified bitumen and a high density polyethylene film with a silicone release film on the lower surface.
- .6 Butyl Adhesive: provide butyl based adhesive membrane for locations in contact with plasticized vinyl including, but not limited to, vinyl deck membranes.

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 ENVIRONMENTAL REQUIREMENTS

- .1 All membrane shall be installed at surface and ambient temperature of 5°C or above, in dry weather conditions.
- .2 For applications below 5°C consult membrane manufacturer's technical representative for instructions and, obtain Departmental Representative's approval before proceeding with Work.
- .3 Self adhered membrane shall not be applied below application temperature of minus 10 °C despite primers being able to be applied at colder temperatures.

3.3 EXAMINATION AND PREPARATION

- .1 Verify that surfaces and conditions are ready to accept work of this section.
- .2 Ensure surfaces are clean, dry, sound, smooth, continuous and comply with air barrier manufacturer's requirements.
- .3 Remove loose or foreign matter, which might impair adhesion of materials.
- .4 Ensure substrates are clean of oil or excess dust; masonry joints struck flush, and open joints filled; and concrete surfaces free of large voids, spalled areas or sharp protrusions
- .5 Do not install materials during rain or snowfall.
- .6 Report unsatisfactory conditions to Departmental Representative in writing.
- .7 Do not start work until deficiencies have been corrected.
 - .1 Beginning of Work implies acceptance of conditions.

3.4 INSTALLATION: SELF ADHERING SYSTEM

- .1 Apply primer to substrates in accordance with manufacturer's written instructions. Apply primer that will be covered with membrane the same day. Re-prime areas that are not covered the same day.
- .2 Align and position self-adhering transition membrane, remove protective film and press firmly into place. Ensure minimum 150 mm overlap at all end and side laps.
- .3 Corner details: Double cover outside and inside corners, use 300 mm wide initial strip of membrane centred on axis of corner. Follow with full width of sheet membrane to cover initial strip completely.
- .4 Construction and control joints: Install membrane in double thickness over properly sealed joints, use 300 mm wide initial strip of membrane centred over joint. Follow with full width of sheet membrane. Assure that joints are properly sealed; joint filler and a compatible sealant are installed

- .5 Tie-in to window frames, aluminium screens, hollow metal doorframes, spandrel panels, roofing system and at the interface of dissimilar materials as indicated in drawings.
- .6 Roll laps and membrane with a counter top roller to effect seal.
- .7 Small protrusions (pipes, etc.) through the waterproofing membrane, should be pre-stripped with a membrane and sealed with mastic
- .8 Inspect membrane installation meticulously and immediately. Holes and tears in the membrane must be repaired with air / vapour barrier membrane material. The repair must exceed the affected surface area by a minimum of 150 mm. The membrane piece applied for the repair must be sealed around its edges with mastic.

3.5 FIELD QUALITY CONTROL

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

3.6 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.7 PROTECTION OF WORK

- .1 Protect finished work from penetrations.
- .2 Do not permit adjacent work to damage work of this section.
- .3 Ensure finished work is protected from climatic conditions.
- .4 Repair to manufacturers written instructions.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 06 10 00 – Rough Carpentry
- .2 Section 07 27 13 – Modified Bituminous Air and Vapour Barrier
- .3 Section 09 21 16 – Gypsum Board Assemblies

1.2 REFERENCES

- .1 American Concrete Institute International (ACI):
 - .1 ACI 302.2R-06, Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM E96/E96M-16, Standard Test Methods for Water Vapor Transmission of Materials.
 - .2 ASTM E154-08a(2013)e1, Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.
 - .3 ASTM E1643-11(2017), Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
 - .4 ASTM E1677-11, Standard Specification for an Air Barrier (AB) Material or System for Low-Rise Framed Building Walls.
 - .5 ASTM E1745-11, Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.
 - .6 ASTM E2178-13, Standard Test Method for Air Permeance of Building Materials.
 - .7 ASTM E2357-11, Standard Test Method for Determining Air Leakage of Air Barrier Assemblies.
 - .8 ASTM F1249-13, Standard Test Method for Water Vapour Transmission Rate through Plastic Film and Sheeting Using a Modulated Infrared Sensor.
- .3 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB 51.32-M77, Sheathing, Membrane, Breather Type.
 - .2 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Coordination between all installers of each component of vapour and air retarder system is essential to ensure continuity of system and that junctions between the various components are effectively sealed.
 - .2 Verify with manufacturers and all tradesmen involved with installation procedures of building products incorporated into vapour and air retarder

elements including, but not limited to, various membranes, coatings and sealants as well as continuity with roofing membrane.

1.4 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 – Submittals Procedures.
 - .1 Submit manufacturer's printed product literature, specifications and data sheet for each product specified.
 - .2 Submit manufacturer's installation instructions including joint treatment recommendations.

1.5 MOCK-UP

- .1 Construct mock-up in accordance with Section 01 45 00 - Quality Control.
- .2 Construct typical exterior wall panel, 3 m long by 4 m wide, incorporating window openings with frame and sill installed, insulation, building corner condition, junction with roof system; illustrating materials interface and seals.
- .3 Locate where directed by Departmental Representative.
- .4 Mock-up may remain as part of Work.
- .5 Allow 24 hours for inspection of mock-up by Departmental Representative before proceeding with air/vapour barrier work.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Store materials in clean, dry area in accordance with manufacturer's instructions.
- .3 Protect materials during handling and application to prevent damage.

1.7 WASTE MANAGEMENT AND DISPOSAL

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

Part 2 Products

2.1 SHEET MATERIALS

- .1 Building Paper: Asphalt impregnated kraft paper manufactured from virgin cellulose and having a 30 minute moisture resistance rating meeting the requirements of CGSB 51.32.

2.2 VAPOUR BARRIER SHEET MATERIALS

- .1 Plastic Sheet Vapour Retarder (Exterior Stud Walls): 6 mil polyethylene sheet meeting requirements of CAN/CGSB-51.34.
- .2 Plastic Sheet Vapour Retarder (Underslab): High density, puncture resistant polyethylene sheet in accordance with ASTM E1745 and CAN/CGSB-51.34, and as follows:

- .1 Thickness: 10 mil
- .2 Vapour Permeance: Nominal ≤ 0.044 Perms maximum
- .3 Tensile Strength and Puncture Resistance: ASTM E1745 Class B minimum
- .4 Acceptable materials:
 - .1 Layfield Construction Materials, VaporFlex 10
 - .2 Raven Industries, VaporBlock VB10
 - .3 Stego Industries LLC, Stego Wrap 10 mil
 - .4 W.R. Meadows, Perminator 10 mil

2.3 ACCESSORIES

- .1 Accessory Materials: Provide manufacturer's required seam tape, pipe boots and vapour proofing mastic forming a complete system in accordance with CAN/CSA A23.1 and ASTM E1643
- .2 Seam Tape: High density, air resistant polyethylene tape with pressure sensitive adhesive. Type as recommended by vapour retarder manufacturer. Minimum 100 mm for lap joints and perimeter seals, 50 mm wide elsewhere.
- .3 Sealant: Asbestos free non-hardening sealant, compatible with vapour retarder materials, recommended by vapour retarder manufacturer in accordance with Section 07 92 00.
- .4 Fasteners: Provide non-corrosive metal screws, nails, plastic clips and other fasteners as recommended by air/vapour retarder manufacturer required for complete installation of Work.
- .5 Staples: minimum 6 mm leg.
- .6 Moulded Box Vapour Retarder: Factory moulded polyethylene box purpose made for use with recessed electric switch and outlet device boxes.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 EXAMINATION

- .1 Examine surfaces to receive membrane. Notify Departmental Representative if surfaces are not acceptable. Do not begin installation until unacceptable conditions have been corrected.

3.3 INSTALLATION: SHEET MATERIALS

- .1 Install two (2) layers of building paper air barrier sheets in direct contact with exterior side of exterior wall sheathing before windows and doors are installed; eliminate any voids behind air barrier by wrapping sheet materials over projections or recesses in wall construction.

- .2 Install in a horizontal manner starting at the lower portion of the wall with subsequent layers installed in a shingle pattern to overlap lower layers. Maintain weather barrier plumb and level.
- .3 Overlapping:
 - .1 Wrap corners of building with a minimum overlap of 300 mm.
 - .2 Overlap horizontal seams a minimum of 100 mm.
 - .3 Overlap vertical seams a minimum of 150 mm.
 - .4 Install second layer of building paper air barrier sheets having an offset of 50% of roll width and same corner and seam overlap widths as the first layer.
- .4 Attach air barrier to sheathing using plastic capped screws or nails placed at a maximum vertical spacing of 450 mm on center along each stud line.
- .5 Cut window and door rough openings as follows:
 - .1 Windows:
 - .1 Cut modified "I" pattern in the air barrier sheet.
 - .2 Cut horizontally along bottom of header.
 - .3 Cut vertically down centre of opening from top down to 2/3 of the way to the bottom.
 - .4 Cut diagonally from bottom vertical cut to left and right corners of opening.
 - .5 Fold side and bottom flaps into window opening and fasten at 150 mm on center and trim off excess material.
 - .2 Doors:
 - .1 Cut standard "I" pattern air barrier sheet.
 - .2 Cut horizontally along bottom of door frame header and along top of sill.
 - .3 Cut vertically cut down the centre of door openings from header to sill.
 - .4 Fold side flaps inside around door openings and fasten at 150 mm on center and trim off excess material.
- .6 Tape horizontal and vertical seam using manufacturer's recommended seaming tape; seal tears and cuts using manufacturer's recommended repair materials and methods.

3.4 INSTALLATION: SHEET VAPOUR BARRIER

- .1 Verify that services are installed and have been accepted by the Departmental Representative and Authorities Having Jurisdiction prior to installation of vapour retarder.
- .2 Install sheet vapour retarder on warm side of exterior wall, ceiling, and floor assemblies prior to installation of gypsum board to form continuous retarder in accordance with manufacturers written instructions.
- .3 Use sheets of largest practical size to minimize joints.
- .4 Install materials in a manner that maintains continuity; repair punctures and tears with sealing tape before work is concealed.

- .5 Openings:
 - .1 Cut sheet vapour retarder to form openings and lap and seal to window and door frames in accordance with good building envelope practice.
- .6 Seal perimeter of sheet vapour retarder as follows:
 - .1 Apply continuous bead of sealant to substrate at perimeter of sheets.
 - .2 Lap sheet over sealant and press into sealant bead.
 - .3 Install staples through lapped sheets at sealant bead into wood substrate.
 - .4 Install sealant bead with no gaps; smooth out folds and ripples occurring in sheet over sealant.
- .7 Seal lap joints of sheet vapour retarder as follows:
 - .1 Attach first sheet to substrate.
 - .2 Apply continuous bead of sealant over solid backing at joint.
 - .3 Lap adjoining sheet minimum 150 mm and press into sealant bead.
 - .4 Install staples through lapped sheets at sealant bead into wood substrate.
 - .5 Install sealant bead with no gaps; smooth out folds and ripples occurring in sheet over sealant.
- .8 Seal electrical switch and outlet device boxes that penetrate vapour retarder as follows:
 - .1 Install moulded box vapour retarder:
 - .2 Apply sealant to seal edges of flange to main vapour retarder and seal wiring penetrations through box cover.

3.5 INSTALLATION: UNDERSLAB SHEET VAPOUR BARRIER

- .1 Install vapour barrier in accordance with manufacturer's written instructions and ASTM E1643, and generally as follows:
 - .1 Unroll vapour barrier with the longest dimension parallel to direction of concrete placement.
 - .2 Lap vapour barrier onto face of grade beams.
 - .3 Overlap joints 200 mm and seal with manufacturer's required tape.
 - .4 Seal penetrations including pipe and conduit risers in accordance with manufacturer's written instructions.
 - .5 Make no additional penetrations except as required for placing of reinforcing steel and permanent utilities.
- .2 Repair damaged areas by cutting patches of vapour barrier membrane; sized to overlap damaged area a minimum of 150 mm to each side of puncture; and tape all sides using manufacturer's required tape.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 06 10 00 – Rough Carpentry
- .2 Section 07 62 00 – Sheet Metal Flashing and Trim

1.2 REFERENCES

- .1 Alberta Roofing Contractor's Association (ARCA)
 - .1 Manual on Good Roofing Practice and Accepted Roofing Systems.
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM D3161-19, Standard Test Method for Wind-Resistance of Steep Slope Roofing Products (Fan-Induced Method)
 - .2 ASTM E108-17, Standard Test Methods for Fire Tests of Roof Coverings
 - .3 ASTM F1667-18, Standard Specification for Driven Fasteners: Nails, Spikes, and Staples.
- .3 Canadian Roofing Contractors' Association (CRCA)
 - .1 Roofing Specification Manual.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .5 National Research Council Canada (NRC)/Institute for Research in Construction (IRC) - Canadian Construction Materials Centre (CCMC)
 - .1 CCMC-2002, Registry of Product Evaluations.
- .6 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC S107-10, Methods of Fire Tests of Roof Coverings

1.3 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 – Submittals.
 - .1 Submit manufacturer's printed product literature, specifications and data sheet. Indicate the following:
 - .1 Product characteristics.
 - .2 Performance criteria.
 - .3 Installation instructions.
 - .4 Limitations.
 - .5 Colour and finish.
 - .2 Submit WHMIS MSDS - Material Safety Data Sheets. WHMIS MSDS acceptable to Labour Canada and Health and Welfare Canada for shingles. Indicate VOC content.
- .2 Submit samples in accordance with Section 01 33 00 – Submittals Procedures.
 - .1 Submit duplicate samples of full size specified shingles.
- .3 Manufacturer's Instructions: Provide to indicate special handling criteria and installation sequence.

- .4 Submit closeout data in accordance with Section 01 78 00 – Closeout Submittals.
 - .1 Provide manufacturer's printed recommendations for general maintenance, including cleaning instructions.

1.4 QUALITY ASSURANCE

- .1 Installer shall be a member in good standing of the Alberta Roofing Contractors Association at the time of installation

1.5 MOCK-UPS

- .1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control.
 - .1 Provide 3000 x 3000 mm mock-up including components as follows.
 - .2 Mock-up will be used:
 - .1 To judge workmanship, substrate preparation, operation of equipment and material application.
 - .3 Locate where directed.
 - .4 Allow 24 hours for inspection of mock-up before proceeding with work.
 - .5 When accepted, mock-up will demonstrate minimum standard of quality required for this work. Approved mock-up may remain as part of finished Work.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, handle, store and protect materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver shingle materials and components in manufacturer's original, unopened, undamaged packages with identification labels intact.
- .3 Provide and maintain dry, off-ground weatherproof storage.
- .4 Remove only in quantities required for same day use.

1.7 WASTE MANAGEMENT AND DISPOSAL

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

1.8 EXTRA MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 All unused shingles remain property of Departmental Representative.

1.9 WARRANTY

- .1 Warranty Certificate: ARCA Warranty Certificate extending for a period of 5 years from date of Substantial Performance of the project.

- .2 Manufacturer's Special Warranty: Provide manufacturer' standard product warranty indicating that they will be responsible to repair or replace shingles that fail in materials or workmanship within specified warranty period; materials failures will include manufacturing defects and failure of shingles to self seal after a reasonable time, and as follows:
 - .1 Material Warranty Period: 30 years from date of Substantial Performance, prorated, with first 12 years non prorated.
 - .2 Workmanship Warranty Period: 10 years from date of Substantial Performance.
- .3 Provide warranty for shingles to include in maintenance manuals as specified in Section 01 78 00 – Closeout Submittals: Operations and Maintenance Data Manuals.

Part 2 Products

2.1 SHINGLES

- .1 Shingles: 95% recycled rubber, self sealing with Class C fire rating and as follows:
 - .1 Mass: minimum 3.4 lb/sq ft
 - .2 Wind Testing: pass at 110 mph for 2 hours to ASTM D3161
 - .3 Impact: Class4 impact Rated to UL 2218
 - .4 Panel Size: Manufacturer's standard.
 - .5 Colours: as indicated on Drawings.
 - .6 Acceptable materials:
 - .1 Euroshield
- .2 Hip and Ridge Shingles: Manufacturer's standard to match shingles.

2.2 SHEET MATERIALS

- .1 Sheathing paper: to CAN/CGSB-51.32, single ply type, perforated.
- .2 Waterproofing underlayment: to ASTM 1970, sheet barrier of self-adhering rubberized asphalt membrane having glass mat fibre reinforcement, mineral granule surfaced, back paper release film, cold applied. Minimum thickness of 1.4 mm.
 - .1 Acceptable materials:
 - .1 ArmourGuard, IKO Global.
 - .2 Roof Defender, Johns Manville International, Inc.
 - .3 WinterGuard, CertainTeed Corporation.
 - .4 Weather Watch, GAF Materials Corporation.

2.3 ACCESSORIES

- .1 Rigid Ridge Vent: Manufacturer's standard rigid section high density polypropylene or other UV stabilized plastic ridge vent with non-woven geotextile filter strips and with external deflector baffles; for use under ridge shingles.
 - .1 Acceptable materials:

- .1 Cobra Rigid Vent II, GAF Materials Corporation.
 - .2 RidgeMaster Plus, Mid America Building Products.
 - .3 ShingleVent II, Air Vent Inc., a CertainTeed Company.
 - .4 SmartAir Ridge Vent, Globe Building Materials, Inc.
- .2 Asphaltic Cement: to ASTM D4586, asbestos free.
- .3 PVC drip edge: extruded profile of unplasticized polyvinyl chloride of minimum thickness of 0.8 mm.
- .4 Nails: to CSA B111, of galvanized steel, sufficient length to penetrate 19 mm into deck.
 - .1 Where nails are in contact with metal flashing, use nails made from same metal as flashing.
- .5 Snow Stops: extruded aluminum with stainless steel base plate, two pipe snow guard, powder coated finish.
 - .1 Basis of Design:
 - .1 PP115, Alpine Snowguards

2.4 METAL FLASHING AND TRIM

- .1 Comply with requirements of Section 07 62 00 – Sheet Metal Flashing and Trim.
- .2 Fabricate sheet metal flashing and trim in accordance with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item, and as follows:
 - .1 Apron Flashings: Fabricate with lower flange a minimum of 100 mm over and 100 mm beyond each side of down slope shingles and 150 mm up the vertical surface.
 - .2 Step Flashings: Fabricate with a head lap of 50 mm and a minimum extension of 100 mm over the underlying shingle and up the vertical surface.
 - .3 Cricket, Backer, and Saddle Flashings: Fabricate with concealed flange extending a minimum of 450 mm beneath upslope shingles and 150 mm beyond each side of chimney and 150 mm above the roof plane.
 - .4 Open Valley Flashings: Fabricate in lengths not exceeding 3050 mm with 25 mm high inverted V profile at centre of valley and equal flange widths of 305 mm, 610 mm total.
 - .5 Drip and Rake Edges: Fabricate in lengths not exceeding 3050 mm with 50 mm roof deck flange and 38 mm fascia flange with 10 mm drip at lower edge.
- .3 Vent Pipe Flashings: Oatey ASTM B749, Type L51121, at least 1.5 mm thick. Provide lead sleeve sized to slip over and turn down into pipe, soldered to skirt at slope of roof and extending at least 100 mm from pipe onto roof.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify substrate and surface conditions are in accordance with shingle manufacture recommended tolerances prior to installation of shingles and accessories.
 - .1 Examine roof sheathing to verify that sheathing joints are supported by framing and blocking or metal clips and that installation is within flatness tolerances.
 - .2 Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and completely anchored; and that provision has been made for flashings and penetrations through shingles.
- .2 Proceed with installation only after unsatisfactory conditions have been corrected.
- .3 Provide notice to third party roofing inspector for required inspections to achieve the ARCA Warranty.
- .4 Allow roofing inspector access for inspections as required.

3.2 INSTALLATION: UNDERLAYMENT

- .1 Single Layer Felt Underlayment: Install single layer of felt underlayment on roof deck perpendicular to roof slope in parallel courses. Lap sides a minimum of 50 mm over underlying course. Lap ends a minimum of 100 mm Stagger end laps between succeeding courses at least 1830 mm. Fasten with felt underlayment nails.
 - .1 Install felt underlayment on roof deck not covered by self adhering sheet underlayment. Lap sides of felt over self adhering sheet underlayment not less than 76 mm in direction to shed water. Lap ends of felt not less than 150 mm over self adhering sheet underlayment.
- .2 Self Adhering Ice Dam Protection Sheet: Install two rows of self adhering sheet, totalling 2125 mm in width, wrinkle free, on roof deck. Comply with low temperature installation restrictions of underlayment manufacturer if applicable. Install over entire roof, lapped in direction to shed water. Lap sides not less than 89 mm. Lap ends not less than 150 mm staggered 610 mm between courses. Roll laps with roller. Cover underlayment within seven days.

- .1 Eaves: Extend from edges of eaves 610 mm beyond interior face of exterior wall.
- .2 Rakes: Extend from edges of rake 610 mm beyond interior face of exterior wall.
- .3 Valleys: Extend from lowest to highest point 450 mm on each side.
- .4 Hips: Extend 450 mm on each side.
- .5 Ridges: Extend 900 mm on each side without obstructing continuous ridge vent slot.
- .6 Sidewalls: Extend beyond sidewall 450 mm and return vertically against sidewall not less than 100 mm.
- .7 Dormers, Chimneys, Skylights, and other Roof Penetrating Elements: Extend beyond penetrating element 450 mm and return vertically against penetrating element not less than 100 mm.
- .8 Roof Slope Transitions: Extend 450 mm on each roof slope.

3.3 INSTALLATION: UNDERLAYMENT VALLEY PROTECTION

- .1 Place eave protection as valley protection in accordance with manufacturer's instructions.
- .2 Place one layer of prefinished sheet metal flashings, minimum 600 mm wide, centered over open valleys and crimped 25 mm down center. Weather lap joints minimum 150 mm. Nail in place minimum 450 mm on centre, 25 mm from edges.
- .3 Valley to be a minimum 150 mm wide at top and increase by 3 mm/300 mm to a maximum of 200 mm.
- .4 Embed each shingle in a band of plastic cement.
- .5 Ensure top corners of shingles are tapered from the valley.

3.4 INSTALLATION: METAL FLASHING

- .1 General: Install metal flashings and other sheet metal in accordance with requirements in Section 07 62 00 – Sheet Metal Flashing and Trim.
- .2 Install metal flashings in accordance with recommendations in ARCA's Steep Roofing Division, Requirements for 5 Year Warranty Certificate.
- .3 Apron Flashings: Extend lower flange over and beyond each side of down slope shingles and up the vertical surface.
- .4 Step Flashings: Install with a head lap of 50 mm and extend over the underlying shingle and up the vertical surface. Fasten to roof deck only.
- .5 Cricket, Backer, and Saddle Flashings: Install against the roof penetrating element extending concealed flange beneath upslope shingles and beyond each side.
- .6 Open Valley Flashings:
 - .1 Adhere one ply of 900 mm wide self adhering ice dam protection material, centred in valley.
 - .2 Install 610 mm wide flashing centred in valley, lapping ends at least 203 mm in direction to shed water.
 - .3 Fasten upper end of each length to roof deck beneath overlap.

- .4 Secure hemmed flange edges into metal cleats spaced 305 mm apart and fastened to roof deck.
- .5 Adhere 225 mm wide strip of self adhering sheet to metal flanges and to self adhering sheet underlayment.
- .7 Rake Drip Edges: Install rake drip edge flashings over underlayment and fasten to roof deck.
- .8 Eave Drip Edges: Install eave drip edge flashings below underlayment and fasten to roof sheathing; maintain a minimum of 6 mm spacing between vertical flashing flange and fascia.
- .9 Pipe Flashings: Form flashing around pipe penetrations and shingles. Fasten and seal to shingles as recommended by manufacturer.

3.5 INSTALLATION: SHINGLES

- .1 Install shingles in accordance with manufacturer's written instructions, recommendations in ARCA's, Steep Roofing Division, requirements for ARCA 5 Year Warranty Certificate for roofs having a slope of 1:3 (4:12) or greater in accordance with CAN3 A123.51, low slope of less than 1:3 (4:12) to 1:6 (2:12) in accordance with CAN3 A123.52.
- .2 Install starter strip along lowest roof edge, consisting of an shingle strip with tabs removed with self sealing strip face up at roof edge.
 - .1 Extend shingles 19 mm over fascia at eaves and rakes.
 - .2 Install starter strip along rake edge.
- .3 Install first and remaining courses of shingles stair stepping diagonally across roof deck with manufacturer's recommended offset pattern at succeeding courses, maintaining uniform exposure. (No blocking or racking of shingles.)
- .4 Install first and remaining courses of shingles stair stepping diagonally across roof deck with manufacturer's recommended offset pattern at succeeding courses, maintaining uniform exposure.
- .5 Fasten shingle strips with a minimum of four (4) roofing nails located in accordance with manufacturer's written instructions.
- .6 Open Valleys: Cut and fit shingles at open valleys, trimming upper concealed corners of shingle strips. Maintain uniform width of exposed open valley, and as follows:
 - .1 Set valley edge of shingles in a 76 mm wide bed of roofing cement.
 - .2 Do not nail shingles to open valley metal flashings.
- .7 Ridge Vents:
 - .1 Install continuous ridge vents accordance with manufacturer's written instructions.
 - .2 Fasten with roofing nails or screws of sufficient length to penetrate sheathing.
 - .3 Fasten ridge cap shingles to cover ridge vent without obstructing airflow:
 - .1 Maintain open area of 1/300 roof area for ventilation.

- .2 Maintain 50% of ventilation from ridge vent; remainder from soffit vents.
- .8 Ridge and Hip Cap Shingles:
 - .1 Maintain same exposure of cap shingles as roofing shingle exposure.
 - .2 Lap cap shingles at ridges to shed water away from direction of prevailing winds.
 - .3 Fasten with roofing nails of sufficient length to penetrate sheathing.

END OF SECTION

Part 1 General

1.1 INTENT

- .1 Work of this section is only used for building fascia.

1.2 RELATED SECTIONS

- .1 Section 06 10 00 – Rough Carpentry
- .2 Section 07 21 13 – Board Insulation
- .3 Section 07 27 13 – Modified Bituminous Air and Vapour Barrier
- .4 Section 07 31 13 – Shingles
- .5 Section 07 62 00 – Sheet Metal Flashing and Trim
- .6 Section 07 92 00 - Sealants

1.3 REFERENCES

- .1 Aluminum Association, Inc. (AA)
 - .1 DAF-45-03, Designation System for Aluminum Finishes.
- .2 American Aluminum Manufacturers Association (AAMA):
 - .1 AAMA 605.2, Voluntary Specification for High Performance Coatings on Architectural Panels and Extrusions.
 - .2 AAMA 620-96, Voluntary Specifications for High Performance Organic Coatings on Coil Coated Architectural Aluminum Substrates.
- .3 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A240/A240M-16a, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - .2 ASTM A480/A480M-16b, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
 - .3 ASTM A653/A653M-15e1, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .4 ASTM A755/A755M-16e1, Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products.
 - .5 ASTM B209-14, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - .6 ASTM C297/C297M-16, Standard Test Method for Flatwise Tensile Strength of Sandwich Constructions.
 - .7 ASTM D523-14, Standard Test Method for Specular Gloss.
 - .8 ASTM D1781-98(2012), Standard Test Method for Climbing Drum Peel for Adhesives.
- .4 Canadian Sheet Steel Building Institute (CSSBI)

- .1 CSSBI 20M-15, Standard for Sheet Steel Cladding for Architectural, Industrial and Commercial Building Applications.
- .2 CSSBI S8-08, Quality and Performance Specification for Prefinished Sheet Steel Used for Building Products.
- .5 Canadian Standards Association (CSA)
 - .1 CAN3 S157/S157.1-05 (R2015), Strength Design in Aluminum/Commentary on CSA S157-05, Strength Design in Aluminum.
 - .2 CSA S136-12, North American Specification for the Design of Cold Formed Steel Structural Members, Includes Update No. 1 (2014).
 - .3 CSA W47.2-11(R2015), Certification of Companies for Fusion Welding of Aluminum, Includes Update No. 1 (2011), Update No. 2 (2012).
- .6 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.4 PRE-INSTALLATION MEETINGS

- .1 Convene pre-installation meeting one week prior to beginning work of this Section and on-site installation, with Contractor, Departmental Representative, installer, manufacturer's representative to:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordination with other building subtrades.
 - .4 Review manufacturer's installation instructions and warranty requirements.
- .2 Manufacturer's representative shall also provide frequent inspection visits during the course of work of this Section to assure quality and competence of panel installation.

1.5 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 – Submittals:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet.
 - .2 Submit WHMIS MSDS - Material Safety Data Sheets acceptable to Labour Canada, and Health and Welfare Canada.
- .2 Submit shop drawings in accordance with Section 01 33 00 – Submittals:
 - .1 Indicate layout, profiles and product components including anchorage, accessories, finish colours and textures.
 - .2 Include details showing thickness and dimensions of the various system parts, fastening and anchoring methods, locations of joints and gaskets and location and configuration of movement joints.
- .3 Submit samples in accordance with Section 01 33 00 – Submittals:
 - .1 Submit duplicate 300 x 300 mm samples of composite panel in thickness specified from representative materials, finishes and colours. Include

clips, anchors, supports, fasteners, closures, and other panel accessories for assembly approval.

- .4 Manufacturer's Instructions:
 - .1 Submit manufacturer's installation instructions and special handling criteria, installation sequence and cleaning procedures.
- .5 Submit quality assurance submittals in accordance with Section 01 45 00 - Quality Control.
 - .1 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
 - .2 Certificates: submit certificates signed by manufacturer certifying that composite wall panels comply with specified performance characteristics and physical properties.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver, store and protect material in accordance with panel manufacturer's recommendations.
- .3 Do not expose panels with strippable film to direct sunlight or extreme heat.

1.7 WASTE MANAGEMENT AND DISPOSAL

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

1.8 WARRANTY

- .1 Special warranties specified in this Article shall not deprive the Departmental Representative of other rights the Departmental Representative may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.
- .2 Special Finish Warranty: Submit a written warranty, signed by manufacturer, covering failure of the factory-applied exterior finish on metal wall panels within the specified warranty period and agreeing to repair finish or replace wall panels that show evidence of finish deterioration. Deterioration of finish includes, but is not limited to, colour fade, chalking, cracking, peeling, and loss of film integrity for a period of 20 years from date of Substantial Performance.

Part 2 Products

2.1 MANUFACTURERS

- .1 Acceptable Manufacturers: Subject to compliance with requirements specified in this Section and as established by the Basis-of-Design Materials, manufacturers offering products that may be incorporated into the Work include; but are not limited to, the following:
 - .1 Accumet 2000, Flynn.

- .2 Alpolic, Mitsubishi Chemical
- .3 Alucobond Plus, Alcan Composites Inc.
- .4 Reynobond, Reynolds American Manufacturing

2.2 PERFORMANCE/DESIGN CRITERIA

- .1 Maximum deflection not to exceed $L/180$ under system's own weight plus wind load (positive and negative) loads acting normal to the plane in accordance with the Building Code Climatic Data, wind load 1:30 years.
- .2 Calculate live load deflections in accordance with CSSBI 20M, as modified by the requirements of this Section.
- .3 Provide for movement of components without causing buckling, failure of joint seals, undue stress on fasteners when subject to seasonal temperature range from -40°C (-40°F) to $+50^{\circ}\text{C}$ (120°F), and wind loads noted above.
- .4 Final review and acceptance of work completed by this Section shall be carried out by the manufacturer's representative, the Departmental Representative, Contractor and the Subcontractor.

2.3 COMPOSITE METAL PANEL MATERIALS

- .1 Composite aluminum panel: Aluminum sheets thermally bonded in continuous process, under tension, to thermoplastic core with no glues or adhesives between dissimilar materials, and as follows:
 - .1 Total Composite Thickness: 4 mm
 - .2 Aluminum Face Sheets:
 - .1 Alloy: AA3000 Series.
 - .2 Thickness: 0.51 mm.
 - .3 Factory Finish: coil coated with fluoropolymer paint to AAMA 620
 - .4 Colour: as indicated on drawings, confirm colour with Departmental Representative prior to ordering.
 - .3 Core: non-combustible
 - .4 Bond Integrity: tested for resistance to delamination as follows:
 - .1 Bond Strength: 10.3 MPa minimum to ASTM C297.
 - .2 Peel Strength: 100 N mm/mm minimum to ASTM D1781.
 - .3 No degradation in bond performance after 8 hours of submersion in boiling water and after 21 days of immersion in water at 21 degrees C.
- .2 Aluminum extrusions:
 - .1 Alloy: AA-6063-T5.
 - .2 Colour: Mill finish where non-exposed.
- .3 Stiffeners:
 - .1 Alloy: AA-6063-T5
 - .2 Colour: Mill finish.

2.4 SYSTEM BACK-UP MATERIALS

- .1 Air/Vapour Retarder: Self-adhering membrane as specified in Section 07 27 13.
- .2 Exterior Sheathing: as specified in Section 06 10 00.

2.5 ACCESSORIES

- .1 System Sealants: Sealants within the panel system, as recommended by manufacturer, colour to be selected by Departmental Representative.
- .2 Gaskets: Santoprene or EPDM as recommended by manufacturer.
- .3 Flashings: Fabricate flashing from 1.57 mm minimum thickness aluminum sheet. Where exposed to view, finish to match adjacent panels. Provide lap strip under flashing at abutted conditions; with lapped surfaces sealed with a full-bed of non-hardening sealant.
- .4 Fasteners:
 - .1 Attachment of the panel system to the primary panel structural supports shall be made using manufacturer's recommended fasteners.
 - .2 Typical joinery shall be attached with concealed, non-corrosive fasteners. When exposed fasteners are required in isolated conditions, the fastener shall be obscured in the panel joinery, exposed fasteners shall be stainless steel.

2.6 FABRICATION

- .1 Aluminum wall components shall comply with details as indicated on drawings and as indicated in shop drawings.
- .2 All components shall be factory fabricated ready for field installation. All components shall match quality and installation of accepted mock-up specified above.
- .3 Tolerances:
 - .1 Panel bow shall not exceed 0.8% of panel overall dimension in width or length.
 - .2 Panel dimensions shall allow for field adjustment and thermal movement.
 - .3 Panel lines, breaks and curves shall be sharp, smooth and free of warps or buckles.
 - .4 Panel shall be visually flat.
 - .5 Panel surfaces shall be free of scratches or marks caused during fabrication.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 PREPARATION

- .1 Obtain all dimensions from job site.
- .2 Ensure all substrate is aligned and condition is acceptable.
- .3 Building surfaces shall be smooth, clean and dry, and free from defects detrimental to the installation of the system. Notify Contractor of conditions not acceptable for installation of system.
- .4 Inspect components before installation and verify that there is no shipping damage.
- .5 Do not install damaged panels; repair or replace as required for smooth and consistent finished appearance.

3.3 INSTALLATION

- .1 Install composite panels in accordance with manufacturer's written instructions and shop drawings.
 - .1 Allow for thermal movement.
- .2 Install air/vapour retarder membrane in accordance with Section 07 27 13 and the manufacturer's instructions.
- .3 Erect panels plumb, level and true.
- .4 Do not install component parts that are observed to be defective, including warped, bowed, dented, scraped and broken members.
- .5 Install metal cladding to structural support by hidden mechanical fasteners.
- .6 All fasteners shall penetrate wall framing. Where fastener does not penetrate framing, DO NOT remove fastener. Removal of fastener will damage integrity of air/vapour membrane. Realign fastener location and install new fastener in close proximity to original fastener.
- .7 Assemble and secure wall system so stresses on sealants are within manufacturers' recommended limits.
- .8 Separate dissimilar metals; use appropriate gasket and fasteners to minimize corrosive or electrolytic action between metals.
- .9 Install flashings to divert all moisture and condensation to exterior. Trim and flash around doors, louvers, and windows. Use only membrane flashing supported by insulation per architectural details.

3.4 CLEANING

- .1 Remove strippable film coating (if used) as soon as possible after surrounding material has been installed.
- .2 Remove all excess materials, debris and equipment at completion.
- .3 Clean panels free of grime and dirt.
- .4 Touch-up damaged finishes with manufacturer's recommended touch-up paint.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 06 10 00 – Rough Carpentry
- .2 Section 07 21 13 – Board Insulation
- .3 Section 07 24 00 – Exterior Insulation and Finish System
- .4 Section 07 27 19 – Sheet Membrane Air and Vapour Barrier
- .5 Section 07 62 00 – Sheet Metal Flashing and Trim
- .6 Section 07 92 00 – Sealants
- .7 Section 09 21 16 – Gypsum Board Assemblies

1.2 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM A653/A653M-15e1, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .2 ASTM C920 - Standard Specification for Elastomeric Joint Sealants.
 - .3 ASTM C1185-08(2016), Standard Test Methods for Sampling and Testing Non-Asbestos Fibre-Cement Flat Sheet, Roofing and Siding Shingles, and Clapboards.
 - .4 ASTM C1186-08(2016), Standard Specification for Flat Fiber-Cement Sheets.
 - .5 ASTM E84-16, Standard Test Methods for Surface Burning Characteristics of Building Materials.
 - .6 ASTM E96/E96M-16, Standard Test Methods for Water Vapor Transmission of Materials.
 - .7 ASTM E136-16a, Standard Test Method for Behaviour of Materials in a Vertical Tube Furnace at 750°C.
 - .8 ASTM E228 - Standard Test Method for Linear Thermal Expansion of Solid Materials With a Vitreous Silica Dilatometer.
 - .9 ASTM G26 - Standard Practice for Operating Light-Exposure Apparatus (Xenon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .3 Underwriters Laboratories' of Canada (ULC)
 - .1 CAN/ULC S102-11, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC S114-05, Standard Method of Test for Determination of Non-Combustibility in Building Materials

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Sequencing: Coordinate installation with flashings and other adjoining construction to ensure proper sequencing.

1.4 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 – Submittals:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet and include:
 - .1 Preparation instructions and recommendations.
 - .2 Installation instructions.
- .2 Submit shop drawings in accordance with Section 01 33 00 – Submittals:
 - .1 Provide shop drawings indicating attachment methods, joinery, sealing methods and compliance with design criteria and requirements of related work.
- .3 Submit samples in accordance with Section 01 33 00 – Submittals:
 - .1 Submit duplicate 150 mm long samples of wall system in each type, colour, texture and pattern required. Include clips, caps, battens, fasteners, closures and other exposed accessories.

1.5 QUALITY ASSURANCE

- .1 Installer Qualifications: Engage experienced installer with a minimum of three (3) years experience who has completed systems similar in material, design, and extent to that indicated for Project and with record of successful performance.
- .2 Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship of the following details:
 - .1 Sill and head connections at windows and penetrations
 - .2 Joint between panels
 - .3 Detailing of corner caps and flashings.
 - .4 Do not proceed with remaining Work until mock-up has been reviewed by Departmental Representative
 - .5 Refinish mock-up area as required to produce acceptable Work; at no additional cost to the Departmental Representative

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Store products in manufacturer's unopened packaging until ready for installation.
- .2 Store siding flat on a smooth level surface. Protect edges and corners from chipping. Store sheets under cover and keep dry prior to installing.

1.7 WASTE MANAGEMENT AND DISPOSAL

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

1.8 ENVIRONMENTAL REQUIREMENTS

- .1 Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
- .2 Proceed with siding installation when substrate is completely dry.

1.9 WARRANTY

- .1 Manufacturer's Warranty: Submit manufacturer's standard warranty that panels are free from defects in materials and workmanship beginning from the date of substantial completion and as follows:
 - .1 Product Warranty: manufacturers standard limited, non prorated product warranty for a period of 30 years.
 - .2 Workmanship Warranty: 2 year
 - .3 Finish Warranty: 15 years: Deterioration of finish includes, but is not limited to, chipping, cracking, and peeling.

Part 2 Products

2.1 MANUFACTURERS

- .1 Acceptable Manufacturers: Subject to compliance with requirements specified in this Section and as established by the Basis-of-Design Materials, manufacturers offering products that may be incorporated into the Work include; but are not limited to, the following:
 - .1 Allura Fiber Cement Products, Plycem
 - .2 James Hardie Industries Inc.

2.2 PERFORMANCE/DESIGN CRITERIA

- .1 Design composite building panel wall to provide for thermal movement of component materials caused by ambient temperature range of 80 degrees C without causing buckling, failure of joint seals, undue stress on fasteners or other detrimental effects.
- .2 Include expansion joints to accommodate movement in wall system and between wall system and building structure, caused by structural movements, without permanent distortion, damage to infills, racking of joints, breakage of seals, or water penetration.
- .3 Design members to withstand dead load and wind loads calculated in accordance with current Building Code and applicable local regulations, to maximum allowable deflection of 1/180th of span.
- .4 Provide for positive drainage of condensation occurring within wall construction and water entering at joints, to exterior face of wall in accordance with NRC "Rain Screen Principles".
- .5 Design wall system to accommodate specified erection tolerances of structure.
- .6 Maintain following installation tolerances:
 - .1 Maximum variation from plane or location shown on drawings: 3 mm/m of length and up to 20 mm/100 m maximum.
 - .2 Maximum offset from true alignment between two adjacent members abutting end to end, in line: 0.75 mm.

2.3 MATERIALS

- .1 Fibre Cement Board: made from fibre reinforced cement board, free from asbestos fibres; in accordance with ASTM C1186 Type A, Grade II; and as follows:
 - .1 Surface Burning Characteristics: Flame spread index of 0, smoke developed index of 5, maximum; when tested in accordance with ASTM E84.
 - .2 Combustibility: Noncombustible, when tested in accordance with ASTM E136, ULC S135 and ULC S114.
 - .3 Flexural Strength: 10 MPa when in equilibrium condition, and 7 MPa when in wet condition, tested in accordance with ASTM C1185.
 - .4 Freeze Thaw Resistance: 80 percent flexural strength retained, when tested in accordance with ASTM C1185.
 - .5 UV Resistance: No cracking, checking, or erosion.
 - .6 Water Tightness: No water droplets on underside, when tested in accordance with ASTM C1185.
- .2 Vertical Fibre Cement Siding:
 - .1 Thickness: 7.9 mm.
 - .2 Size: 1220 mm by 2440 mm with vertical battens or lines
 - .3 Texture: Stucco.
 - .4 Factory Finish: Manufacturers standard factory applied finish in colour as selected by Departmental Representative or indicated on Drawings.
 - .5 Basis-of-Design:
 - .1 HardiePanel, James Hardie Inc.
 - .2 Allura Vertical Siding
- .3 Fibre Cement Horizontal Lap Siding:
 - .1 Thickness (nominal): 8 mm.
 - .2 Width: 158 mm exposure
 - .3 Texture: Smooth.
 - .4 Factory Finish: Manufacturers standard factory applied finish in colour [as selected by Departmental Representative
 - .5 Basis-of-Design:
 - .1 Artisan Lap Siding, James Hardie Inc.

2.4 ACCESSORIES

- .1 Thermal Clips: 100 mm Fiberglass clips: Cascadia Clip to suit installation and details.
- .2 Subgirts: Rolled, Z-shaped, Z-275 galvanized steel girts to suit design loads and application.
- .3 Hat Sections and Other Sub framing: Rolled shapes, Z-275 galvanized steel to suit design loads and application.
- .4 Siding Accessories: Provide starter strips, edge trim, corner cap, perforated soffit boards and other items as recommended by siding manufacturer for building configuration, and as follows:

- .1 Provide accessories made from same material as adjacent siding, unless otherwise indicated.
- .2 Provide accessories matching colour and texture of adjacent siding, unless otherwise indicated.
- .5 Flashing: Provide pre-finished, galvanized sheet steel flashing and trims in accordance with Section 07 62 00, at window and door heads and where indicated.
- .6 Gaskets: Manufacturer's standard type suitable for use with system, permanently resilient; ultraviolet and ozone resistant; colour as directed.
- .7 Elastomeric Joint Sealant: single component polyurethane sealant joint sealant in accordance with Section 07 92 00.
- .8 Fasteners: Corrosion resistant fasteners as recommended by siding manufacturer for materials being fastened to and as follows:
 - .1 Fastening to Wood: Ribbed, bugle head screws of sufficient length to penetrate a minimum of 25 mm into substrate.
 - .2 Fastening to Metal: Ribbed, bugle head screws of sufficient length to penetrate a minimum of 6 mm or 3 - screw threads into substrate.
- .9 Touch Up Kit: Provide manufacturers standard touch-up kit for each colour provided.

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 PREPARATION

- .1 Building surfaces shall be smooth, clean and dry, and free from defects detrimental to the installation of the system. Notify Contractor of conditions not acceptable for installation of system.
- .2 Proceed with installation only after unsatisfactory conditions have been corrected.
- .3 Ensure air/vapour barrier installation is complete and has been reviewed by the Departmental Representative.

3.3 INSTALLATION: HORIZONTAL LAP SIDING

- .1 Install materials in strict accordance with manufacturer's installation instructions.
- .2 Starting: Install a minimum 6 mm thick lath starter strip at the bottom course of the wall. Apply planks horizontally with minimum 32 mm wide laps at the top. The bottom edge of the first plank overlaps the starter strip.
- .3 Allow minimum vertical clearance between the edge of siding and any other material in strict accordance with the manufacturer's installation instructions.
- .4 Align vertical joints of the planks over framing members.

- .5 Maintain clearance between siding and adjacent finished grade.
- .6 Locate splices at least one stud cavity away from window and door openings.
- .7 Face nail to rain screen strapping.
- .8 Locate splices at least 305 mm away from window and door openings.
- .9 Specific framing and fastener requirements: refer to the applicable building code compliance reports.
- .10 Site paint exposed cut edges to match colour of board, trim, or plank.

3.4 INSTALLATION: VERTICAL SIDING

- .1 Install materials in strict accordance with manufacturer's installation instructions.
- .2 Block framing between studs where horizontal joints occur.
- .3 Install metal Z flashing and provide a 6 mm gap at horizontal panel joints.
- .4 Place fasteners no closer than 9.5 mm from panel edges and 51 mm from panel corners.
- .5 Allow minimum vertical clearance between the edge of siding and any other material in strict accordance with the manufacturer's installation instructions.
- .6 Maintain clearance between siding and adjacent finished grade.
- .7 Specific framing and fastener requirements: refer to the applicable building code compliance reports.
- .8 Site paint exposed cut edges to match colour of board, trim, or plank.

3.5 INSTALLATION: TRIM AND MOULDING

- .1 Install materials in strict accordance with manufacturer's installation instructions. Install flashing around all wall openings.
- .2 Fasten through trim into structural framing or code complying sheathing. Fasteners must penetrate minimum 25 mm plus full thickness of sheathing. Additional fasteners may be required to ensure adequate security.
- .3 Place fasteners no closer than 19 mm and no further than 51 mm from side edge of trim board and no closer than 25 mm from end. Fasten maximum 406 mm on center.
- .4 Maintain clearance between trim and adjacent finished grade.
- .5 Trim inside corner with single board.
- .6 Outside Corner Board: Attach trim on both sides of corner with 16 gage corrosion resistant finish nail 13 mm from edge spaced 406 mm apart, weather cut each end spaced minimum 305 mm apart.
- .7 Allow 3 mm gap between trim and siding.
- .8 Seal gap with high quality, paint-able sealant.
- .9 Shim frieze board as required to align with corner trim.
- .10 Site paint exposed cut edges to match colour of board, trim, or plank.

3.6 TOUCH-UPS

- .1 Factory Finish Touch Up: Apply touch up paint to cut edges in accordance with manufacturer's printed instructions.
 - .1 Touch-up nicks, scrapes, and nail heads in pre-finished siding using the manufacturer's touch-up kit pen.
 - .2 Touch-up of nails shall be performed after application, but before plastic protection wrap is removed to prevent spotting of touch-up finish.
 - .3 Use touch-up paint sparingly. If large areas require touch-up, replace the damaged area with new pre-finished siding. Match touch up colour to siding colour through use of manufacturer's branded touch-up kits.

3.7 CLEANING

- .1 Remove damaged, improperly installed, or otherwise defective siding materials and replace with new materials complying with specified requirements.
- .2 Clean finished surfaces according to siding manufacturer's written instructions and maintain in a clean condition during construction.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Structural Drawings – Cast-in-Place Concrete
- .2 Section 06 10 00 – Rough Carpentry
- .3 Section 07 27 19 – Sheet Membrane Air and Vapour Barrier
- .4 Section 07 62 00 – Sheet Metal Flashing and Trim
- .5 Section 07 92 00 – Sealants
- .6 Division 22 – Plumbing: Coordination of pipes and pipe fittings and other materials penetrating roof membranes.
- .7 Division 23 – Heating, Ventilation and Air Conditioning: Coordination of ductwork and other materials penetrating roof membranes.
- .8 Division 26 – Electrical: Coordination conduit, wiring, communications cabling, cable trays and other materials penetrating roof membranes.

1.2 REFERENCES

- .1 Alberta Roofing Contractors Association Ltd. (ARCA)
 - .1 Roofing Application Standards Manual
- .2 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM C726-17, Standard Specification for Mineral Wool Roof Insulation Board.
 - .2 ASTM C728-17a, Standard Specification for Perlite Thermal Insulation Board.
 - .3 ASTM C1002-16, Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
 - .4 ASTM C1177-17, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing
 - .5 ASTM C1278-17, Standard Specification for Fiber-Reinforced Gypsum Panel
 - .6 ASTM D41/D41M-11(2016), Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.
 - .7 ASTM D312/D312M-16a, Standard Specification for Asphalt Used in Roofing.
 - .8 ASTM D448-12(2017) Standard Classification for Sizes of Aggregate for Road and Bridge Construction.
 - .9 ASTM D2178/D2178M-15a, Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing.
 - .10 ASTM D3272-76(2003), Standard Practice for Vacuum Distillation of Solvents from Solvent-Reducible Paints for Analysis (Withdrawn 2008)
 - .11 ASTM D6162/D6162M-16, Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fibre Reinforcements.

- .12 ASTM D6163/D6163M-16, Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fibre Reinforcements.
- .13 ASTM D6164/D6164M-16, Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Polyester Reinforcements.
- .14 ASTM D6222/D622M-16, Standard Specification for Atactic Polypropylene (APP) Modified Bituminous Sheet Materials Using Polyester Reinforcement.
- .15 ASTM D6223/D6223M-16, Standard Specification for Atactic Polypropylene (APP) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fiber Reinforcement.
- .16 ASTM D6509/D6509M-16, Standard Specification for Atactic Polypropylene (APP) Modified Bituminous Sheet Materials Using Glass Fiber Reinforcement.
- .17 ASTM E96/E96M-16, Standard Test Methods for Water Vapor Transmission of Materials.
- .3 Canadian General Standards Board (CGSB)
 - .1 CGSB 37-GP-9Ma-83, Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing and Waterproofing. (Withdrawn)
 - .2 CGSB 37-GP-56M AMEND, Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing. (Withdrawn)
 - .3 CAN/CGSB-51.33-M89, Vapour Barrier Sheet, Excluding Polyethylene, for Use in Building Construction. (Withdrawn)
- .4 Canadian Roofing Contractors Association (CRCA)
 - .1 CRCA Roofing Specifications Manual.
- .5 Canadian Standards Association (CSA International)
 - .1 CSA-A123.3-05 (R2015), Asphalt Saturated Organic Roofing Felt (Reaffirmed 2010).
 - .2 CAN/CSA-A123.4-04 (R2013), Asphalt for Constructing Built-Up Roof Coverings and Waterproofing Systems.
 - .3 CSA A123.21-14, Standard Test Method for the Dynamic Wind Uplift Resistance of Membrane Roofing Systems, Includes Update No. 1 (2010).
 - .4 CSA A231.1-14/A231.2-14, Precast Concrete Paving Slabs/Precast Concrete Pavers.
 - .5 CAN/CSA O80 Series-15, Wood Preservation
 - .6 CSA O121-17, Douglas Fir Plywood, Includes Update No. 1 (2013).
 - .7 CSA O151-17, Canadian Softwood Plywood.
- .6 Department of Justice Canada (Jus).
 - .1 Canadian Environmental Protection Act, 1999 (CEPA).
- .7 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .8 Underwriters Laboratories' of Canada (ULC)

- .1 CAN/ULC S102-18, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
- .2 CAN/ULC S107-10, Methods of Fire Tests of Roof Coverings.
- .3 CAN/ULC-S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.
- .4 ULC-S702.2-15, Mineral Fibre Thermal Insulation for Buildings, Part 2: Application Guidelines.
- .5 CAN/ULC-S704.1-17, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.
- .6 CAN/ULC-S706-09, Standard for Wood Fibre Insulating Boards for Buildings.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Convene pre-installation meeting one week prior to beginning work of this Section, with Contractor, Consultant, installer, manufacturer's representative in accordance with Section 01 31 19 – Project Meetings to:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordination with other building subtrades.
 - .4 Review manufacturer's installation instructions and warranty requirements.
 - .5 Review ARCA warranty certificate requirements.

1.4 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 – Submittals:
 - .1 Provide copies of most recent technical roofing components data sheets describing materials' physical properties and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Provide copies of WHMIS MSDS and indicate VOC content for:
 - .1 Primers
 - .2 Vapour retarder membrane
 - .3 Sealers
 - .4 Insulation
 - .5 Base and cap sheet
- .2 Submit shop drawings in accordance with Section 01 33 00 – Submittals:
 - .1 Indicate flashing, control joints, tapered insulation details.
 - .2 Provide layout for tapered insulation.
- .3 Manufacturer's Certificate: certify that products meet or exceed specified requirements.
- .4 Test and Evaluation Reports: submit laboratory test reports certifying compliance of bitumens, roofing felts, and membrane with specification requirements.
- .5 Manufacturer's Installation Instructions: indicate special precautions required for seaming the membrane.

- .6 Manufacturer's field report: in accordance with Section 01 45 00 – Quality Control.
- .7 Reports: indicate procedures followed, ambient temperatures and wind velocity during application.

1.5 QUALITY ASSURANCE

- .1 Obtain roofing membrane materials through one source from a single manufacturer.
- .2 Installer Qualifications: company or person specializing in application of modified bituminous roofing systems with 5 years documented experience approved by manufacturer.
- .3 Roofing and sheet metal work shall be performed in conformance with roofing manufacturer's written recommendations using materials in accordance with CAN/ULC S107.
- .4 Conform to Roofing Application Standards Manual as published by ARCA.
- .5 Work shall be executed by an applicator approved by the ARCA as a member in good standing at time of application.
- .6 Inspection: Roofing system to be inspected throughout the installation by an ARCA Warranty Ltd. Accepted independent Inspector in accordance with ARCA Warranty Ltd. Accepted Inspectors' Manual.

1.6 FIRE PROTECTION

- .1 Comply with safety measures described in manufacturer's written installation requirements, requirements of insurance companies and other requirements of the Authorities Having Jurisdiction.
- .2 Fire Extinguishers, located within six (6) meters of each roofing torch, ULC labelled for ABC protection.
- .3 At the end of each workday, use a heat detector gun to spot any smouldering or concealed hot spots. Job planning must be organized to ensure workers are still on location at least one hour after torch application.
- .4 Do not apply torch directly to dry or unprotected wood surfaces.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions and Section 01 61 00 – Common Product Requirements.
- .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 selva 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 weather, daylight and deleterious materials.
- .8 Do not store materials on roof in concentrations that exceed design live load.

1.8 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 – Waste Management and Disposal.

1.9 ENVIRONMENTAL REQUIREMENTS

- .1 Do not perform roofing work when air temperature, including wind chill, falls below the membrane manufacturer's recommended limit.
- .2 Do not apply roofing materials to a damp, frozen or unsuitable surface.
- .3 Do not expose roofing materials vulnerable to water or sun damage in quantities greater than can be weatherproofed during the same day.

1.10 WARRANTY

- .1 Roofing Membrane Manufacturer: Provide manufacturer's warranty stating that they will repair or replace defective roofing (including labour) and base flashing materials that do not remain watertight, that splits, tears, or separates at the seams or from the substrate within the specified warranty period and as follows:
 - .1 Warranty Period: 15 years Platinum Warranty, starting from Substantial Performance for the Project.
 - .2 Name of Warrantee: Warrantor shall issue a written and signed warranty identifying the Departmental Representative's name as the warrantee, and stating that executed work will remain in place and be free of any defects in materials and workmanship for the stated warranty period.
- .2 Special Warranty: In addition, provide an ARCA ten (10) year Warranty Certificate starting from the date of Substantial Performance.

Part 2 Products

2.1 MANUFACTURERS

- .1 Basis of Design: Materials and colours listed below form the Basis of Design materials for this project.
- .2 Acceptable Membrane Manufacturers: Subject to compliance with requirements specified in this section and as established by the Basis-of-Design materials, manufacturers offering similar products that may be incorporated into the Work include the following:
 - .1 IKO Industries Ltd
 - .2 Siplast
 - .3 Soprema
- .3 Use only materials from one manufacturer.

2.2 PERFORMANCE / DESIGN CRITERIA

- .1 Provide system with products to achieve 10 year ARCA warranty certificate.
- .2 Compatibility between components of roofing system is essential. Provide written declaration to Consultant stating that materials and components, as assembled in system, meet this requirement.
- .3 Roofing System: to CSA A123.21 for wind uplift resistance.

2.3 DECK COVERING

- .1 Glass Mat Faced Roof Boards: to ASTM C1278 for manufacturing and ASTM D3272 for mould resistance, standard, mould resistant, thickness as indicated.
 - .1 Surface Burning Characteristics: In accordance with CAN/ULC S102.
 - .1 Flame Spread: 0
 - .2 Smoke Developed: 0
 - .2 Long Edges: Square.
 - .3 Location: Where indicated on Drawings.
Acceptable Materials:
 - .1 GlasRoc Sheathing, CertainTeed.
 - .2 Securock Gypsum Fiber Roof Board, CGC.
 - .3 DensDeck, Georgia Pacific.

2.4 PRIMER

- .1 Primer comprised of elastomeric bitumen, volatile solvents and adhesive enhancing additives as recommended by membrane roofing manufacturer to suit substrate and installation conditions.
 - .1 Acceptable Materials:
 - .1 Blueskin Adhesive – Henry Company
 - .2 IKO SAM Adhesive
 - .3 TA-325, Siplast
 - .4 Elastocol Stick, Soprema.

2.5 AIR AND VAPOUR RETARDER

- .1 Premanufactured Self Adhesive Air/Vapour Barrier: Self-adhesive vapour barrier membrane composed of SBS modified bitumen with thermoplastic polymers and high density polyethylene film and as follows:
 - .1 Thickness: Minimum 0.8 mm.
 - .2 Cold Bending: -35°C
 - .3 Static Puncture: 400 N.
 - .4 Membrane Breaking Strength (MPa): MD=75, XD=98.
 - .5 Water Vapour Permeance: 0.02 ng/Pa•s•m² to ASTM E96.
 - .6 Acceptable Materials:
 - .1 Vapor Bloc SA – Henry Company
 - .2 MVP, IKO
 - .3 Sopravap'R, Soprema

- .4 V-Force Vapor Barrier for Siplast System, Firestone
- .2 Vapour retarder continuity strip: SBS membrane with reinforcement, and elastomeric bitumen. Sanded upper surface; underside self-adhesive, compatible with wall and roof air/vapour retarder membranes as recommended by accepted membrane manufacturers below.
 - .1 Acceptable Materials:
 - .1 ModifiedPlus G100 Tack Sheet – Henry Company
 - .2 IKO
 - .3 Paradiene 20 SA by Siplast
 - .4 Sopraseal Stick 130 – Soprema

2.6 INSULATION

- .1 Primary Flat and Sloped Insulation: Closed-cell polyisocyanurate foam core laminated to heavy non-asphaltic glass fibre reinforced facers; 25 mm thickness of largest panels practical, having square edges, minimum LTTR RSI 1.04/25 mm; conforming to ULC S704, Type 3, Class 2, to a tolerance not exceeding 3 mm from nominal size in any dimension, and as follows:
 - .1 Acceptable Materials:
 - .1 Secureshield GC, Carlisle
 - .2 ACFoam III, Atlas Roofing Corporation
 - .3 H-Shield GC, Hunter
 - .4 Therm III, IKO
 - .5 E'NRGY 3, Johns Manville
 - .6 Paratherm by Siplast
 - .7 Sopra-ISO Plus, Soprema
 - .2 Sloped insulation: sloped as indicated on Drawings.

2.7 OVERLAY BOARD

- .1 Cover Board: gypsum based, non-structural water resistant core material integrally bonded with fiberglass mats on both sides having a nominal thickness of 6 mm, factory primed with a non-asphaltic primer.
 - .1 Basis of Design Materials:
 - .1 DensDeck Prime Gypsum Roof Board, Georgia Pacific Corporation

2.8 MEMBRANE

- .1 Composite Cover Board: Asphaltic-support board and factory applied base sheet:
 - .1 Description: SBS modified base sheet membrane and polyester reinforcement, factory applied to a semi-rigid asphaltic board. The top surface is covered with sand. The membrane side lap is 60% self-adhesive and 40% covered with a poly film that is heat sealed.
 - .1 Board size: 910 mm x 2440 mm x thickness as indicated on Drawings (minimum 5 mm).
 - .2 In conformance with: CGSB 37.56-M
 - .3 Properties: MD XD

- | | | | |
|----|--------------------------------|--------------|------|
| .1 | Strain Energy (kN/m) | 9 | 7 |
| .2 | Breaking Strength (N/50 mm) | 17 | 12.5 |
| .3 | Ultimate Elongation (%) | 60 | 65 |
| .4 | Tear Resistance (N) | 60 | |
| .5 | Static Puncture Resistance (N) | 400 | |
| .6 | Dimensional Stability (%) | -0.4 | 0.3 |
| .7 | Plastic Flow (°C) | ≥ 115 | |
| .8 | Cold Bending (at -30°C) | No Cracking | |
| .9 | Lap Joint Strength (kN/m) | Pass > 4kN/m | |
- .2 Acceptable Materials:
- .1 Protectoboard Base 180, IKO
 - .2 Soprasmart Board 180, Soprema,
- .2 Membrane base sheet flashing (stripping):
- .1 Primer: Manufacturer's recommended elastomeric bitumen or synthetic rubber blend, volatile solvents, adhesive enhancing additives and resins used to prime substrate to enhance the adhesion of self-adhesive membranes suitable for application temperatures.
 - .2 Roofing membrane with non-woven polyester reinforcement and glass grid and elastomeric bitumen. Top face covered with thermofusible plastic film, underside self-adhesive and protected by silicone release paper in accordance with CGSB 37-GP-56M type 2, class C, grade 1.
 - .3 Components:
 - .1 Reinforcement: Non-woven polyester and glass grid.
 - .2 Elastomeric bitumen: Mix of selected bitumen and SBS polymer.
 - .3 Mark top face with lines to ensure proper roll alignment.
 - .4 Characteristics:
 - .1 Cold bending at minimum -25°C: No cracking
 - .2 Softening point: ≥ 110°C
 - .3 Reinforcing weight: minimum 160 g/m²
 - .4 Membrane Thickness: minimum 2.5 mm
 - .5 Acceptable Materials:
 - .1 Armourbond Flash, IKO
 - .2 Sopralene Flam Stick, Soprema,
- .3 Roofing cap sheet membrane for field surfaces and flashings and parapets:
- .1 Description: Roofing membrane composed of SBS modified bitumen with a composite reinforcement and elastomeric bitumen. The surface is protected with coloured granules. The underface is covered with a release film.
 - .1 Coloured Granules: grey.
 - .2 In conformance with: ASTM D6162
 - .3 Properties:

	MD	XD
.1 Strain Energy (kN/m)	7.8	7.2
.2 Breaking Strength (N/50 mm)	15	13.5

.3	Ultimate Elongation (%)	60	65
.4	Tear Resistance (N)	125	
.5	Static Puncture Resistance (N)	560	
.6	Dimensional Stability (%)	0.2	0
.7	Plastic Flow (°C)	≥ 110	
.8	Cold Bending (at –30°C)	No Cracking	
.9	Lap Joint Strength (kN/m)	Pass > 4kN/m	
.2	Acceptable Materials:		
.1	Torchflex TP-HD-CAP, IKO		
.2	Parator 30TG, Siplast		
.3	Sopraply Traffic Cap 560, Soprema,		

2.9 ADHESIVE

- .1 Insulation Adhesive: Manufacturers standard adhesives specifically formulated for installation of plastic insulation to roofing materials:
 - .1 Acceptable Materials:
 - .1 Insta-Foam Products Inc. Insta-Stik, Dow
 - .2 880-333 – Henry Company
 - .3 IKO Millenium
 - .4 Parafast Insulation Adhesive by Siplast
 - .5 DuotackAdhesive, Soprema
- .2 Sheathing Board Adhesive: Manufacturers standard adhesives specifically formulated for installation of sheathing to metal deck.
 - .1 Basis of Design Materials:
 - .1 830-05 by Henry Company

2.10 ACCESSORIES

- .1 Perimeter Fire Seal: SBS modified bitumen, minimum 60 gm/m² glass fleece reinforced, self adhering membrane having sanded top face, cut into strips minimum 150 mm wide x nominal 1.5 mm thick.
 - .1 Acceptable Materials:
 - .1 Modiflex Tapes, IKO
 - .2 Sopraguarde Tape, Soprema
- .2 Flashing and sheet metal in accordance with section 07 62 00 – Sheet Metal Flashing and Trim.
- .3 Waterproofing Mastic: Black, solvent based mastic containing SBS modified bitumen, fibres and mineral fillers.
- .4 Waterproofing Mastic: two component PMMA liquid membrane with fleece fabric.
 - .1 Acceptable Materials:
 - .1 Parapro Field/ Parapro Flashing, Siplast
 - .2 RS 230 Field, Soprema Alsan with Alsan RS 230 Flash, Soprema

- .5 Torches: Use only torches designed for torching roofing material and acceptable to manufacturer.

Part 3 Execution

3.1 QUALITY OF WORK

- .1 Do examination, preparation and roofing Work in accordance with Roofing Manufacturer's Specification Manual and ARCA Roofing Manual.
- .2 Do priming in accordance with manufacturers written recommendations.
- .3 The interface of the walls and roof assemblies to be fitted with durable rigid material sheet metal and plywood providing connection point for continuity of air barrier.
- .4 Assembly, component and material connections to be made in consideration of appropriate design loads.

3.2 EXAMINATION OF ROOF DECKS

- .1 Verification of Conditions:
 - .1 Inspect with Consultant deck conditions including parapets, construction joints, roof drains, plumbing vents and ventilation outlets to determine readiness to proceed. The start of roofing work will mean roofing conditions are acceptable for work completion.
- .2 Evaluation and Assessment:
 - .1 Prior to beginning of work ensure:
 - .1 Decks are firm, straight, smooth, dry, free of snow, ice or frost, and swept clean of dust and debris. Do not use calcium or salt for ice or snow removal.
 - .2 Curbs have been built.
 - .3 Roof drains have been installed at proper elevations relative to finished roof surface.
 - .4 Plywood and lumber nailer plates have been installed to deck, walls and parapets as indicated.
 - .3 Do not install roofing materials during rain or snowfall.
 - .4 Provide fire protection during installation.

3.3 SHEATHING

- .1 Adhere sheathing with adhesive where indicated on Drawings with manufacturer's written instructions.
- .2 Place with long axis of each sheet transverse to trusses, with end joints staggered and fully supported.

3.4 PRIMING DECK

- .1 Apply deck primer to deck substrate at the rate recommended by manufacturer.
- .2 Surfaces to be primed must be free of rust, dust or any residue that may hinder adherence.

- .3 Cover primed surfaces with roofing membrane within time limits recommended by roofing membrane system manufacturer.

3.5 AIR AND VAPOUR RETARDER INSTALLATION

- .1 Install self adhering air/vapour barrier membrane by unrolling air/vapour barrier membrane onto substrate aligned with substrate materials starting at bottom of slope without removing silicone release sheet, and as follows:
 - .1 Align roll parallel to steel deck flutes supporting membrane overlaps on top of flute along entire length.
 - .2 Peel back one end of silicone release sheet and adhere membrane to substrate; peel remaining release sheet at a 45° angle to avoid wrinkles in membrane.
 - .3 Cut roll and start again where membrane is not properly aligned to deck flutes; re-align membrane and overlap end of misaligned piece by 150 mm.
 - .4 Overlap adjacent membranes by 75 mm; overlap end laps by 150 mm; stagger end laps by 300 mm; place thin sheet of metal under end lap of membrane to provide structural support to lapped membranes.
- .2 Overlap roof air/vapour barrier to wall air/vapour barrier using compatible continuity strip to provide continuity of building envelope.

3.6 (EXPOSED) CONVENTIONAL MEMBRANE ROOFING (CMR) APPLICATION

- .1 Insulation: fully adhered, adhesive application:
 - .1 Adhere insulation to vapour barrier using manufacturer's recommended adhesive applied at a rate recommended by the manufacturer
 - .2 Place boards in parallel rows with ends staggered, and in firm contact with one another.
 - .3 Cut end pieces to suit.
 - .4 Apply adhesive in continuous ribbons at 300 mm on centre.
 - .5 Separate the membrane and insulation with a drainage layer or slipsheet.
- .2 Tapered insulation application:
 - .1 Adhere insulation using manufacturer's recommended adhesive applied at rate recommended by manufacturer; adhere insulation at locations where roof deck will be visible in final installation.
 - .2 Install tapered insulation in accordance with shop drawings. Stagger joints between layers 150 mm minimum.
- .3 Installation of Composite Cover Board and Factory Laminated Base Sheet:
 - .1 Adhere base sheet board using adhesive applied in continuous strips spaced as required and based on manufacturer's instructions and the CSA A123.21 Wind Uplift Roof System Analysis Report.
 - .2 Heat seal side laps of the cover board with an industrial hot air welder as recommended by manufacturer.
 - .3 Line up end laps of the cover boards (not staggered) and apply primer as per manufacturer's recommendations and allow to "flash off" in preparation for the application of the self-adhesive cover strip membrane.

- .4 Self-adhesive cover strip membrane shall be applied over each primed end lap of the cover board, rolled into place and a hot air welder is required to heat seal the side and end laps.
- .5 Avoid the formation of wrinkles, swellings or fishmouths.
- .4 Perimeter Fire Seal Application
 - .1 Apply perimeter fire seal to roof perimeter and curb substrates prior to applying base sheet materials. Apply fire seal to vertical joints in parapet or curb sheathing, and at vertical corners.
 - .2 Extend fire seal minimum 50 mm up parapet faces and extend fire seal minimum 75 mm onto adjacent substrates. Ensure air bubbles and fish mouths are removed.
 - .3 Install perimeter fire seal to act as temporary moisture seal until installation of flashing materials.
- .5 Reinforced gusset installation:
 - .1 Install gussets at every angle, and on inside and outside corners.
 - .2 Install self adhesive gussets before installing self adhesive base sheet flashing membranes.
- .6 Base sheet flashing installation:
 - .1 Apply base sheet flashing when primer coat is dry and in accordance with manufacturer's written instructions.
 - .2 Position pre-cut membrane pieces; peel back 100 mm to 150 mm of silicone release paper to hold the membrane in place at the top of the parapet, then gradually peel back remaining silicone release paper, pressing down on the membrane with aluminium applicator to provide good adhesion and to provide smooth transition between up-stand and field surface; smooth entire membrane surface with a roller for full adhesion.
 - .3 Cut off corners at end laps being covered by next roll.
 - .4 Install a reinforcing gusset in all inside and outside corners.
 - .5 Seal overlaps at the end of each workday.
- .7 Cap sheet application – torched:
 - .1 Once base sheet is applied and no defects are apparent, proceed with cap sheet installation.
 - .2 Unroll cap sheet at drain. Carefully align first side lap (parallel to roof edge).
 - .3 Weld cap sheet onto base sheet with torch recommended by membrane manufacturer. During application, simultaneously melt both designated contact surfaces so a bead of bitumen is apparent as cap sheet unrolls.
 - .4 Avoid overheating. Take care to avoid excessive bitumen bleed-out at joints during installation.
 - .5 Unless overlap widths differ between cap and base sheets, make sure joints between the two layers are staggered by at least 300 mm.
 - .6 Overlap cap sheet side laps by 75 mm and end laps by 150 mm. Cut off corners at end laps to be covered by next roll. Overlap surfaces must be granule-free or degranulated.

- .7 Complete welds between two membranes. Leave no zone unwelded. In cold weather, adjust welding time to obtain homogenous seam.
- .8 Once cap sheet is installed, carefully check overlapped joints. Leave bleed-out at joints ungranulated until inspected and accepted by the roofing inspector. Apply coloured granules to bleed-out area by priming with self-adhesive primer, and while still tacky shake granules onto surface and press into place.
- .8 Cap Sheet Flashings Application:
 - .1 Install cap sheet flashing in 1 m widths. Overlap side by 100 mm. Stagger base and cap sheet overlaps by minimum 100 mm. Make overlaps 150 mm wide.
 - .2 Draw parallel chalk line 150 mm from parapet or upstand bases. Sink surface granules into bed of hot bitumen with torch from chalk line to parapet or upstand.
 - .3 Adhere cap sheet to base sheet membrane starting from bottom and working to top using trowel grade adhesive applied with 5 mm notched steel trowel at a rate recommended by membrane manufacturer; use roller to apply even pressure over entire surface to provide uniform adhesion across entire surface.
- .9 Roof penetrations:
 - .1 Install roof drain pans, vent stack covers and other roof penetration flashings and seal to membrane in accordance with manufacturer's recommendations and details.

3.7 FIELD QUALITY CONTROL

- .1 Inspection and testing of roofing application to be carried out by testing laboratory designated by Departmental Representative in cooperation with Consultant.
- .2 Inspection fees to be paid by Departmental Representative, in accordance with Section 01 45 00 – Quality Control.
- .3 Manufacturers' Field Services:
 - .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 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 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.
 - .4 Obtain reports within three days of review and submit.

3.8 CLEANING

- .1 Remove bituminous markings from finished surfaces.
- .2 In areas where finished surfaces are soiled caused by work of this section, consult manufacturer of surfaces for cleaning advice and complying with their documented instructions.
- .3 Repair or replace defaced or disfigured finishes caused by work of this section.

3.9 PROTECTION OF IN-PLACE CONDITIONS

- .1 Cover walls, walks, sloped roofs and adjacent work where materials hoisted or used. Roofing Contractor shall assume full responsibility for damage.
- .2 Use warning signs and barriers. Maintain in good order until completion of Work.
- .3 Clean off drips and smears of bituminous material immediately.
- .4 Dispose of rain water off roof and away from face of building until roof drains or hoppers installed and connected.
- .5 Protect roof from traffic and damage. Comply with precautions deemed necessary by Consultant.
- .6 At end of each day's work or when stoppage occurs due to inclement weather, provide protection for completed Work and materials out of storage.
- .7 Metal connectors and decking shall be treated with rust proofing or galvanization.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 06 10 00 – Rough Carpentry
- .2 Section 07 26 00 – Vapour and Air Retarder
- .3 Section 08 11 13 – Steel Doors and Frames
- .4 Section 08 11 16 – Aluminum Doors and Frames
- .5 Section 08 50 13 – Aluminum Clad Wood Windows

1.2 REFERENCES

- .1 Alberta Roofing Contractor's Association (ARCA)
 - .1 Manual on Good Roofing Practice and Accepted Roofing Systems.
- .2 The Aluminum Association Inc. (AA)
 - .1 Specifications for Aluminum Sheet Metal Work in Building Construction.
 - .2 DAF45-2003(R2009), Designation System for Aluminum Finishes.
- .3 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A240/A240M-16a, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - .2 ASTM A606/A606M-15, Standard Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance.
 - .3 ASTM A653/A653M-15e1, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .4 ASTM A792/A792M-10(2015), Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
 - .5 ASTM B32-08(2014), Standard Specification for Solder Metal.
 - .6 ASTM B370-12, Standard Specification for Copper Sheet and Strip for Building Construction.
 - .7 ASTM D523-14, Standard Test Method for Specular Gloss.
 - .8 ASTM D822/D822M-13, Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings.
 - .9 ASTM D4586/D4586M07(2012)e1, Standard Specification for Asphalt Roof Cement, Asbestos-Free.
- .4 Canadian Roofing Contractors Association (CRCA)
 - .1 Roofing Specifications Manual
- .5 Canadian Standards Association (CSA International)
 - .1 CSA A123.3-05 (R2015), Asphalt Saturated Organic Roofing Felt.
 - .2 AAMA/WDMA/CSA 101/I.S.2/A440-11, Standard/Specification for Windows, Doors, and Skylights, Includes Update No. 1 (2013).
 - .3 CSA B111-74(R2003), Wire Nails, Spikes and Staples.

- .6 Green Seal Environmental Standards
 - .1 Standard GS-03-97, Anti-Corrosive Paints.
 - .2 Standard GS-11-10, Paints and Coatings.
 - .3 Standard GS-36-15, Commercial Adhesives.
- .7 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .8 Sheet Metal and Air Conditioning Contractors' National Association ([SMACNA](#)):
 - .1 Architectural Sheet Metal Manual, 7th Edition, 2012
- .9 South Coast Air Quality Management District (SCAQMD), California State
 - .1 SCAQMD Rule #1113-04, Architectural Coatings.
 - .2 SCAQMD Rule #1168-05, Adhesives and Sealants.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Coordinate work of this Section with interfacing and adjoining Work for proper sequencing of each installation and to provide positive weather resistance, durability of the work, and protection of materials and finishes.

1.4 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 – Submittals:
 - .1 Submit manufacturer's printed product literature for sheet metal flashing systems materials, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

1.5 QUALITY CONTROL

- .1 Installer: Engage an experienced installer having a minimum of three years experience who has completed projects similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- .2 Construct and install roof metal flashings in accordance with ARCA Manual details and in accordance with the ARCA Manual. If requirements conflict, this specification takes precedence over the manual.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Stack pre-formed and pre-finished material in manner to prevent twisting bending and rubbing.
- .2 Provide protection for galvanized surfaces.
- .3 Prevent contact of dissimilar metals during storage and protect from acids, flux, and other corrosive materials and elements
- .4 Protect prefinished surfaces from scratches and from rust staining.

1.7 WASTE MANAGEMENT AND DISPOSAL

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

1.8 WARRANTY

- .1 The same warranty provisions apply to flashings associated with roofing as to the roofing.
- .2 Provide Warranty for sheet metal flashing and trim to include in maintenance manuals as specified in Section 01 78 00 – Operations and Maintenance Data Manuals.

Part 2 Products

2.1 METAL FLASHINGS

- .1 Zinc coated galvanized steel sheet (pre-finished): Type A commercial quality to ASTM A653/A653M, with Z275 designation zinc coating.
 - .1 Class: F1S-Finished one side
 - .2 Thickness: minimum 0.45 mm base metal thickness.
 - .3 Factory Finish: silicone modified polyester
 - .1 Acceptable materials:
 - .1 Valspar WeatherX or Dofasco Perspectra
 - .4 Colour: As directed by Departmental Representative or as indicated on drawings.
- .2 Formed aluminum flashings: Tension levelled, aluminum sheet in accordance with ASTM B209 and ANSI H35.1 alloy designation 3003-H14 and as follows:
 - .1 Thickness: minimum 1.00 mm.
 - .2 Finish: prefinished, colour to match window frames or as directed by Departmental Representative
- .3 Form flashings, copings and fascias to profiles indicated.

2.2 EAVES TROUGHS AND DOWNSPOUTS

- .1 Form downspouts from 0.55 mm thick prefinished aluminum sheet metal. Sizes and profiles as indicated.
- .2 Form eaves troughs from 0.55 mm thick prefinished aluminum sheet metal. Sizes and profiles as indicated.
- .3 Provide goosenecks, outlets, strainer baskets and necessary fastenings.

2.3 ACCESSORIES

- .1 Isolation coating: alkali resistant bituminous paint.
- .2 Roofing Cement: to ASTM D4586, asphalt based, asbestos free.
- .3 Underlay for metal flashing: No. 15 perforated asphalt felt to CSA A123.3.
- .4 Sealants: as indicated in Section 07 92 00 - Sealants.

- .1 Mastic Sealant: CAN/CGSB 37.29 polyisobutylene; non-hardening, non-skinning, non-drying, non-migrating sealant.
- .2 Elastomeric Sealant: Generic type recommended by sheet metal manufacturer and fabricator of components being sealed and complying with requirements for joint sealants as specified in Section 07 92 00.
- .5 Fasteners: of same material as sheet metal, to CSA B111, as recommended by sheet metal manufacturer; non-corrosive. Finish of exposed parts to match material being fastened.
- .6 Washers: of same material as sheet metal, 1 mm thick with rubber packings.
- .7 Solder: to ASTM B32, alloy composition Sn.
 - .1 Flux: rosin, cut hydrochloric acid, or commercial preparation suitable for materials to be soldered
- .8 Adhesives: Type recommended by flashing sheet metal manufacturer for waterproof and weather resistant seaming and adhesive application of flashing sheet metal.
- .9 Metal Accessories: Provide non-corrosive sheet metal clips, straps, anchoring devices, and similar accessory units as required for installation of Work. Accessories shall match or be compatible with material being installed; size and thickness as required.
- .10 Touch-up paint: as recommended by prefinished material manufacturer.

2.4 FABRICATION

- .1 Fabricate sheet metal building flashings and trim in accordance with the recommendations of SMACNA's Architectural Sheet Metal Manual that apply to the design, dimensions, metal, and other characteristics as required.
- .2 Fabricate aluminum flashings and other sheet aluminum work in accordance with AAI-Aluminum Sheet Metal Work in Building Construction.
- .3 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.
- .4 Apply isolation coating to metal surfaces to be embedded in concrete or mortar.
- .5 Make flashings of prefinished metal for all cap flashings, for all flashings adjacent to roofing at roof edges and area dividers and where exposed to view from ground. Make flashings for other locations, of plain galvanized metal as follows:
 - .1 Use 0.45 mm metal core thickness except where otherwise indicated.
 - .2 Use 0.62 mm metal core thickness wherever a flat length exceeding 305 mm wide occurs.
 - .3 Use 0.80 mm metal core thickness for concealed fastening strips.
- .6 All straight run joints shall be S-Lock.
- .7 Make joints to allow for thermal movement, space S-Lock joints at 2440 mm maximum centers.
- .8 Form non-expansion, but movable, joints in metal to accommodate elastomeric sealant in accordance with SMACNA standards.

- .9 Make flashings for building into masonry and concrete so that joints can be lapped 100 mm or more.
- .10 Strengthen free edges of metal flashings by folding to form a 13 mm hem.
- .11 Make flashings to curbs, walls and parapets a minimum of 200 mm high, where possible.
- .12 Where curb-mounted roof penetrations are not required, provide flashing sleeves and collars for all pipes and conduit extending through the roof. Sleeves shall be soldered to a piece of sheet metal extending at least 150 mm onto the surrounding roof.
- .13 Make joints for corners and intersections with standing seams except where exposed of pre-finished metal when seams shall be flat locked.
- .14 All bends machine made; form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.
- .15 Fabricate cleats and attachment devices from same material as sheet metal component being anchored or from compatible, non-corrosive metal recommended by sheet metal manufacturer, and as follows:
 - .1 Size as recommended by SMACNA manual or sheet metal manufacturer for application but not less than thickness of metal being secured.
- .16 Back paint metal flashings in contact with dissimilar metals or materials with bituminous paint that would result in electrolytic action or corrosion.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSPECTION

- .1 Check mounting and counterflashing of mechanical items and report any defect to the Departmental Representative.
- .2 Verify that solid wood blocking or sheathing provided to back-up all flashings and that all nails, screws set and wood provides a smooth flat plane.
- .3 Verify that all reglets, provided under other Sections or built-in by other trades, properly and securely located, true and level in line.

3.3 INSTALLATION: METAL FLASHING

- .1 Apply metal roof flashing to ARCA recommended requirements as a minimum.
- .2 Install sheet metal flashing and trim in accordance with performance requirements, manufacturer's installation instructions, and SMACNA's Architectural Sheet Metal Manual.
- .3 Do not install metal flashings over flexible roof flashing until the flexible roof flashing has been inspected and approved by the Roofing Inspector. This includes curbs for roof mounted items.

- .4 Fasten metal base flashing to walls or upstands along top of flashing. Do not secure to cant strip. Form lapped corner joints. Extend rolled edge of base flashing approximately 25 mm on to roof from toe of cant, and rest on top of roof surface.
- .5 Do not use exposed fastening unless indicated, or concealed fastening is not possible. Locations and methods shall be approved by Departmental Representative.
- .6 Provide underlay under sheet metal.
 - .1 Secure in place and lap joints 100 mm.
- .7 Counterflash bituminous flashings at intersections of roof with vertical surfaces and curbs.
 - .1 Flash joints using S-lock forming tight fit over hook strips, [as detailed].
- .8 Lock end joints and caulk with sealant.
- .9 Separate metal from non-compatible metal or corrosive substrates by coating concealed surfaces, at locations of contact, with asphalt mastic or other permanent separation as recommended by manufacturer.
- .10 Underlayment: Install a slip sheet of red rosin paper and a course of polyethylene underlayment where installing stainless steel or aluminum directly on cementitious or wood substrates.
- .11 Bed flanges of Work in a thick coat of roofing cement where required for waterproof performance.
- .12 Caulk flashing at cap flashing with sealant.
- .13 Install drainage items fabricated from sheet metal, with straps, adhesives, and anchors recommended by SMACNA's Manual or the Item manufacturer, to drain roof in the most efficient manner.
- .14 Coordinate roof drain flashing installation with roof drainage system installation.
- .15 All exposed and pre-finished flashings to provide a smooth flat surface free of indentations, bumps, oil-canning, or twists, all edges, bends hard, sharp and true to line.

3.4 INSTALLATION: EAVES TROUGHS AND DOWNSPOUTS

- .1 Install eaves troughs and secure to building at 750 mm on centre with eaves trough spikes through spacer ferrules.
 - .1 Slope eaves troughs to downpipes as indicated.
 - .2 Solder or Seal joints watertight.
- .2 Install downpipes and provide goosenecks back to wall.
 - .1 Secure downpipes to wall with straps at 1800 mm on centre; minimum two straps per downpipe.
 - .2 Connect downpipes to drainage system and seal joint with plastic cement.
- .3 Install splash pans as indicated.

3.5 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.
- .3 Clean exposed metal surfaces, removing substances that might cause corrosion of metal or deterioration of finishes.
- .4 Provide final protection and maintain conditions that ensure sheet metal flashing and trim Work during construction is without damage or deterioration other than natural weathering at the time of Substantial Performance.
- .5 Leave work areas clean, free from grease, finger marks and stains.

END OF SECTION

Part 1 General

1.1 INTENT

- .1 This Section includes through penetration firestopping and smoke seal systems for penetrations through the following fire resistance rated assemblies, including both empty openings and openings containing penetrating items:
 - .1 Floors.
 - .2 Wall and partitions.
 - .3 Smoke barriers.
 - .4 Construction enclosing compartmentalized areas.
- .2 This Section includes fire resistive joint systems for the following:
 - .1 Floor-to-floor joints.
 - .2 Floor-to-wall joints.
 - .3 Head-of-wall joints.
 - .4 Wall-to-wall joints.
 - .5 Joints between perimeter edge of fire resistance rated floor assemblies and back of curtainwall system.
- .3 This specification section provides requirements for Rated Systems or systems requiring Engineered Judgements:
 - .1 Use of materials that have not been tested in a system or that are not capable of obtaining an engineered judgement will not be acceptable for use on this Project.
 - .2 Materials having only a ULC label will not be acceptable for use on this Project, unless supporting documentation is provided indicating its use in a listed assembly.

1.2 RELATED SECTIONS

- .1 Section 01 35 00 – Delegated Design
- .2 Structural Drawings – Cast-In-Place Concrete
- .3 Structural Drawings – Structural Steel
- .4 Section 09 21 16 – Gypsum Board Assemblies
- .5 Division 23 Mechanical
- .6 Division 26 Electrical

1.3 REFERENCES

- .1 ASTM International Inc. (ASTM)
 - .1 ASTM E119-16a, Standard Test Methods for Fire Tests of Building Construction and Materials.
 - .2 ASTM A653/A653M-15e1, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .3 ASTM E814-13a(2017), Standard Test Method for Fire Tests of Penetration Firestop Systems.

- .4 ASTM A1008/A1008M-16, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
- .5 ASTM E1966-15, Standard Test Method for Fire-Resistive Joint Systems.
- .6 ASTM E2174-14b, Standard Practice for On-Site Inspection of Installed Fire Stops.
- .7 ASTM E2307-15b e1, Standard Test Method for Determining Fire Resistance of Perimeter Fire Barrier Systems Using Intermediate-Scale, Multi-story Test Apparatus.
- .8 ASTM E2393-10a(2015), Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .3 National Fire Protection Agency (NFPA)
 - .1 NFPA 251, Standard Methods of Tests of Fire Endurance of Building Construction and Materials, 2006 Edition.
- .4 Underwriter's Laboratories of Canada (ULC)
 - .1 ULC Guide No. 40 U19-1998, Firestop Systems.
 - .2 CAN/ULC S101-14, Standard Methods of Fire Endurance Tests of Building Construction and Materials.
 - .3 CAN/ULC S102-11, Standard Method of Tests for Surface Burning Characteristics of Building Materials and Assemblies.
 - .4 CAN4 S114-05, Standard Method of Test for Determination of Non-Combustibility in Building Materials.
 - .5 CAN/ULC-S115-11, Standard Method of Fire Tests of Firestop Systems.
 - .6 CAN/ULC S702-14, Standard for Thermal Insulation Mineral Fibre for Buildings, Includes Amendment 1(January 2012).
 - .7 ULC S702.2-15, Mineral Fibre Thermal Insulation for Buildings, Part 2: Application Guidelines.
 - .8 List of Equipment and Materials.
- .5 Underwriters Laboratories Inc. (UL)
 - .1 ANSI/UL 1479-15, Standard for Fire Test of Through-Penetration Firestops.

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Installation Meetings: convene pre-installation meeting one week prior to beginning work of this Section, with contractor's representative and Departmental Representative in accordance with Section 01 31 19 – Project Meetings to:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordination with other building subtrades.
 - .4 Review manufacturer's installation instructions and warranty requirements.

1.5 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal.
 - .1 Not later than 30 working days following Award of Contract, submit a schedule listing surfaces or components to which firestopping and smoke seals is to be applied, and indicating the firestopping and smoke seals system and materials required and detailing installation.
 - .2 Where possible determine thickness to be applied from tests of assemblies identical to the assembly to be protected, conducted in accordance with ULC S-101, ASTM E119, ULI 1479, NFPA 251, and ASTM E814.
 - .3 Determine system from available engineering studies, or correspondence with the labelling agency indicating the effect of the differences on the fire separation of the assembly. Confirm acceptance of system by authorities having jurisdiction in writing.
 - .4 Where the assembly includes conditions that do not correspond to those included in any previously tested assembly and for which no relevant engineering information is available use the same system and material as would be required for a tested assembly with similar conditions.
- .2 Delegated Design Requirements: Design firestopping and smoke seals required by the Contract Documents to withstand fire ratings indicated and in accordance with requirements of the Building Code, and as described in Section 01 35 00.
- .3 Submit product data in accordance with Section 01 33 00 – Submittals:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Provide two copies of WHMIS MSDS - Material Safety Data Sheets in accordance with WHMIS acceptable to Labour Canada, and Health and Welfare Canada.
- .4 Quality assurance submittals: submit following in accordance with Section 01 45 00 - Quality Control.
 - .1 Test reports: in accordance with CAN-ULC-S101 for fire endurance and CAN-ULC-S102 for surface burning characteristics.
 - .1 Submit certified test reports from approved independent testing laboratories, indicating compliance of applied fire stopping with specifications for specified performance characteristics and physical properties.
 - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .3 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, and cleaning procedures.
 - .4 Manufacturer's Field Reports: submit to manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.

1.6 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installer: company or person specializing in fire stopping installations and approved by manufacturer with 5 years documented experience.
- .2 Use materials and methods of determining required thickness of application that have the full acceptance of authority having jurisdiction.
- .3 Use materials tested to CAN/ULC-S115. Assemblies containing the materials shall be in accordance with assemblies tested and approved by agencies acceptable to authority having jurisdiction.
- .4 Source Responsibility: Obtain through penetration firestop and joint systems, for each kind of penetration and construction condition indicated, from a single source of installation responsibility.
- .5 Delegated Design Professional: Use a professional engineer, registered in the province of the Work and familiar with installations of similar scope and complexity to design firestopping and smoke seals.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
 - .3 Deliver materials to the site in undamaged condition and in original unopened containers, marked to indicate brand name, manufacturer, and ULC markings.
- .2 Storage and Protection:
 - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.
 - .3 Use stock before its expiration date.

1.8 WASTE MANAGEMENT AND DISPOSAL

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

1.9 PROJECT CONDITIONS

- .1 Install firestopping and smoke seals materials only when the areas in which they are scheduled are closed-in and protected from dampness.
- .2 Environmental Limitations: Install firestopping and smoke seals systems when ambient or substrate temperatures are within temperature and moisture limits permitted by firestopping and smoke seals system manufacturers or when substrates are not wet due to rain, frost, condensation, or other causes.
- .3 Ventilate firestopping and smoke seals systems in accordance with manufacturer's written instructions by natural means or forced air circulation where natural means are not adequate.

Part 2 Products

2.1 MANUFACTURERS

- .1 Acceptable Manufacturers: Subject to compliance with requirements specified in this Section, manufacturers offering products that may be incorporated into the Work include; but are not limited to, the following:
 - .1 3M Canada Inc.
 - .2 A/D Fire Protection Systems Inc.
 - .3 EZ-Path Fire Rated Pathways
 - .4 Firestop Systems Inc.
 - .5 Hilti Canada Ltd.
 - .6 Johns Manville Fire Protection Systems
 - .7 Nuco Self Seal Firestopping Products.
 - .8 Passive Fire Protection Partners Firestop Systems Inc.
 - .9 Roxtec, Preformed Fire Stopping Systems
 - .10 Specified Technologies Inc.
 - .11 Tremco Ltd.

2.2 PERFORMANCE/DESIGN CRITERIA

- .1 Delegated Design Requirements: Design firestopping and smoke seals required by the Contract Documents to withstand fire ratings indicated and in accordance with requirements of the Building Code, and as described in Section 01 35 00.
- .2 Performance Requirements: Manufacturer shall design proprietary assemblies to withstand the listed ratings in accordance with the Building Code, Underwriters Laboratories Canada, and authorities having jurisdiction, and as follows:
 - .1 Provide through penetration firestop and joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire resistance rating of assembly penetrated:
 - .1 Fire resistance rated load bearing walls, including partitions, with fire protection rated openings.
 - .2 Fire resistance rated non-load bearing walls, including partitions, with fire protection rated openings.
 - .3 Fire resistance rated floor assemblies.
 - .2 F-Rated Systems: Provide through penetration firestop systems with F-ratings indicated, as determined by ULC S115 or ASTM E814, but not less than that equalling or exceeding fire resistance rating of constructions penetrated.
 - .3 T-Rated Systems: For the following conditions, provide through penetration firestop systems with T-ratings indicated, as well as F-ratings, as determined per by ULC S115 or ASTM E814, where systems protect penetrating items exposed to potential contact with adjacent materials:
 - .1 Penetrations located outside wall cavities.
 - .2 Penetrations located outside fire resistive shaft enclosures.
 - .3 Penetrations located in construction containing fire protection rated openings.

- .4 Penetrating items larger than 100 mm diameter nominal pipe or 100 cm² in overall cross sectional area.
- .4 Firestopping and Smoke seals Systems Exposed To View: Systems exposed to view, traffic, moisture, and physical damage; provide products that after curing do not deteriorate when exposed to these conditions both during and after construction, and as follows:
 - .1 Provide moisture resistant through penetration firestop systems for piping penetrations for plumbing and wet pipe sprinkler systems.
 - .2 Provide firestopping and smoke seals systems capable of supporting floor loads involved either by installing floor plates or by other means for floor penetrations with annular spaces exceeding 100 mm in width and exposed to possible loading and traffic.
 - .3 Provide firestopping and smoke seals systems not requiring removal of insulation for penetrations involving insulated piping.
 - .4 Provide products with flame spread ratings of less than 25 and smoke developed ratings of less than 50 for firestopping and smoke seals and joint systems exposed to view.
- .5 Fire Resistance of Joint Systems: Assembly ratings and movement capabilities indicated, but with assembly ratings not less than that equalling or exceeding fire resistance rating of constructions in which joints are located.

2.3 FIRESTOPPING AND SMOKESEALS: GENERAL

- .1 Compatibility: Provide firestopping and smoke seals systems that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating firestopping and smoke seals systems, under conditions of service and application, as demonstrated by firestopping and smoke seals system manufacturer based on testing and field experience, and as follows:
 - .1 Service penetration assemblies: certified by ULC in accordance with ULC S115 and listed in ULC Guide No. 40 U19.
 - .2 Service penetration firestopping and smoke seals components: certified by ULC in accordance with ULC S115 and listed in ULC Guide No. 40 U19.13, under the Label Service of ULC.
 - .3 Fire resistance rating of installed firestopping and smoke seals assembly not less than the fire resistance rating of surrounding floor and wall assembly.
 - .4 Firestopping and Smoke seals at openings intended for ease of re-entry such as cables: elastomeric seal; do not use cementitious or rigid seal at such locations.
 - .5 Firestopping and Smoke seals at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control: elastomeric seal; do not use a cementitious or rigid seal at such locations. Exemption to fire dampers.
- .2 Accessories: Provide components for each firestopping and smoke seals systems that are needed to install fill materials. Use only components specified by firestopping and smoke seals system manufacturer and approved by the qualified

testing and inspecting agency for firestopping and smoke seals systems indicated. Accessories include, but are not limited to, the following items:

- .1 Permanent forming, damming and backing materials, including the following:
 - .1 Slag or rock wool fibre insulation.
 - .2 Sealants used in combination with other forming, damming or backing materials to prevent leakage of fill materials in liquid state.
 - .3 Fire-rated form board.
 - .4 Fillers for sealants.
- .2 Temporary forming materials.
- .3 Substrate primers.
- .4 Collars.
- .5 Steel sleeves.
- .6 Primers: to manufacturer's recommendation for specific material, substrate, and end use.
- .7 Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.
- .8 Metal fire stop: Commercial galvanized steel, to ASTM A1008/A1008M, zinc coating 260 g/m², minimum metal core thickness 0.912 mm.
- .9 Steel Deck Moulded Flute Inserts: One piece moulded mineral fibre flute inserts, sized for steel deck profiles, for placement at top of fire rated wall assemblies:
 - .1 Acceptable material: Hilti CP777 Speed Plugs.
- .10 Labels: Peel-and-stick labels printed with the following information:
 - .1 ATTENTION: FIRE RATED ASSEMBLY. DO NOT MODIFY
 - .2 Name of firestopping manufacturer
 - .3 Names of products used
 - .4 Hour Rating of Assembly
 - .5 Manufacturers standard detail number, or Engineered Judgement identifier; ULC or cUL_{US} Number
 - .6 Date of installation
 - .7 Name of installing Subcontractor
 - .8 Contact telephone number for repair or replacement of firestopping materials.

2.4 FILL MATERIALS

- .1 General:
 - .1 Provide firestopping and smoke seals systems containing the types of fill materials indicated in the Firestopping and Smoke seals System Schedule below by reference to the types of materials described in this Article. Fill materials are those referred to in directories of the referenced testing and inspecting agencies as fill, void, or cavity materials.
 - .2 Firestopping and smoke seal systems shall be tested in accordance with ULC S115, and be comprised of asbestos-free materials and systems capable of maintaining an effective barrier against flame, smoke and

gases, and not to exceed opening sizes for which they are intended for the ratings as indicated on drawings.

- .2 Cast-in-Place Firestopping and Smoke seals Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
- .3 Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.
- .4 Firestopping and Smoke seals Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrating item.
- .5 Cable Penetration Devices: Premanufactured intumescent blocks, consisting of a system of inserts and adjustable cores; or premanufactured fire rated cable pathway systems, the following products are acceptable:
 - .1 EZ-Path Fire Rated Pathway, Specified Technologies Inc.
 - .2 CP 653 Speed Sleeve, Hilti
 - .3 Intumescent Blocks CFS-BL, Hilti
 - .4 Intumescent Blocks, Roxtec.
- .6 Intumescent Composite Sheets: Rigid panels consisting of aluminum foil faced elastomeric sheet bonded to galvanized steel sheet.
- .7 Intumescent Putties: Non-hardening dielectric, water resistant putties containing no solvents, inorganic fibres, or silicone compounds.
- .8 Intumescent Spray Foam: Expanding spray-in-place intumescent foam sealant.
- .9 Intumescent Wrap Strips: Single component intumescent elastomeric sheets with aluminum foil on one side.
- .10 Mortars: Pre-packaged, dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a non-shrinking, homogeneous mortar.
- .11 Pillows/Bags: Reusable, heat expanding pillows/bags consisting of glass fibre cloth cases filled with a combination of mineral fibre, water insoluble expansion agents and fire retardant additives.
- .12 Silicone Foams: Multi-component, silicone based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.
- .13 Silicone Sealants: Moisture curing, single component, silicone based, neutral curing elastomeric sealants of grade indicated below:
 - .1 Grade for Horizontal Surfaces: Pourable (self levelling) formulation for openings in floors and other horizontal surfaces.
 - .2 Grade for Vertical Surfaces: non-sag formulation for openings in vertical and other surfaces.

2.5 ACCESSORIES

- .1 Primers: to manufacturer's recommendation for specific material, substrate, and end use.

- .2 Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.
- .3 Damming and backup materials, supports and anchoring devices: to manufacturer's recommendations, and in accordance with tested assembly being installed as acceptable to authorities having jurisdiction.
- .4 Metal fire stop: Commercial galvanized steel, to ASTM A1008/A1008M, zinc coating 260 g/m², minimum metal core thickness 0.95 mm (20 ga.).

2.6 MIXING

- .1 For those products requiring mixing before application, comply with firestopping and smoke seals system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 EXAMINATION

- .1 Examine surfaces, components, materials to receive firestopping and smoke seals material; report any conditions which would detrimentally affect the application of the material or the proper firestopping and smoke seals of the system.
- .2 Commence Work when conditions of surfaces and the working conditions are suitable.
- .3 Where penetration sealants or caulking are required, ensure all service lines are in place, tested and approved.
- .4 Verify all proper blocking, framing (using non-combustible materials) are properly installed and prepared to receive firestopping and smoke seals. Notify Departmental Representative in writing of any deficiencies affecting the proper performance of the firestopping and smoke seals, do not proceed until deficiencies are corrected.

3.3 PREPARATION

- .1 Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials.
 - .1 Ensure that substrates and surfaces are clean, dry and frost free.
- .2 Prepare surfaces in contact with fire stopping materials and smoke seals to manufacturer's instructions.
- .3 Maintain insulation around pipes and ducts penetrating fire separation without interruption to vapour barrier.

- .4 Prime surfaces as required.
- .5 Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.

3.4 INSTALLATION

- .1 Install fire stopping and smoke seal material and components in accordance with manufacturer's certified tested system listing.
- .2 Apply firestopping and smoke seals materials/systems to maintain the fire separations in the project as indicated on drawings.
- .3 Seal holes or voids made by through penetrations, poke-through termination devices, and unpenetrated openings or joints to ensure continuity and integrity of fire separation are maintained.
- .4 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.
- .5 Tool or trowel exposed surfaces to neat finish.
- .6 Remove excess compound promptly as work progresses and upon completion.

3.5 FIELD QUALITY CONTROL

- .1 Inspections: notify Departmental Representative when ready for inspection and prior to concealing or enclosing fire stopping materials and service penetration assemblies.
 - .1 Cut tests may be made at random by the Departmental Representative. Frequency of cut tests shall be determined by the Departmental Representative, but will not be more than 1% of total length of firestopping and smoke seals.
 - .2 Make all necessary repairs and correct all deficiencies noted after completion of cut tests.
- .2 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, twice during progress of Work at 25% and 60% complete.

3.6 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.
- .3 Remove temporary dams after initial set of fire stopping and smoke seal materials.

3.7 SCHEDULE

- .1 Design and provide through penetration firestopping and smoke seals as follows for:
 - .1 Systems with No Penetrating Items: Select one or more of the following fill materials:
 - .1 Latex sealant.
 - .2 Silicone sealant.
 - .3 Intumescent putty.
 - .4 Intumescent foam blocks or boards.
 - .5 Intumescent spray foam.
 - .2 Systems for Metallic Pipes, Conduit, or Tubing: Select one or more of the following fill materials:
 - .1 Latex sealant.
 - .2 Silicone sealant.
 - .3 Intumescent putty.
 - .4 Intumescent foam blocks or boards.
 - .5 Intumescent spray foam.
 - .3 Systems for Non-metallic Pipe, Conduit, or Tubing: Select one or more of the following fill materials:
 - .1 Latex sealant.
 - .2 Silicone sealant.
 - .3 Intumescent putty.
 - .4 Intumescent wrap strips.
 - .5 Firestopping and Smoke seals device.
 - .6 Intumescent spray foam.
 - .4 Re-enterable and Cable Managed Systems for Electrical, and Data and Communications Cables:
 - .1 Prefabricated Firestop Sleeve CP653 (Hilti)
 - .2 Preformed Intumescent Blocks CFS-BL (Hilti)
 - .3 Preformed Intumescent Blocks (Roxtec)
 - .4 Prefabricated Cable Pathways (EZ-Path)
 - .5 Systems for Electrical, and Data and Communications Cables: Select one or more of the following fill materials:
 - .1 Latex sealant.
 - .2 Silicone sealant.
 - .3 Intumescent putty.
 - .4 Silicone foam.
 - .5 Prefabricated Firestop Sleeve CP 653 (Hilti).
 - .6 Preformed Intumescent Blocks CFS-BL (Hilti)
 - .7 Preformed Intumescent Blocks (Roxtec).
 - .8 Prefabricated Cable Pathways (EZ-Path).
 - .9 Intumescent foam blocks or boards.
 - .10 Intumescent spray foam.

- .6 Systems for Cable Trays: Select one or more of the following fill materials:
 - .1 Latex sealant.
 - .2 Intumescent putty.
 - .3 Silicone foam.
 - .4 Pillows/bags.
 - .5 Intumescent foam blocks or boards.
- .7 Systems for Insulated Pipes: Select one or more of the following fill materials:
 - .1 Latex sealant.
 - .2 Intumescent putty.
 - .3 Silicone foam.
 - .4 Intumescent wrap strips.
 - .5 Intumescent foam blocks or boards.
 - .6 Intumescent spray foam.
- .8 Systems for Miscellaneous Electrical Penetrations: Select one or more of the following fill materials:
 - .1 Latex sealant.
 - .2 Intumescent putty.
 - .3 Intumescent foam blocks or boards.
 - .4 Intumescent spray foam.
- .9 Systems for Miscellaneous Mechanical Penetrations: Select one or more of the following fill materials:
 - .1 Latex sealant.
 - .2 Intumescent foam blocks or boards.
 - .3 Intumescent spray foam.
- .10 Systems for Groupings of Penetrations: Select one or more of the following fill materials:
 - .1 Latex sealant.
 - .2 Intumescent wrap strips.
 - .3 Firestopping and Smoke seals device.
 - .4 Intumescent composite sheet.
 - .5 Intumescent foam blocks or boards.
 - .6 Intumescent spray foam.
- .2 Design and provide joint firestopping and smoke seals as follows for:
 - .1 Floor-to-Floor, Fire Resistive Joint System: Provide materials to meet the following criteria:
 - .1 Assembly Rating: As indicated.
 - .2 Nominal Joint Width: As indicated.
 - .3 Movement Capabilities: Compression and extension.
 - .2 Floor-to-Wall, Fire Resistive Joint System: Provide materials to meet the following criteria:
 - .1 Assembly Rating: As indicated.

- .2 Nominal Joint Width: As indicated.
 - .3 Movement Capabilities: To be confirmed, compression, extension, or horizontal shear.
- .3 Head-of-Wall, Fire Resistive Joint System: Provide materials to meet the following criteria:
 - .1 Assembly Rating: As indicated.
 - .2 Nominal Joint Width: As indicated.
 - .3 Movement Capabilities: Compression and extension.
- .4 Wall-to-Wall, Fire Resistive Joint System: Provide materials to meet the following criteria:
 - .1 Assembly Rating: As indicated.
 - .2 Nominal Joint Width: As indicated.
 - .3 Movement Capabilities: Compression and extension.
- .3 Design and provide perimeter fire containment firestopping and smoke seals as follows for:
 - .1 Perimeter Fire Containment System: Provide materials to meet the following criteria:
 - .1 Integrity Rating: As indicated.
 - .2 Insulation Rating: As Indicated.
 - .3 Linear Opening Width: As indicated.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 03 30 00 – Cast-In-Place Concrete
- .2 Section 06 40 00 – Architectural Woodwork
- .3 Section 07 21 19 – Foamed-In-Place Insulation
- .4 Section 07 27 19 – Sheet Membrane Air and Vapour Barrier
- .5 Section 07 62 00 – Sheet Metal Flashing and Trim
- .6 Section 08 50 00 – Aluminum Clad Wood Windows
- .7 Section 08 80 50 – Glazing
- .8 Section 09 21 16 – Gypsum Board Assemblies
- .9 Section 09 30 13 – Tiling
- .10 Section 09 65 00 – Resilient Flooring
- .11 Division 23 - Mechanical

1.2 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM C919-12, Standard Practice for Use of Sealants in Acoustical Applications.
 - .2 ASTM C920-14a, Standard Specification for Elastomeric Joint Sealants.
 - .3 ASTM D2240-15, Standard Test Methods for Rubber Property, Durometer Hardness.
- .2 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Protection Act, 1999 (CEPA).
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .4 South Coast Air Quality Management District (SCAQMD), California State
 - .1 SCAQMD Rule 1168-05, Adhesives and Sealants Applications.
- .5 Transport Canada (TC)
 - .1 Transportation of Dangerous Goods Act, 1992 (TDGA).

1.3 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 – Submittals.
 - .1 Submit manufacturer's printed product literature, specifications and data sheet. Indicate the following:
 - .1 Caulking compound
 - .2 Primers
 - .3 Sealing compound, each type, including compatibility when different sealants are in contact with each other.
 - .4 Manufacturers Sample Warranty

- .2 Submit WHMIS MSDS - Material Safety Data Sheets. WHMIS MSDS acceptable to Labour Canada and Health and Welfare Canada for sealants. Indicate VOC content.
- .3 Submit manufacturer's installation instructions for each product used.
- .4 When required by Departmental Representative, submit test certificates from an approved Canadian materials testing laboratory indicating that sealants meet the requirements of the standards specified, and that the tests have been conducted in accordance with ASTM D2240.
- .2 Submit samples in accordance with Section 01 33 00 – Submittals Procedures.
 - .1 Provide colour samples of the actual sealants for approval; painted or printed colour charts are not acceptable.

1.4 QUALITY ASSURANCE

- .1 Caulking shall be performed by a caulking contractor with minimum 3 years successful experience in Work of similar size and complexity.
- .2 Before performing Work of this Section, submit the names of proposed materials. If specified using Standards, indicate Qualification Number.
- .3 Compatibility: Ensure sealants are compatible with adjacent materials and are approved by manufacture for use with adjacent materials.

1.5 MOCK-UPS

- .1 Construct mock-up in accordance with Section 01 45 00 - Quality Control.
- .2 Before performing caulking work do sample applications of each type of sealant for approval. Site locations for sample applications shall be designated by Departmental Representative. Approved samples shall form standard for this project and no work of inferior quality will be allowed. Start no final work until approval of samples is given by the Departmental Representative.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, handle, store and protect materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver containers labelled and sealed, complete with written application and maintenance instructions.
- .3 Store materials in a dry heated enclosure in accordance with manufacturer's instructions.

1.7 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for recycling in accordance with Section 01 74 21 - Waste Management and Disposal.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Place materials defined as hazardous or toxic in designated containers.
- .4 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional and Municipal regulations.

- .5 Unused sealant material must not be disposed of into sewer system, into streams, lakes, onto ground or in other location where it will pose health or environmental hazard.
- .6 Divert unused joint sealing material from landfill to official hazardous material collections site approved by Departmental Representative.
- .7 Empty plastic joint sealer containers are not recyclable. Do not dispose of empty containers with plastic materials destined for recycling.
- .8 Fold up metal banding, flatten, and place in designated area for recycling.

1.8 PROJECT CONDITIONS

- .1 Environmental Limitations:
 - .1 Do not proceed with installation of joint sealants under following conditions:
 - .1 When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 4.4 degrees C.
 - .2 When joint substrates are wet.
- .2 Joint-Width Conditions:
 - .1 Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.
- .3 Joint-Substrate Conditions:
 - .1 Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.
 - .2 Substrate must be clean, dry, and frost free.

1.9 WARRANTY

- .1 Contractor hereby warrants that caulking work will not leak, crack, crumble, melt, shrink, run, lose adhesion or stain adjacent surfaces in accordance with General Conditions, but for three (3) years.
- .2 Provide Warranty for sealants to include in maintenance manuals as specified in Section 01 78 00 – Operations and Maintenance Data Manuals.

Part 2 Products

2.1 MANUFACTURERS

- .1 Acceptable Manufacturers: Subject to compliance with requirements in this Section and as recommended by the manufacturer, manufacturers offering products that may be incorporated into the Work include the following:
 - .1 BASF, Sonneborn.
 - .2 Chemtron Manufacturing Ltd.
 - .3 Dow Corning Canada Inc.
 - .4 GE Silicones Limited.
 - .5 Sika Chemical of Canada Ltd.

.6 Tremco Ltd.

2.2 SEALANT MATERIALS

- .1 Do not use caulking that emits strong odours, contains toxic chemicals or is not certified as mould resistant in air handling units.
- .2 When low toxicity caulks are not possible, confine usage to areas which offgas to exterior, are contained behind air barriers, or are applied several months before occupancy to maximize offgas time.
- .3 Unless otherwise specified, VOC content limits of sealants shall be in accordance with SCAQMD Rule 1168 and as follows:
 - .1 Architectural Materials:
 - .1 Sealants: VOC content limit 250 g/L.
 - .2 Sealant Primers for Non-Porous Surfaces: VOC content limit 250 g/L.
 - .3 Sealant Primers for Porous Surfaces: VOC content limit 775 g/L.
 - .2 Roofing:
 - .1 Non-Membrane Related Sealants: VOC content limit 300 g/L.
 - .2 Single Ply Roofing Sealants: VOC content limit 450 g/L.
 - .3 SBS Membrane Sealant Primer: VOC content limit 500 g/L.
 - .3 All Other Applications:
 - .1 Sealants: VOC content limit 420 g/L.
 - .2 Sealant Primers: VOC content limit 750 g/L.

2.3 SEALANT MATERIAL DESIGNATIONS

- .1 Type S-1: Acrylic Latex One Part, Shore A Hardness 20, to ASTM C834.
 - .1 Acceptable materials:
 - .1 Latacalk, Chemtron.
 - .2 Sonolac, BASF Sonneborn.
 - .3 Latex 100, Tremco.
- .2 Type S-2: Silicone Sealant; mould and mildew resistant.
 - .1 To ASTM C920; type S; grade NS; class 50; use NT, G, and A.
 - .2 Acceptable materials:
 - .1 Chemtron Multiseal
 - .2 GE SCS2000
 - .3 795 Silicone, Dow Corning.
 - .4 Spectrum 2 Silicone, Tremco Inc.
 - .1 To ASTM C920; type S; grade NS; class 50; use NT, G, and A.
 - .2 Acceptable materials:
 - .1 790 Silicone, Dow Corning.
 - .2 Spectrum 1 Silicone, Tremco Inc.
 - .3 To ASTM C920; type S; grade NS; class 25; use NT, G, and A.
 - .4 Acceptable materials:
 - .1 786 Silicone, Dow Corning.

- .2 OmniPlus, BASF Sonneborn.
 - .3 SCS1700, General Electric.
 - .4 Tremsil 200, Tremco Inc.
- .3 Type S-3: Silicone Sealant; general construction and air-seal sealant.
 - .1 To ASTM C920: type S; grade NS; class 25; use NT, M, G, A, O.
- .4 Type S-4: Silicone Sealant; structural glazing.
 - .1 To ASTM C920: type S; grade NS; class 25; use NT, A, G, O.
 - .2 Acceptable materials:
 - .1 995 Silicone, Dow Corning.
 - .2 Proglaze SSG, Tremco Inc.
 - .3 SSG4000, General Electric.
- .5 Type S-5: Acoustical Sealant; interior, non-skimming, non-hardening, simple component synthetic rubber sealant.
 - .1 Acceptable materials:
 - .1 Acoustical Sealant, Tremco
 - .2 Metaseal, Chemtron.
- .6 Type S-6: Multi-component polyurethane sealant; chemical curing, exterior wall sealant.
 - .1 To ASTM C920: type M; grade NS; class 50; use T, NT, M, A, O.
 - .2 Acceptable materials:
 - .1 Dymeric, Tremco.
 - .2 Sikaflex 2c NS, Sika.
 - .3 Sonolastic NP 2, BASF Sonneborn.
 - .4 Thioplast 400, Chemtron
- .7 Type S-7: One-component polyurethane sealant; non-sag, for general constructions.
 - .1 To ASTM C920: type S; grade NS; class 25; use NT, M, A, O.
 - .2 Acceptable materials:
 - .1 Dymonic FC, Tremco Inc
 - .2 Multiflex, Chemtron.
 - .3 Sonolastic NP 1, BASF Sonneborn.
 - .4 Sikaflex 1a, Sika.
 - .5 Mapeflex P1, MAPEI Inc
- .8 Type S-8: Horizontal joint sealant; two component, self-levelling.
 - .1 To ASTM C920: type M; grade P; class 25; use T, M, O.
 - .2 Acceptable materials:
 - .1 Sikaflex 2c SL, Sika.
 - .2 Sonolastic SL 2, BASF Sonneborn.
 - .3 THC-901, Tremco Inc

- .9 Type S-9: One part moisture curing, low modulus polyurethane sealant for sealing joints in level and slightly slope surfaces conforming to ASTM C920, type S, grade P, class 50, use T, M, A,O, MC-1-25-B-N.
 - .1 Acceptable materials:
 - .1 Sonolastic SL 1, BASF Sonneborn.
 - .2 Vulkem 45 SSL, Tremco Inc
- .10 Type S-10: Control joint sealant: two-component, epoxy-urethane, self-levelling, load bearing saw cut or preformed control joints.
 - .1 Acceptable materials:
 - .1 Loadflex, Sika.
 - .2 Planiseal Rapid Joint 15, MAPEI Inc.
 - .3 Rezi-Weld Flex with Pourthane NS, WR Meadows
- .11 Type S-11: One-component polyurethane sealant; medium-modulus, non-sag, low-VOC, UV stable.
 - .1 To ASTM C920: type S; grade NS; class 50; use NT, T, M, A, O, I.
 - .2 Acceptable materials:
 - .1 Dymonic 100, Tremco Inc.
 - .2 Multiflex, Chemtron
 - .3 Vulkem 116, Mameco

2.4 ACCESSORIES

- .1 Preformed Compressible and Non-Compressible back-up materials that are non-staining, compatible with joint substrate, sealants, primers, and other joint fillers, and are approved for applications indicated by sealant manufacturer based on site experience and laboratory testing.
 - .1 Rod Type Sealant Backings:
 - .1 ASTM C1330, Type C (closed cell material with a surface skin), Type O (open cell material) or Type B (bi-cellular material with a surface skin).
 - .2 Use any of the preceding types, as approved in writing by joint sealant manufacturer for joint application indicated.
 - .3 Size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
 - .4 Non-adhering to sealant, to maintain two sided adhesion across joint.
 - .2 High Density Foam.
 - .1 Extruded closed cell polyvinyl chloride (PVC), extruded polyethylene, closed cell, Shore A hardness 20, tensile strength 140 to 200 kPa, extruded polyolefin foam, 32 kg/m³ density, or neoprene foam backer, size as recommended by manufacturer.
 - .3 Bond Breaker Tape.
 - .1 Polyethylene bond breaker tape or other tape recommended by sealant manufacturer which will not bond to sealant.
- .2 Preformed Sealants

- .1 Preformed Silicone Sealant System: Manufacturer's standard system consisting of pre-cured low modulus silicone extrusion, in sizes to fit joint widths indicated, combined with a neutral curing silicone sealant for bonding extrusions to substrates:
 - .1 Acceptable materials:
 - .1 Dow Corning Corporation; 123 Silicone Seal.
 - .2 GE Silicones; UltraSpan US1100.
 - .3 Tremco; Spectrem Ez Seal.
- .3 Primer: Non-staining type as recommended by sealant manufacturer.
- .4 Joint Cleaner: Non-corrosive solvent type recommended by sealant manufacturer for applicable substrate materials.

2.5 COLOURS

- .1 Colours: To match adjacent materials, as selected by Departmental Representative, from manufacturer's standard colour range.

2.6 SEALANT SELECTION

- .1 Where no specified type of sealant is shown or specified, choose one of the sealants specified in this Section appropriate for its location.
- .2 Make sealant selections consistent with manufacturer's recommendations.
- .3 Use acrylic sealant Type S-1 only on the interior and only in situations where little or no movement can occur.
- .4 Use mould & mildew resistant silicone sealant Type S-2 for non-moving joints in washrooms and kitchens. Do not use on floors.
- .5 Use silicone general construction sealant Type S-3 or Type S-6 and S-7 for all joints, interior and exterior, where no other specific sealant type specified.
- .6 Use structural glazing silicone Type S-4 for sealing glass, interior and exterior.
- .7 Use acoustical sealant Type S-5 and air seal sealant Type S-3 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 type S-6, primed penetration element surfaces other than concrete, for mechanical and electrical service penetrations in concrete foundation walls.
- .9 Use multi-component sealant Type S-8 for horizontal joint sealant of plaza, floors and decks, exterior areas only, subject to pedestrian and vehicular traffic.
- .10 Use polyurethane, semi-self levelling sealant Type S-9 for in expansion joints in sidewalks, plazas, floors and other pedestrian and vehicular horizontal surfaces with slopes up to 6%.
- .11 Use control joint sealant S-10 as filler for interior, horizontal saw cut or preformed control joints where joints are subject to load bearing conditions.
- .12 Use sealant S-11 for sealing exterior holes and penetrations around pipes and other services passing through concrete foundations and requiring greater movement capability.

Part 3 Execution

3.1 PROTECTION

- .1 Protect installed Work of other trades from staining or contamination.

3.2 INSPECTION

- .1 Carefully inspect surfaces, materials to receive sealants and verify they are physically capable of retaining sealant bond.
- .2 Verify that fillers and backing provided under other Sections properly installed.

3.3 SURFACE PREPARATION

- .1 Prepare surfaces in accordance with manufacturer's instructions.
- .2 Examine joint sizes and conditions to establish correct depth to width relationship for installation of backup materials and sealants.
- .3 Maintain workmanship of highest quality in accordance with best trade practice.
- .4 Ensure that joint forming materials are compatible with sealant.
- .5 Clean bonding joint surfaces of harmful matter substances including dust, rust, oil grease, and other matter which may impair Work. Wire brush loose materials and other foreign matter which might impair adhesion of sealant.
- .6 Use air stream to blow out dirt and water from crevices.
- .7 Ensure joint surfaces are dry and frost free
- .8 Prime all porous material (e.g. wood, masonry, concrete, ceramic or paver tile, etc).
- .9 Prime other joints when recommended by manufacturer. Use a brush that will reach all parts of the joints. Mask adjoining surfaces with tape prior to priming to prevent staining.

3.4 PRIMING

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

3.5 BACKUP MATERIAL

- .1 Use backer rod as specified, to limit depth of sealant and to act as bond breaker at back of joint.
- .2 Install joint filler to achieve correct joint depth and shape, with approximately 30% compression.
- .3 Where depth of joint does not permit the use of backer rod apply paper masking tape to back of joint to act as bond breaker.
- .4 Ensure that no joints are formed which are bonded on adjacent sides where there is any possibility of movement.

3.6 MIXING

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

3.7 APPLICATION

- .1 Apply sealant in strict accordance with manufacturer's recommendations.
- .2 For joints where movement is possible, apply backer rod to achieve a joint depth of one half the joint width but not less than 9 mm; for joints larger than 25 mm use a depth of 13 mm
- .3 Use pressure gun fitted with suitable nozzle. Use sufficient pressure to fill voids and joints solid.
- .4 Form surface of sealant smooth, free from ridges, wrinkles, sags, or air pockets and imbedded impurities. Neatly tool surface to a slight concave appearance.
- .5 Tool sealants to achieve air tight joints. Use wet tools as required.
- .6 Ensure bead is solid, filling entire space between sides and bedding material, exerting sufficient pressure to obtain maximum bond, by allowing sealant to bulge out in advance of nozzle.
- .7 Apply sealant within recommended temperature ranges. Consult manufacturer when sealant cannot be applied within recommended temperature range.
- .8 Seal perimeters of hollow metal door frames on both sides.
- .9 Seal control joints in gypsum board and stucco, and junctures between interior partitions with exterior walls.
- .10 Seal window and door frames around the inside perimeter, so that an airtight seal is obtained, as indicated on drawings.
- .11 Seal joints in floors and walls and around service and mechanical and electrical fixture penetrations.
- .12 Seal at all locations where dissimilar material meet.
- .13 Curing
 - .1 Cure sealants in accordance with sealant manufacturer's instructions.
 - .2 Do not cover up sealants until proper curing has taken place.

3.8 CLEAN UP

- .1 Clean adjacent surfaces immediately and leave Work neat and clean.
- .2 Remove excess and droppings, using recommended cleaners as work progresses.
- .3 Remove masking tape after initial set of sealant.
- .4 On porous surfaces allow sealant to cure overnight, and remove excess by light wire brushing.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 07 21 19 – Foamed-In-Place Insulation
- .2 Section 07 92 00 – Sealants
- .3 Section 08 14 16 – Flush Wood Doors
- .4 Section 08 71 00 – Door Hardware
- .5 Section 08 80 50 – Glazing
- .6 Section 09 91 00 – Painting

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A653/A653M-15e1, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .2 ASTM A780/A780M-09(2015), Standard Practice for Repair of Damaged and Uncoated Areas of Hot Dip Galvanized Coatings.
 - .3 ASTM A879/A879M-12(2017), Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface
 - .4 ASTM A924 / A924M-16ae1, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
 - .5 ASTM B29-14, Standard Specification for Refined Lead.
 - .6 ASTM B749-14, Standard Specification for Lead and Lead Alloy Strip, Sheet and Plate Products.
 - .7 ASTM C553-13, Specification for Mineral Fiber Blanket Insulation for Commercial and Industrial Applications
 - .8 ASTM C578-16, Specification for Rigid, Cellular Polystyrene Thermal Insulation
 - .9 ASTM C591-16, Specification for Un-Faced Pre-formed Rigid Cellular Polyisocyanurate Thermal Insulation
 - .10 ASTM C592-16, Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type)
 - .11 ASTM C1289-16a, Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
 - .12 ASTM D1622/D1622M-14, Standard Test Method for Apparent Density of Rigid Cellular Plastics.
 - .13 ASTM D4726-15, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Exterior-Profile Extrusions Used for Assembled Windows and Doors.
 - .14 ASTM D6386-16a, Standard Practice for Preparation of Zinc (Hot Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting.
 - .15 ASTM D7396-14, Standard Guide for Preparation of New, Continuous Zinc-Coated (Galvanized) Steel Surfaces for Painting.

- .2 Builders Hardware Manufacturers Association (BHMA)
 - .1 BHMA A156.16-2013, Auxiliary Hardware.
- .3 Canadian Standards Association (CSA International)
 - .1 CAN4-S106-M80(R1985), Standard Method for Fire Tests of Window and Glass Block Assemblies
 - .2 CSA-G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel, Includes Update No. 1 (2014).
 - .3 CSA W47.1-09(R2014), Certification of companies for fusion welding of steel, Includes Update No. 3 (2011), Update No. 5 (2012), Update No. 6 (2013).
 - .4 CSA W59-13, Welded Steel Construction (Metal Arc Welding), Includes Update No. 1 (2014).
- .4 Canadian Steel Door Manufacturers' Association (CSDMA)
 - .1 CSDMA, Guide Specification for Installation and Storage of Hollow Metal Doors and Frames, 2012.
 - .2 CSDMA, Recommended Specifications for Commercial Steel Doors and Frames, 2006.
 - .3 CSDMA, Selection and Usage Guide for Commercial Steel Doors, 2009.
- .5 National Fire Protection Association (NFPA)
 - .1 NFPA (Fire) 80, Standard for Fire Doors and Other Opening Protectives, 2016 Edition.
 - .2 NFPA (Fire) 252, Fire Tests of Door Assemblies, 2012 Edition.
- .6 South Coast Air Quality Management District (SCAQMD), California State
 - .1 SCAQMD Rule 1113-11, Architectural Coatings.
 - .2 SCAQMD Rule 1168-05, Adhesives and Sealants Applications.
- .7 The Society for Protective Coatings (SSPC)
 - .1 SSPC-PS 12.0-1-02, One Coat Zinc-Rich Painting System.
 - .2 SSPC-PS Guide 12.00, Guide to Zinc-Rich Coating Systems.
- .8 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC S104-15, Standard Method for Fire Tests of Door Assemblies.
 - .2 CAN/ULC S105-16, Standard Specification for Fire Door Frames Meeting the Performance Required by CAN/ULC-S104.
 - .3 CAN/ULC-S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.
 - .4 CAN/ULC-S702-14, Standard for Thermal Insulation Mineral Fibre for Buildings, Includes Amendment 1 (January 2012).
 - .5 CAN/ULC-S704-11, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.

1.3 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 – Submittals:

- .1 Submit manufacturer's printed product literature, specifications and data sheets for each type of door and frame specified.
- .2 Submit test and engineering data, and installation instructions.
- .2 Submit shop drawings in accordance with Section 01 33 00 – Submittals:
 - .1 Indicate general construction of each type of door and frame, configurations, material, material thickness, jointing methods, mortises, reinforcements, anchors, arrangement of hardware, fire ratings, finish and special features.
 - .2 Reference door and frame types to Door Schedule. Indicate door numbers where applicable.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for cleaning and maintenance of finishes for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 QUALITY ASSURANCE

- .1 Manufacturer/Fabricator: member in good standing of the Canadian Steel Door and Frame Manufacturer's Association.
- .2 Installer: Use installers who are experienced with the installation of hollow metal doors and frames of similar complexity and extent to that required for the Project.
- .3 Provide fire labelled frame products for those openings requiring fire protection ratings, as scheduled:
 - .1 List by nationally recognized agency having factory inspection service and construct as detailed in Follow-up Service Procedures/Factory Inspection Manuals issued by listing agency to individual manufacturers.
 - .2 Fabricate all rated doors, frames and screens to labelling authority standard.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and as follows:
 - .1 Receive and store materials as recommended by materials manufacturer.
 - .2 Adequately protect surfaces from damage during moving, handling and storage.

1.7 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 – Waste Management and Disposal.

Part 2 Products

2.1 PERFORMANCE/DESIGN CRITERIA

- .1 Perform work in accordance with CSDMA, Recommended Specifications for Commercial Steel Doors and Frames, except as otherwise specified herein.

- .2 Design exterior frame assembly to accommodate to expansion and contraction when subjected to minimum and maximum surface temperature of -35 degrees C to 35 degrees C.
- .3 Maximum deflection for exterior steel entrance screens under wind load of 1.2 kPa not to exceed 1/175th of span.
- .4 Steel fire rated doors and frames: Label and list fire rated doors and frames by an organization accredited by the Standards Council of Canada in conformance with CAN4-S104 and CAN4-S105 for ratings specified or indicated. Fire labels must be factory applied by the manufacturer.
- .5 Be responsible for securing approval from authorities having jurisdiction for materials, fabrication and installation of fire rated oversized door and frame assemblies

2.2 MATERIALS

- .1 Steel:
 - .1 Doors and Frames: coated steel sheets to ASTM A924/M924; coating designation to ASTM A653/A653M: Commercial Steel (CS), Type B, ZF180; stretcher levelled.
 - .2 Exterior doors and frames and Interior High Humidity Area: coated steel sheets to ASTM A924/M924; coating designation to ASTM A653/A653M: Commercial Steel (CS), Type B, ZF180 galvanized; stretcher levelled.
- .2 Nominal Base Metal Thickness Requirements:
 - .1 Frames: refer to frame fabrication requirements specified in this section.
 - .2 Doors: refer to door fabrication requirements specified in this section.
 - .3 Hardware Reinforcement for Doors and Frames: Carbon steel, welded in place, prime painted, to the following minimum nominal thicknesses:

Hardware Reinforcement	Door (mm)	Frame (mm)
Mortise Hinge:	3.51	3.51
Mortise or Bored Lock or Deadbolt:	1.98	1.98
Flush or Surface Bolt Front:	1.98	1.98
Surface or Concealed Closer:	2.74	2.74
Strike Reinforcements:	1.98	1.98
Hold Open Arm:	1.98	1.98
Electronic Hardware Reinforcements:	1.98	1.98
Pull Plates and Bars:	1.30	1.30
Mortar Box:	--	0.84
Surface Exit Devices:	1.98	1.98
Door Surface Hardware Reinforcements:	1.30	1.30
Frame surface hardware reinforcements:	2.74	2.74
Notes: Provide guard boxes to protect mortised cut-outs from spray applied insulation, fully sealed.		

- .3 Door Core Materials
 - .1 Honeycomb: Structural small cell 25 mm maximum. kraft paper honeycomb:
 - .1 Weight: 36.3 kg/ream minimum.
 - .2 Density: 16.5 kg/m³ minimum.
 - .3 Sanded to required thickness.
 - .2 Polystyrene: Rigid extruded, closed cell insulation, fire retardant treated meeting the requirements of ULC S701, Type 4, minimum thermal resistance RSI 0.8/25 mm thickness.
 - .3 Polyurethane: rigid, cellular type, board, conforming to ASTM D1622, or foamed-in-place, 1.8 pound per cubic foot (29 kilograms per cubic meter) density minimum, containing no urea formaldehyde resins.

2.3 ADHESIVES

- .1 Honeycomb cores and steel components: heat resistant, spray grade, resin reinforced neoprene/rubber (polychloroprene) based, low viscosity, contact cement.
 - .1 Adhesive: maximum VOC content 50 g/L to SCAQMD Rule 1168.
- .2 Polystyrene and polyurethane cores: heat resistant, epoxy resin based, low viscosity, contact cement.
- .3 Interlocking Edge Seam Adhesive: fire resistant, resin reinforced polychloroprene, high viscosity, sealant/adhesive.

2.4 PRIMER

- .1 Touch-up primer: to ASTM A780/A780M and SSPC-PS 12.01.
 - .1 Maximum VOC limit 50 g/L to GC-03.

2.5 PAINT

- .1 Prepare surfaces for field painting to ASTM D6386 and ASTM D7396.
- .2 Field paint steel doors and frames in accordance with Section 09 91 00 - Painting. Protect weatherstrips from paint. Provide final finish free of scratches or other blemishes.
 - .1 Maximum VOC emission level 50 g/L to GS-11 and to SCAQMD Rule 1113.

2.6 ACCESSORIES

- .1 Door silencers (bumpers): Grey rubber, to ANSI/BHMA A156.16 Type 6-180; three silencers on strike jambs of single door frames; two silencers on heads of double door frames; screw fastener applied. Stick on bumpers are not acceptable.
- .2 Floor anchors: 3.5 mm minimum adjustable floor clip angles with 2 holes for anchorage to floor.
- .3 Exterior Top Caps: Rigid polyvinylchloride (PVC) extrusion in accordance with CAN/CGSB 41-GP-19Ma.

- .4 Fabricate glazing stops as formed channel, minimum 16 mm height, accurately fitted, butted at corners and fastened to frame sections with counter-sunk oval head sheet metal screws.
- .5 Make provisions for glazing as indicated and provide necessary glazing stops.
 - .1 Provide removable 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 Metallic paste filler: to manufacturer's standard.
- .7 Fasteners: tamperproof type 304 stainless steel screws with countersunk flat head.
- .8 Labels for fire doors and door frame: brass plate, riveted to door and door frame.
- .9 Sealant: Section 07 92 00 – Joint Sealants.
 - .1 Maximum VOC limit 250 g/L to SCAQMD Rule 1168.
- .10 Glazing: Section 08 80 50 – Glazing.

2.7 FABRICATION GENERAL

- .1 Welded construction: assemble units by welding in accordance with CSA W59 to produce a finished unit square, true and free of distortion. Welding shall be undertaken only by a fabricator fully approved by the Canadian Welding Bureau to the requirements of CSA W47.1.
- .2 Permit access by an approved inspection and testing company for the purpose of inspecting at random, doors being fabricated for this project.
- .3 Make provisions in doors and frames to suit requirements of trade or section providing electrically operated hardware or security devices. Provide removable plates or knock outs for electrical contacts. Provide junction boxes on security door frames as required for door strikes, mag locks and door contacts. Ensure frames arrive on site prepared for wiring.
- .4 Fabricate galvanized steel channels to reinforce frames and screens as required for size, and for fire protection rating requirements. Extend reinforcements from floor to structure above. Design top connection to accommodate structural deflection. Conceal reinforcements in frames and screens.

2.8 FRAMES AND SCREENS FABRICATION: GENERAL

- .1 Fabricate frames in accordance with CSDMA specifications.
- .2 Accurately form frames to profiles indicated. Construct frames straight and free from twist or warp.
- .3 Exterior frames: 1.98 mm minimum welded type construction. 50 mm face standard frame profile, throat and frame width to suit wall construction.
- .4 Interior frames: 1.6 mm minimum for single doors; 1.98 mm for frames with opening width in excess of 1220 mm; welded type construction. 50 mm face standard frame profile, throat and frame width to suit wall construction.
- .5 Blank, drill, reinforce and tap frames to receive mortised, templated hardware, security and electrical devices, using templates provided by finish hardware supplier. Reinforce frames for installation of closers. For transportation, install

stiffener plates or two angle spreaders where required to prevent bending of frame and to maintain alignment when setting. Weld reinforcement in place. Remove prior to installation.

- .6 Provide removable portion of stop and frame where required for overhead concealed door closers, properly connected to frame, and prepare for attachment of closer prior to shipment.
- .7 Protect mortised cutouts with steel guard boxes.
- .8 Manufacturer's nameplates on frames and screens are not permitted.
- .9 Conceal fastenings except where exposed fastenings are indicated.
- .10 Provide factory-applied touch up primer at areas where zinc coating has been removed during fabrication.
- .11 Partition Screens:
 - .1 Fabricate metal screens to profiles indicated.
 - .2 Supply jamb and mullion extensions and anchors required to secure screens to structure or framing provided under other Sections. Fabricate anchorage to prevent transfer of load from support framing to the screens when deflection of structure occurs.
 - .3 Provide concealed reinforcement for screens to receive handrails.
 - .4 Provide closely fitted steel glass stops where required. Mitre corners. Drill and countersink fasteners symmetrically at 150 mm o.c. Screw stops in place.
- .12 Provide fire labelled frames for those openings requiring fire protection ratings, as indicated in as scheduled on Drawings.

2.9 FRAME ANCHORAGE

- .1 Provide appropriate anchorage to floor and wall construction.
- .2 Where frames terminate at finished floor, supply floor plates for anchorage to slab. Check depth of extension of finished floor to structural slab and provide jamb extension anchorage as required. Provide 50 mm minimum adjustment
- .3 Locate wall anchors immediately above or below each hinge reinforcement on the hinge jamb, and directly opposite on the strike jamb. Provide three anchors per jamb for frames up to 2300 mm. Add one anchor per jamb for each additional 760 mm or fraction thereof in frame height.
- .4 Locate anchors for frames in existing openings not more than 150 mm from top and bottom of each jambs and intermediate at 660 mm on centre maximum.

2.10 FRAMES: WELDED TYPE

- .1 Welding in accordance with CSA W59.
- .2 Cut frame mitres accurately and weld on inside of frame profile. Fill frame corners, exposed surface depressions and butted joints with air drying paste filler. Sand to a smooth uniform finish. Touch up damaged galvanized finish with zinc rich primer.
- .3 Cope accurately and securely weld butt joints of mullions, transom bars, centre rails and sills.

- .4 Grind welded joints and corners to a flat plane, fill with metallic paste and sand to uniform smooth finish.
- .5 Securely attach floor anchors to inside of each jamb profile.
- .6 Weld in 2 temporary jamb spreaders per frame to maintain proper alignment during shipment.

2.11 DOOR FABRICATION GENERAL

- .1 Fabricate steel doors rigid, neat in appearance, and free from defects including warp and buckle; 45 mm thickness of types and sizes indicated on drawing, and as follows:
 - .1 Door faces of all steel doors shall be fabricated without visible seams, free of scale, pitting, coil brakes, buckles and waves.
 - .2 Form edges true and straight with minimum radius suitable for thickness of steel used.
 - .3 Bevel lock and hinge edges 3 mm in 50 mm; confirm requirement with builder's hardware or door swing that could dictate a different bevel.
 - .4 Top and bottom of doors shall be provided with inverted, recessed, nominal 1.60 mm steel end channels, welded to each face sheet at 150 mm O/C.
 - .5 Equip exterior doors with factory installed flush PVC top caps. Equip fire labelled exterior doors with factory installed flush steel top caps.
 - .6 Provide fire labelled doors for those openings requiring fire protection ratings, as indicated on Drawings.
 - .7 Fabricate doors with the following clearances:
 - .1 Clearance between door and frame and between meeting edges of doors swinging in pairs shall not exceed 3 mm
 - .2 Clearance between the bottom of door and floor shall not exceed 19 mm or as required to accommodate specified hardware
 - .3 Clearance between bottom of door and a raised non-combustible sill in accordance with NFPA 80
 - .4 Clearance between bottom of door and nominal surface of combustible floor coverings in accordance with NFPA 80
- .2 Fabricate doors with longitudinal edges locked seam and spot welded. Seams: not visible, grind welded joints to a flat plane, fill with metallic paste filler and sand to a uniform smooth finish. Bevel both stiles of single doors 1 in 16.
- .3 Exterior Doors: Flush, lock seam construction, insulated doors fabricated in accordance with CAN/CGSB 82.5, and as follows:
 - .1 Face Sheets: Minimum 1.60 mm base steel sheet thickness.
 - .2 Insulation Stiffened Core: Insulated and sound deadened with polystyrene core laminated under pressure to each face sheet.
- .4 Interior Doors: Flush, lock seam construction, hollow steel doors fabricated in accordance with CSDMA Manufacturing Specifications for Doors and Frames, and as follows:
 - .1 Face sheets: Minimum 1.30 mm base steel sheet thickness.

- .2 Stiffened and sound deadened with honeycomb core laminated under pressure to each face sheet.
- .5 Fire Rated Doors: Flush, lock seam construction, hollow steel doors fabricated in accordance with CAN4 S104 and NFPA 80, and as follows:
 - .1 Face sheets: Minimum nominal 1.60 mm base steel sheet thickness.
 - .2 Stiffened and sound deadened with honeycomb core laminated under pressure to each face sheet.
 - .3 Equip pairs of fire labelled doors with minimum 2.74 mm steel surface mounted flat bar astragal, welded to door face; plug welded on face and stitch welded to butt edge of door.
 - .4 Labelled by Underwriters Laboratories of Canada, ITS/Warnock Hersey, or other testing laboratory approved by the authority having jurisdiction.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 EXAMINATION

- .1 Verify condition and dimensions of previously installed work upon which this Section depends. Report defects to Departmental Representative.
Commencement of work means acceptance of existing conditions

3.3 INSTALLATION GENERAL

- .1 Install fire rated doors and frames in accordance with requirements of NFPA 80.
- .2 Install doors, frames and accessories in accordance with reviewed shop drawings, ANSI A250.11, CSDMA Guide Specification for Installation and Storage of Hollow Metal Doors and Frames, manufacturer's data, and as specified in this Section.

3.4 FRAME INSTALLATION

- .1 Door Frames:
 - .1 Remove temporary spreaders before installing door frames, leaving exposed surfaces smooth and undamaged.
 - .2 Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set; limit of acceptable frame distortion 2 mm out of plumb measured on face of frame, maximum twist corner to corner of 3 mm; align horizontal lines in final assembly.
 - .3 Brace frames rigidly in position until adjacent construction is complete; install wooden spreaders at third points of frame rebate to maintain frame width, install centre brace to support head of frames 1200 mm and wider in accordance with ANSI A250.1; do not use temporary metal spreaders for bracing of frames 1.

- .4 Place frames before construction of enclosing walls and ceilings, except for frames located in existing walls or partitions allowing for deflection of adjacent construction to ensure that structural loads are not transmitted to frames, and as follows:
 - .1 Check and correct opening width and height, squareness, alignment, twist and plumb as frames are installed in accordance with CSDMA Recommended Dimensional Standards for Commercial Steel Doors and Frames.
 - .2 Metal Stud Partitions: Provide a minimum of three wall anchors per jamb for frames up to 2150 mm high and 1 additional anchor for each 600 mm over 2150 mm high; install adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb; attach wall anchors to studs with screws.
 - .3 Remove wooden braces after frames are securely fastened or attached to adjacent construction.
- .5 Install glazing materials and studded door silencers.
- .6 Do not site weld unless approved by Departmental Representative in writing for the specific screen.
- .7 For frames over 1220 mm in width, provide vertical support at the centre of head.
- .2 Window Frames:
 - .1 Installation of borrowed lights is same as for door frames.
 - .2 Site assemble large borrowed lights to provide true and even alignment with flush butt hairline jointing, all fasteners concealed.
 - .3 Site weld only when approved by Departmental Representative in writing for the specific location.
 - .4 Align all horizontal rails in final assembly.
 - .5 Install sealant and back-up materials
- .3 Frame Tolerances: Install frames to tolerances listed in ANSI A250.11, and as follows:
 - .1 Squareness: Maximum 1.6 mm measured across opening between hinge jam and strike jamb.
 - .2 Plumbness: Maximum 1.6 mm measured from bottom of frame to head level.
 - .3 Alignment: Maximum 1.6 mm measured offset between face of hinge jamb and strike jamb relative to wall construction.
 - .4 Twist: Maximum 1.6 mm measured from leading edge of outside frame rabbet to leading edge of inside frame rabbet.
- .4 Install door silencers.
- .5 Caulk perimeter of frames between frame and adjacent material.
- .6 Maintain continuity of air barrier and vapour retarder.

3.5 DOOR INSTALLATION

- .1 Fit hollow metal doors accurately in frames within clearances required for proper operation; shim as necessary for proper operation.

- .2 Install hardware in accordance with hardware templates and manufacturer's instructions and Section 08 71 00 - Door Hardware.
- .3 Provide even margins between doors and jambs and doors and finished floor and thresholds as follows.
 - .1 Hinge side: 1.0 mm.
 - .2 Latchside and head: 1.5 mm.
 - .3 Finished floor, top of carpet or noncombustible sill and thresholds: 6 mm; 13 mm at openings in non-fire rated separations where undercuts are indicated.
- .4 Adjust operable parts for correct clearances and function.
- .5 Install louvres.

3.6 FINISH REPAIRS

- .1 Touch-up areas where galvanized coating has been removed or damaged with primer.
- .2 Fill exposed frame anchors and surfaces with imperfections with metallic paste filler and sand to a uniform smooth finish.

3.7 GLAZING

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

3.8 ADJUSTING AND CLEANING

- .1 Adjust doors for smooth and balanced door movement.
- .2 Clean doors, frames and screens.

3.9 FIELD PAINTING

- .1 Prepare surfaces for field painting, to ASTM D6386 and ASTM D7396.
- .2 Field painting: refer to Section 09 91 00 Painting. Protect weatherstrips from paint. Provide final finish, free of scratches or other blemishes.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 06 20 00 - Finish Carpentry
- .2 Section 08 11 13 - Steel Doors and Frames
- .3 Section 08 71 00 - Door Hardware - General
- .4 Section 08 80 50 - Glazing

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)
 - .1 ANSI A208.1-2009, Particleboard.
- .2 Architectural Woodwork Manufacturers Association of Canada (AWMAC)
 - .1 AWMAC/AWI Architectural Woodwork Standards, Most Recent Edition.
- .3 Canadian Hardwood Plywood and Veneer Association (CHPVA)
 - .1 CHPA Official Grading Rules for Rotary Cut Face Veneers.
- .4 Canadian Standards Association (CSA International)
 - .1 CSA O115-M1982(R2001), Hardwood and Decorative Plywood.
- .5 Environmental Choice Program (ECP)
 - .1 UL 2761 (formerly CCD-045), Sealants and Caulking Compounds.
 - .2 UL 2762 (formerly CCD-046), Adhesives.
- .6 National Fire Protection Association (NFPA)
 - .1 NFPA Fire 80-15, Standard for Fire Doors and Other Opening Protectives, 2016 Edition.
 - .2 NFPA Fire 252-16, Standard Methods of Fire Tests of Door Assemblies, 2012 Edition.
- .7 National Lumber Grades Authority (NLGA)
 - .1 Standard Grading Rules for Canadian Lumber 2010.
- .8 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC S104-15, Standard Method for Fire Tests of Door Assemblies.
 - .2 CAN/ULC S105-16, Standard Specification for Fire Door Frames Meeting the Performance Required by CAN/ULC-S104.

1.3 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 – Submittals.
 - .1 Submit manufacturer's printed product literature, specifications and data sheet.
 - .2 Submit two copies of WHMIS MSDS - Material Safety Data Sheets. Indicate VOC's:
 - .1 For caulking materials during application and curing.
 - .2 For door materials and adhesives.

- .2 Submit shop drawings in accordance with Section 01 33 00 – Submittals.
 - .1 Show construction and materials used in cores, size and species of edge strip, thickness and species of cross-banding, and thickness and species of face veneer.
 - .2 Show details of openings and mouldings for glazing.
 - .3 Indicate locations, sizes and types of all doors to be supplied reference to the Door and Hardware Schedule.
 - .4 Indicate elevation of each kind of door, details of construction, location and extent of hardware blocking, [fire ratings], requirements for factory finishing and other pertinent data.
 - .5 Include finishing specifications for doors to receive factory-applied finish.
 - .6 Include certifications as might be required to show compliance with specifications.

1.4 QUALITY ASSURANCE

- .1 Fabricate doors in accordance with the AWMAC/AWI Architectural Woodwork Standards, Section 9 - Doors, Premium grade.
- .2 Manufacturer Qualification: Manufacturer specializing in products in this section who have a minimum of five years of documented experience and are a member in good standing of the Architectural Woodwork Manufacturers Association of Canada (AWMAC).
- .3 Regulatory Requirements:
 - .1 Wood fire rated doors: labelled and listed by an organization accredited by Standards Council of Canada.
- .4 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
- .5 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Delivery and Acceptance Requirements:
 - .1 Deliver doors and panels to minimize storage on site and when site conditions conform to requirements for storage.
- .2 Storage and Protection:
 - .1 Store and handle doors and panels in accordance with AWMAC requirements, and as follows:
 - .1 Protect doors from dampness. Arrange for delivery after work causing abnormal humidity has been completed.
 - .2 Store doors in well ventilated room, off floor, in accordance with manufacturer's recommendations.
 - .3 Protect doors from scratches, handling marks and other damage.
 - .4 Store doors away from direct sunlight.

1.6 WASTE MANAGEMENT AND DISPOSAL

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

1.7 WARRANTY

- .1 Provide warranty issued in the name of the Departmental Representative stating that doors are warranted against defects in materials and workmanship for the life of the original installation.
- .2 Warranty to include coverage for reasonable amount to remove, replace, refinish, and re-hang doors that do not meet accepted AWMAC tolerances.

Part 2 Products

2.1 FIRE RATED WOOD DOORS

- .1 Wood doors: tested in accordance with CAN/ULC-S104 or NFPA 252 to achieve rating as scheduled.
 - .1 Face panels: species to match non-rated doors.
 - .2 Edges: to match face panels.
 - .3 Metal label secured to hinge edge of door.
 - .4 Finish: painted.

2.2 SOLID AND HOLLOW CORE DOORS

- .1 Flush wood doors: solid core to AWMAC Standard.
- .2 Dry lumber to an average moisture content of between 6 and 12% maximum at time of manufacture.
- .3 Construction:
 - .1 Solid particleboard core having minimum density of 449 kg/m³ in accordance with ANSI A208.1 and as follows:
 - .1 Stiles and Rails: Structural Composite Lumber (SCL) bonded to core to AWMAC Manual standards and as follows:
 - .1 Side Stiles: SCL with 16 mm hardwood edge, to match face veneers; no finger jointed materials permitted.
 - .2 Top and Bottom Rails: SCL with 16 mm soft wood cap.
 - .2 Reinforcement: with wood lock blocks.
 - .3 Construction: 5-ply
 - .4 Use: interior.
 - .2 Door Thickness: 45 mm overall.
- .4 Hollow Core Construction: mesh or cellular core surrounded by 57 mm minimum wood stiles and rails, with lock blocks, 5-ply construction, 35 mm overall thickness.
- .5 Face Panels:
 - .1 Hardboard: Type 2, minimum density 500 kg/m³, 6 mm nominal thickness one face smooth finish suitable for painted finish.

- .6 Adhesive: Type I (waterproof)
- .7 Wood Door Frames and Stops: Refer to Section 06 20 00 – Finish Carpentry.
- .8 Metal Door Frames: Refer to Section 08 11 13 – Steel Doors and Frames.

2.3 ACCESSORIES

- .1 Transom and Side Panels: to match materials and construction of adjacent doors and as follows:
 - .1 Meeting edges of doors and transom panels to be square.
 - .2 Veneer of doors and transom panels to be end and colour matched.
- .2 Glass: Clear tempered safety glass as specified under Section 08 80 50.
- .3 Glazing Stops: Solid hardwood with mitred corners, to match veneers.

2.4 FABRICATION

- .1 Fabricate doors in accordance with AWS section 9.
- .2 Fabricate fire rated doors to sizes required to allow clearances specified in NFPA 80 and as follows. Coordinate with door frames and door hardware to be utilized.
 - .1 Between door and jamb or head: 3.2 mm maximum.
 - .2 Between meeting edges of paired doors: 3.2 mm maximum.
 - .3 Between door and noncombustible finished floor: 19.05 mm maximum.
 - .4 Between door and floor coverings: 12.7 mm maximum.
 - .5 Between door and raised noncombustible sill or threshold: 9.5 mm maximum.
- .3 Vertical edge strips to match face veneer.
- .4 Prepare doors for louvres and glazing. Provide hardwood species to match face veneer and glazing stops with mitred corners.
- .5 Doors shall be pre-fitted, bevelled and machined at the factory for all mortise hardware items as per templates and approved hardware schedules provided.
- .6 Bevel vertical edges of single acting doors 3 mm in 50 mm on lock side and 1.5 mm in 50 mm on hinge side.
- .7 Radius vertical edges of double acting doors to 60 mm radius.
- .8 Provide waterproof non-staining membrane at cutouts on exterior doors to exclude moisture from core.

2.5 FINISHES

- .1 Paint in accordance with Section 09 91 00 – Painting.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Unwrap and protect doors in accordance with AWMAC.
- .2 Install labelled fire rated doors in accordance with NFPA 80 and to provide specified clearances. Do not site modify labeled fire rated doors.
- .3 Install doors and hardware in accordance with manufacturer's printed instructions and AWMAC.
- .4 Adjust hardware for correct function.
- .5 Install glazing in accordance with Section 08 80 50 - Glazing.
- .6 Install louvres and stops.
- .7 Secure transom and side panels by means of stops, concealed fasteners or countersunk screws concealed by means of wood plugs matching panel in grain and colour.

3.3 ADJUSTMENT

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

3.4 CLEANING

- .1 Perform cleaning as soon as possible after installation to remove construction and accumulated environmental dirt.
- .2 Remove traces of primer, caulking; clean doors and frames.
- .3 Clean glass and glazing materials with approved non-abrasive cleaner.
- .4 On completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 05 50 00 – Metal Fabrications.
- .2 Section 08 71 00 – Door Hardware.
- .3 Section 09 91 00 – Painting.
- .4 Division 26: Electrical power supply.

1.2 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM A653/A653M-15e1, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .2 ASTM A1008/A1008M-16, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
 - .3 ASTM D523-14, Standard Test Method for Specular Gloss.
 - .4 ASTM D822/D822M-13, Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings.
- .2 Canadian Standards Association (CSA International)
 - .1 CAN/CSA G164-M92 (R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
- .3 Environmental Choice Program (ECP)
 - .1 UL 2985, Thermal Insulation.
 - .2 UL 2768, Architectural Surface Coatings.
 - .3 UL 2760, Surface Coatings - Recycled Water-Borne.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Convene pre-installation meeting one week prior to beginning work of this Section and on-site installation, with Contractor, Departmental Representative, installer, manufacturer's representative to:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordination with other building subtrades.
 - .4 Review manufacturer's installation instructions and warranty requirements.

1.4 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 – Submittals:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet.
 - .2 Door operator motor information indicating nameplate data and ratings, characteristics, and mounting arrangements.

- .3 Provide two copies of WHMIS MSDS - Material Safety Data Sheets in accordance with WHMIS acceptable to Labour Canada, and Health and Welfare Canada. Indicate VOC's:
 - .1 For caulking materials during application and curing.
 - .2 For door materials and adhesives.
- .2 Submit shop drawings in accordance with Section 01 33 00 – Submittals:
 - .1 Indicate sizes, service rating, types, materials, operating mechanisms, and details, hardware and accessories, required clearances and electrical connections.
- .3 Manufacturer's Instructions:
 - .1 Submit manufacturer's installation instructions.
- .4 Manufacturers' Field Reports: submit copies of manufacturers field reports.

1.5 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for overhead door hardware for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.6 QUALITY ASSURANCE

- .1 Installer Qualifications: Company or person specializing in installation of sectional overhead doors with 5 years documented experience and approved by door manufacturer.
- .2 Manufacturer: Obtain sectional overhead doors and component materials through one source from single manufacturer and as follows:
 - .1 Obtain operators from sectional overhead door manufacturer.
 - .2 Obtain controls from sectional overhead door manufacturer.
- .3 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
- .4 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .5 Regulatory Requirements: electrical components, devices and accessories are listed and labelled by Canadian Standards Association (CSA).

1.7 WASTE MANAGEMENT AND DISPOSAL

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

1.8 WARRANTY

- .1 Provide manufacturers 10 year warranty against delamination of panels.

Part 2 Products

2.1 MANUFACTURERS

- .1 Subject to compliance with requirements specified in this section and as established by the Basis-of-Design materials, manufacturers offering similar products that may be incorporated into the Work include the following:

- .1 Creative Door Services Ltd.
- .2 Overhead Door Company
- .3 Wayne Dalton Garage Doors

2.2 PERFORMANCE/DESIGN CRITERIA

- .1 Design Requirements:
- .1 Design exterior door assembly to withstand windload of 1 kPa with a maximum horizontal deflection of 1/240 of opening width.
 - .2 Air Infiltration: Maximum rate not more than 0.025 L/s/m² at 25 kph and 0.04 L/s/m² at 40 kph when tested in accordance with ASTM E283.
 - .3 Design door assembly to withstand minimum 50 000 cycles per annum, and 5 years total life cycle.

2.3 MATERIALS

- .1 Overhead Door Panels: galvanized steel sheet to ASTM A653/653M commercial quality Z180 zinc coating.
- .2 Fibreglass panels: molded wood grain fibreglass.
- .3 Tracks and Accessories: coated (galvanized), cold rolled, commercial steel (CS) sheet, in accordance with ASTM A653/A653M, Z180 coating designation.
- .4 Insulation: rigid polyurethane containing no ozone depleting substances including CFC (Chlorofluorocarbon) or HCFC (Hydrochlorofluorocarbon).
- .5 Cable: multi-strand galvanized steel aircraft cable.

2.4 DOORS

- .1 Sectional Door Assembly: Metal/foam/metal sandwich panel construction, with EPDM thermal break and ship-lap design. Units shall have the following characteristics:
- .1 Exterior Panels: molded wood grain fibreglass panels:
 - .1 Colour: as indicated on Drawings.
 - .2 Profile: as indicated on Drawings.
 - .2 Interior Face Sheets: 0.40 mm core metal thickness:
 - .1 Colour: white.
 - .2 Surface: Flat.
 - .3 Panel Thickness: 25 mm.
 - .4 End Stiles: 1.6 mm core metal thickness.
 - .5 Insulation: Foamed-in-place polyurethane
 - .6 Thermal Performance: RSI 1.33 minimum.

.7 Basis-of-Design:

.1 Impression Collection, Series 980, Overhead Door

- .2 Fabricate panel frames in a continuous box frame with vertical stiffeners at 600 mm centres.
- .3 Assemble components by means of spot or arc welding or coated rivet system or adhesive and self tapping screws to manufacturer's recommendations.

2.5 COMMERCIAL DUTY HARDWARE

- .1 Track: standard lift hardware with 50 mm size 1.9 mm core thickness galvanized steel track.
- .2 Track Supports: 2.3 mm core thickness continuous galvanized steel angle track supports.
- .3 Spring counter balance: heavy duty oil tempered torsion spring with manufacturer's standard brackets.
 - .1 Drum: 100 mm diameter die cast aluminum.
 - .2 Shaft: 25 mm diameter galvanized steel.
- .4 Top roller carrier: galvanized Steel 2.28 mm thick adjustable.
- .5 Rollers: full floating grease packed hardened steel, ball bearing 50 mm diameter stamped tire.
- .6 Roller brackets: adjustable, galvanized steel, minimum 2.5 mm thick.
- .7 Hinges: commercial duty, minimum 1.9 mm thick galvanized.
- .8 Cable: minimum 3 mm diameter galvanized steel aircraft cable.

2.6 ACCESSORIES

- .1 Overhead horizontal track and operator supports: galvanized steel, type and size to suit installation.
- .2 Track guards: 5 mm thick formed sheet 1500 mm high track guards.
- .3 Pusher springs.
- .4 Handles:
 - .1 Flat bar door latch with night latch and electric interlock switch.
 - .2 Handles: key operated from outside, handle operated from inside.
- .5 One horizontal sliding lock bolts on interior.
- .6 Weather stripping:
 - .1 Sills: double contact full width extruded neoprene weatherstrip.
 - .2 Jambs and head: extruded aluminum and arctic grade vinyl weatherstrip to manufacturer's standard.
- .7 Finish ferrous hardware items with minimum zinc coating of 300 g/m² to CSA G164.

2.7 PREFINISHED STEEL SHEET

- .1 Prefinished steel with factory applied silicone modified polyester.

- .1 Class F1S.
- .2 Colour: as selected by Departmental Representative.
- .3 Specular gloss: 30 units +/-5 in accordance with ASTM D523.
- .4 Coating thickness: not less than 25 micrometres.
- .5 Resistance to accelerated weathering for chalk rating of 8, colour fade 5 units or less and erosion rate less than 20% to ASTM D822 as follows:
 - .1 Outdoor exposure period 1000 hours.
 - .2 Humidity resistance exposure period 1000 hours.

2.8 OPERATORS

- .1 Equip doors for operation by:
 - .1 Hand, two handles on inside face of door.
- .2 Cable fail safe device.
 - .1 Able to stop door immediately if cable breaks on door free fall. Braking capacity 500 kg.

2.9 ELECTRICAL OPERATOR

- .1 Electrical jack shaft side mounted type operator.
- .2 Electrical motors, controller units, remote pushbutton stations, relays and other electrical components: to CSA approval.
- .3 Motor: Medium Duty Commercial $\frac{3}{4}$ HP, 115 Volt Single Phase; with manual reset current sensing overload protection, high starting torque, continuous duty motor; separate from reduction mechanism; factory pre-wired motor controls, starter; rated for door size and usage classification.
- .4 Controller units with integral motor reversing starter, solenoid operated brake 3 heater elements for overload protection, including 3 pushbuttons and control relays as applicable.
- .5 Operation:
 - .1 Remote pushbutton stations: flush mounted, in 2 locations, with "OPEN-STOP-CLOSE" "SECURITY LOCKOUT" designations on pushbuttons in English.
 - .2 Radio Control Station: Multifunction remote control] with 3 channel, universal coaxial receiver to open, close, and stop door; one per operator and remote antenna mounting kit.
- .6 Safety switch: combination roll rubber with limit switches for full length of bottom rail of bottom section of door, to reverse door to open position when coming in contact with object on closing cycle.
- .7 For jack shaft operators:
 - .1 Provide floor level disconnect device to allow for manual operation in event of power failure.
 - .2 Equip Operator with:
 - .1 Electrical interlock switch to disconnect power to operator when in manual operation.
 - .2 Built-in chain hoist for manual operation in event of power failure.

- .8 Automatic illumination complete with time delay, self extinguishing.
- .9 Door speed: 200 mm per second.
- .10 Control transformer: for 24 VAC control voltage.
- .11 Mounting brackets: galvanized steel, size and gauge to suit conditions.
- .12 Obstruction Detection Device: Equip each motorized door with external automatic safety sensor capable of protecting full width of door opening; activation of sensor immediately stops and reverses downward door travel, as follows:
 - .1 Pressure Sensor Edge: Self monitoring Electrically actuated located within astragal or weather stripping mounted to bottom bar; contact with sensor immediately stops and reverses downward door travel, connect to control circuit using manufacturer's standard take up reel or self coiling cable.
- .13 Acceptable materials:
 - .1 Chamberlain Lift-Master, Inc.
 - .2 Doorlec Corporation.
 - .3 Lynx Commercial Operators.
 - .4 Manaras Commercial Operators.

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 doors and hardware in accordance with manufacturer's instructions.
- .2 Rigidly support rail and operator and secure to supporting structure. Provide steel/metal support components to connect to structure shown on detailed drawings.
- .3 Touch-up steel doors with primer where galvanized finish damaged during fabrication.
- .4 Install operator including electrical motors, controller units, pushbutton stations, relays and other electrical equipment required for door operation.
- .5 Lubricate and adjust door operating components to ensure smooth opening and closing of doors.
- .6 Adjust weatherstripping to form a weather tight seal.
- .7 Adjust doors for smooth operation.

3.3 FIELD 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 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 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.
- .4 Obtain reports within three days of review and submit.

3.4 CLEANING

- .1 Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .2 Remove traces of primer, caulking; clean doors and frames.
- .3 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

Part 1 General

1.1 INTENT

- .1 Section includes fire rated glazing and framing systems for installation as indicated on Drawings.

1.2 RELATED SECTIONS

- .1 Section 05 50 00 – Metal Fabrications
- .2 Section 07 84 00 – Firestopping and Smoke seals
- .3 Section 08 11 13 – Steel Doors and Frames
- .4 Section 08 80 50 – Glazing
- .5 Section 08 71 00 – Door Hardware

1.3 REFERENCES

- .1 Aluminum Association (AA)
 - .1 DAF 45-2003 (R2009), Designation System for Aluminum Finishes.
- .2 American Architectural Manufacturers Association (AAMA)
 - .1 AAMA 609-15, Cleaning and Maintenance Guide for Architecturally Finished Aluminum.
 - .2 AAMA 611-14, Voluntary Specification for Anodized Architectural Aluminum.
 - .3 AAMA 2603-17a, Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
 - .4 AAMA 2604-17a, Voluntary Specification Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.
 - .5 AAMA 2605-17a, Voluntary Specification, Performance requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
- .3 American National Standards Institute (ANSI).
 - .1 ANSI Z97.1-2015, Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test
- .4 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM E119-18 ce1, Standard Methods for Fire Tests of Building Construction and Materials.
 - .2 ASTM A1008/A1008M-18, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, Solution Hardened and Bake Hardened.
 - .3 ASTM A1011/A1011M-18a, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability and Ultra-High Strength.

- .5 Builders Hardware Manufacturers Association (BHMA)
 - .1 ANSI/BHMA A156, Series of Standards.
- .6 Canadian Standards Association (CSA International)
 - .1 CAN4-S106-M80(R1985), Standard Method for Fire Tests of Window and Glass Block Assemblies
- .7 Consumer Product Safety Commission Publications (CPSC)/Code of Federal Regulations (CFR)
 - .1 CPSC, 16 CFR 1201, Safety Standard for Architectural Glazing Materials
 - .2 CPSC, 16 CFR 1201 CAT II.
- .8 National Fire Protection Agency (NFPA)
 - .1 NFPA 80-2019, Standard for Fire Doors and Other Opening Protectives.
 - .2 NFPA 251, Standard Methods of Tests of Fire Endurance of Building Construction and Materials, 2006 Edition.
 - .3 NFPA 252, Fire Tests of Door Assemblies, 2017 Edition.
 - .4 NFPA 257, Fire Test for Window and Glass Block Assemblies, 2017 Edition.
- .9 Underwriter's Laboratories (UL)
 - .1 UL 9, Fire Tests of Door Assemblies
 - .2 UL 10 B, Fire Tests of Door Assemblies
 - .3 UL 10 C, Positive Pressure Fire Tests of Window & Door Assemblies
 - .4 UL 263, Fire tests of Building Construction and Materials
 - .5 UL-752, Ratings of Bullet-Resistant Materials
- .10 Underwriter's Laboratories of Canada (ULC)
 - .1 CAN/ULC S101-14, Standard Methods of Fire Endurance Tests of Building Construction and Materials.
 - .2 CAN/ULC S104-15, Standard Method for Fire Tests of Door Assemblies.

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-installation Meetings: Convene pre-installation meeting one week prior to beginning work of this Section, with Contractor, Departmental Representative, installer, manufacturer's representative in accordance with Division 01 to:
 - .1 Verify project requirements, substrate conditions, manufacturer's installation instructions, and manufacturer's warranty requirements;
 - .2 Co-ordination with other building subtrades;
 - .3 Review location and alignment of vertical and horizontal elements as they relate to the aesthetic criteria indicated on the Drawings, and the technical requirements indicated on the shop drawings.

1.5 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00.
 - .1 Submit manufacturer's printed product literature, specifications, technical data sheet and ULC listings.

- .2 Submit manufacturer's installation instructions and special handling criteria, installation sequence and cleaning procedures.
- .2 Submit shop drawings in accordance with Section 01 33 00:
 - .1 Include plans, elevations and details of product showing component dimensions; framing opening requirements, dimensions, tolerances, and attachment to structure.
 - .2 Provide templates for the location of embeds and anchor locations required for any adjoining work.
- .3 Submit samples in accordance with Section 01 33 00:
 - .1 Submit two 300 mm x 300 mm samples for glass.
 - .2 Submit sample of frame.
 - .3 Submit verification of sample of selected finish.
- .4 Information Submittals: Provide the following:
 - .1 Submit design data in accordance with Section 01 33 00.
 - .1 Provide structural calculations sealed by a licensed professional engineer in the Province in which the project is located; prepared in compliance with referenced documents and these specifications.
 - .2 Submit certificates of compliance from glass and glazing materials manufacturers attesting that glass and glazing materials furnished for project comply with requirements.
- .5 Closeout Submittals: Provide operation and maintenance data for incorporation into manual specified in Division 01 and as follows:
 - .1 Submit data for cleaning of finishes and maintenance of hardware;
 - .2 Instruction for replacement of glass units.

1.6 QUALITY ASSURANCE

- .1 Qualifications: The firm producing and executing the Work of this Section shall have a minimum of 5 years successful experience in the fabrication and erection of systems of similar sizes, shapes and finishes to the units required for this project and shall have ample facilities to produce, furnish and supply the units as required for installation without delay to the Work.
- .2 Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance.
- .3 Source Limitations for Glazing Accessories: Obtain glazing accessories from one source for each product and installation method indicated.
- .4 Delegated Design Professional: Retain a Professional Engineer, registered in the Province of the Work, to design fabrication and erection of the Work of this Section in accordance with applicable Building Code and Contract Documents requirements including, but not limited to, the following:
 - .1 Seal and signature to shop drawings and design submittals.
 - .2 Site review of installed components.

- .5 Provide fire labelled frame products for those openings requiring fire protection ratings, as scheduled:
 - .1 List by nationally recognized agency having factory inspection service and construct as detailed in Follow-up Service Procedures/Factory Inspection Manuals issued by listing agency to individual manufacturers.
 - .2 Fire-Rated Window Assemblies: Assemblies complying with NFPA 80 that are classified and labeled by UL, for fire ratings indicated, based on testing according to NFPA 257, ASTM E119.
 - .3 Fabricate all rated doors, frames and screens to labelling authority standard.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, handle and store units in accordance with manufacturer's directions and as follows:
 - .1 Inspect containers for damage at delivery.
 - .2 Examine glass and frame units for damage.
 - .3 List all damage to containers on the shipping company's Bill of Lading.
 - .4 Report damage to manufacturer immediately.
 - .5 Store glazing materials and frame units in original packing containers.
 - .6 Do not expose glazing material of frame units to sunlight and weather.
 - .7 Do not store horizontally.
 - .8 Place glass and frames upright, no less than 6 degrees from vertical.
 - .9 Store all materials in dry conditions, off the ground.
 - .10 Protect from construction activities.
 - .11 Fully support glass units along entire length.
 - .12 Glass and frame units must be separated by non-abrasive pads such as cloth or cork.
 - .13 Do not stack containers.

1.8 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Division 01.

1.9 SITE CONDITIONS

- .1 Site Measurements: Verify dimensions of other construction by site measurements before fabrication and indicate measurements on shop drawings where curtain wall systems are indicated to fit to other construction.
- .2 Established Dimensions: Establish dimensions and proceed with fabricating curtain wall without site measurements where site measurements cannot be made without delaying the Work, coordinated with other construction to ensure that actual dimensions correspond to established dimensions.
- .3 Ambient Conditions: Confirm installation requirements for ambient and surface temperatures of sealants with manufacturer and apply sealants when temperatures are greater than manufacturer's stated minimum from time of application until sealants have cured.

1.10 WARRANTY

- .1 Provide manufacturers standard five year warranty for glazing and frames.

Part 2 Products

2.1 MANUFACTURERS

- .1 Manufacturer Glazing Material: Pilkington Pyrostop fire-rated glazing as manufactured by the Pilkington Group and distributed by Technical Glass Products.
- .2 Manufacturer Frame System: Fireframes Designer and Fireframes Aluminum Series fire-rated frame system as manufactured and supplied by Technical Glass Products.

2.2 PERFORMANCE/DESIGN CRITERIA

- .1 System Description:
 - .1 Steel fire-rated glazed wall and/or window system, dual aluminum cover cap format.
 - .1 Face widths: as indicated on Drawings.
 - .2 Fire Rating Duration: as indicated on Drawings.
- .2 Retain a professional engineer registered in province of Work, experienced in structural design in glass and fire rated frames, connections to door units and connections to building, to ensure the adequacy of the structural aspects of the design, manufacture, and installation of complete assembly.
- .3 Design Requirements:
 - .1 Design and size the system to withstand structural forces placed upon it without damage or permanent set when tested in accordance with ASTM E330 using load 1.5 times the design wind loads and of 10 seconds in duration at +/- 10 PSF.
 - .2 Limit mullion deflection to L/175; with full recovery of glazing materials.
 - .3 Size glass units and glass dimensions to limits established in CAN/CGSB-12.20.

2.3 MATERIALS: GLASS

- .1 Fire Rated Glazing: Composed of multiple sheets of Pilkington Optiwhite™ high visible light transmission glass laminated with an intumescent interlayer.
- .2 Impact Safety Resistance: ANSI Z97.1 and CPSC 16CFR1201 (Cat. I and II).
- .3 Properties Interior Glazing:
 - .1 Fire Rating: as indicated on Drawings.
 - .2 Glazing Tape: single
 - .3 Nominal Thickness: 23 mm
 - .4 Daylight Transmission: 88%
 - .5 Sound Transmission Coefficient: minimum 41 dB

- .4 Logo: Each piece of fire-rated glazing shall be labeled with a permanent logo including name of product, manufacture, testing laboratory (UL), fire rating period, safety glazing standards, and date of manufacture.
- .5 Glazing Accessories: Manufacturer's standard compression gaskets, standoff, spacers, setting blocks and other accessories necessary for a complete installation.

2.4 MATERIALS: ALUMINUM FRAMES

- .1 Aluminum Framing System: to meet fire ratings as indicated on Drawings and as follows:
 - .1 Steel Frame: steel framing members are constructed of two halves, nominal 48.3 mm wide with a nominal minimum depth of 35 mm with lengths cut according to glazing size.
 - .2 Aluminum Trim: supplied with the steel framing members. Nominal 50.8 mm wide with a nominal depth of 39 mm with lengths cut according to glazing size.
 - .3 Stainless Steel Standoffs: supplied with the steel framing members. Nominal 8 mm diameter with a nominal minimum depth of 28 mm with depth adjusted to match Pilkington Pyrostop panel thickness.
 - .4 Stainless Steel Moment and Connecting Braces: supplied with the steel framing members. Nominal 10 mm thick with a nominal minimum depth of 28 mm with depth adjusted to match Pilkington Pyrostop Panel thickness.
 - .5 Framing Member Fasteners: supplied with the steel framing members. Screws are M6 x16mm Button Head Socket Cap Screws for frame assembly and #6 x 1" Pan Head Sheet Metal Screws for door installation.
 - .6 Glazing Gasket: supplied with the steel framing members. Nominal 19 mm by 4.5 mm black applied to the steel framing members to cushion and seal the glazing material when installed.

2.5 ACCESSORIES

- .1 Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 0.762 mm thickness per coat.

2.6 FABRICATION

- .1 Obtain reviewed shop drawings prior to fabrication.
- .2 Fabrication Dimensions: Fabricate fire-rated assembly to field dimensions.
- .3 Factory prepared, fire-rated steel door assemblies by manufacturer to be prehung, prefinished with hardware preinstalled for field mounting.
- .4 Field glaze door and frame assemblies.

2.7 FINISHES

- .1 Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- .2 Finish frames after assembly.

- .3 Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable. Noticeable variations in the same piece are not acceptable.
- .4 Anodized Finishes:
 - .1 Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 - .2 Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 611.

Part 3 Execution

3.1 EXAMINATION

- .1 Site Verification of Conditions: Examine substrates and members to which the work of this section attaches or adjoins prior to frame installation are acceptable for product installation in accordance with manufacturer's instructions. Provide openings plumb, square and within allowable tolerances. The manufacturer recommends 9.5 mm shim space at all walls.
- .2 Notify Departmental Representative of any conditions which jeopardize the integrity of the proposed fire wall and door system.
- .3 Do not proceed until such conditions are corrected.

3.2 INSTALLATION

- .1 Install curtain wall system in accordance with manufacturer's instructions.
- .2 General: Install frame system plumb, level, and true to line, without warp or rack of frames with manufacturer's prescribed tolerances and installation instructions. Provide support and anchor in place.
- .3 Install fire walls and doors by a specialty contractor with appropriate experience qualifications; and in strict accordance with the approved shop drawings. Employ experienced mechanics familiar with this type of specialized work. Firmly pack perimeter of framing system to rough opening with mineral wool fire stop insulation or appropriately rated intumescent sealant.
- .4 Install glazing in strict accordance with fire resistant glazing material manufacturer's specifications. Field cutting or tampering is not permissible.
- .5 Do not install damaged frames or chipped glazing units.
- .6 Install plumb and true. Limit out of plumb or true to 3.2 mm in 3048 mm in any dimension.

3.3 MANUFACTURER'S FIELD SERVICES

- .1 Product manufacturers to provide field surveillance of installation of their Products.
- .2 Monitor and report installation procedures, unacceptable conditions.

3.4 REPAIRS AND TOUCH-UPS

- .1 Anodized Finishes:
 - .1 Protect the anodized finish from harsh chemicals such as concrete/mortar or muriatic acid/brick wash. If reasonable care is taken during handling and high and low pH chemicals can be avoided, repair and/or touch-up of an anodize finish will not be needed.
 - .2 Some rub marks on an anodized surface can be removed with a mild abrasive pad such as a Scotch-Brite pad prior to touch up painting.
 - .3 Touch-up paint should be used even more sparingly over anodize. Only the visible raw aluminum in the scratch or gouge should be touched up with a matching paint.
- .2 Remove and replace glass that is broken, chipped, cracked, abraded, or damaged.

3.5 PROTECTION AND CLEANING

- .1 Protect glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.
 - .1 Do not clean with astringent cleaners. Use a clean grit free cloth and a small amount of mild soap and water or mild detergent.
 - .2 Do not use any of the following:
 - .1 Steam jets.
 - .2 Abrasives.
 - .3 Strong acidic or alkaline detergents, or surface-reactive agents.
 - .4 Detergents not recommended in writing by the manufacturer.
 - .5 Do not use any detergent above 25 degrees C.
 - .6 Organic solvents including but not limited to those containing ester, ketones, alcohols, aromatic compounds, glycol ether, or halogenated hydrocarbons.
 - .7 Metal or hard parts of cleaning equipment must not touch the glass surface.
- .2 Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If contaminating substances do come into contact with glass, remove them immediately as recommended by glass manufacturer.
- .3 Wash glass on both exposed surfaces in each area of Work not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended by glass manufacturer.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 This Section includes conventionally glazed aluminum curtain walls installed as stick built systems consisting of; but not limited to, the following:
 - .1 Fixed, clear low emissivity (Low E) sealed glass units.
 - .2 Full length pressure plate system.
 - .3 Dry glazed from exterior with screw on pressure plate, keyed-in neoprene gasket and thermal break.
 - .4 Internal weep drainage and compartmentalization in accordance with established design principles for rain screen and pressure equalization in curtain wall systems.
 - .5 Snap-On covers.
- .2 Drawings contain details that suggest directions for solving some of the major design requirements; these details can be developed further by the Contractor provided that the final installation 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.

1.2 RELATED REQUIREMENTS

- .1 Section 01 35 00 – Delegated Design.
- .2 Section 05 50 00 – Metal Fabrications: Metal fabricated attachment devices framed openings
- .3 Section 06 10 00 – Rough Carpentry.
- .4 Section 07 21 16 – Fibrous Insulation.
- .5 Section 07 25 19 – Foam-In-Place Insulation.
- .6 Section 07 27 19 – Sheet Membrane Air and Vapour Barrier.
- .7 Section 07 62 00 – Sheet Metal Flashing and Trim
- .8 Section 07 92 00 - Sealants.
- .9 Section 08 41 23 – Fire Rated Aluminum Frames
- .10 Section 08 80 50 – Glazing.
- .11 Section 09 21 16 – Gypsum Board Assemblies.

1.3 REFERENCES

- .1 Aluminum Association (AA)
 - .1 AA DAF-45-2003(R2009), Designation System for Aluminum Finishes.
- .2 American Architectural Manufacturers Association (AAMA).
 - .1 AAMA CW-DG-1-96, Aluminum Curtain Wall Design Guide Manual.
 - .2 AAMA CW-10-12, Care and Handling of Architectural Aluminum from Shop to Site.

- .3 AAMA CW-11-85, Design Wind Loads for Buildings and Boundary Layer Wind Tunnel Testing.
- .4 AAMA CWG-1-89, Installation of Aluminum Curtain Walls.
- .5 AAMA T1R-A1-04, Sound Control for Fenestration Products.
- .6 AAMA 501-15, Methods of Test for Exterior Walls.
- .7 AAMA 501.1, Standard Test Method for Water Penetration of Windows, Curtain Walls and Doors Using Dynamic Pressure.
- .8 AAMA 501.5, Test Method for Thermal Cycling of Exterior Walls.
- .9 AAMA 503-14, Voluntary Specification for Field Testing of Metal Storefronts, Curtain Wall and Sloped Glazing Systems.
- .10 AAMA 611-14, Voluntary Specifications for Anodized Finishes Architectural Aluminum.
- .11 AAMA 612-17, Voluntary Specifications, Performance Requirements, and Test Procedures for Combined Coatings of Anode Oxide and Transparent Organic Coatings on Architectural Aluminum.
- .12 AAMA 701/702-11, Voluntary Specification for Pile Weatherstripping and Replaceable Fenestration Weatherseals.
- .13 AAMA 2603-17, Voluntary Specification Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
- .14 AAMA 2604-17, Voluntary Specification Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.
- .3 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM A36/A36M-14, Standard Specification for Carbon Structural Steel.
 - .2 ASTM A123/A123M-15, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .3 ASTM A480/A480M-16b, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
 - .4 ASTM A653/A653M-15e1, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .5 ASTM B209-14, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - .6 ASTM B221-14, Standard Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - .7 ASTM C165-07(2012), Standard Test Method for Measuring Compressive Properties of Thermal Insulations.
 - .8 ASTM C719-14, Standard Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement (Hockman Cycle)
 - .9 ASTM C794-15a, Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants.
 - .10 ASTM C920-18, Standard Specification for Elastomeric Joint Sealants

- .11 ASTM C1087-16, Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems.
- .12 ASTM E90-09(2016), Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- .13 ASTM E283-04(2012), Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
- .14 ASTM E330/E330M-14, Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights, and Curtain Walls, by Uniform Static Air Pressure Difference.
- .15 ASTM E331-00(2016), Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform Static Air Pressure Difference.
- .16 ASTM E413-16, Classification for Rating Sound Insulation.
- .17 ASTM E547-00(2016), Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Cyclic Static Air Pressure Difference.
- .18 ASTM E1105-15, Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference.
- .4 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB 12.1-2017, Tempered or Laminated Safety Glass.
 - .2 CAN/CGSB 12.3-M91(R2017), Flat, Clear Float Glass.
 - .3 CAN/CGSB 12.4-M91(R2017), Heat Absorbing Glass.
 - .4 CAN/CGSB 12.8-97 AMEND, Insulating Glass Units.
- .5 Canadian Standards Association (CSA Group).
 - .1 CSA A440H-14, NAFS - North American Fenestration Standard for Windows, Doors, and Skylights.
 - .2 CSA A440S1-17, Canadian Supplement to AAMA/WDMA/CSA 101/1.S.2/A440, NAFS - North American Fenestration Standard for Windows, Doors, and Skylights.
 - .3 CSA-G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steels, Includes Update No. 1 (2014).
 - .4 CSA-S136-12, North American Specification for the Design of Cold-Formed Steel Structural Members, Includes Update No. 1 (2009), Update No. 2 (2010).
 - .5 CSA-S157-05/S157.1-05 (R2015), Strength Design in Aluminum / Commentary on CSA S157-05, Strength Design in Aluminum, Includes Update No. 1 (2007), Update No. 3 (2009).
 - .6 CSA W47.1-09 (2014), Certification of companies for fusion welding of steel.
 - .7 CSA W47.2-11 (R2015), Certification of companies for fusion welding of aluminum, Welded Aluminum Construction.

- .8 CSA W59-13, Welded Steel Construction (Metal Arc Welding), Includes Update No. 1 (2014), Update No. 3 (2015), Update No. 4 (2015).
- .6 Environmental Choice Program (ECP).
 - .1 UL2761 (formerly CCD-45) 2011, Sustainability for Sealants and Caulking Compounds.
 - .2 UL 2768 (formerly CCD-47) 2011, Sustainability for Architectural Surface Coatings.
 - .3 UL 2760 (formerly CCD-48) 2011, Sustainability for Surface Coatings: Recycled Water-borne.
- .7 Society for Protective Coatings (SSPC).
 - .1 SSPC - Paint 20, Zinc Rich Coating (Type I inorganic and Type II organic).
 - .2 SSPC - Paint 25, Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel.

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-installation Meetings: Convene pre-installation meeting one week prior to beginning work of this Section and on-site installation, with Contractor, Departmental Representative, installer, manufacturer's representative in accordance with Section 01 31 29 – Project Meetings to:
 - .1 Verify project requirements, substrate conditions, manufacturer's installation instructions, and manufacturer's warranty requirements;
 - .2 Review location and alignment of vertical and horizontal elements as they relate to the aesthetic criteria indicated on the Drawings, and the technical requirements indicated on the shop drawings.
- .2 Coordination: Coordinate installation of system with work specified in other Sections to ensure proper placement and installation of vapour barrier, insulation and flashing in order that air, vapour and thermal barrier of building is intact and moisture will be diverted to the exterior, and as follows:
 - .1 Coordinate installation of sealants so that ambient and surface temperatures are greater than 5°C from time of application until sealants have cured.
 - .2 Coordinate connection of curtain wall system structural connections at floor slabs to vertical members.
 - .3 Coordinate Work of this Section with installation of firestopping and adjacent components or materials.

1.5 ACTION SUBMITTALS / INFORMATION SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 – Submittals:
 - .1 Submit manufacturer's printed product literature, specifications and technical data sheet.
 - .2 Submit product data indicating construction details, material descriptions, dimensions of individual components and profiles, finishes, anchorage and fasteners, glass and infill, internal drainage details
 - .3 Provide two copies of WHMIS MSDS - Material Safety Data Sheets.

- .2 Submit shop drawings in accordance with Section 01 33 00 – Submittals:
 - .1 Submit copies of test reports to establish that products used comply with air leakage and water penetration performance requirements. Submit test reports or calculations to establish that products used comply with energy performance criteria. Submit test reports to establish that products used comply with condensation resistance criteria. Energy and condensation calculation reports to be submitted under the seal of a Saskatchewan Professional Engineer.
 - .2 Submit shop drawings, signed and sealed by the delegated design engineer, detailing fabrication and assembly of glazed aluminum curtain wall systems clearly indicating all construction details including; but not limited to, the following:
 - .1 Fully dimensioned layouts for positioning of secondary support members and anchorage of tie-back devices to structures;
 - .2 Large scale details of members and materials, of brackets and anchorage devices and of connection and jointing details;
 - .3 Include thermal values and weathertightness rating data.
 - .4 Fully dimensioned layouts for positioning of brackets and anchorage devices to structures;
 - .5 Dimensions, gauges, thicknesses;
 - .6 Type, size and spacing of fastening devices;
 - .7 Glazing details;
 - .8 Air/vapour barrier details, acoustic control details, aluminum alloy and temper designations, metal finishing specifications and other pertinent data and information;
 - .9 Internal drainage;
 - .10 Show details of perimeter and interface connecting work of this section with work of adjacent sections.
- .3 Submit samples in accordance with Section 01 33 00 – Submittals:
 - .1 Submit samples of materials for Departmental Representative's verification of specified finishes including; but not limited to, the following:
 - .1 300 mm x 450 mm for sheets, plates and glass;
 - .2 300 mm long for extrusions and formed or rolled shapes;
 - .3 300 mm long for tapes and gaskets;
 - .4 150 mm long for sealants;
 - .5 Samples shall fully represent physical and chemical properties, finish, and colours of materials to be supplied.
 - .2 Submit two samples 610 x 610 mm in size illustrating window frame section, insulation, vapour barrier, glass, vents and sealant.
- .4 Information Submittals: Provide the following:
 - .1 Delegated Design Submittals: Submit letters of commitment and compliance in accordance with Section 01 35 00 – Delegated Design Submittals as follows:
 - .1 Provide Letter of Commitment in conjunction with shop drawings, signed and sealed by the professional engineer required by the

Work of this Section indicating the following are designed to the intent of the Building Code:

- .1 Curtain wall connections to building structure.
 - .2 Curtain wall reinforcement.
 - .3 Deflection of members.
 - .4 Glass thickness as it relates to glass area.
- .2 Provide Letter of Compliance, signed and sealed by the professional engineer required by the Work of this Section indicating that connections, reinforcement and deflection criteria, and glass thickness of installed system is in compliance with the intent of the Building Code and reviewed shop drawings before declaration of Substantial Performance.
- .2 Calculations:
 - .1 Submit complete design study calculations, certified by a professional engineer licensed to design structures and registered in the jurisdiction of the Place of the Work, including pertinent information affecting design, wind reactions, shading effects and failure probability for thermal glazing units, to Departmental Representative as evidence of compliance with design criteria, prior to manufacture.
 - .2 Pressure equalized rain screen (PER) design: calculations to include the following:
 - .1 Pressure equalization during exposure to the design wind pressures and gusts;
 - .2 PER design provides pressure equalization of the cavity compartments within 0.5 seconds.
- .3 Sealant Data:
 - .1 Submit product information on the sealants to be used, complete with all recommendations and installation instructions, including cleaning and priming procedures.
 - .2 Submit sealant manufacturer's test reports on adhesion to metal and glass production samples tested in accordance with ASTM C794, 7 day cure and 7 day water submersion, tensile strength at 100% elongation and bite size of sealants.
 - .3 Submit sealant manufacturer's compatibility statement that all materials in contact with the sealants are compatible with the sealants in accordance with procedures of ASTM C1087.
 - .4 Submit sealant manufacturer's verification that sealants are suitable for purposes intended.
- .5 Provide Tests in Accordance with Section 01 45 00 – Quality Control:
 - .1 Static Pressure Air Exfiltration Smoke Test: provide one test.
 - .2 Static Pressure Water Infiltration: ASTM E331 Standard Test Method for Water Penetration by Uniform Static Air Pressure Difference. A minimum 15 minute wait period shall be included after this and each subsequent water penetration test.

- .3 Dynamic Pressure Water Infiltration: AAMA 501.1 Standard Test Method for Exterior for Water Penetration using Dynamic Pressure. Include two setups.
- .6 Closeout Submittals: Provide operation and maintenance data for incorporation into manual specified in Section 01 11 00 – General Requirements, Closeout Submittals and as follows:
 - .1 Submit data for cleaning of aluminum finishes and maintenance of [structural silicone glazing system and] operational hardware;
 - .2 Instruction for replacement of glass units (insulating and structural glass).

1.6 QUALITY ASSURANCE

- .1 Qualifications: The firm producing and executing the Work of this Section shall have a minimum of 10 years successful experience in the fabrication and erection of systems of similar sizes, shapes and finishes to the units required for this project and shall have ample facilities to produce, furnish and supply the units as required for installation without delay to the Work.
- .2 Delegated Design Professional: Retain a Professional Engineer, registered in the Province of the Work, to design fabrication and erection of the Work of this Section in accordance with applicable Building Code and Contract Documents requirements including, but not limited to, the following:
 - .1 Seal and signature to shop drawings and design submittals.
 - .2 Site review of installed components.
- .3 Mock-Ups
 - .1 Construct mock-ups in accordance with Section 01 45 00 – Quality Control.
 - .2 Provide 3000 x 3000 mm mock-up including intermediate mullion, sill muntin, column cover, vision glass light, and infill glass. Assemble to illustrate component assembly including glazing materials, weep drainage system, attachments, anchors, and perimeter sealant.
 - .3 Locate where directed.
 - .4 Allow 24 hours for review of mock-up by Departmental Representative before proceeding with work.
 - .5 When accepted, mock-up will demonstrate minimum standard for this work. Mock-up may remain as part of finished work.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Comply with AAMA CW-10 for care and handling of all aluminum Products through the entire manufacturing, finishing, fabrication, delivery and installation phases.
- .2 Protect metal and metal finishes to prevent damage during fabrication, storage, shipping, handling and installation.
- .3 Protect insulating glass units during shipment. Repair or replace damaged components or units as required to meet Contract requirements, and replace any gas leakage during shipping to specified concentrations.

- .4 Deliver, handle and store units by methods approved by manufacturer. Store units at site on wood platforms raised above grade or in enclosures protected from elements and corrosive materials. Stack units vertically in manner to prevent racking. Do not remove from crates or other protective covering until ready for installation.

1.8 WASTE MANAGEMENT AND DISPOSAL

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

1.9 SITE CONDITIONS

- .1 Site Measurements: Verify dimensions of other construction by site measurements before fabrication and indicate measurements on shop drawings where aluminum curtain wall systems are indicated to fit to other construction.
- .2 Established Dimensions: Establish dimensions and proceed with fabricating aluminum curtain wall without site measurements where site measurements cannot be made without delaying the Work, coordinated with other construction to ensure that actual dimensions correspond to established dimensions.
- .3 Ambient Conditions: Confirm installation requirements for ambient and surface temperatures of sealants with manufacturer and apply sealants when temperatures are greater than manufacturer's stated minimum from time of application until sealants have cured.

1.10 WARRANTY

- .1 Provide manufacturers written guarantee, signed and issued in the name of Departmental Representative, to replace the following items for defective material and workmanship for the time stated from date of Substantial Performance:
 - .1 Framing, panels and glazing: failure of performance requirements specified in Contract Documents; 10 years.
 - .2 Sealants, caulking: failure to maintain seal; 2 years.
 - .3 Aluminum brake shapes: oil-canning and delaminations; 2 years.
- .2 Provide Warranty for aluminum windows to include in maintenance manuals as specified in Section 01 11 00 – General Requirements, Operations and Maintenance Data Manuals.

Part 2 Products

2.1 MANUFACTURERS

- .1 Acceptable Manufacturers: Subject to compliance with requirements specified in this Section and as established by the Basis-of-Design Materials, manufacturers offering products that may be incorporated into the Work include; but are not limited to, the following:
 - .1 A & D Prevost Inc.
 - .2 Alumicor Limited.

- .3 CRL/US Aluminum
- .4 Ferguson Glass Western Ltd. (Engineered Aluminum Products Inc.)
- .5 Kawneer Company Canada Ltd.

2.2 PERFORMANCE/DESIGN CRITERIA

- .1 General Performance: Comply with performance requirements specified, as determined by testing of glazed aluminum curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
 - .1 Glazed aluminum curtain walls shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads. Failure also includes the following:
 - .1 Thermal stresses transferring to building structure.
 - .2 Glass breakage.
 - .3 Loosening or weakening of fasteners, attachments, and other components.
 - .2 Retain a professional engineer registered in province of Work, experienced in structural design in glass and aluminum window units, connections to door units and connections to building, to ensure the adequacy of the structural aspects of the design, manufacture, and installation of complete assembly. Verify site specific thermal values and weather tightness data.
 - .3 Design and size components to withstand dead and live loads caused by pressure and suction of wind, acting normal to plane of system as calculated in accordance with Climatic Data for 1/30 year occurrence included in Building Code as measured in accordance with AAMA CW 11 and ASTM E330.
 - .4 Limit mullion deflection to flexure limit of glass; with full recovery of glazing materials.
 - .5 Size glass units and glass dimensions to limits established in CAN/CGSB-12.20.
 - .6 Provide system to accommodate, without damage to components or deterioration of seals:
 - .1 Movement within system.
 - .2 Movement between system and perimeter framing components.
 - .3 Dynamic loading and release of loads.
 - .4 Deflection of structural support framing.
 - .5 Shortening of building concrete structural columns.
 - .6 Creep of concrete structural members.
 - .7 Thermal performance:
 - .1 U-value maximum 0.38 (IP)
 - .2 SHGC: maximum 0.4.
 - .8 Sound attenuation through wall system (exterior to interior): STC 45, measured in accordance with ASTM E413.

- .9 Limit air infiltration through assembly to 0.2 L/sm² of wall area, measured at a reference differential pressure across assembly of 75 Pa as measured in accordance with ASTM E283.
- .10 Vapour seal with interior atmospheric pressure of 25 mm sp, 22 degrees C, 40% RH: No failure.
- .11 Water leakage: none, when measured at a test pressure of 500 Pa in accordance with ASTM E331
- .12 System to provide for expansion and contraction within system components caused by a cycling temperature range of 95 degrees C over a 12 hour period without causing detrimental affect to system components.
- .13 Drain water entering joints, condensation occurring in glazing channels, or migrating moisture occurring within system, to the exterior by a weep drainage network.
- .14 Maintain continuous air barrier and vapour retarder throughout assembly, primarily in line with inside pane of glass and heel bead of glazing compound.
- .15 Ensure no vibration harmonics, wind whistles, noises caused by thermal movement, thermal movement transmitted to other building elements, loosening, weakening, or fracturing of attachments or components of system occur.
- .16 Tolerances:
 - .1 Design and install the curtain wall to accommodate tolerances of related work not included in this section. This requirement is in addition to building structure movements and deflections.
 - .2 Fabricate components to provide a plumb, square, level and true installation, and to accommodate allowable tolerances for work of other sections upon which work of this section depends.
 - .3 Erection tolerances for frame assemblies relate to the structural grid of the building, and apply to each individual assembly as follows:
 - .1 vertical position: +3 mm;
 - .2 horizontal position: +3 mm;
 - .3 deviation from plumb: 3 mm maximum each plane;
 - .4 racking of face: 6 mm maximum;
 - .5 racking in elevation: Nil;
 - .6 offset from true alignment between two identical members abutting end to end in line: 0.8 mm;
 - .7 tolerances shall not be accumulative;
 - .8 erection tolerances for operable elements: consistent with smooth operation and weatherproof performance.

2.3 MATERIALS

- .1 Extruded aluminum: Alloy and temper recommended by glazed aluminum curtain wall manufacturer for strength, corrosion resistance, application of required finish and complying with ASTM B221, Aluminum Association (AA) alloy 6063-T5 or 6063-T6.

- .2 Aluminum sheet (exposed): to ASTM B209, Aluminum Association (AA) alloy 1100, anodizing quality.
- .3 Aluminum sheet (unexposed): utility sheet to CSA HA-Series 6063 alloy, T5 temper.
- .4 Steel Reinforcement: to CSA G40.20/G40.21, 300W hot dipped galvanized after fabrication to ASTM A653/A653M, minimum coating of 600 g/m² shapes to suit mullion sections.
- .5 Aluminum welding: to CSA W59.2.
- .6 Stainless steel: to ASTM A480, Type 304 or 316; of one type throughout.
- .7 Anchors: 3-way adjustable hot-dip galvanized cast iron.
- .8 Pressure Plate: aluminum plate, fastened to the mullion with stainless steel screws.
- .9 Glass: Clear or Tinted, as indicated in window schedule, sealed glass units as specified under Section 08 80 50 – Glazing.
- .10 Fasteners: To ASTM A480, stainless steel, type 304 as recommended by curtain wall manufacturer selected to prevent galvanic action with the components fastened, of suitable size to sustain imposed loads.
- .11 Anti-Rotation Channels: Extruded aluminum anti-rotation channel designed to mechanically retain air seal membrane to the face of the tubular back section.
- .12 Grout fill for anchor pockets: non-shrink Masterflow 713 Plus, by BASF, or SikaGrout 212, by Sika Canada.
- .13 Primer for adhesives: as recommended by the adhesive manufacturer for the materials to be adhered.
- .14 Thermal separators (thermal break): of size to conform to the extruded aluminum members or other locations where required, neoprene, EPDM or polyvinyl chloride and having a minimum tensile strength of (14 MPa) (2000 psi) and Durometer A Hardness of 60, +/- 5.
- .15 Concealed Flashing: Manufacturer's standard corrosion resistant, non-staining, non-bleeding flashing compatible with adjacent materials.
- .16 Gaskets: Neoprene or EPDM with dimensional tolerances and durometer hardness and of suitable size and shape to meet the requirements of the specifications and their specific application, designed to remain flexible at low temperatures; heat resistant where required due to proximity of heating units.
 - .1 Gaskets shall be virgin material as manufactured by Tremco Ltd., Tremco Ltd. Gaskets shall conform to Tremco Information Bulletins:
 - .1 For EPDM - TDB-460-1;
 - .2 For Neoprene - TDB-270-1.
- .17 Isolation coating: alkali resistant bituminous paint.
- .18 Insulation for packing into voids and cavities: Lightweight resilient, inorganic fibrous glass having a nominal density of 11 kg/cu.m

- .19 Waterproofing sheet membrane at coping: sheet rubber, Sure Seal EPDM, by Lexcan Industrial Supply Limited or similar, minimum thickness 1.5 mm; adhesive, tapes and sealant for membrane: as manufactured by or recommended by the membrane manufacturer.
- .20 Flexible flashing, flexible air/vapour retarder:
 - .1 Compounded plasticized polyvinyl chloride reinforced with woven glass fibre mesh FR-40, by Lexsuo Canada Limited or similar, minimum thickness 40 mils.
 - .2 Adhesive, tapes, primers and sealant: as recommended by the flexible flashing manufacturer.
- .21 Setting Blocks: silicone compatible to 50-80 durometer A hardness
- .22 Glazing Tape: continuous polyurethane bond breaker tape compatible with silicone sealant.
 - .1 Basis of Design Materials:
 - .1 Thermabond V-2100, Norton.
- .23 Sheet metal air/vapour barrier to be bonded to glazing frame and extended behind mounting frame. Seal to maintain continuity of seal. Install flexible flashing with continuous metal retaining strip to lap to interior wall assembly.
 - .1 Sheet metal for metal air/vapour barriers and air seals: ASTM A653 / A653M, minimum 1 mm sheet steel, galvanized, stretcher-levelled, minimum coating weight 380 g/m².
- .24 Sealants (including primer, joint filler): as specified in section 07 92 00 and as follows:
 - .1 Sealants used in structural joints shall have adequate strength to retain insulating units to the metal framing under design conditions.
 - .2 Sealants shall be from the same manufacturer for all work of this section.
 - .3 Materials used in the work shall be resistant to rodents, vermin, mildew, fungus and algae.

2.4 FRAMING SYSTEM: STICK BUILT

- .1 Frame Type: To profiles and thicknesses required to meet performance criteria; but not less than 3 mm thickness, and as follows:
 - .1 Frame Dimensions: Nominal 65 mm wide x 76 mm deep back section having a 28 mm glazing throat for a total nominal frame depth of 104 mm.
 - .2 Cover Depth: Nominal 65 mm wide x 19 mm deep.
 - .3 Acceptable Materials:
 - .1 A & D Prevost Inc., 3400 Series.
 - .2 Alumicor Limited, 2500 Series.
 - .3 CRL/US Aluminum, 3250 Series.
 - .4 Engineered Aluminum Products Inc., EAP 100.
 - .5 Kawneer Company Canada Ltd., 1600 System 1.
 - .6 Oldcastle Building Envelope

2.5 GLAZING AND ACCESSORIES

- .1 Double Pane Insulating Glass Units: meet or exceed requirements of CAN/CGSB-12.8. Units shall be certified by the Insulated Glass Manufacturers Alliance (IGMA). Overall unit thickness shall be 25 mm using 6 mm glass thickness for individual panes. Use two stage seal method of manufacture, as follows:
 - .1 Primary Seal: polyisobutylene sealing compound between glass and metal spacer/separator, super spacer bar or TDSE Intercept.
 - .2 Secondary Seal: polyurethane, silicone or polysulphide base sealant, filling gap between the two lites of glass at the edge up to the spacer/separator and primary seal.
- .2 Spacer/separator to provide continuous vapour barrier between interior of sealed unit and secondary seal.
- .3 Clear Float Glass: to CAN/CGSB-12.3, glazing quality, for inner lite.
- .4 Safety Glass: to CAN/CGSB-12.1-M90.
 - .1 Class: B - Heat strengthened.
- .5 Provide low-E coating on No.3 surface of insulating glass units.
- .6 Glazing Gaskets for Sections: neoprene, thermoplastic rubber or EPDM, flexible at minimum design temperature, and as follows:
 - .1 Profiled with a minimum of three (3) fins to contact glazing and to mechanically key into window frame and sash glazing stops, at interior and exterior of glass units.
 - .2 Removable without special tools and without dismantling of window frames.
 - .3 Designed to maintain pressure contact against glass units through design temperature range.
 - .4 Coextruded material is not acceptable.
- .7 Other Glazing Accessories: setting blocks to CAN/CSA-A440.

2.6 FABRICATION: GENERAL

- .1 Do not start fabrication until samples, shop and erection drawings have been reviewed and have been approved.
- .2 Execute fitting and assembly in the shop, insofar as practical, with the various parts or assemblies ready for erection at the building site.
- .3 Where possible, take field measurements and levels required to verify or supplement those shown on the drawings for the proper layout and installation of the work. Coordinate dimensional tolerances in adjacent building elements and confirm prior to the commencement of the Work.
- .4 Weld aluminum, where required, with inert metal arc equipment. Welders to qualify according to CSA W47.2. Make exposed welds continuous and flush with adjacent surface. Do not mar surface finishes with welds in back of exposed aluminum. Do not deform the exposed metal and finish way by welding.

- .5 Weld steel, where required, to CSA W59. Welded joints to be of adequate strength and durability with jointing tight and flush. Welders to be fully approved by the Canadian Welding Bureau and to comply with CSA W47.1. Where it is necessary to weld components already galvanized, remove galvanizing for 50 mm around weld.
- .6 In locations where curtain wall framing extends up to top of roof parapets, the headrail and glazing cap shall be reinforced to withstand force from window cleaner's suspension chair ropes, which will extend over the top of the parapet and down the face of the building.
- .7 Make provisions in doors and frames to suit requirements of electrically operated hardware and security devices, as applicable, provided under other trades or sections. Blank, drill, reinforce and tap to receive hardware, security and electrical devices. Provide removable plates or knockouts for electrical contacts. Provide fish wires as required.
- .8 Visible manufacturer's identification labels not permitted

2.7 FABRICATION: FRAMING MEMBERS

- .1 Fabricate members to the profiles shown on the Drawings. Wall thickness of extrusions to be as required to meet the design requirements. Frames that are to receive insulating glass units shall have a continuous thermal break.
- .2 Accurately machine file and fit, and rigidly frame together joints, corners and mitres. Match components carefully to produce perfect continuity of line and design. Make exterior joints weathertight and interior joints airtight in accordance with specified allowances. Metal in contact to have hairline joints. Locations of exposed joints to be subject to the approval of the Departmental Representative.
- .3 Sill Trim: Provide continuous extruded "U" trim to inside of bottom rail at each level with provision for receiving steel base and convactor covers, as detailed
- .4 Reinforce frames and assemblies by concealed means as necessary to meet the specified design requirements and as shown. Reinforcing to be hot-rolled mild steel and be securely anchored to horizontal and vertical members by approved positive mechanical means.
- .5 Seal hairline joints at junctions of frame members. Gun-inject sealant from inside ensuring a continuous seal of the joint. Ensure that bead in the glazing space does not impair seating of glazing materials. Remove excess sealant which is forced onto face of frame assembly.
- .6 Location of joints and pressure equalizing drain vents to be subject to Departmental Representative's acceptance.
- .7 Provide sheet continuous air/vapour barrier between framing and building structure. Overlap corner joints. Apply barriers and retain with continuous aluminum or galvanized steel plates or bars and non-corrosive mechanical fasteners. Where indicated, fill void between frame and other building components solid with foamed in place polyurethane foam insulation.
- .8 Develop drainage holes with moisture path to exterior.
- .9 Prepare components to receive anchor devices. Fabricate anchorage items.
- .10 Arrange fasteners, attachments, and jointing to ensure concealment from view.

- .11 Cope, notch and drill so as to provide minimum tolerance throughout system and to fit with hairline joints.
- .12 Conceal interconnecting members and fastenings in completed assembly. Provide pressure equalizing holes in members and condensation drains.
- .13 Backup panels, framing members and associated sealing shall combine to form air tight vapour barrier for entire interior skin of curtain wall system. Cooperate and coordinate with other sections to ensure continuous thermal and air barrier seal at interfaces with adjacent materials. Insulate backpans with 75 mm thick semi-rigid mineral wool insulation.
- .14 Provide for vertical expansions and construction joints as necessary and install air cut-offs in continuous vertical members to prevent stack effect of enclosed air columns.
- .15 Jointing and intersections of metals shall be accurately cut, fitted to a tolerance of 0.8 mm, in true planes with adequate concealed beads where required.
- .16 Fabricate expansions joints between mullion sections with formed extruded aluminum internal sleeve sections, secure to permit joint function and maintain true alignment of sections.
- .17 Fabricate sections to accommodate and interface with work of other sub-contractors by means of rabbets, interlocks, miscellaneous angles, trim and filler sections as required.
- .18 Fabricate mullions not less than one storey height with fully fashioned expansion joints adequate for expansion and contraction required. Avoid chimney effect inside mullions by stopping voids at each floor level with packing consisting of rigid insulation.
- .19 Brake form parapet caps and sills out of 3 mm thick aluminum sheet.
- .20 Reinforce mullions with structural steel sections where required with adequate anchorage to structure.
- .21 Provide internal reinforcement in horizontal window mullions to satisfy wind loads and to maintain rigidity.
- .22 Perform fitting and assembly of component parts in shop insofar as practicable. Work that cannot be permanently shop assembled shall be fitted, assembled, marked and disassembled to assure proper fitting in field. Identify shop assembled components on shop drawings for location and erection at site.
- .23 Isolate aluminum in contact with other metals, masonry, concrete, plaster or mortar to prevent corrosion.
- .24 Verify wall openings and adjoining air and vapour seal materials are ready to receive work of this section.
- .25 Beginning installation means acceptance of site conditions.
- .26 Provide airtight vapour seals in curtain wall framing.

2.8 FINISHES

- .1 Clear Anodized: Exposed aluminum surfaces shall be Aluminum Association (AA) Architectural Class I, AA-M12C22A41, clear anodized matching Kawneer #14

- .2 Steel exposed to exterior conditions that is on cold-in-winter side of air/vapour barrier, but not exposed to view, shall be blast cleaned and hot dip galvanized in accordance with CAN/CSA G164, minimum coating mass 381 g/m². Thread dimensions to be such that nuts will thread over bolts without re-threading or chasing galvanized threads.
- .3 Galvanize after fabrication where possible. Follow standard precautions to avoid making the base metal brittle by over pickling, overheating or during galvanizing.
- .4 Provide compatible 70% Kynar-based touch-up coating for field application.
- .5 Colour and sheen to be uniform with no variations detectable by the naked eye at a distance of 1525 mm under natural lighting.
- .6 Shop and touch-up primer for steel components: SSPC 25 Paint red oxide.
- .7 Touch-up primer for galvanized steel surfaces: SSPC 20 Paint zinc rich.
- .8 Concealed steel items: galvanized in accordance with ASTM A123 to 600 gm/m² primed with iron oxide paint.
- .9 Apply one coat of bituminous paint to concealed aluminum and steel surfaces in contact with cementitious or dissimilar materials.

Part 3 Execution

3.1 INSPECTION

- .1 Inspect Work and conditions affecting the Work of this Section. Proceed only after deficiencies have been corrected.
- .2 Ensure that all flashings built-in or provided by others integrate with system to divert moisture to exterior.
- .3 Ensure that all anchor blocks or inserts required to receive system are correctly located and installed.
- .4 Ensure that all anchors and setting or installing components provided by this Section for installation are properly located and installed.
- .5 Ensure that building air and vapour retarding membranes can be sealed to window units to maintain system integrity. Coordinate with materials installation specified in Section 07 21 19 and Section 07 27 19.

3.2 PREPARATION

- .1 Coordinate dimensions, tolerances, and method of attachment with other work.
- .2 Supply anchorage devices and inserts to the appropriate sections where required for building in or casting-in-place and instruct as to proper location and position. Anchors shall have three-way adjustments.
- .3 Remove dust and other loose material from openings.
- .4 Verify that surfaces are ready to receive work and floor to floor dimensions are as indicated on shop drawings.

3.3 INSTALLATION: CURTAIN WALL

- .1 Install curtain wall systems to AAMA CWG-1-89, and manufacturer's written instructions, as required to meet or exceed specified performance criteria.
- .2 Use only concealed fasteners, type 304 stainless steel unless otherwise specified.
- .3 Erect all work plumb and true and in proper alignment and relationship to established lines and grades.
- .4 Devices for anchoring the frame assemblies shall have sufficient adjustment to permit correct and accurate alignment. After alignment, positively secure anchorage devices to prevent movement other than those designed for expansion and contraction. Take into consideration climatic conditions prevailing at time of installation.
- .5 Perform welding and drilling of concrete as required to install fixings. Repair, concrete chipped by drilling or fixing operations.
- .6 Group components with shop applied finishes so that those that relate most closely to one another, with regard to colour and appearance, shall be installed adjacent to each other.
- .7 Coordinate work of this section with, and provide connection for, compartmentalization of air spaces provided under other sections.
- .8 Provide thermal insulation and air/vapour barriers compatible and continuous with adjacent thermal and air/vapour barrier systems.
- .9 Apply continuous butyl sealing tape between sheets at lap and between steel and other materials. Screw sheets to each other and metal framing with type 304 stainless steel sheet metal screws, 150 mm o.c. maximum. Continuously seal perimeter of panels with tape and sealant. Place type 304 stainless steel washers over rubber washers under screw heads and cover with sealant to make fastenings air and vapour tight.
- .10 Seal joints of metal, apertures and protrusions of any kind with specified sealant to produce homogeneous air/vapour barrier seal. Joints shall be air, water and weathertight.
- .11 Apply a continuous bead of sealant to all joints and air/vapour barrier junctions with adjacent construction. Liberally butter screw fastenings with sealant.
- .12 Supply and install flexible, continuous gasket air/vapour barrier seals between work of this section and adjacent construction, and at deflection and expansion connections, where required. Prime substrates, apply gaskets to framing and to concrete and masonry with adhesive and retain with continuous aluminum or stainless steel plates or bars and non-corrosive mechanical fasteners. Ensure a continuous permanent seal at joints.
- .13 Provide air tight seals at penetrations in air/vapour barriers.
- .14 Apply insulation to the cold in winter side of air/vapour barriers. Ensure tight butt joints.
- .15 Support adhesive-applied clips in place until adhesive has set.
- .16 Isolate metal air/vapour barriers with thermal breaks and spacers.
- .17 Locate vapour barrier on the warm-in-winter side of the insulation.

- .18 Ensure a uniform, continuous thermal and vapour barrier effect. Where adjacent insulation and vapour barriers are to be provided under other sections, coordinate the work such that thermal and vapour barrier continuity is achieved. Ensure compatibility with adjacent thermal and air/vapour barrier systems. Ensure compatibility between tapes, sealants and air/vapour barriers.
- .19 Cut insulation as required and fit snugly to penetrations, obstructions, openings and corners. Butt insulation boards tightly. Cut out back of board insulation as required to accommodate substrate irregularities and build up over cut out areas on the other side as required to ensure thermal barrier uniformity unless otherwise approved.
- .20 Install insulation to thicknesses shown on the Drawings.
- .21 Press insulation boards firmly to barrier or substrate impaling them on clips without bending clips. Butt insulation boards tightly. Install retainers to clips.
- .22 Fill irregular shaped voids within assemblies with fibrous glass packing insulation to maintain continuity of thermal barrier.
- .23 Protect exterior finished surfaces by installing snap-on caps only when building is closed in, and when the possibility of damage due to construction has been minimized, to the approval of the Departmental Representative.
- .24 Secure snap-on caps with concealed stainless steel fasteners, minimum two per cap.
- .25 Protect exterior finished surfaces by installing snap-on caps when the possibility of damage due to construction has been minimized.
- .26 Provide structural steel framing and supports required to support work of this Section unless indicated to be supplied under other Sections. Provide structural steel support or reinforcement for anchorage of railings.
- .27 Supply and install galvanized formed steel coping supports.
- .28 Gun-apply three continuous beads of sealant under extruded aluminum thresholds. Make bead diameter sufficient to ensure a full width seal. Remove excess sealant.

3.4 INSTALLATION GLAZING: FIELD

- .1 Install windows to AAMA/WDMA/CSA 101/I.S.2/A440.
- .2 Install glass and insulating glass units to GANA Glazing Manual recommendations, minimum, and as required to meet or exceed specified performance criteria.
- .3 Provide double-glass insulating vision lights, as indicated on the drawings, throughout the curtain wall cladding.
- .4 Fabricate units accurately to size allowing 6 mm clearance between frame and glass edge. Butt joints shall be plumb and square, uniformly spaced. Ensure that glass rebates/glazing surfaces are clean and dry before placing glass and glazing gaskets and in place.
- .5 Apply structural glazing tape to faces of back-up mullions and setting blocks to top of horizontal rails, to evenly distribute weight.

- .6 Clean edges of glass units with recommended cleaner and lift them in place. Press into place to assure good contact between glazing gaskets/structural glazing tape and glass, and secure with temporary pressure plates/clamps. Align glass, as necessary; butt joints to be aligned and plumbed and centred on back-up mullion. Vertical joints shall be aligned top to bottom of curtain wall.
- .7 Run a continuous bead of structural sealant into void space between glass and backup mullion filling same completely. Tool/wipe flush with face of mullion.
- .8 Face seal butt joint behind horizontal pressure plates.
- .9 Remove temporary clamps/plates after silicone has set. Apply pressure plates and caps to horizontals to secure glass.
- .10 Excepting corner joints, open faces of vertical joints shall be covered with a snap-in-place, neoprene face seal gasket, colour matched to glass. Cut and fit ends tight to glazing caps. Corner joints shall be packed and sealed with structural silicone; tool surface and wipe off excess each side of joint.

3.5 SEALANT

- .1 General:
 - .1 Seal joints between frame assemblies and adjacent construction except where specified to be done under other sections, and within glazed assemblies where required to maintain weather tightness and integrity of air/vapour barrier. Seal junctions in sheet metal air/vapour barriers and between air/vapour barriers and adjacent construction.
- .2 Preparation:
 - .1 Ensure that joint conditions are suitable for the materials to be installed.
 - .2 Ensure that surfaces to be sealed are sound, dry, free from dirt, water, frost, loose scale, corrosion, or other contaminants which may adversely affect the performance of the sealant materials. Remove protective oil coatings and other oil or grease films.
 - .3 Perform cleaning to the extent required to achieve acceptable joint surfaces.
 - .4 Protect cleaned and primed surfaces from further contamination by oil, dust, rain, condensation and other materials detrimental to sealant bonding strength. Re-clean and re-prime contaminated surfaces.
 - .5 Install joint filler strips as backup for sealant to provide optimum joint profile, but not less than 6 mm depth of sealant bead. Provide bond breaker tapes where required.
 - .6 Mask areas adjacent to the joints to prevent contamination of adjacent surfaces. Remove masking promptly after the joint has been completed.
 - .7 If recommended by the manufacturer of the sealant materials, prime joints to prevent staining, or to assist the bond.
 - .8 Apply primer with a brush which will permit all joint surfaces to be primed. Perform priming immediately before installation of sealant.
- .3 Installation:
 - .1 Obtain approval from the sealant manufacturer for the priming, cleaning and application techniques at commencement of the sealant installation.

- .2 Before sealant installation is commenced, test the sealant for adhesion to substrates.
- .3 Install materials in compliance with the recommendations of their manufacturers.
- .4 Do not exceed shelf life and pot life of materials, nor installation times, as stated by the manufacturer. Ensure sealant manufacturer's on-site quality control procedures are maintained.
- .5 Be familiar with the work life of the sealant to be used. Do not mix multiple component materials until required for use.
- .6 Mix sealants thoroughly with a mechanical mixer without mixing air into the materials. Continue mixing until the material is a uniform colour and free from streaks of unmixed material.
- .7 Before any sealing is commenced, test the materials for indications of staining or poor adhesion.
- .8 Sealants shall be of gun grade or knife grade consistency to suit the joint condition. Use gun nozzles of the proper sizes to suit the joints and the sealant material.
- .9 Install sealant with pressure operated guns.
- .10 Use sufficient pressure to fill all voids and joints full. Sealants shall bond to all sides of joint except where filler or bond breaker material is used. Where filler or bond break material is used, sealant shall bond to both sides of joints and shall not adhere to the filler or bond break material.
- .11 Ensure that the correct sealant depth is maintained. Superficial painting with a skin bead will not be accepted.
- .12 Sealant installations shall be a full bead free from air pockets and embedded impurities and having smooth surfaces, free from ridges, wrinkles and sags.
- .13 After joints have been completely filled, tool them neatly to a slightly concave surface.
- .14 If joints are masked, remove masking immediately after tooling and before sealants begin to cure.
- .15 Install exposed structural silicone sealants at glazing so that top surfaces of the beads are formed to drain water away from the glass.
- .16 Clean excess sealants from glass and framing surfaces immediately after installation.
- .17 Cover all fasteners penetrating the air/vapour barriers with sealant.
- .18 Immediately clean adjacent surfaces which have been soiled and leave work in a neat, clean condition. Remove excess materials and droppings using recommended cleaners and solvents.

3.6 FIELD QUALITY CONTROL

- .1 Inspection will monitor quality of installation and glazing.
- .2 Test to ASTM E1105, and AAMA 501.
- .3 Evaluate installed system by thermo-photographic scan.

3.7 MANUFACTURER'S FIELD SERVICES

- .1 Curtain wall product manufacturers to provide field surveillance of installation of their Products.
- .2 Monitor and report installation procedures, unacceptable conditions.

3.8 ADJUSTING

- .1 Replace defective materials and materials damaged due to faulty installation, careless handling or other causes resulting from work of this section.
- .2 Upon completion of the work and just prior to final review, or at a time as directed, inspect units for damage and correct same immediately.
- .3 Test and adjust hardware and replace or repair faulty items.
- .4 Adjust weather-stripping to leave each opening unit in its most weathertight position.
- .5 Test operable elements and ensure easy and smooth operation.

3.9 CLEANING

- .1 Remove protective material from pre-finished aluminum surfaces, interior and exterior.
- .2 Remove, as work progresses, corrosive and foreign materials that may set or become difficult to remove at time of final cleaning or that may damage members. Inspect minimum monthly to ensure cleanliness.
- .3 Wash exposed surfaces with a pre-approved cleaning solution approved by manufacturers of glass and aluminum. Take care to remove dirt from corners. Wipe surfaces clean.
- .4 Select, apply and maintain cleaning and protective methods to ensure finishes will not become uneven or impaired as a result of unequal exposure to light and weathering conditions.
- .5 Perform final cleaning after completion of entire installation when approved by the Departmental Representative. Remove dirt and stains where such does not respond to the washing or cleaning specified in Section 01 11 00 – General Requirements, refer the condition to the Departmental Representative, with recommendations as to the remedial action required; but do not undertake any cleaning procedure of a more severe nature without the written approval.
- .6 Cleaning shall include the interior/exterior surfaces of materials installed under this section.
- .7 Remove excess sealant by moderate use of mineral spirits or other solvent acceptable to sealant manufacturer.
- .8 Final cleaning shall be performed under work of Section 01 11 00 – General Requirements, Cleaning.
- .9 Upon completion of the work of this section, remove debris, equipment and excess material resulting from the work of this section from the site.
- .10 Provide the Departmental Representative with instructions for proper method and materials to be used in maintenance cleaning of finished surfaces.

3.10 PROTECTION

- .1 Protect finished Work from damage.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 06 10 00 – Rough Carpentry
- .2 Section 07 21 19 – Foam-In-Place Insulation
- .3 Section 07 62 00 – Sheet Metal Flashing and Trim
- .4 Section 07 92 00 – Sealants
- .5 Section 08 80 50 – Glazing

1.2 REFERENCES

- .1 American Architectural Manufacturers Association/Window and Door Manufacturers Association (AAMA/WDMA), American National Standards Institute/Window and Door Manufacturers Association (ANSI/WDMA)
 - .1 AAMA 1503-09, Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections.
 - .2 AAMA 1503.1-88, Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections.
 - .3 AAMA 2605-11, Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
 - .4 WDMA I.S.4-07, Water Repellant Preservative Treatment for Millwork.
- .2 ASTM International (ASTM)
 - .1 ASTM E283-04(2012) Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
 - .2 ASTM E330/E330M-14 Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
 - .3 ASTM E547-00(2009) Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Cyclic Static Air Pressure Difference.
 - .4 ASTM E1423-14 Standard Practice for Determining Steady State Thermal Transmittance of Fenestration Systems.
 - .5 ASTM E1425-07 Standard Practice for Determining the Acoustical Performance of Windows, Doors, Skylight, and Glazed Wall Systems.
 - .6 ASTM F588-14 Standard Test Methods for Measuring the Forced Entry Resistance of Window Assemblies, Excluding Glazing Impact.
- .3 Canadian Standards Association (CSA International)
 - .1 CSA A440-11, NAFS - North American Fenestration Standard/Specification for Windows, Doors, and Skylights, Includes Update No. 1 (2014).
 - .2 CSA A440.2-14/A440.3-14, Fenestration energy performance/User guide to CSA A440.2-14.
 - .3 CAN/CSA A440.4-07 (R2012) - Window, Door, and Skylight Installation.

- .4 CSA Certification Program for Windows and Doors 2000.
- .4 Glass Association of North America (GANA)
 - .1 GANA Glazing Manual 50th Anniversary Edition.
- .5 Insulating Glass Manufacturer's Alliance (IGMA)
 - .1 TM-3000-90(04), Glazing Guidelines for Sealed Insulating Glass Units.
- .6 Living Building Challenge SM 3.0, August 2014
- .7 National Fenestration Rating Council (NFRC)
 - .1 NFRC 100-2014, Procedure for Determining Fenestration Product U-factors.
 - .2 NFRC 100A-2014, Procedure for Determining Fenestration Attachment Product U-factors.
 - .3 NFRC 200-2014, Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence.
 - .4 NFRC 200A-2014, Procedure for Determining Fenestration Attachment Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence
 - .5 NFRC 500-2014, Procedure for Determining Fenestration Product Condensation Resistance Values.

1.3 SUBMITTALS

- .1 Submit the following in accordance with Section 01 33 00 – Submittals:
 - .1 Submit manufacturer's product data including construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, and operating instructions for each type of window indicated.
 - .2 Submit shop drawings including plans, elevations, large-scale sections and details, hardware, attachments to other work, operational clearances, and the following:
 - .1 Sections details showing all window perimeter conditions.
 - .2 Sash frame details and corner connections, including reinforcement and stiffeners.
 - .3 Joinery and frame anchorage to wall structure details.
 - .4 Expansion provisions.
 - .5 Flashing and drainage details, sill flashing terminations, in isometric view, including coordination with wall cladding materials.
 - .6 Connection to air and vapour retarder membrane
 - .7 Weather stripping details showing air sealing within and around perimeter of framing and operable sash
 - .8 Glazing details.
 - .9 Required sizes and tolerances of openings.
 - .3 Submit product test reports indicating compliance with CSA A440 based on evaluation of comprehensive tests performed within the last four years by a qualified testing agency, for each type, grade, and size of window

indicated for the project; test results based on use of down sized test units will not be accepted.

- .4 Provide a letter from window manufacturer identifying compliance with CSA A440 Design Criteria.
- .2 Submit maintenance data in accordance with Section 01 78 00 – Closeout Submittals.
 - .1 Provide manufacturer's printed recommendations for maintenance, including cleaning instructions.
- .3 Submit warranty.

1.4 DESIGN CRITERIA

- .1 Design pressure for windows in accordance with the National Building Code.
- .2 Meet or exceed requirements of CSA A440, assuming an hourly design wind pressure of 540 Pa, and the following performance requirements:
 - .1 Windows, Ventilators:
 - .1 Performance class: CW.
 - .2 Performance grade: 30.
- .3 Submit data sheets and test results demonstrating compliance with these requirements.

1.5 SINGLE SOURCE RESPONSIBILITY

- .1 Single-Source Responsibility: obtain all windows from a single manufacturer regularly engaged in the manufacturing and supply of the specified products, meeting or exceeding the material properties and performance characteristics of the materials and manufacturers named in this Section.

1.6 WARRANTY

- .1 Provide manufacturer's standard warranty indicating that the window unit will be free from material and workmanship defects from the date of Substantial Performance for the periods indicated below:
 - .1 Window Units: 20 years.
 - .2 Clad Finish: 20 years against peeling, checking, cracking caulk or color change.
 - .3 Glazing: Insulated Glass: 20 years against seal breakage.

Part 2 Products

2.1 MANUFACTURED UNITS

- .1 Description: fixed windows (direct set), shall be factory assembled, as manufactured by one of the following:
 - .1 Acceptable Materials:
 - .1 JELD-WEN Windows and Doors
 - .2 Kolbe & Kolbe Millwork Co., Inc.

- .3 Lincoln Wood Products, Inc.
 - .4 Loewen
 - .5 Marvin Windows & Doors of Canada
 - .6 Pella Corporation
 - .7 VistaLuxe Collection, Kolbe & Kolbe Millwork Co., Inc.
- .2 Special Requirements: high performance units, manufactured to meet or exceed the requirements of this Section. Meet or exceed to performance characteristics and material properties of the Basis-of-Design product.

2.2 WINDOW MATERIALS

- .1 Frame: Constructed of UPVC core, with pine interior stops and mull casings on mulled units, water repellent, preservative treated in accordance with WDMA I.S. 4-07'A. Clad assembled frames have integrated heavy vinyl nailing fins at head, side jambs, and sill. Drip cap for installation at the head will be applied to the unit when possible; cut to fit and shipped loose when application at the factory is not possible. Transom head drip cap to be field applied to frame.
- .1 Jamb Thickness: 22 mm.
 - .2 Basic jamb width: 71 mm.
 - .3 Standard overall jamb with extensions applied: 116 mm.
 - .4 Sill thickness: 22 mm.
 - .5 Exterior: All frame parts shall be 1.3 mm thick 6063-T5 or T6 extruded aluminum alloy with accessory grooves, press fit onto the UPVC frame.
 - .6 Corner Construction: Welded mitered corners and sealer.
 - .7 Wood species on exposed wood frame components: pine.
- .2 Surface Finish:
- .1 Exterior Finish – Aluminum: exterior aluminum frame and sash components shall be coated with a wood veneer, colour as indicated on Drawings.
 - .2 Interior Finish – Wood: interior wood to have a premium quality, commercial grade, 100% acrylic paint system (primer and two finish coats) applied, colour as indicated on drawings.
- .3 Jamb Extensions:
- .1 Provide factory installed jamb extensions up to 305 mm for wall thickness indicated or required.
 - .2 Finish: match interior frame finish.
- .4 Accessories and Trim:
- .1 Provide manufacturer's accessories and trim, including stainless steel anchors, fasteners and fitments, as required for a complete installation.

2.3 GLAZING

- .1 Glass and glazing materials, to Section 08 80 50 – Glazing.

2.4 HARDWARE

- .1 Exposed Hardware Components: metal; finish to match frame.
- .2 Hardware exposed to exterior environment shall be stainless steel.
- .3 Hardware shall be screw-attached.

2.5 ACCESSORIES

- .1 Flashing: to Section 07 62 00 – Sheet Metal Flashing and Trim.
- .2 Air and vapour retarder: to Section 07 27 13 – Air and Vapour Retarders.
- .3 Foam-in-place insulation: to Section 07 21 19 – Foam-In-Place Insulation.
- .4 Sealants: to Section 07 92 00 – Sealants.

2.6 FABRICATION

- .1 Fabricate window 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 3 mm for units with a diagonal measurement over 1800 mm.
- .2 Continuously and uniformly compress length of gaskets during installation to compensate for linear shrinkage.
- .3 Glass shall be factory-installed into frames, to Section 08 80 50 – Glazing.

Part 3 Execution

3.1 COMPLIANCE

- .1 Install windows to CAN/CSA A440.4, and as required to meet specified performance criteria.
- .2 Comply with manufacturer's printed installation instructions, standard details, and data sheets.

3.2 EXAMINATION

- .1 Verification of Conditions: Before installation, verify that openings are plumb and square and of proper dimension. Report frame defects or unsuitable conditions to the General Contractor before proceeding.
- .2 Acceptance: Beginning of installation means acceptance of existing conditions.

3.3 INSTALLATION

- .1 Erect and secure window units in prepared openings, plumb, and square, free from warp, twist, or superimposed loads.
- .2 Mount with exterior surface of frame flush with exterior sheathing.
- .3 Secure work accurately to structure and in a manner not restricting thermal movement of materials.
- .4 Transfer dead load to wall construction by anchors alone or in combination with plastic shims.

- .5 Place shims under sill frame at setting block locations, and as recommended by manufacturer.
- .6 Conceal anchors and fitments.
- .7 Maintain dimensional tolerances after installation and alignment with adjacent work.
- .8 Provide seal around interior perimeter of frame using foam joint sealant or foam backer rod, size as required to lightly compress between frame and rough opening, and sealant.
- .9 Provide seal at head and jamb of exterior perimeter of frame using foam joint sealant or foam backer rod, size as required to lightly compress between frame and rough opening, and sealant.
- .10 Install jamb extensions, casings, moulds and trim as indicated on Drawings, or as otherwise required for a complete installation.
- .11 Adjust operable parts for correct function.

3.4 GLAZING

- .1 Install glass in accordance with Section 08 80 50 – Glazing.

3.5 FLASHING

- .1 Install flashing as required for proper management of wind driven rainwater: refer to Section 07 62 00 – Sheet Metal Flashing and Trim.

3.6 AIR AND VAPOUR BARRIER

- .1 Install air and vapour retarder as required to maintain continuity of barrier.

3.7 SEALANTS

- .1 Install sealants as required for weathertight and watertight installation, to Section 07 92 00 – Sealants.

3.8 CLEANING AND PROTECTION

- .1 Cover windows during spray painting or other construction operations (such as muretic acid washing after completion of masonry) that might cause damage.
- .2 Clean interior and exterior surfaces as soon as adjacent contaminating activities are completed to recommendations of manufacturer.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 08 11 13 – Steel Doors and Frames.
- .2 Section 08 14 16 – Flush Wood Doors.
- .3 Drawings – Door Hardware Schedule.
- .4 Division 26: Electrical wiring for magnetic strikes, electric releases and electric locks.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/Builders Hardware Manufacturers Association (BHMA)
- .2 Canadian Steel Door and Frame Manufacturers' Association (CSDFMA)
 - .1 CSDFMA Canadian Metric Guide for Steel Doors and Frames (Modular Construction): standard hardware location dimensions.
- .3 Builders Hardware Manufacturers Association (BHMA)
 - .1 Directory of Certified Products.
- .4 Door and Hardware Institute (DHI)
 - .1 Sequence and Format for the Hardware Schedule.
 - .2 ANSI/DHI A115.IG, Installation Guide for Doors and Hardware.

1.3 PRE-INSTALLATION MEETINGS

- .1 Pre-Installation Meetings: convene pre-installation meeting in accordance with Section 01 31 19 – Project Meetings to:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordination with other building subtrades.
 - .4 Review manufacturer's warranty requirements.

1.4 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 – Submittal Procedures:
 - .1 Submit manufacturer's printed product literature, specifications and data sheets.
- .2 Submit samples in accordance with Section 01 33 00 – Submittals:
 - .1 Identify each sample by label indicating applicable specification paragraph number, brand name and number, finish and hardware package number.
 - .2 After approval samples will be returned for incorporation in the Work.
- .3 Hardware List:
 - .1 Submit contract hardware list in accordance with Drawings.

- .2 Indicate specified hardware, including make, model, material, function, size, finish and other pertinent information.
- .3 Coordinate Security Contractor, Electrical Contractor and Door and Hardware Contractors to jointly prepare, submit, and obtain certified approval from the Departmental Representative shop drawings for work related to door access control systems prior to undertaking the on-site work. The joint submission will clarify and assign responsibility between these Divisions for labour and materials associated with the supply and installation of electronic and physical components for doors and access control. An individual drawing shall be submitted in AutoCadd format for each door within the project scope depicting both public and secure side of door and arrangement of access control and security components, conduit, and cabling.
- .4 Keying Schedule:
 - .1 Submit keying schedule prepared by or under the supervision of qualified Architectural Hardware Consultant (AHC), detailing Departmental Representative's final keying instructions for locks, including schematic keying diagram and index each key set to unique door designations.
- .5 Manufacturer's Instructions:
 - .1 Submit manufacturer's installation instructions.
- .6 Closeout Submittals
 - .1 Provide operation and maintenance data for door closers, locksets, door holders electrified hardware and fire exit hardware for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 MAINTENANCE MATERIAL

- .1 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 Supply two sets of wrenches for door closers, locksets, and fire exit hardware.

1.6 QUALITY ASSURANCE

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

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, Shipping, Handling and Unloading:

- .1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Package each item of hardware including fastenings, separately or in like groups of hardware, label each package as to item definition and location.
- .2 Storage and Protection:
 - .1 Store finishing hardware in locked, clean and dry area.

1.8 WASTE DISPOSAL AND MANAGEMENT

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

1.9 WARRANTY

- .1 Provide written warranty, executed by manufacturer agreeing to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
- .2 Failures include, but are not limited to, the following:
 - .1 Structural failures including excessive deflection, cracking, or breakage.
 - .2 Faulty operation of operators and door hardware.
 - .3 Deterioration of metals, metal finishes, and other materials beyond normal weathering.
- .3 Warranty Period: From date of Substantial Performance, and as follows:

Hardware Type	Warranty Term
Locks, latches and cylinders	2 years
Closers	25 years
Hinges	1 year
Panics	3 years
Miscellaneous	1 year
Electrical Hardware:	5 years

Part 2 Products

2.1 HARDWARE ITEMS

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

2.2 DOOR HARDWARE

- .1 As indicated in Section 08 71 10.

2.3 FASTENINGS

- .1 Use only fasteners provided by manufacturer. Failure to comply may void warranties and applicable licensed labels.
- .2 Supply screws, bolts, expansion shields and other fastening devices required for satisfactory installation and operation of hardware.
- .3 Exposed fastening devices to match finish of hardware.

- .4 Where pull is scheduled on one side of door and push plate on other side, supply fastening devices, and install so pull can be secured through door from reverse side. Install push plate to cover fasteners.
- .5 Use fasteners compatible with material through which they pass.

2.4 KEYING

- .1 Doors, padlocks and cabinet locks to be keyed differently as noted in Hardware Schedule. Prepare detailed keying schedule in conjunction with Departmental Representative.
- .2 Provide keys in duplicate for every lock in this Contract.
- .3 Provide three masterkeys for each MK or GMK group.
- .4 Stamp keying code numbers on keys and cylinders.
- .5 Key Control Cabinet:
 - .1 Wall Mounted Cabinet: Cabinet with hinged-panel door equipped with key holding panels and pin-tumbler cylinder door lock.

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.
- .2 Furnish metal door and frame manufacturers with complete instructions and templates for preparation of their work to receive hardware.
- .3 Furnish manufacturers' instructions for proper installation of each hardware component.

3.2 INSTALLATION

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

3.3 ADJUSTING

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

3.4 CLEANING

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

3.5 DEMONSTRATION

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

3.6 SCHEDULE

- .1 As per Drawings.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 06 40 00 – Architectural Woodwork
- .2 Section 08 11 13 – Steel Doors and Frames
- .3 Section 08 14 16 – Flush Wood Doors
- .4 Section 08 41 23 – Fire Rated Aluminum Frames
- .5 Section 08 44 13 – Glazed Aluminum Curtain Wall
- .6 Section 08 50 00 – Aluminum Clad Wood Windows
- .7 Section 08 87 53 – Glazing Films

1.2 REFERENCES

- .1 American National Standards Institute (ANSI).
 - .1 ANSI Z97.1-2015, Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test
- .2 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM C542-05 (2011), Specification for Lock-Strip Gaskets.
 - .2 ASTM D790-15e2, Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
 - .3 ASTM D1003-13, Test Method for Haze and Luminous Transmittance of Plastics.
 - .4 ASTM D1929-16, Test Method for Determining Ignition Temperature of Plastics.
 - .5 ASTM D2240-15, Standard Test Method for Rubber Property - Durometer Hardness.
 - .6 ASTM E84-16, Test Method for Surface Burning Characteristics of Building Materials.
 - .7 ASTM E330/E330M-14, Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
 - .8 ASTM F1233-08(2013), Test Method for Security Glazing Materials and Systems.
 - .9 ASTM C1503-08(2013), Standard Specification for Silvered Flat Glass Mirror
- .3 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB-12.1-2017, Tempered or Laminated Safety Glass.
 - .2 CAN/CGSB-12.2-M91(R2017), Flat, Clear Sheet Glass.
 - .3 CAN/CGSB-12.3-M91(R2017), Flat, Clear Float Glass.
 - .4 CAN/CGSB-12.4-M91(R2017), Heat Absorbing Glass.
 - .5 CAN/CGSB-12.8-97 AMEND, Insulating Glass Units.
 - .6 CAN/CGSB 12.20-M89, Structural Design of Glass for Buildings
- .4 Canadian Standards Association (CSA International).

- .1 CAN/CSA A440.2-14/A440.3-14, Fenestration energy performance/User guide to CSA A440.2-09.
- .2 CSA Certification Program for Windows and Doors 2000.
- .5 Environmental Choice Program (ECP)
 - .1 CCD-045-95, Sealants and Caulking.
- .6 European Standard (EN)
 - .1 EN 1096-4:2004, Glass in building - Coated glass: Evaluation of conformity/Product standard.
 - .2 EN 14179-1:2016, Glass in building - Heat soaked thermally toughened soda lime silicate safety glass - Part 1: Definition and description.
 - .3 EN 14179-2:2005, Glass in building - Heat soaked thermally toughened soda lime silicate safety glass - Part 2: Evaluation of conformity/Product standard.
- .7 Glazing Association of North America (GANA)
 - .1 GANA Glazing Manual.
 - .2 GANA Glazing Reference.
- .8 Insulating Glass Manufacturers Alliance.
- .9 National Fire Protection Association (NFPA):
 - .1 NFPA 80, Standard for Fire Doors and Other Opening Protectives, 2016 Edition.
 - .2 NFPA 252, Fire Tests of Door Assemblies, 2017 Edition.
 - .3 NFPA 257, Fire Test for Window and Glass Block Assemblies, 2017 Edition.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Convene pre-installation meetings: one week prior to beginning work of this Section.
 - .1 Verify project requirements.
 - .2 Review installation conditions.
 - .3 Co-ordinate with other building subtrades.
 - .4 Review manufacturer's instructions and warranty requirements.

1.4 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 – Submittals.
 - .1 Submit manufacturer's printed product literature, specifications and data sheet.
 - .2 Submit two copies of WHMIS MSDS - Material Safety Data. Indicate VOC's:
 - .1 For glazing sealant materials during application and curing.
- .2 Submit shop drawings in accordance with Section 01 33 00 – Submittals.
 - .1 Submit shop drawings for window glazing and include the following:

- .1 Submit glass thermal and wind load stress analysis documenting adequate glass thickness and/or heat treatment to meet stresses generated. Thermal stress analysis to consider effects of external shading, conduction at glass edge, heat build-up and contribution of Low-E coatings.
- .2 Shop drawings shall be signed and sealed by a professional engineer qualified in the province of the Work, and who was responsible for their preparation.
- .3 Submit samples in accordance with Section 01 33 00 – Submittals.
 - .1 Submit 300 mm x 300 mm size of each glazing type. Departmental Representative reserves the right to change colour of glass after review of submitted samples.
- .4 Information Submittals:
 - .1 Manufacturer's Instructions: Submit manufacturer's installation instructions.
 - .2 Submit proof of IGMAC certification for insulating glass units, including component codes.
- .5 Closeout Submittals:
 - .1 Provide maintenance data including cleaning instructions for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 QUALITY ASSURANCE

- .1 Manufacturer's technical recommendations:
 - .1 Perform glazing work in accordance with written recommendations from the glass manufacturer or glass fabricator.
 - .2 Certify glass compatibility with glazing materials (i.e. insulating glass sealants, structural sealants and silicones, gaskets, setting blocks, etc.)
 - .3 Designs to be analyzed for thermal stress and wind/snow loads.
 - .4 Provide shop inspection for glass.
- .2 Window fabricator shall be a member in good standing of the Northern Alberta Glass Trades Association and adhere to the rules and regulations for workmanship, training and personnel as set forth by the association.
- .3 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
 - .1 Provide testing and analysis of glass under provisions of Section 01 45 00 - Quality Control.
 - .2 Provide shop inspection and testing for glass.
- .4 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .5 Glazing for Fire-Rated Door and Window Assemblies: Glass tested per NFPA 252 and NFPA 257, as applicable, for assemblies complying with NFPA 80 and listed and labelled per requirements of authorities having jurisdiction.

1.6 MOCK-UPS

- .1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control.
- .2 Construct mock-up to including glass, and perimeter air barrier and vapour retarder seal.
- .3 Mock-up will be used:
 - .1 To judge workmanship, substrate preparation, operation of equipment and material application.
- .4 Locate where directed.
- .5 Allow 24 hours for inspection of mock-up before proceeding with work.
- .6 When accepted, mock-up will demonstrate typical standard of quality required for this work. Approved mock-up may remain as part of finished work.

1.7 SITE CONDITIONS

- .1 Environmental Requirements:
 - .1 Install glazing when ambient temperature is 4 degrees C minimum. Maintain ventilated environment for 24 hours after application.
 - .2 Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.8 WASTE MANAGEMENT AND DISPOSAL

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

1.9 WARRANTY

- .1 Provide manufacturers guarantee for the following types of glass listed, against defects in materials and workmanship for the period indicated, commencing from the date of Substantial Performance of Work.
 - .1 Sealed Glass Units: Replace units that exhibit failure of hermetic seal under normal use evidenced by the obstruction of vision by dust, moisture, or film on interior surface of glass: 10 Years.
 - .2 Coated- Glass: Replace units that display peeling, cracking, and other deterioration in metallic coating under normal use: 10 Years.
 - .3 Provide warranty for glazing to include in maintenance manuals as specified in Section 01 78 00 – Operations and Maintenance Data Manuals.

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 Pilkington Glass of Canada
 - .4 Prelco Inc.
 - .5 PPG Industries
 - .6 Schott Glass AG
 - .7 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 Safety glass: to CAN/CGSB-12.1, transparent, 6 mm minimum thickness.
 - .1 Type: 2-tempered.
 - .2 Class: B-float.
 - .3 Category: II – 540 J impact resistance.
- .2 Fire Rated Glass: Comprised of multiple layers of tempered glass ceramic, laminated with transparent intumescent materials, providing distortion free viewing through pane and as follows:
 - .1 Thickness: As required by manufacturer to meet structural requirements for performance and specified.
 - .2 Impact Safety Rating: Category I, 665 J/m in accordance with ANSI Z97.1.
 - .3 Temperature Rise Rating: Not required.
 - .4 Fire Rating: as indicated in door and frame schedule.
 - .5 Labelled: Permanent logo listing name of product, manufacturer, testing laboratory, fire rating period and safety requirements.
 - .6 Acceptable Manufacturers :
 - .1 InterEdge Technologies
 - .2 SAFTI Fire and Safety Rated Glass
 - .3 Saint-Gobain Glass Solutions

.4 Technical Glass Products

- .3 Low Emissivity (Low E) Glass: to CAN/CGSB-12.10, thickness as indicated and as follows:
 - .1 Metallic coating: soft, sputtered
 - .2 U-Value Winter Nighttime: 0.25
 - .3 U-Value Summer Daytime: 0.22
 - .4 SHGC: 0.45
 - .5 Shading Coefficient: 0.51
 - .6 Visible Light Transmittance: 70%
 - .7 Basis of Design: Solarban 60 by PPG Industries on No. 2 surface.
 - .8 Acceptable Manufacturers:
 - .1 AGC
 - .2 Guardian
 - .3 Viracon

2.4 MATERIALS: SEALED INSULATING GLASS

- .1 Drawings and Specifications for insulated glass units are intended to show design concept, configuration, components and arrangement; they are not intended to identify nor solve completely the problems from thermal stress. Insulating glass units shall withstand thermal stresses created by shadowing of exterior components or assembly and elevated interstitial space temperatures. Glass thermal stress analysis shall be provided by Contractor.
- .2 Double Pane Insulating Glass Units: meet or exceed requirements of CAN/CGSB-12.8. Units shall be certified by the Insulated Glass Manufacturers Alliance (IGMA). Overall unit thickness shall be 25 mm using 6 mm glass thickness for individual panes. Use two stage seal method of manufacture, as follows:
 - .1 Primary Seal: polyisobutylene sealing compound between glass and metal spacer/separator, super spacer bar or TDSE Intercept.
 - .2 Secondary Seal: polyurethane, silicone or polysulphide base sealant, filling gap between the two lites of glass at the edge up to the spacer/separator and primary seal.
- .3 Spacer/separator to provide continuous vapour barrier between interior of sealed unit and secondary seal.
- .4 Clear Float Glass: to CAN/CGSB-12.3, glazing quality, for inner lite and exterior lite above 2133 mm and as indicated on Drawings.
- .5 Clear Safety Glass: to CAN/CGSB-12.1-M90 for outer lite below 2133 mm, as indicated on Drawings and as follows:
 - .1 Type: 2-tempered.
 - .2 Class: B-float.
- .6 Provide low-E coating on No.2 surface of insulating glass units.
- .7 Other Glazing Accessories: setting blocks to CAN/CSA-A440.
- .8 Gas: 95% Argon gas and 5% air.

2.5 ACCESSORIES

- .1 Plastic Film: in accordance with Section 08 87 53 – Glazing Films.
- .2 Sealant: in accordance with Section 07 92 00 – Joint Sealants.
- .3 Setting blocks: Neoprene, EPDM, or Silicone, 80-90 Shore A durometer hardness to ASTM D2240, to suit glazing method, glass light weight and area.
- .4 Spacer shims: Neoprene or Silicone, 50-60 Shore A durometer hardness to ASTM D2240, 75 mm long x one half height of glazing stop x thickness to suit application. Self adhesive on one face.
- .5 Glazing tape:
 - .1 Preformed butyl compound with integral resilient tube spacing device, 10-15 Shore A durometer hardness to ASTM D2240; coiled on release paper; black colour.
 - .2 Closed cell polyvinyl chloride foam, coiled on release paper over adhesive on two sides, maximum water absorption by volume 2%, designed for compression of 25%, to effect an air and vapour seal.
- .6 Glazing compound for fire rated glazing materials:
 - .1 Glazing Tape: Closed cell polyvinyl chloride foam, coiled on release paper over adhesive on two sides, maximum water absorption by volume of 2%, designed for compression of 25% to effect an air and vapour seal.
 - .2 Silicone Sealant: One-part neutral curing silicone, medium modulus sealant, Type S; Grade NS; Class 25 with additional movement capability of 50% in both extension and compression (total 100%); Use (Exposure) NT; Uses (Substrates) G, A, and O as applicable.
 - .1 Acceptable materials:
 - .1 Dow Corning Corp., Dow Corning 795
 - .2 General Electric Co., Silglaze-II 2800
 - .3 Tremco Inc., Spectrum 2
 - .3 Setting Blocks: Hardwood, glass width by 100 mm x 5 mm thick.
 - .4 Spacers: Neoprene or other resilient blocks of 40 to 50 Shore A durometer hardness, adhesive-backed on one face only, tested for compatibility with specified glazing compound.
 - .5 Cleaners, Primers, and Sealers: Type recommended by manufacturer of glass and gaskets.
- .7 Glazing splines: resilient polyvinyl chloride or silicone, extruded shape to suit glazing channel retaining slot, black colour.
- .8 Glazing clips: manufacturer's standard type.
- .9 Lock-strip gaskets: to ASTM C542.

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 EXAMINATION

- .1 Verify that openings for glazing are correctly sized and within tolerance.
- .2 Verify that surfaces of glazing channels or recesses are clean, free of obstructions, and ready to receive glazing.

3.3 PREPARATION

- .1 Ensure all wood backing rebates and stops properly primed and finished, coordinate with Section 06 20 00 – Finish Carpentry and Section 06 40 00 – Architectural Woodwork.
- .2 Ensure all glazing rebates smooth and true, free of projections nails, screws, fastenings properly set to prevent contact with glass.
- .3 Ensure all stops, splines, glazing accessories provided by others accurately cut to length and proper size and type for specific glazing.
- .4 Clean contact surfaces with solvent and wipe dry.
- .5 Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- .6 Prime surfaces scheduled to receive sealant.

3.4 INSTALLATION: EXTERIOR - DRY METHOD (PREFORMED GLAZING)

- .1 Perform work in accordance with GANA Glazing Manual, IGMA, and GANA Laminated Glazing Reference Manual for glazing installation methods.
- .2 Cut glazing tape to length; install on glazing light. Seal corners by butting tape and sealing junctions with sealant.
- .3 Place setting blocks at 1/3 points, with edge block maximum 150 mm from corners.
- .4 Rest glazing on setting blocks and push against fixed stop with sufficient pressure to attain full contact.
- .5 Install removable stops without displacing glazing tape. Exert pressure for full continuous contact.
- .6 Trim protruding tape edge.

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

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

- .7 Knife trim protruding tape.

3.6 FIRE RATED GLASS

- .1 Comply with GANA 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 Place hardwood setting blocks located at quarter points of glass with edge block no more than 150 mm from corners.
- .4 Glaze vertically into labelled 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.
- .5 Place glazing tape on free perimeter of glazing in same manner described above.
- .6 Do not remove protective edge tape.
- .7 Install removable stop and secure without displacement of tape.
- .8 Do not pressure glaze.
- .9 Knife trim protruding tape.
- .10 Provide minimum 5 mm edge clearance.
- .11 Install vision panels in fire rated doors to requirements of NFPA 80.
- .12 Install so that appropriate fire rating labels and markings remain permanently visible.

3.7 INSTALLATION: PLASTIC FILM

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

3.8 CLEANING

- .1 Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .2 Remove traces of primer, caulking.
- .3 Remove glazing materials from finish surfaces.
- .4 Remove labels after work is complete.
- .5 Clean glass using approved non-abrasive cleaner in accordance with manufacture's instructions.
- .6 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

3.9 PROTECTION OF FINISHED WORK

- .1 After installation, mark light with an "X" by using removable plastic tape or paste.

3.10 SCHEDULE

- .1 Aluminum Clad Wood Windows:
 - .1 Insulating glass units, 6 mm clear float exterior light (6 mm clear tempered glass for windows below 2133 mm); 6 mm clear float interior light, low e coating to #2 surface
- .2 Glazed Aluminum Curtain Walls:
 - .1 Insulating glass units, 6 mm clear float exterior light (6 mm clear tempered glass for windows below 2133 mm); 6 mm clear float interior light, low e coating to #2 surface
- .3 Fire Rated Aluminum Frames
 - .1 Insulating glass units, 6 mm clear fire rated exterior light (6 mm clear fire rated tempered glass for windows below 2133 mm); 6 mm clear fire rated interior light, low e coating to #2 surface
- .4 Hollow Metal Doors and Borrowed Lights:
 - .1 Exterior Doors: Sealed glass unit, 6 mm tempered safety glazing for both lights with low e coating to #2 surface.
 - .2 Interior Doors:
 - .1 Single pane 6 mm tempered safety glazing.
 - .2 Single 6 mm clear fire rated light, as indicated.
- .5 Flush Wood Doors:
 - .1 Interior Doors:
 - .1 Single pane 6 mm tempered safety glazing.
 - .2 Single 6 mm clear fire rated light, as indicated.
- .6 Borrowed Light in Pressed Steel Frames:
 - .1 Single 6 mm clear tempered safety glazed units.
- .7 Other glass types as indicated on Drawings.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 06 10 00 – Rough Carpentry
- .2 Section 07 21 16 – Fibrous Insulation
- .3 Section 07 24 00 – Exterior Insulation and Finish Systems
- .4 Section 07 27 19 – Sheet Membrane Air and Vapour Barrier
- .5 Section 07 84 00 – Firestopping
- .6 Section 07 92 00 – Sealants
- .7 Section 09 91 00 – Painting

1.2 REFERENCES

- .1 Aluminum Association (AA)
 - .1 AA DAF-45-2003(R2009), Designation System for Aluminum Finishes.
- .2 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM C475/C475M-15, Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
 - .2 ASTM C514-04(2014), Specification for Nails for the Application of Gypsum Board.
 - .3 ASTM C557-03(2017), Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing.
 - .4 ASTM C840-17, Specification for Application and Finishing of Gypsum Board.
 - .5 ASTM C954-15, Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness.
 - .6 ASTM C1002-16, Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
 - .7 ASTM C1047-14a, Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
 - .8 ASTM C1278/C1278M-07a(2015), Standard Specification for Fiber-Reinforced Gypsum Panel.
 - .9 ASTM C1280-13a, Specification for Application of Exterior Gypsum Panel Products for Use as Sheathing.
 - .10 ASTM C1396/C1396M-14a, Standard Specification for Gypsum Board.
 - .1 ASTM C1629/C1629M-15, Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels.
 - .2 ASTM C1658/C1658M-13, Standard Specification for Glass Mat Gypsum Panels
- .3 Association of the Wall and Ceilings Industries International (AWCI)
- .4 Canadian General Standards Board (CGSB)

- .1 CAN/CGSB-51.34-M86., AMEND., Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
- .5 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-10, Surface Burning Characteristics of Building Materials and Assemblies.

1.3 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 – Submittals:
 - .1 Submit manufacturer's printed product literature, specifications and data sheet for each product specified.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver materials in original packages, containers or bundles bearing manufacturers brand name and identification.
- .2 Store materials inside, level, under cover. Keep dry. Protect from weather, other elements and damage from construction operations and other causes.
- .3 Handle gypsum boards to prevent damage to edges, ends or surfaces. Protect metal accessories and trim from being bent or damaged.

1.5 SITE ENVIRONMENTAL REQUIREMENTS

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

1.6 WASTE MANAGEMENT AND DISPOSAL

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

Part 2 Products

2.1 MANUFACTURERS

- .1 Acceptable Manufacturers:
 - .1 CertainTeed Gypsum Canada Inc.
 - .2 CGC Inc.
 - .3 Georgia-Pacific Canada, Inc.

2.2 GYPSUM MATERIALS

- .1 Standard board: to ASTM C1396/C1396M and as follows:
 - .1 Type: regular and fire resistant.
 - .2 Size: 1200 mm x maximum practical length.
 - .3 Thickness: as indicated on Drawings.

- .4 Ends: square cut.
- .5 Edges: tapered
- .6 Acceptable materials:
 - .1 Wallboard (Type X), CertainTeed.
 - .2 Sheetrock (Firecode), CGC Inc.
 - .3 Toughrock Gypsum Wallboard (Fireguard), Georgia-Pacific Canada, Inc.
- .2 Wall sheathing board: to ASTM C1177/C1177M and as follows:
 - .1 Type: regular and fire resistant.
 - .2 Size: 1200 mm x maximum practical length.
 - .3 Thickness: as indicated on Drawings.
 - .4 Edges: square.
 - .5 Acceptable materials:
 - .1 Dens-Glass Gold, Georgia-Pacific Canada, Inc.
 - .2 GlasRoc Exterior Sheathing, Certain Teed.
 - .3 Securock Glass Mat Sheathing, CGC Inc.
- .3 Sag Resistant Gypsum Board: to ASTM C1396/C1396M and as follows:
 - .1 Type: regular and fire resistant.
 - .2 Thickness: as indicated on Drawings.
 - .3 Acceptable materials:
 - .1 CD Ceiling Board, Georgia-Pacific Canada, Inc.
 - .2 Interior Ceiling Board, CertainTeed.
 - .3 Sheetrock Interior Ceiling Board, CGC Inc.
- .4 Cementitious backer board: to ASTM C1325 and as follows:
 - .1 Substrate for ceramic tiles.
 - .2 Size: 1200 mm x maximum practical length.
 - .3 Thickness: as indicated on Drawings.
 - .4 Acceptable materials:
 - .1 Durock, CGC Inc.
 - .2 Wonderboard, Custom Building Products Ltd.

2.3 FRAMING MATERIALS

- .1 Studs and Tracks: as indicated in Section 06 10 00.
- .2 Metal furring runners, hangers, tie wires, inserts, anchors.
- .3 Drywall furring channels: 0.75 mm core thickness galvanized steel channels for screw attachment of gypsum board.
- .4 Resilient drywall furring: 0.5 mm base steel thickness galvanized steel for resilient attachment of gypsum board.

2.4 INSULATION MATERIALS

- .1 Mineral Fiber Insulation For Fire and Smoke Rated Assemblies: Un-faced preformed GreenGuard™ or formaldehyde free binder fibrous insulation meeting

the requirements of ULC S702; having maximum flame spread and smoke developed of 20/20 in accordance with CAN/ULC S102 and being non-combustible in accordance with CAN/ULC S114 and as follows:

- .1 Type: 1.
- .2 Width: to friction fit in stud spaces.
- .3 Thickness: to fill a minimum of 90% of the cavity thickness.
- .4 STC Ratings: as indicated on Drawings.
- .5 Acceptable materials:
 - .1 Johns Manville, MinWool Sound Attenuation Fire Batts
 - .2 Owens-Corning Canada LP, EcoTouch QuietZone PINK FiberGlas Acoustic Insulation
 - .3 Rockwool Inc., Roxul AFB Acoustical Fire Batt.
- .2 Mineral Fiber Acoustical Insulation For Non-rated Assemblies: Un-faced, preformed GreenGuard™ or formaldehyde free binder fibrous insulation meeting the requirements of ASTM C423, ASTM E90, ASTM E413 and ULC S702 and as follows:
 - .1 Type: 1.
 - .2 Width: to friction fit in stud spaces.
 - .3 Thickness: to fill a minimum of 90% of the cavity thickness.
 - .4 STC Ratings: as indicated on Drawings
 - .5 Acceptable materials:
 - .1 CertainTeed, NoiseReducer, Sound Control Fibre Glass Batts.
 - .2 Johns Manville, Sound Shield Glass Fibre Batts.
 - .3 Owen-Corning Canada LP., EcoTouch Quietzone PINK FiberGlas Acoustic Insulation.

2.5 CEILING/WALL ACCESS DOORS

- .1 Architectural, flush mounting access panels for gypsum board installation, thickness and fire rating to match wall assembly, manufacturer's standard sizes selected to suit access requirements, complete with extruded aluminum frame, concealed hinge and a removable door panel, air tight gasket and screwdriver slot latch mechanism. Confirm proposed location and number of access doors with Departmental Representative prior to installation.
 - .1 Basis-of-Design: Bauco Products Incorporated, Bauco Plus.
 - .2 Acceptable Manufacturers:
 - .1 Access Panel Solutions
 - .2 Acudor Products, Inc.
 - .3 Chicago Metallic/Rockfon Corporation
 - .4 Nystrom Building Products Co.

2.6 ACCESSORIES

- .1 Nails: to ASTM C514.
- .2 Steel drill screws: to ASTM C1002.
- .3 Stud adhesive: to CAN/CGSB-71.25.

- .4 Laminating compound: as recommended by manufacturer, asbestos-free.
- .5 Casing beads, corner beads, control joints and edge trim: to ASTM C1047, ABS, 0.5 mm base thickness, perforated flanges, one piece length per location.
- .6 Shadow mould: 35 mm high, snap-on trim, of 0.6 mm base steel thickness galvanized sheet pre-finished in satin enamel, white colour.
- .7 Strippable Edge Trim: Extruded PVC with pre-masked L-shaped tape on trim with tear away protective serrated strip for removal after compound and paint is applied, for use at areas where gypsum butts aluminum frames and where gypsum butts concrete or concrete block.
- .8 Sealants: in accordance with Section 07 92 00 - Sealants.
- .9 Acoustic sealant: non-hardening, non-skinning, permanently flexible and having VOC content less than the VOC limits of State of California's South Coast Air Quality Management District Rule #1168 and in accordance with Section 07 92 00 – Sealants.
- .10 Polyethylene: in accordance with Section 07 27 13 – Sheet Membrane Air and Vapour Barrier.
- .11 Insulating strip: rubberized, moisture resistant, 3 mm thick cork or closed cell neoprene strip, 12 mm wide, with self sticking permanent adhesive on one face, lengths as required.
- .12 Joint Treatment Materials: Provide joint compound and accessory materials in accordance with ASTM C475 and as follows:
 - .1 Joint Tape:
 - .1 Interior Gypsum Board: Paper.
 - .2 Tile Backing Panels: As recommended by panel manufacturer.
 - .2 Joint Compound for Interior Gypsum Board: Vinyl based, non-asbestos, low dusting type compatible with other compounds applied on previous or for successive coats, and as follows:
 - .1 Pre-filling: Setting type taping compound.
 - .2 Embedding and First Coat: Drying type compound.
 - .3 Fill Coat: Drying type compound.
 - .4 Finish Coat: Drying type, sandable topping compound.
 - .5 Skim Coat: Drying type, sandable topping compound.
 - .6 Acceptable Materials:
 - .1 CertainTeed Dust Away
 - .2 CGC Dust Control
 - .3 Joint Compound for Tile Backing Panels:
 - .1 Gypsum based tile backing board: Use setting type taping and setting type, sandable topping compounds.

2.7 FINISHES

- .1 Paint: in accordance with Section 09 91 00 – Painting.
- .2 Tiling: in accordance with Section 09 30 13 – Tiling.

Part 3 Execution

3.1 ERECTION

- .1 Do application and finishing of gypsum board in accordance with ASTM C840 except where specified otherwise.
- .2 Do application of gypsum sheathing in accordance with ASTM C1280.
- .3 Erect hangers and runner channels for suspended gypsum board ceilings in accordance with ASTM C840 except where specified otherwise.
- .4 Support light fixtures by providing additional ceiling suspension hangers within 150 mm of each corner and at maximum 600 mm around perimeter of fixture.
- .5 Install work level to tolerance of 1:1200.
- .6 Frame with furring channels, perimeter of openings for access panels, light fixtures, diffusers, grilles.
- .7 Install 19 x 64 mm furring channels parallel to, and at exact locations of steel stud partition header track.
- .8 Furr gypsum board faced vertical bulkheads within and at termination of ceilings.
- .9 Furr above suspended ceilings for gypsum board fire and sound stops and to form plenum areas as indicated.
- .10 Install wall furring for gypsum board wall finishes in accordance with ASTM C840, except where specified otherwise.
- .11 Furr openings and around built-in equipment, cabinets, access panels, on four sides. Extend furring into reveals. Check clearances with equipment suppliers.
- .12 Furr duct shafts, beams, columns, pipes and exposed services where indicated.
- .13 Erect drywall resilient furring transversely across studs and joists spaced maximum 600 mm on centre and not more than 150 mm from ceiling/wall juncture. Secure to each support with 25 mm drywall screw.
- .14 Install 150 mm continuous strip of 12.7 mm gypsum board along base of partitions where resilient furring installed.

3.2 APPLICATION

- .1 Do not apply gypsum board until bucks, anchors, blocking, sound attenuation, electrical and mechanical work are approved.
- .2 Apply single or double layer gypsum board to wood furring or framing using screw fasteners for first layer, screw fasteners for second layer. Maximum spacing of screws 300 mm on centre.
 - .1 Single-Layer Application:
 - .1 Apply gypsum board on ceilings prior to application of walls in accordance with ASTM C840.
 - .2 Apply gypsum board vertically or horizontally, providing sheet lengths that will minimize end joints.
 - .2 Double-Layer Application:
 - .1 Install gypsum board for base layer and exposed gypsum board for face layer.

- .2 Apply base layer to ceilings prior to base layer application on walls; apply face layers in same sequence. Offset joints between layers at least 250 mm.
- .3 Apply base layers at right angles to supports unless otherwise indicated.
- .4 Apply base layer on walls and face layers vertically with joints of base layer over supports and face layer joints offset at least 250 mm with base layer joints.
- .3 Apply single and double layer gypsum board to concrete block surfaces, where indicated, using laminating adhesive.
 - .1 Comply with gypsum board manufacturer's recommendations.
 - .2 Brace or fasten gypsum board until fastening adhesive has set.
 - .3 Mechanically fasten gypsum board at top and bottom of each sheet.
- .4 Exterior Soffits and Ceilings: Install exterior gypsum board perpendicular to supports; stagger end joints over supports. Install with 6 mm gap where boards abut other work.
- .5 Apply 12 mm diameter bead of acoustic sealant continuously around periphery of each face of partitioning to seal gypsum board/structure junction where partitions abut fixed building components. Seal full perimeter of cut-outs around electrical boxes, ducts, in partitions where perimeter sealed with acoustic sealant.
- .6 Apply board using stud adhesive on furring or framing and laminating adhesive on base layer of gypsum board.
- .7 Install ceiling boards in direction that will minimize number of end-butt joints. Stagger end joints at least 250 mm.
- .8 Install gypsum board on walls vertically to avoid end-butt joints. At stairwells and similar high walls, install boards horizontally with end joints staggered over studs, except where local codes or fire-rated assemblies require vertical application.
- .9 Install gypsum board with face side out.
- .10 Do not install damaged or damp boards.
- .11 Locate edge or end joints over supports. Stagger vertical joints over different studs on opposite sides of wall.

3.3 INSTALLATION

- .1 Erect accessories straight, plumb or level, rigid and at proper plane. Use full length pieces where practical. Make joints tight, accurately aligned and rigidly secured. Mitre and fit corners accurately, free from rough edges. Secure at 150 mm on centre or using contact adhesive for full length.
- .2 Install casing beads around perimeter of suspended ceilings.
- .3 Install casing beads where gypsum board butts against surfaces having no trim concealing junction and where indicated. Seal joints with sealant.
- .4 Install insulating strips continuously at edges of gypsum board and casing beads abutting metal window and exterior door frames, to provide thermal break.
- .5 Install shadow mould at gypsum board/ceiling juncture as indicated. Minimize joints; use corner pieces and splicers.

- .6 Construct control joints of preformed units or two back-to-back casing beads set in gypsum board facing and supported independently on both sides of joint.
- .7 Provide continuous polyethylene dust barrier behind and across control joints.
- .8 Locate control joints where indicated and at changes in substrate construction at approximate 10 m spacing on long corridor runs at approximate 15 m spacing on ceilings.
- .9 Install control joints straight and true.
- .10 Construct expansion joints at building expansion and construction joints. Provide continuous dust barrier.
- .11 Install expansion joint straight and true.
- .12 Splice corners and intersections together and secure to each member with 3 screws.
- .13 Install access doors to electrical and mechanical fixtures specified in respective sections.
- .1 Rigidly secure frames to furring or framing systems.
- .14 Finish face panel joints and internal angles with joint system consisting of joint compound, joint tape and taping compound installed according to manufacturer's directions and feathered out onto panel faces.
- .15 Gypsum Board Finish: finish gypsum board walls and ceilings to following levels in accordance with Association of the Wall and Ceiling Industries (AWCI) International Recommended Specification on Levels of Gypsum Board Finish:
 - .1 Levels of finish:
 - .1 Level 0: No taping, finishing or accessories required for areas of temporary construction.
 - .2 Level 1: Embed tape for joints and interior angles in joint compound. Surfaces to be free of excess joint compound; tool marks and ridges are acceptable and for plenum areas above ceilings, in attics or in concealed spaces.
 - .3 Level 2: Embed tape for joints and interior angles in joint compound and apply one separate coat of joint compound over joints, angles, fastener heads and accessories; surfaces free of excess joint compound; tool marks and ridges are acceptable and when gypsum is used as a substrate for tile.
 - .4 Level 3: Embed tape for joints and interior angles in joint compound and apply two separate coats of joint compound over joints, angles, fastener heads and accessories; surfaces smooth and free of tool marks and ridges and where areas are to receive a heavy coating of textured material.
 - .5 Level 4: Embed tape for joints and interior angles in joint compound and apply three separate coats of joint compound over joints, angles, fastener heads and accessories; surfaces smooth and free of tool marks and ridges and where light textures or wall coverings are to be applied.
 - .6 Level 5: Embed tape for joints and interior angles in joint compound and apply three separate coats of joint compound over joints, angles, fastener heads and accessories; apply a thin skim

coat of joint compound to entire surface; surfaces smooth and free of tool marks and ridges. Use this level of finish to minimize joint photographing, in long corridors, and where severe lighting occurs.

- .16 Finish corner beads, control joints and trim as required with two coats of joint compound and one coat of taping compound, feathered out onto panel faces.
- .17 Fill screw head depressions with joint and taping compounds to bring flush with adjacent surface of gypsum board so as to be invisible after surface finish is completed.
- .18 Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surface of board.
- .19 Completed installation to be smooth, level or plumb, free from waves and other defects and ready for surface finish.
- .20 Mix joint compound slightly thinner than for joint taping.
- .21 Apply thin coat to entire surface using trowel or drywall broadknife to fill surface texture differences, variations or tool marks.
- .22 Remove ridges by light sanding or wiping with damp cloth.
- .23 Provide protection that ensures gypsum drywall work will remain without damage or deterioration at time of substantial completion.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 03 30 00 – Cast-In-Place Concrete
- .2 Section 03 35 00 – Concrete Finishing
- .3 Section 06 10 00 – Rough Carpentry
- .4 Section 07 92 00 – Sealants
- .5 Section 09 21 16 – Gypsum Board Assemblies

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/Ceramic Tile Institute (CTI)
 - .1 ANSI/CTI (Ceramic) A108/A118/A136.1-2013, Specification for the Installation of Ceramic Tile - A Collection of 20 ANSI/CTI A108 Series Standards on Ceramic Tile Installation: A108.1A-C, 108.4 -.13, A118.1-.10, ANSI A136.1.
 - .2 CTI (Ceramic) A118.3-2013, Specifications for Chemical Resistant, Water Cleanable Tile-Setting and Grouting Epoxy and Water Cleanable Tile Setting Epoxy Adhesive (included in ANSI A108.1-2013).
 - .3 CTI (Ceramic) A118.4-2012, Specifications for Latex Portland Cement Mortar (included in ANSI A108.1-2013).
 - .4 CTI (Ceramic) A118.5-1999, Specification for Chemical Resistant Furan Resin Mortars and Grouts for Tile Installation (included in ANSI A108.1-2013).
 - .5 CTI (Ceramic) A118.6-2013, Specification for Ceramic Tile Grouts (included in ANSI A108.1-2013).
 - .6 CTI/ANSI A137.1-2012, Testing for Dynamic Coefficient of Friction
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM C144-11, Standard Specification for Aggregate for Masonry Mortar.
 - .2 ASTM C207-06(2011), Standard Specification for Hydrated Lime for Masonry Purposes.
 - .3 ASTM C847-14a, Standard Specification for Metal Lath.
 - .4 ASTM C979/C979M-16, Standard Specification for Pigments for Integrally Coloured Concrete.
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
- .4 Canadian Standards Association (CSA International)
 - .1 CSA-A3000-13, Cementitious materials compendium (Consists of A3001, A3002, A3003, A3004 and A3005), Includes Update No. 1 (2014), Update No. 2 (2014).
- .5 International Organization for Standardization (ISO)
 - .1 ISO 13007:2014, Classifications for Adhesives and Grouts.

- .6 South Coast Air Quality Management District (SCAQMD), California State
 - .1 SCAQMD Rule 1168-05, Adhesives and Sealants Applications.
- .7 Tile Council of North America (TCNA)
 - .1 2015 TCNA Handbook for Ceramic, Glass, and Stone Tile Installation.
- .8 Terrazzo Tile and Marble Association of Canada (TTMAC)
 - .1 Tile Specification Guide 09 30 00, 2016-2017, Tile Installation Manual.
 - .2 Hard Surface Maintenance Guide.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Preconstruction Meeting: Arrange a preconstruction meeting in accordance with Section 01 31 19 – Project Meetings attended by Contractor, Departmental Representative, tile installer, tile supplier, and mortar and grout representative to discuss the following:
 - .1 Substrate and backing surfaces flatness requirements.
 - .2 Installation techniques associated with specified materials.
 - .3 Compatibility between specified materials and between adjacent materials.
 - .4 Concerns arising from site conditions.
 - .5 Concerns of installers or suppliers arising from as-constructed conditions.

1.4 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 – Submittals Procedures:
 - .1 Include manufacturer's information on:
 - .1 Ceramic tile, marked to show each type, size, and shape required.
 - .2 Chemical resistant mortar and grout (Epoxy and Furan).
 - .3 Cementitious backer unit.
 - .4 Dry-set cement mortar and grout.
 - .5 Divider strip.
 - .6 Elastomeric membrane and bond coat.
 - .7 Reinforcing tape.
 - .8 Levelling compound.
 - .9 Latex cement mortar and grout.
 - .10 Commercial cement grout.
 - .11 Organic adhesive.
 - .12 Slip resistant tile.
 - .13 Waterproofing/Crack isolation membrane.
 - .14 Fasteners.
- .2 Submit shop drawings in accordance with Section 01 33 00 – Submittals Procedures:
 - .1 Indicate tile layout, patterns, colour arrangement, perimeter conditions, junctions with dissimilar materials, thresholds, and setting details.

- .2 Locate and detail movement joints.
- .3 Submit samples in accordance with Section 01 33 00 – Submittals Procedures:
 - .1 Tile: Submit actual tile samples illustrating colour, texture, size and pattern for each type of tile specified.
 - .2 Grout: Submit manufacturer's full range of colours available for each type of grout specified.
 - .3 Trim shapes, bullnose cap and cove including bullnose cap and base pieces at internal and external corners of vertical surfaces, each type, colour, and size.
 - .4 Adhere tile samples to 11 mm thick plywood and grout joints to represent project installation.

1.5 EXTRA MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittal.
- .2 Provide minimum 2% of each type and colour of tile required for project for maintenance use. Store where directed.
- .3 Maintenance material same production run as installed material.

1.6 QUALITY ASSURANCE

- .1 Conform to requirements of Terrazzo, Tile and Marble Association of Canada (TTMAC), Tile Specification Guide 09 30 00, Tile Installation Manual.
- .2 Obtain each type of tile material required from single source. For colour consistency, ensure the supplier has capacity to provide products from the same production run, dye lot, calibre and batch number.
- .3 Obtain setting and grouting materials from one manufacturer to ensure compatibility.
- .4 Installer Qualifications: Specializing in tile work having minimum of 5 years successful documented experience with work comparable to that required for this project. Installer must be registered as a member in good standing with the Terrazzo, Tile and Marble Association of Canada.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver materials in containers with labels legible and intact and grade-seals unbroken.
- .2 Store materials so as to prevent damage or contamination.
- .3 Store materials in a dry area, protected from freezing, staining and damage.
- .4 Store cementitious materials on a dry surface.

1.8 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 – Waste Management and Disposal.

1.9 SITE CONDITIONS

- .1 Surfaces for tile installation must be clean, dimensionally stable, cured, level, plumb and free of contaminants such as oil, sealers and curing compounds.
- .2 Maintain air temperature and structural base temperature at ceramic tile installation area above 12 degrees C for 48 hours before, during, and 48 hours after, installation. Tile and setting material stored at same conditions 48 hours before and 7 days after application.
- .3 Do not install tiles at temperatures less than 12 degrees C or above 38 degrees C.
- .4 Do not apply epoxy mortar and grouts at temperatures below 15 degrees C or above 25 degrees C.

Part 2 Products

2.1 MATERIALS

- .1 Factory blend tile that exhibits colour variations within the ranges selected and package so tile units taken from one package show the same range in colours as those taken from other packages.
- .2 Provide tile products manufactured in accordance with CAN/CGSB 75.1 or ANSI A108.1 as appropriate to the Basis-of-Design Materials.
- .3 Performance Requirements:
 - .1 Static Coefficient of Friction: Tile installed on walkway surfaces having following values as determined by testing identical products per ANSI A137.1:
 - .1 Level Surfaces: Minimum 0.6 dry.
 - .2 Step Treads: Minimum 0.6 dry.
 - .3 Ramp Surfaces: Minimum 0.8 dry.
 - .2 Load-Bearing Performance: Provide installations rated for the following load-bearing performance in accordance with ASTM C627 for ceramic tile installed on walkway surfaces:
 - .1 Extra Heavy: Passes cycles 1 through 14.
 - .2 Heavy: Passes cycles 1 through 12.
 - .3 Moderate: Passes cycles 1 through 10.
 - .4 Light: Passes cycles 1 through 6.
 - .5 Residential: Passes cycles 1 through 3.
 - .3 Floor Level Tolerances: Provide materials to attain floor levelness tolerances required by this Section and as required by TTMAC; calculate quantity of materials based on the difference between the specified tolerance and the initial tolerance specified in Section 03 35 00; measurements will be made in the same manner as used in Section 03 35 00.
 - .1 Large Format Tiles: provide minimum floor flatness of FF50; equivalent to 3 mm with no more than 2 gaps under 3000 mm straightedge measurement.

- .4 Provide Products used in exits having a flame spread rating of 25 or less when tested in accordance with ASTM E84 or ULC S102.2.

2.2 FLOOR TILE

- .1 Porcelain tile: to CAN/CGSB-75.1, and as indicated on Drawings.

2.3 WALL TILE

- .1 Ceramic tile: to CAN/CGSB-75.1, and as indicated on Drawings.

2.4 BASE TILE

- .1 Base: coved; type, size, colour and texture to match adjacent flooring material.

2.5 MORTAR, GROUT, AND ADHESIVE MANUFACTURERS

- .1 Acceptable Manufacturers: Subject to compliance with requirements herein, provide products from one of the following manufacturers:
 - .1 Custom Building Products Ltd.
 - .2 Flextile Ltd.
 - .3 Laticrete International Inc.
 - .4 MAPEI Inc.

2.6 MORTAR AND ADHESIVE MATERIALS

- .1 Mortar to be of the following properties unless otherwise specified:
 - .1 Cement: Grey meeting requirements of CSA A3000.
 - .2 Sand: to ASTM C144, passing 16 mesh.
 - .3 Hydrated lime: to ASTM C207, Type N
 - .4 Latex additive: formulated for use in cement mortar and thin set bond coat.
 - .5 Water: potable and free of minerals and chemicals which are detrimental to mortar and grout mixes.
 - .6 Mortars and Adhesives:
 - .1 Maximum VOC limit 65 g/L to SCAQMD Rule 1168.
- .2 Thin Set Mortar: modified, non-sagging, dry-set lightweight cement mortar with polymer and complying with ANSI A118.4, A118.11 and ISO 13007 C2TES1P1.
 - .1 Acceptable Products:
 - .1 Custom Building Products, ProLite Premium Blend LFT Mortar
 - .2 Flextile Ltd., 66 FlexLite Mortar
 - .3 Laticrete International Inc., 255 Multimax
 - .4 MAPEI Inc, Ultralite Mortar
- .3 Polymer Modified Mortar (large tiles): Modified non-sagging dry-set cement mortar with polymer for large and heavy tile thin-set applications, complying with ANSI A118.4, A118.11 and ISO 13007 C2TES1P1:
 - .1 Acceptable Products:
 - .1 Custom Building Products, Versabond LFT
 - .2 Flextile Ltd., 56SR Mortar

- .3 Laticrete International Inc., 4-XLT
- .4 MAPEI Inc., Ultraflex LFT

2.7 GROUT

- .1 Colouring Pigments:
 - .1 Pure mineral pigments, limeproof and nonfading, complying with ASTM C979.
 - .2 Colouring pigments to be added to grout by manufacturer.
 - .3 Job coloured grout are not acceptable.
 - .4 Use in Commercial Cement Grout, Dry-Set Grout, and Latex Cement Grout.
- .2 Ready-to-Use Grout: Professional-grade, ready-to-use colour consistent quartz aggregate, for use with grout joints 1.5 to 12 mm.
 - .1 Colour: Colours to match materials, confirm colour with Departmental Representative prior to ordering.
 - .2 Basis-of-Design:
 - .1 Custom Building Products, Fusion Pro Component Grout
 - .2 Flexile Ltd., ColorMax Plus or Flex-Quartz
 - .3 Laticrete International Inc., Plasma
 - .4 MAPEI Inc., Flexcolour CQ
- .3 Epoxy Grout: Multi-component, factory prepared, 100 percent epoxy resin and hardener with sand or mineral filler material; comply with ANSI A118.3 and ISO 130007 Classification R2/RG/ Classification RD for industrial grade.
 - .1 Colour: Colours to match materials, confirm colour with Departmental Representative prior to ordering.
 - .2 Acceptable Products:
 - .1 CEG-Lite, CEG-IG 100% Solid Commercial Epoxy Grout, Custom Building Products.
 - .2 FlexEpoxy 100 – 100% Solids 2-Component Epoxy Grout, Flexile Ltd.
 - .3 Kerapoxy CQ, Premium Epoxy Mortar and Grout, MAPEI Inc.
 - .4 Latapoxy SpectraLOCK Pro Premium, Laticrete International Inc.
 - .3 Maximum VOC limit 65 g/L to SCAQMD Rule 1168.

2.8 MEMBRANES

- .1 Crack Isolation Membrane: Sheet membrane
 - .1 Basis-of-Design:
 - .1 Crack Buster Pro Crack Prevention Mat & Peel N Stick Primer, Custom Building Products
 - .2 Flexilastic 1000 Crack Isolation Membrane with 4000 Primer, Flexile Ltd.
 - .3 Fracture Ban, Laticrete International Inc.
 - .4 Mapeguard 2, MAPEI Inc.

- .2 Sound Attenuation Matt: Acoustic underlayment: 5 mm thick polypropylene fibers with sound index of FSTC 58 to ASTM E336.

- .1 Basis of Design: Acoustitech 5000

2.9 ACCESSORIES

- .1 Trim shapes:

- .1 Conform to applicable requirements of adjoining floor and wall tile.
 - .2 Use slip resistant trim shapes for horizontal surfaces of showers, overflow ledges, recessed steps, shower curbs, drying area curbs, and stools.
 - .3 Use trim shapes sizes conforming to size of adjoining field wall tile, including existing spaces, unless specified otherwise.
 - .4 Expansion and Control Joints for Thin-Set Applications: Solid brass profiles joined by a soft CPE movement joint material, with integral perforated anchoring legs for setting the joint into the setting bed:
 - .1 Height: As required to suit application
 - .2 Colour: As selected by Departmental Representative
 - .3 Basis of Design
 - .1 Schlüter®-DILEX
 - .5 Transition joint strip with integral perforated anchoring leg for setting the strip into the setting materials:
 - .1 Profile: Sloped, narrow profile transition strip.
 - .2 Height: As required to suit application.
 - .3 Material: Brass
 - .4 Finish: As selected by Departmental Representative from manufacturer's standard finishes.
 - .5 Basis of Design:
 - .1 Schlüter®-RENO
 - .6 Straight edge strips with integral perforated anchoring leg for setting the strip into the setting material:
 - .1 Height: As required to suit application.
 - .2 Basis of Design:
 - .1 Schlüter®-SCHIENE
 - .7 Internal and External Corners: provide trim shapes as follows where indicated.
 - .1 Bullnose shapes for external corners including edges.
 - .2 Coved shapes for internal corners.
 - .3 Special shapes for:
 - .1 Base to floor internal corners to provide integral coved vertical and horizontal joint.
 - .2 Base to floor external corners to provide bullnose vertical edge with integral coved horizontal joint. Use as stop at bottom of openings having bullnose return to wall.
 - .3 Wall top edge internal corners to provide integral coved vertical joint with bullnose top edge.

- .4 Wall top edge external corners to provide bullnose vertical and horizontal joint edge.
- .8 Provide cove and bullnose shapes where indicated and required to complete tile work.
- .2 Divider strips:
 - .1 Laminated strips, core 32 x 3 mm black neoprene, outsides (both sides) brass 32 x 1.29 mm complete with anchors, both sides spaced at 150 mm on centre.
- .3 Reducer Strips: purpose made metal extrusion; stainless steel type; maximum slope of 1:2.
- .4 Sealant: in accordance with Section 07 92 00 - Joint Sealants.
 - .1 Sealants: maximum VOC limit 250 g/L to SCAQMD Rule 1168.
- .5 Tile sealer and protective coating: to CAN/CGSB-25.20, Type to tile and grout manufacturers recommendations.

2.10 PATCHING AND LEVELLING COMPOUND

- .1 Cement base, acrylic polymer compound, manufactured specifically for resurfacing and leveling concrete floors. Products containing gypsum are not acceptable.
- .2 Have not less than the following physical properties:
 - .1 Compressive strength - 25 MPa.
 - .2 Tensile strength - 7 MPa.
 - .3 Flexural strength - 7 MPa.
 - .4 Density - 1.9.
- .3 Capable of being applied in layers up to 12 mm thick, being brought to feather edge, and being trowelled to smooth finish.
- .4 Ready for use in 48 hours after application.
- .5 Acceptable materials:
 - .1 59 Flex Flo with 4040 Concrete Primer, Flextile Ltd.
 - .2 CustomTech TechLevel 150 with CustomTech TechPrime A, Custom Building Products
 - .3 Novoplan Easy Plus, MAPEI Inc
 - .4 NXT Level, Laticrete International Inc.

2.11 CLEANING COMPOUNDS

- .1 Specifically designed for cleaning masonry and concrete and which will not prevent bond of subsequent tile setting materials including patching and leveling compounds and elastomeric waterproofing membrane and coat.
- .2 Materials containing acid or caustic material are not acceptable.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 PREPARATION

- .1 Protect surrounding work from damage or disfiguration arising from work of this Section.
- .2 Surfaces: Thoroughly clean substrate surfaces receiving tile finishes to remove grease, oil or dust films, and other contaminants affecting bond of materials within bonding systems and as follows:
 - .1 Clean back of each tile before installation to remove surface contaminants and cutting residue, firing release dust and other debris detrimental to bond and final surface appearance.
- .3 Surface Levelling: apply self levelling compound to make backing surfaces flat and true to tolerances in plane listed in performance requirements above and as required by TTMAC.

3.3 WORKMANSHIP

- .1 Do tile work in accordance with TTMAC Tile Installation Manual except where specified otherwise.
- .2 Apply tile or backing coats to clean and sound surfaces.
- .3 Back Buttering: Obtain minimum 95% mortar coverage in accordance with applicable requirements for back buttering of tile in referenced TTMAC and ANSI A108 series of tile installation standards for the following applications:
 - .1 Tile having tiles 305 mm or larger in any direction.
 - .2 Tile installed with chemical resistant mortars and grouts
 - .3 Tile having tiles with raised or textured backs.
 - .4 Tile having tile installation rated for Heavy or Extra Heavy Duty.
 - .5 All porcelain tiles with more than 20% of the tile backs covered with "white firing release" shall be "back buttered" so that 100% of the back is covered with adhesive mortar rated for C627, Extra Heavy Duty rating.
- .4 Fit tile around corners, fitments, fixtures, drains and other built-in objects. Maintain uniform joint appearance. Cut edges smooth and even. Do not split tiles.
- .5 Maximum surface tolerance 1:800.
- .6 Make joints between tile uniform, plumb, straight, true, even and flush with adjacent tile. Confirm joint width with Departmental Representative. Ensure sheet layout not visible after installation. Align patterns.
- .7 Lay out tiles so perimeter tiles are minimum 1/2 size.
- .8 Sound tiles after setting and replace hollow-sounding units to obtain full bond.
- .9 Make internal angles square, external angles bullnosed.

- .10 Use bullnose edged tiles at termination of wall tile panels, except where panel abuts projecting surface or differing plane.
- .11 Install divider strips at junction of tile flooring and dissimilar materials.
- .12 Allow minimum 24 hours after installation of tiles, before grouting.
- .13 Clean installed tile surfaces after installation and grouting cured.
- .14 Install prefabricated control and movement joints in tile Work in accordance with detail 301MJ from TTMAC Installation Manual to suit installation indicated.
- .15 Locate expansion, control, contraction, and isolation joints, as indicated in the TTMAC Installation manual to suit installation.
- .16 Fill control joints with sealant in accordance with Section 07 92 00 - Joint Sealants. Keep building expansion joints free of mortar and grout.

3.4 UNCOUPLING MEMBRANE INSTALLATION

- .1 Install uncoupling membrane in accordance with manufacturer's written instructions to produce membrane of uniform thickness bonded securely to substrate.

3.5 WALL TILE

- .1 Install tile on concrete and masonry walls to TTMAC details 302W and 303W.
- .2 Install tile on gypsum and cementitious board to TTMAC details 305W and 306W:
 - .1 Install cementitious board to areas listed.

3.6 FLOOR TILE

- .1 Install tile on concrete floor substrates to TTMAC detail 309F, 310F or 311F.
- .2 Install tile on wood floor substrates to TTMAC detail 313F A, B, or C and 314F.
- .3 Install large format floor tile in accordance with TTMAC detail 329 LFT

3.7 TILE SEALER AND PROTECTIVE COATING

- .1 Apply manufacturer's recommended floor sealer in strict accordance with manufacturer's written instructions for the specific tile type being sealed.
- .2 Apply sealer to tiles before grouting in cases of absorbent biscuit tiles and again after completion and cleaning of grouting process.

3.8 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.9 CLEANING

- .1 On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter using Job Site Cleaner listed above:

- .1 Remove grout residue from tile as soon as possible.
- .2 Unglazed tile may be cleaned with acid solutions only when permitted by tile and grout manufacturer's written instructions, but no sooner than 10 days after installation.
- .3 Protect metal surfaces, cast iron, and vitreous plumbing fixtures from effects of acid cleaning.
- .4 Flush surface with clean water before and after cleaning.
- .5 Remove temporary protective coating by method recommended by coating manufacturer that is acceptable to brick and grout manufacturer. Trap and remove coating to prevent it from clogging drains.
- .2 Leave finished installation clean and free of cracked, chipped, broken, unbonded, or other tile deficiencies:
 - .1 Protect finished areas from traffic until setting materials have sufficiently cured in accordance with TTMAC requirements.
 - .2 Protect floor areas from traffic after grouting is completed in accordance with manufacturer's written instructions.
 - .1 Keep traffic off floors for a minimum of 24 hours after completion of grouting.
 - .2 Use stepping boards where access is required for light foot traffic only after 4 hours from completion of grouting.
- .3 Provide protective covering until Substantial Performance of the Work.
 - .1 Protect wall tiles and bases from impact, vibration, heavy hammering on adjacent and opposite walls for a minimum of 7 days after installation.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 06 10 00 – Rough Carpentry
- .2 Section 07 92 00 – Sealants

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM F710-11, Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
 - .2 ASTM F1066-04(2014)e1, Standard Specification for Vinyl Composition Floor Tile.
 - .3 ASTM F1303-04(2014), Standard Specification for Sheet Vinyl Floor Covering with Backing.
 - .4 ASTM F1344-15, Standard Specification for Rubber Floor Tile.
 - .5 ASTM F1516-13, Standard Practice for Sealing Seams of Resilient Flooring Products by the Heat Weld Method (when Recommended).
 - .6 ASTM F1700-13a, Standard Specification for Solid Vinyl Floor Tile.
 - .7 ASTM F1860-14e1, Standard Specification for Rubber Sheet Floor Covering With Backing.
 - .8 ASTM F1861-16, Standard Specification for Resilient Wall Base.
 - .9 ASTM F1913-04(2014), Standard Specification for Vinyl Sheet Floor Covering Without Backing.
 - .10 ASTM F2034-08(2013), Standard Specification for Sheet Linoleum Floor Covering.
 - .11 ASTM F2195–13, Standard Specification for Linoleum Tile Flooring, Type 1
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .3 South Coast Air Quality Management District (SCAQMD), California State
 - .1 SCAQMD Rule 1113-16, Architectural Coatings.
 - .2 SCAQMD Rule 1168-05, Adhesives and Sealants Applications.
- .4 Underwriters Laboratories of Canada (ULC):
 - .1 CAN/ULC S102.2-10, Method of Test for Surface Burning Characteristics of Flooring, Floor Covering and Miscellaneous Materials and Assemblies.

1.3 SUBMITTALS

- .1 Provide product data in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Submit one copy of product data for each type of product specified.
 - .2 Submit WHMIS Material Safety Data Sheets (MSDS) for flooring adhesive and seam welding. Indicate VOC content.
- .2 Provide samples in accordance with Section 01 33 00 - Submittal Procedures.

- .1 Submit duplicate 300 x 300 mm sample pieces of sheet material, 300 mm long base, and nosing.
- .3 Closeout Submittals:
 - .1 Provide manufacturer's printed recommendations for general maintenance, including cleaning instructions and guidelines for use of waxes and other protective coatings and appearance enhancers in accordance with Section 01 78 00 – Closeout Submittals.

1.4 EXTRA MATERIALS

- .1 Provide extra materials of resilient sheet flooring and adhesives in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Provide 5 m² of each colour, pattern and type flooring material required for project for maintenance use.
- .3 Extra materials one piece and from same production run as installed materials.
- .4 Clearly identify each roll of sheet flooring and each container of adhesive.
- .5 Deliver to Departmental Representative upon completion of the work of this section.
- .6 Store where directed by Departmental Representative.

1.5 QUALITY ASSURANCE

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

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials in good conditions to the jobsite in the manufacturer's original unopened containers that bear the name and brand of the manufacturer, project identification, and shipping and handling instructions.
- .3 Store materials in a clean, dry, enclosed space off the ground, and protect from the weather and from extremes of heat and cold. Protect adhesive from freezing.

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

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

1.7 WASTE MANAGEMENT AND DISPOSAL

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

1.8 AMBIENT CONDITIONS

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

1.9 WARRANTY

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

Part 2 Products

2.1 MATERIALS

- .1 Basis-of-Design: Materials and colours listed below form the Basis-of-Design materials for this project.
- .2 Materials other than named products Basis-of-Design materials may be acceptable to the Departmental Representative; submit information in accordance with Section 01 62 00 – Product Options no later than seven (7) days prior to bid closing date and as follows:
 - .1 Proposed alternates shall match colour range, texture and performance characteristics of named products, and shall not require a change to colour board for Project.
 - .2 Proposed alternates found acceptable by Departmental Representative will be listed in an Addendum.
 - .3 The Departmental Representative is not obliged to accept any materials presented for their review and does not need to provide reasons for rejection of proposed alternates.

2.2 TILE FLOORING

- .1 Solid Vinyl Floor Tile: to ASTM F1700, and as follows:
 - .1 Class: I – monolithic
 - .2 Thickness: 3 mm.
 - .3 Size: 305 x 305 mm.
 - .4 Colour: as indicated in Finish Schedule on Drawings.

2.3 RESILIENT BASE

- .1 Resilient Base: to ASTM F1861, and as follows:
 - .1 Type: TS – Thermoset Vulcanized Rubber.
 - .2 Group: 1 – solid
 - .3 Style: B – Cove
 - .4 Thickness: 2.03 mm.
 - .5 Height: as indicated
 - .6 Length: 36.5 meter rolls.
 - .7 End Stops and External Corners: premoulded.
 - .8 Colour: as indicated on Finish Schedule.

2.4 ACCESSORIES

- .1 Resilient Transition and Edge Strips: Extruded vinyl shapes meeting or exceeding ADA Recommendations for change of level transitions for transition between floors finishes having different levels; acceptable materials as follows:
 - .1 The following list is included to indicate the most commonly used transition and edge strip accessories; additional materials may be required where transition heights differ from the products listed and shall be included as a part of the Contract.
 - .1 Transition Strip: Ceramic Tile to Resilient Flooring Transition: Johnsonite CTA-XX-K Transitional Moulding between flooring materials having dissimilar thicknesses; colour: selected from manufacturer's standard range.
 - .2 Transition Strip: Resilient Flooring to Concrete Slab Transition: Johnsonite SSR-XX-B Transitional Moulding between materials having a thickness to materials having no thickness; colour: selected from manufacturer's standard range.
 - .3 Transition Strip: Resilient Flooring to Resilient Flooring Transition: Johnsonite CTA-XX-N Transitional Moulding between materials having the same thickness; colour: selected from manufacturer's standard range.
 - .2 Metal edge strips:
 - .1 Extruded, smooth, mill finish stainless steel with lip to extend under floor finish, shoulder flush with top of adjacent floor finish.
 - .3 Sub-floor filler and leveller: white premix latex requiring water only to produce cementitious paste or 2 part latex-type filler requiring no water as recommended by flooring manufacturer for use with their product.
 - .4 Primers and adhesives: of types recommended by resilient flooring manufacturer for specific material on applicable substrate, above, on or below grade.
 - .1 VCT adhesives:
 - .1 Adhesive: maximum VOC limit 50 g/L to SCAQMD Rule 1168.
 - .2 Cove base adhesives:
 - .1 Adhesive: maximum VOC limit 50 g/L to SCAQMD Rule 1168.
 - .5 Sealer and wax: type recommended by resilient flooring material manufacturer for material type and location.

- .1 Sealer: maximum VOC limit 100 g/L to SCAQMD Rule 1113.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 SITE VERIFICATION OF CONDITIONS

- .1 Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring substrate.
- .2 Ensure concrete floors have maximum 2.5% moisture content, exhibit normal alkalinity and no carbonization or dusting.
- .3 Ensure concrete floors are clean, smooth, and flat to plus or minus 3 mm over 3 meters.

3.3 PREPARATION

- .1 Clean floor and apply filler; trowel and float to leave smooth, flat hard surface. Prohibit traffic until filler cured and dry.
- .2 Remove sub-floor ridges and bumps. Fill low spots, cracks, joints, holes and other defects with sub-floor filler.
- .3 Prohibit traffic until filler is cured
- .4 Clean substrates of contaminants.
- .5 Alkalinity and Adhesion Testing: perform tests recommended by manufacturer. Proceed with installation after substrates pass testing.
- .6 Moisture Testing: perform tests recommended by manufacturer and as follows:
 - .1 Perform anhydrous calcium chloride test ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapour-emission rate of 3 lb of water/1000 sq. ft in 24 hours.
 - .2 Perform relative humidity test using in situ probes, ASTM F2170. Proceed with installation only after substrates have maximum 75 percent relative humidity level measurement.
 - .3 Proceed with installation after substrates pass testing.
- .7 Prime or seal concrete slab or plywood sub-floor to resilient flooring manufacturer's printed instructions.

3.4 INSTALLATION: GENERAL

- .1 Provide high ventilation rate, with maximum outside air, during installation, and for 48 to 72 hours after installation. If possible, vent directly to outside. Do not let contaminated air recirculate through district or whole building air distribution system. Maintain extra ventilation for at least one month following building occupation.

- .2 Apply adhesive uniformly using recommended trowel in accordance with flooring manufacturer's instructions. Do not spread more adhesive than can be covered by flooring before initial set takes place.
- .3 Cut flooring around fixed objects.
- .4 Install feature strips and floor markings where indicated. Fit joints tightly.
- .5 Install flooring in pan type floor access covers. Maintain floor pattern.
- .6 Continue flooring over areas which will be under built-in furniture.
- .7 Continue flooring through areas to receive movable type partitions without interrupting floor pattern.
- .8 Terminate flooring at centreline of door in openings where adjacent floor finish or colour is dissimilar.
- .9 Install metal edge strips at unprotected or exposed edges where flooring terminates.

3.5 INSTALLATION: FLOOR TILE

- .1 Lay flooring with joints parallel to building lines to produce symmetrical tile pattern. Border tiles minimum half tile width.
- .2 Install flooring to pattern as directed by Departmental Representative
- .3 As installation progresses and after installation is complete, roll resilient tile flooring in accordance with manufacture's instructions.

3.6 INSTALLATION: BASE

- .1 Lay out base to keep number of joints at minimum.
- .2 Clean substrate and prime with one coat of adhesive.
- .3 Apply adhesive to back of base.
- .4 Set base against wall and floor surfaces tightly by using 3 kg hand roller.
- .5 Install straight and level to variation of 1:1000.
- .6 Scribe and fit to door frames and other obstructions. Use premoulded end pieces at flush door frames.
- .7 Cope internal corners. Use premoulded corner units for right angle external corners. Use formed straight base material for external corners of other angles.
- .8 Use toeless type base where floor finish will be carpet, coved type elsewhere.
- .9 Install toeless type base before installation of carpet on floors.
- .10 Heat weld base in accordance with manufacturer's printed instructions.

3.7 INSTALLATION: ACCESSORIES

- .1 Install feature strips and floor markings where indicated. Fit joints tightly.
- .2 Install metal edge strips at unprotected and exposed edges where flooring terminates.
- .3 Install cove support strips continuously where sheet flooring is to be coved to vertical surfaces.

- .4 Install cap strips continuously to cover top edge of coved sheet flooring. Mitre corners. Top of cap strip shall be straight and level to variation of plus or minus 3 mm over 3 m straight edge.

3.8 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.9 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Remove excess adhesive from floor, base and wall surfaces without damage.
- .3 Clean, seal and wax floor and base surface to flooring manufacturer's printed instructions.

3.10 PROTECTION

- .1 Protect new floors from time of final set of adhesive until final inspection.
- .2 Prohibit traffic on floor for 48 hours after installation.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Technical sections as indicated.

1.2 REFERENCES

- .1 American Society of Testing and Materials (ASTM)
 - .1 ASTM D16-16, Standard Terminology for Paint, Related Coatings, Materials, and Applications.
 - .2 ASTM E84-16, Standard Test Method for Surface Burning Characteristics of Building Materials.
- .2 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
- .3 Environmental Protection Agency (EPA)
 - .1 EPA Test Method for Measuring Total Volatile Organic Compound Content of Consumer Products, Method 24 - 1995, (for Surface Coatings).
- .4 Green Seal
 - .1 Green Seal Standards GS-11, Paint.
 - .2 Green Seal Standard GC-03, Anti-Corrosive Paints.
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .6 Master Painters Institute (MPI)
 - .1 MPI Architectural Painting Specifications Manual.
- .7 National Fire Code of Canada – 2015.
- .8 South Coast Air Quality Management District (SCAQMD), California State
 - .1 SCAQMD Rule 1113-16, Architectural Coatings.
- .9 Society for Protective Coatings (SSPC)
 - .1 SSPC Painting Manual, Volume 2

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Installation Meeting:
 - .1 Convene pre-installation meeting one week prior to beginning work of this Section and on-site installations in accordance with Construction Progress Schedule.
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Coordination with other building subtrades.
 - .4 Review manufacturer's installation instructions and warranty requirements.
- .2 Scheduling

- .1 Submit work schedule for various stages of painting to Departmental Representative for review. Submit schedule minimum of 48 hours in advance of proposed operations.
- .2 Obtain written authorization from Departmental Representative for changes in work schedule.
- .3 Schedule painting operations to prevent disruption of and by other trades.
- .4 Schedule painting operations to prevent disruption of occupants.
- .3 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Health and Safety Requirements.

1.4 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 – Submittals
 - .1 Submit product data and instructions for each paint and coating product to be used.
 - .2 Submit product data for the use and application of paint thinner.
 - .3 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures. Indicate VOCs during application and curing.
- .2 Submit samples in accordance with Section 01 33 00 – Submittals.
 - .1 Submit full range colour sample chips to indicate where colour availability is restricted.
 - .2 Submit duplicate 200 x 300 mm sample panels of each paint and stain with specified paint or coating in colours, gloss/sheen and textures required to MPI Architectural Painting Specification Manual standards submitted on following substrate materials:
 - .1 3 mm plate steel for finishes over metal surfaces.
 - .2 13 mm birch plywood for finishes over wood surfaces.
 - .3 50 mm concrete block for finishes over concrete or concrete masonry surfaces.
 - .4 13 mm gypsum board for finishes over gypsum board and other smooth surfaces.
 - .5 10 mm plywood for finishes over wood surfaces.
 - .3 Retain reviewed samples on-site to demonstrate acceptable standard of quality for appropriate on-site surface.
- .3 Closeout Submittals: submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals include following:
 - .1 Product name, type and use.
 - .2 Manufacturer's product number.
 - .3 Colour numbers.
 - .4 MPI Environmentally Friendly classification system rating.
- .4 If requested, submit a list of all painting materials to the Departmental Representative and the Paint Inspection Agency for review prior to ordering materials. If requested, provide an invoice list of all paint materials ordered for

project work to Paint Inspection Agency indicating manufacturer, types and quantities for verification and compliance with specification and design requirements.

- .5 Manufacturer's Instructions:
 - .1 Submit manufacturer's installation and application instructions.
- .6 Submit quality assurance submittals in accordance with Section 01 45 00 - Quality Control.
 - .1 Test reports: submit certified test reports for paint from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
 - .1 Lead, cadmium and chromium: presence of and amounts.
 - .2 Mercury: presence of and amounts.
 - .3 Organochlorines and PCBs: presence of and amounts.
 - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.5 QUALITY ASSURANCE

- .1 Contractor: minimum of five years proven satisfactory experience. Provide list of last three comparable jobs including, job name and location, specifying authority, and project manager.
- .2 Journeymen: qualified journeymen who have "Tradesman Qualification Certificate of Proficiency" engaged in painting work.
- .3 Apprentices: working under direct supervision of qualified trades person in accordance with trade regulations.
- .4 Testing and Inspection: painting work to be inspected by a Paint Inspection Agency (Inspector) acceptable to MPI Accredited Quality Assurance Association.
- .5 Notify the Paint Inspection Agency on award of contract and make application for assignment of an Inspector using appropriate forms supplied by the Agency as well as provide a copy of the project painting specification, drawings, color schedule and list of proposed materials for review purposes prior to commencement of work.

1.6 MOCK-UPS

- .1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control.
 - .1 Provide 3 m x 3 m mock-up. Prepare and paint designated surface, area, room or item (in each colour scheme) to specified requirements, with specified paint or coating showing selected colours, gloss/sheen, textures.
 - .2 Mock-up will be used to judge workmanship, substrate preparation, operation of equipment and material application and workmanship to MPI Architectural Painting Specification Manual standards.
 - .3 Locate where directed.
 - .4 Allow 24 hours for review of mock-up before proceeding with work.

- .5 When accepted, mock-up will demonstrate minimum standard of quality required for this work. Approved mock-up may remain as part of finished work.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, Shipping, Handling and Unloading:
 - .1 Pack, ship, handle and unload materials in accordance with Section 01 61 00 - Common Product Requirements and manufacturer's written instructions.
- .2 Acceptance at Site:
 - .1 Identify products and materials with labels indicating:
 - .1 Manufacturer's name and address.
 - .2 Type of paint or coating.
 - .3 Compliance with applicable standard.
 - .4 Colour number in accordance with established colour schedule.
- .3 Remove damaged, opened and rejected materials from site.
- .4 Storage and Protection:
 - .1 Provide and maintain dry, temperature controlled, secure storage.
 - .2 Store materials and supplies away from heat generating devices.
 - .3 Store materials and equipment in well ventilated area with temperature range 7 degrees C to 30 degrees C.
- .5 Store temperature sensitive products above minimum temperature as recommended by manufacturer.
- .6 Keep areas used for storage, cleaning and preparation clean and orderly. After completion of operations, return areas to clean condition.
- .7 Remove paint materials from storage only in quantities required for same day use.
- .8 Fire Safety Requirements:
 - .1 Provide one 9 kg Type ABC dry chemical fire extinguisher adjacent to storage area.
 - .2 Store oily rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.
 - .3 Handle, store, use and dispose of flammable and combustible materials in accordance with National Fire Code of Canada requirements.

1.8 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for recycling in accordance with Section 01 74 21 - Waste Management and Disposal.
- .2 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal, regulations.
- .3 Ensure emptied containers are sealed and stored safely.

- .4 Unused paint materials must be disposed of at official hazardous material collections site as approved by Departmental Representative.
- .5 Paint, stain and wood preservative finishes and related materials (thinners, and solvents) are regarded as hazardous products and are subject to regulations for disposal. Information on these controls can be obtained from Provincial Ministries of Environment and Regional levels of Government.
- .6 Material which cannot be reused must be treated as hazardous waste and disposed of in an appropriate manner.
- .7 Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in containers or areas designated for hazardous waste.
- .8 To reduce the amount of contaminants entering waterways, sanitary/storm drain systems or into ground follow these procedures:
 - .1 Retain cleaning water for water-based materials to allow sediments to be filtered out.
 - .2 Retain cleaners, thinners, solvents and excess paint and place in designated containers and ensure proper disposal.
 - .3 Return solvent and oil soaked rags used during painting operations for contaminant recovery, proper disposal, or appropriate cleaning and laundering.
 - .4 Dispose of contaminants in approved legal manner in accordance with hazardous waste regulations.
 - .5 Empty paint cans are to be dry prior to disposal or recycling (where available).
- .9 Where paint recycling is available, collect waste paint by type and provide for delivery to recycling or collection facility.
- .10 Set aside and protect surplus and uncontaminated finish materials. Deliver to or arrange collection by individuals or organizations for verifiable re-use or re-manufacturing.

1.9 SITE CONDITIONS

- .1 Heating, Ventilation and Lighting:
 - .1 Ventilate enclosed spaces.
 - .2 Provide heating facilities to maintain ambient air and substrate temperatures above 10 degrees C for 24 hours before, during and after paint application until paint has cured sufficiently.
 - .3 Provide continuous ventilation for seven days after completion of application of paint.
 - .4 Coordinate use of existing ventilation system with Departmental Representative and ensure its operation during and after application of paint as required.
 - .5 Provide temporary ventilating and heating equipment where permanent facilities are not available or supplemental ventilating and heating equipment if ventilation and heating from existing system is inadequate to meet minimum requirements.
 - .6 Provide minimum lighting level of 323 Lux on surfaces to be painted.

- .2 Temperature, Humidity and Substrate Moisture Content Levels:
 - .1 Unless pre-approved written approval by Departmental Representative and product manufacturer, perform no painting when:
 - .1 Ambient air and substrate temperatures are below 10 degrees C.
 - .2 Substrate temperature is above 32 degrees C unless paint is specifically formulated for application at high temperatures.
 - .3 Substrate and ambient air temperatures are not expected to fall within MPI or paint manufacturer's prescribed limits.
 - .4 The relative humidity is over 85% or when the dew point is more than 3 degrees C variance between the air/surface temperature. Paint should not be applied if the dew point is less than 3 degrees C below the ambient or surface temperature. Use sling psychrometer to establish the relative humidity before beginning paint work.
 - .5 Rain or snow are forecast to occur before paint has thoroughly cured or when it is foggy, misty, raining or snowing at site.
 - .6 Ensure that conditions are within specified limits during drying or curing process, until newly applied coating can itself withstand 'normal' adverse environmental factors.
 - .2 Perform painting work when maximum moisture content of the substrate is below:
 - .1 12% for concrete and masonry (clay and concrete brick/block).
 - .2 15% for wood.
 - .3 12% for plaster and gypsum board.
 - .4 Allow new concrete and masonry to cure minimum of 28 days.
 - .3 Test for moisture using calibrated electronic Moisture Meter. Test concrete floors for moisture using "cover patch test".
 - .4 Test concrete, masonry and plaster surfaces for alkalinity as required.
- .3 Surface and Environmental Conditions:
 - .1 Apply paint finish in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.
 - .2 Apply paint to adequately prepared surfaces and to surfaces within moisture limits.
 - .3 Apply paint when previous coat of paint is dry or adequately cured.
- .4 Additional interior application requirements:
 - .1 Apply paint finishes when temperature at location of installation can be satisfactorily maintained within manufacturer's recommendations.
 - .2 Apply paint in occupied facilities during silent hours only. Schedule operations to approval of Departmental Representative such that painted surfaces will have dried and cured sufficiently before occupants are affected.
- .5 Additional exterior application requirements:
 - .1 Apply paint finishes when conditions forecast for entire period of application fall within manufacturer's recommendations.

- .2 Do not apply paint when:
 - .1 Temperature is expected to drop below 10 degrees C before paint has thoroughly cured.
 - .2 Substrate and ambient air temperatures are expected to fall outside MPI or paint manufacturer's limits.
 - .3 Surface to be painted is wet, damp or frosted.
- .3 Provide and maintain cover when paint must be applied in damp or cold weather. Heat substrates and surrounding air to comply with temperature and humidity conditions specified by manufacturer. Protect until paint is dry or until weather conditions are suitable.
- .4 Schedule painting operations such that surfaces exposed to direct, intense sunlight are scheduled for completion during early morning.
- .5 Remove paint from areas which have been exposed to freezing, excess humidity, rain, snow or condensation. Prepare surface again and repaint.

1.10 GUARANTEE

- .1 Furnish either the local MPI Accredited Quality Assurance Association's two (2) year guarantee, or, alternatively, a 100% two (2) year Maintenance Bond - both in accordance with MPI Painting Manual requirements. The Maintenance Bond shall warrant that all painting work has been performed in accordance with MPI Painting Manual requirements.
- .2 All painting and decorating work shall be in accordance with MPI Painting Manual requirements and shall be inspected by the local MPI Accredited Quality Assurance Association's Paint Inspection Agency (inspector), whether using either the MPI Accredited Quality Assurance Association's guarantee, or the Maintenance Bond option. The cost for such inspections, and for either the local MPI Accredited Quality Assurance Association's Guarantee, or the Maintenance Bond, shall be included in the Base Bid Price.
- .3 Painting and decorating Subcontractors choosing the Maintenance Bond option shall provide a maintenance bond consent from a reputable surety company licensed to do business in Canada. Cash or certified check are not acceptable in lieu of surety consent.

Part 2 Products

2.1 MATERIALS

- .1 Paint materials listed in the MPI Approved Products List (APL) are acceptable for use on this project.
- .2 Provide paint materials for paint systems from single manufacturer.
- .3 Only qualified products with E2 "Environmentally Friendly" ratings are acceptable for use on this project, Use E3 rated products where available.
- .4 Use only MPI listed L rated materials.
- .5 Conform to latest MPI requirements for all painting work including preparation and priming.

- .6 Materials (primers, paints, coatings, varnishes, stains, lacquers, fillers, thinners, solvents, etc.) in accordance with MPI - Architectural Painting Specification Manual "Approved Product" listing.
- .7 Linseed oil, shellac, and turpentine: highest quality product from approved manufacturer listed in MPI Architectural Painting Specification Manual, compatible with other coating materials as required.
- .8 Paints, coatings, adhesives, solvents, cleaners, lubricants, and other fluids:
 - .1 Use water-based coatings where available.
 - .2 Non-flammable.
 - .3 Manufactured without compounds which contribute to ozone depletion in the upper atmosphere.
 - .4 Manufactured without compounds which contribute to smog in the lower atmosphere.
 - .5 Do not contain methylene chloride, chlorinated hydrocarbons, toxic metal pigments.
- .9 Formulate and manufacture water-borne surface coatings with no aromatic solvents, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavalent chromium or their compounds.
- .10 Flash point: 61.0 degrees C or greater for water-borne surface coatings and recycled water-borne surface coatings.
- .11 Ensure manufacture and process of both water-borne surface coatings and recycled water-borne surface coatings does not release:
 - .1 Matter in undiluted production plant effluent generating 'Biochemical Oxygen Demand' (BOD) in excess of 15 mg/L to natural watercourse or sewage treatment facility lacking secondary treatment.
 - .2 Total Suspended Solids (TSS) in undiluted production plant effluent in excess of 15 mg/L to natural watercourse or a sewage treatment facility lacking secondary treatment.
- .12 Water-borne paints and stains, recycled water-borne surface coatings and water borne varnishes to meet minimum "Environmentally Friendly" E2 rating.
- .13 Recycled water-borne surface coatings to contain 50% post-consumer material by volume.
- .14 Recycled water-borne surface coatings must not contain:
 - .1 Lead in excess of 600.0 ppm weight/weight total solids.
 - .2 Mercury in excess of 50.0 ppm weight/weight total product.
 - .3 Cadmium in excess of 1.0 ppm weight/weight total product.
 - .4 Hexavalent chromium in excess of 3.0 ppm weight/weight total product.
 - .5 Organochlorines or polychlorinated biphenyls (PCBS) in excess of 1.0 ppm weight/weight total product.
- .15 VOC limits for architectural paints and coatings applied to interior surfaces in accordance with Green Seal Standard GS-11 and as follows:
 - .1 Interior Flat Coating or Primer: maximum VOC limit 50 g/L.
 - .2 Interior Non-Flat Coating or Primer: maximum VOC limit 150 g/L.

- .16 VOC limits for anti-corrosive and anti-rust paints applied to interior ferrous metal substrates in accordance with Green Seal Standard GS-03 and as follows:
 - .1 Anti-Corrosive/Anti-Rust Paint: maximum VOC limit 250 g/L.
- .17 VOC limits for wood finishes, floor coatings, stains, primers and shellacs applied to interior elements in accordance with SCAQMD Rule 1113 and as follows:
 - .1 Clear Wood Finishes – Lacquer: maximum VOC limit 550 g/L.
 - .2 Clear Wood Finishes – Sanding Sealers: maximum VOC limit 350 g/L.
 - .3 Clear Wood Finishes – Varnish: maximum VOC limit 350 g/L.
 - .4 Clear Brushing Lacquer: maximum VOC limit 680 g/L.
 - .5 Floor Coatings: maximum VOC limit 100 g/L.
 - .6 Sealers and Undercoaters: maximum VOC limit 200 g/L.
 - .7 Shellac – Clear: maximum VOC limit 730 g/L.
 - .8 Shellac – Pigmented: maximum VOC limit 550 g/L.
 - .9 Stain: maximum VOC limit 250 g/L.
 - .10 Pigmented Lacquer: maximum VOC limit 550 g/L.
 - .11 Low-Solids Coatings: maximum VOC limit 120 g/L.

2.2 COLOURS

- .1 As indicated on Drawings
- .2 Second coat in three coat system to be tinted slightly lighter colour than top coat to show visible difference between coats.

2.3 MIXING AND TINTING

- .1 Unless otherwise specified or pre-approved, all paint shall be ready-mixed and pre-tinted. Re-mix all paint in contained prior to and during application to ensure break-up of lumps, completed dispersion of settled pigment, and colour and gloss uniformity.
- .2 Mix paste, powder or catalyzed paint mixes in accordance with manufacturer's written instructions.
- .3 Use and add thinner in accordance with paint manufacturer's recommendations. Do not use kerosene or similar organic solvents to thin water-based paints.
- .4 Thin paint for spraying in accordance with paint manufacturer's instructions.

2.4 GLOSS/SHEEN RATINGS

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

	Gloss @ 60 degrees	Sheen @ 85 degrees
Gloss Level 1 - Matte Finish (flat)	Max. 5	Max. 10
Gloss Level 2 - Velvet-Like Finish	Max.10	10 to 35
Gloss Level 3 - Eggshell Finish	10 to 25	10 to 35
Gloss Level 4 - Satin-Like Finish	20 to 35	min. 35

	Gloss @ 60 degrees	Sheen @ 85 degrees
Gloss Level 5 - Traditional Semi-Gloss Finish	35 to 70	
Gloss Level 6 - Traditional Gloss	70 to 85	
Gloss Level 7 - High Gloss Finish	More than 85	

- .2 Gloss level ratings of painted surfaces as indicated.

2.5 EXTERIOR SURFACES

- .1 Unless otherwise specified, all exterior painting work to be in accordance with MPI Premium Grade finish requirements.
- .2 Asphalt Surfaces: (zone / traffic marking for drive and parking areas, etc.)
- .1 EXT 2.1A Latex zone / traffic marking finish.
- .3 Concrete Vertical Surfaces: (including horizontal soffits):
- .1 EXT 3.1A - Latex gloss level as directed.
- .4 Concrete Masonry Units: smooth and split face block and brick:
- .1 EXT 4.2A - Latex gloss level as directed.
- .5 Structural Steel and Metal Fabrications: columns, beams, joists and miscellaneous metal:
- .1 EXT 5.1D - Alkyd gloss level as directed.
- .6 Steel - High Heat: heat exchangers, breeching, pipes, flues, stacks, etc., with temperature range as noted:
- .1 EXT 5.2A - Heat resistant enamel finish, maximum degrees C.
- .2 EXT 5.2B - Heat resistant aluminum enamel finish, maximum 427 degrees C.
- .3 EXT 5.2C - Inorganic zinc rich coating, maximum 400 degrees C.
- .4 EXT 5.2D - High heat resistant coating, maximum 593 degrees C.
- .7 Galvanized Metal: non chromate passivated; high contact/high traffic areas (doors, frames, railings and handrails, etc.):
- .1 EXT 5.3B - Alkyd gloss level as directed.
- .8 Aluminum: sash, sills and frames, flashing, posts and railings, downpipes, etc.:
- .1 EXT 5.4G - Waterborne light industrial gloss level as directed.
- .9 Dimension Lumber: columns, beams, exposed joists, underside of decking, siding, fencing, etc.:
- .1 EXT 6.2B - Waterborne solid colour stain finish.
- .2 EXT 6.2C - Alkyd gloss level as directed.
- .3 EXT 6.2L - Semi-transparent stain finish.
- .10 Dressed Lumber: doors, door and window frames, casings, battens, smooth facias, etc.:
- .1 EXT 6.3B - Alkyd gloss level as directed do not use flat finish on doors

- .2 EXT 6.3C - Solid colour stain finish , do not use in high contact areas or on doors.
- .3 EXT 6.3D - Semi-transparent stain finish, do not use on doors.
- .11 Bituminous Coated Surfaces: cast iron pipe, concrete, etc.:
 - .1 EXT 10.2A - Latex level as directed.

2.6 INTERIOR SURFACES

- .1 Unless otherwise specified, all interior painting work to be in accordance with MPI Premium Grade finish requirements.
- .2 Concrete horizontal surfaces: floors and stairs:
 - .1 INT 3.2B - Alkyd floor enamel finish as directed.
- .3 Structural Steel and Metal Fabrications: columns, beams, joists and miscellaneous metal:
 - .1 INT 5.1E Alkyd - gloss level as directed.
- .4 Steel - high heat: (boilers, furnaces, heat exchangers, breeching, pipes, flues, stacks, etc., with temperature range as noted):
 - .1 INT 5.2A - Heat resistant enamel finish, maximum 205 degrees C.
 - .2 INT 5.2B - Heat resistant aluminum paint finish, maximum 427 degrees C.
 - .3 INT 5.2C - Inorganic zinc rich coating, maximum 400 degrees C.
 - .4 INT 5.2D - High heat resistant coating, maximum 593 degrees C.
- .5 Galvanized metal: doors, frames, railings, misc. steel, pipes, overhead decking, and ducts:
 - .1 INT 5.3C - Alkyd gloss level as directed (over cementitious primer).
- .6 Glue laminated beams and columns:
 - .1 INT 6.1D - Polyurethane varnish finish as directed.
- .7 Dimension lumber: columns, beams, exposed joists, underside of decking:
 - .1 INT 6.2H - Polyurethane varnish like stain cloth level finish.
- .8 Dressed Lumber: doors, door and window frames, casings, mouldings, etc.:
 - .1 INT 6.3A – Latex, finish as directed.
 - .2 INT 6.3B – Alkyd, finish as directed.
 - .3 INT 6.3E - Polyurethane varnish, finish as directed (over stain).
 - .4 INT 6.3K - Polyurethane varnish, finish as directed.
- .9 Plaster and gypsum board: gypsum wallboard, drywall, "sheet rock" type material, and textured finishes:
 - .1 INT 9.2B - High performance architectural latex; gloss level as directed.
- .10 Acoustic panels and tiles (touch up paint):
 - .1 INT 9.3A - Latex flat finish.
- .11 Bituminous coated surfaces: cast iron pipe, concrete, etc.:
 - .1 INT 10.2A - Latex semi-gloss level finish.

2.7 SOURCE QUALITY CONTROL

- .1 Perform following tests on each batch of consolidated post-consumer material before surface coating is reformulated and canned. Testing by laboratory or facility which has been accredited by Standards Council of Canada.
 - .1 Lead, cadmium and chromium are to be determined using ICP-AES (Inductively Coupled Plasma - Atomic Emission Spectroscopy) technique no. 6010 as defined in EPA SW-846.
 - .2 Mercury is to be determined by Cold Vapour Atomic Absorption Spectroscopy using Technique no. 7471 as defined in EPA SW-846.
 - .3 Organochlorines and PCBs are to be determined by Gas Chromatography using Technique no. 8081 as defined in EPA SW-846.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 GENERAL

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

3.3 EXAMINATION

- .1 Investigate existing substrates for problems related to proper and complete preparation of surfaces to be painted. Report to Departmental Representative damages, defects, unsatisfactory or unfavourable conditions before proceeding with work.
- .2 Conduct moisture testing of surfaces to be painted using properly calibrated electronic moisture meter, except test concrete floors for moisture using simple "cover patch test". Do not proceed with work until conditions fall within acceptable range as recommended by manufacturer.
- .3 Maximum moisture content as follows:
 - .1 Stucco, plaster and gypsum board: 12%.
 - .2 Concrete: 12%.
 - .3 Wood: 15%.
 - .4 Clay and Concrete Block/Brick: 12%

3.4 PREPARATION

- .1 Protection:
 - .1 Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage by suitable non-staining covers or

- masking. If damaged, clean and restore surfaces as directed by Departmental Representative.
- .2 Protect items that are permanently attached such as Fire Labels on doors and frames.
- .3 Protect factory finished products and equipment.
- .4 Protect general public in and about the building.
- .2 Surface Preparation:
 - .1 Remove electrical cover plates, light fixtures, surface hardware on doors, bath accessories and other surface mounted equipment, fittings and fastenings prior to undertaking painting operations. Identify and store items in secure location and re-installed after painting is completed.
 - .2 Move and cover furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.
 - .3 Place "WET PAINT" signs in occupied areas as painting operations progress. Signs to approval of Departmental Representative.
- .3 Clean and prepare surfaces in accordance with MPI - Architectural Painting Specification Manual requirements and coating manufacturer's recommendations. Refer to MPI Manual in regard to specific requirements and as follows:
 - .1 Remove dust, dirt, and other surface debris by vacuuming, wiping with dry, clean cloths or compressed air.
 - .2 Wash surfaces with a biodegradable detergent and bleach where applicable and clean warm water using a stiff bristle brush to remove dirt, oil and other surface contaminants.
 - .3 Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.
 - .4 Allow surfaces to drain completely and allow to dry thoroughly.
 - .5 Prepare surfaces for water-based painting, water-based cleaners should be used in place of organic solvents.
 - .6 Use trigger operated spray nozzles for water hoses.
 - .7 Many water-based paints cannot be removed with water once dried. Minimize use of mineral spirits or organic solvents to clean up water-based paints.
- .4 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats. Apply primer, paint, or pretreatment as soon as possible after cleaning and before deterioration occurs.
- .5 No painting work shall commence until all such adverse conditions and defects have been corrected and surfaces and conditions are acceptable to the Painting Subcontractor and Inspection Agency.
- .6 Where possible, prime non-exposed surfaces of new wood surfaces before installation. Use same primers as specified for exposed surfaces.
 - .1 Apply vinyl sealer to MPI #36 over knots, pitch, sap and resinous areas.
 - .2 Apply wood filler to nail holes and cracks.
 - .3 Tint filler to match stains for stained woodwork.

- .7 Sand and dust between coats as required to provide adequate adhesion for next coat and to remove defects visible from a distance up to 1000 mm.
- .8 Clean metal surfaces to be painted by removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with MPI requirements. Remove traces of blast products from surfaces, pockets and corners to be painted by brushing with clean brushes, blowing with clean dry compressed air, or vacuum cleaning.
- .9 Touch up of shop primers with primer as specified.
- .10 Do not apply paint until prepared surfaces have been accepted by Departmental Representative.

3.5 APPLICATION

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

- .8 Finish surfaces both above and below sight lines as specified for surrounding surfaces, including such surfaces as tops of interior cupboards and cabinets and projecting ledges.
- .9 Finish inside of cupboards and cabinets as specified for outside surfaces.
- .10 Finish closets and alcoves as specified for adjoining rooms.
- .11 Finish top, bottom, edges and cutouts of doors after fitting as specified for door surfaces.

3.6 MECHANICAL/ELECTRICAL EQUIPMENT

- .1 Paint finished area exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment with colour and finish to match adjacent surfaces, except as indicated.
- .2 Boiler room, mechanical and electrical rooms: paint exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment.
- .3 Other unfinished areas: leave exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment in original finish and touch up scratches and marks.
- .4 Touch up scratches and marks on factory painted finishes and equipment with paint as supplied by manufacturer of equipment.
- .5 Do not paint over nameplates.
- .6 Keep sprinkler heads free of paint.
- .7 Paint inside of ductwork where visible behind grilles, registers and diffusers with primer and one coat of matt black paint.
- .8 Paint fire protection piping red.
- .9 Paint disconnect switches for fire alarm system and exit light systems in red enamel.
- .10 Paint natural gas piping yellow.
- .11 Paint both sides and edges of backboards for telephone and electrical equipment before installation. Leave equipment in original finish except for touch-up as required, and paint conduits, mounting accessories and other unfinished items.
- .12 Do not paint interior transformers and substation equipment.

3.7 SITE TOLERANCES

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

3.8 FIELD QUALITY CONTROL

- .1 Where "special" painting, coating or decorating system applications (i.e. elastomeric coatings) or non-MPI listed products or systems are to be used, paint or coating manufacturer shall provide as part of this work, certification of surfaces

and conditions for specific paint or coating system application as well as on site supervision, inspection and approval of their paint or coating system application as required at no additional cost to Departmental Representative.

- .2 Advise Departmental Representative when surfaces and applied coating is ready for inspection. Do not proceed with subsequent coats until previous coat has been approved.
- .3 Cooperate with inspection firm and provide access to areas of work.
- .4 Retain purchase orders, invoices and other documents to prove conformance with noted MPI requirements when requested by Departmental Representative.
- .5 Painted surfaces rejected by the inspector shall be made good at the expense of the Contractor. Small affected areas may be touched up; large affected areas or areas without sufficient dry film thickness of paint shall be repainted. Runs, sags of damaged paint shall be removed by scraper or by sanding prior to application of paint.

3.9 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Remove paint where spilled, splashed, splattered or sprayed as work progresses using means and materials that are not detrimental to affected surfaces

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 08 80 50 - Glazing: Mirrors.

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM A153/A153M-16a, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - .2 ASTM A167-99 (2009), Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - .3 ASTM A653/A653M-15e1, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .4 ASTM A666-15, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
 - .5 ASTM A924/A924M-16ae1, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
 - .6 ASTM A1008/A1008M-16, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
 - .7 ASTM B16/B16M-10 (2015), Standard Specifications for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines.
 - .8 ASTM B19-15, Standard Specification for Cartridge Brass Sheet, Strip, Plate, Bar, and Disks.
 - .9 ASTM B456-11e1, Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.
 - .10 ASTM C1503 -08(2013), Standard Specification for Silvered Flat Glass Mirror.
- .2 Canadian Standards Association (CSA)
 - .1 CSA-B651-12, Accessible Design for the Built Environment.
 - .2 CAN/CSA-G164-M92 (R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.

1.3 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 – Submittals:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet.
- .2 Submit shop drawings in accordance with Section 01 33 00 – Submittals:
 - .1 Indicate size and description of components, base material, surface finish inside and out, hardware and locks, attachment devices, description of rough-in-frame, building-in details of anchors for grab bars.
- .3 Submit samples in accordance with Section 01 33 00 – Submittals:
 - .1 Samples to be returned for inclusion into work.

- .4 Submit closeout data in accordance with Section 01 78 00 – Closeout Submittals:
 - .1 Provide maintenance data for toilet and bath accessories for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
 - .2 Include list of sources for disposable supplies, replacement parts and service recommendations.

1.4 WASTE MANAGEMENT AND DISPOSAL

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

1.5 EXTRA MATERIALS

- .1 Provide special tools required for accessing, assembly/disassembly or removal for toilet and bath accessories in accordance with requirements specified in Section 01 78 00 - Closeout Submittals.
- .2 Deliver special tools to Departmental Representative.

Part 2 Products

2.1 MANUFACTURERS

- .1 Acceptable Manufacturers: subject to compliance with requirements specified in this Section and as established by the basis-of-design materials, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - .1 ASI Specialties Inc.
 - .2 Bobrick Washroom Equipment of Canada Ltd.
 - .3 Bradley Corporation.
 - .4 Frost

2.2 MATERIALS

- .1 Sheet steel: to ASTM A653/A653M cold rolled, commercial quality, 0.912 mm minimum nominal thickness, with ZF001 designation zinc coating.
- .2 Stainless steel sheet metal: to ASTM A666, Type 304, finish as indicated in component list in 1.519 mm minimum nominal thickness.
- .3 Stainless steel tubing: Type 304, commercial grade, seamless welded, 1.2 mm wall thickness.
- .4 Fasteners: concealed screws and bolts hot dip galvanized after fabrication, tamper and theft resistant exposed fasteners to match material of unit. Expansion shields fibre, lead or rubber as recommended by accessory manufacturer for component and its intended use.

2.3 COMPONENTS

- .1 As indicated on Drawings.

2.4 FABRICATION

- .1 Weld and grind joints of fabricated components flush and smooth. Use mechanical fasteners only where approved.
- .2 Wherever possible form exposed surfaces from one sheet of stock, free of joints.
- .3 Brake form sheet metal work with 1.5 mm radius bends.
- .4 Form surfaces flat without distortion. Maintain flat surfaces without scratches or dents.
- .5 Back paint components where contact is made with building finishes to prevent electrolysis.
- .6 Hot dip galvanize concealed ferrous metal anchors and fastening devices to CSA G164.
- .7 Shop assemble components and package complete with anchors and fittings.
- .8 Deliver inserts and rough-in frames to job site at appropriate time for building-in. Provide templates, details and instructions for building in anchors and inserts.
- .9 Provide steel anchor plates and components for installation on studding and building framing.

2.5 FINISHES

- .1 Chrome and nickel plating: to ASTM B456, satin finish.
- .2 Baked enamel: condition metal by applying one coat of metal conditioner to CGSB 31-GP-107Ma, apply one coat Type 2 primer to CAN/CGSB-1.81 and bake, apply two coats Type 2 enamel to CAN/CGSB-1.88 and bake to hard, durable finish. Sand between final coats. Colour selected from standard range by Departmental Representative.
- .3 Labels: Non-exposed faces, provide maximum 38 mm diameter stamped manufacturer logo.

Part 3 Execution

3.1 PREPARATION

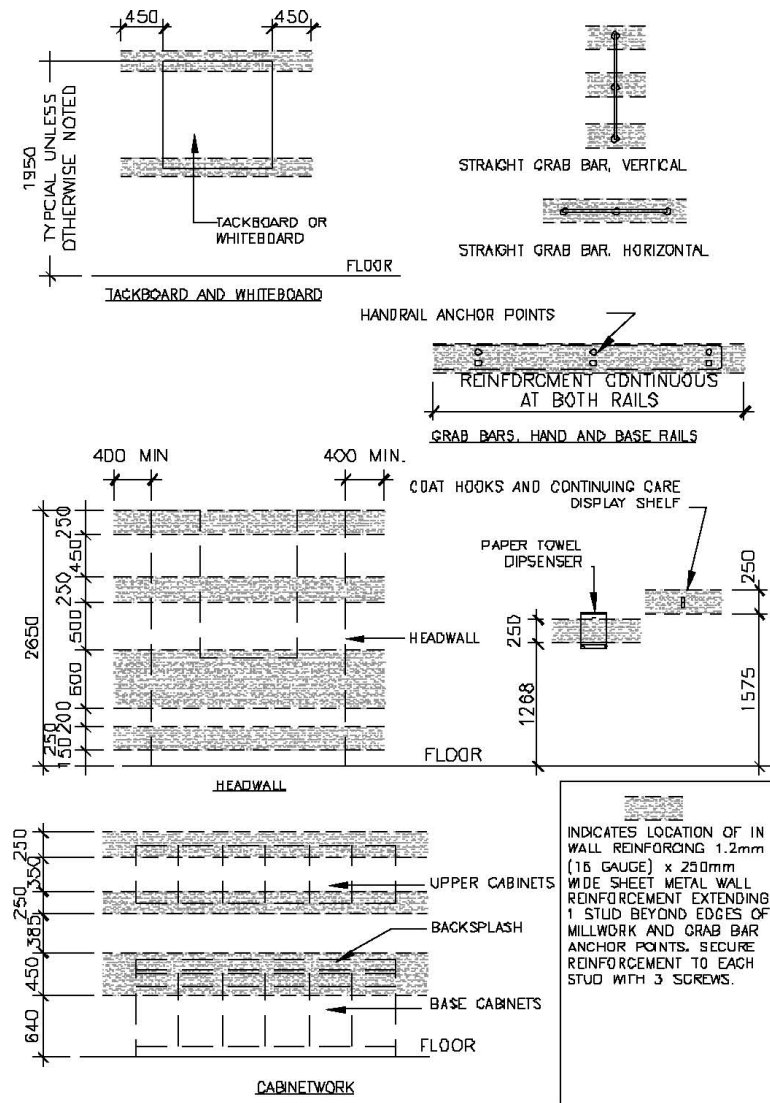
- .1 Verify wall thickness and construction that will accept recessed accessories.
- .2 Verify that solid blocking for support and anchoring of washroom accessories is installed where required. Confirm exact height and location with Departmental Representative and Manufacturers Instructions.
- .3 Verify that frames and anchors provided, whether by this Section or others, are correctly and securely installed ready to accept the accessory scheduled for the specific location.
- .4 Verify that painting is complete and dry in area of installation before accessories are installed.

3.2 INSTALLATION

- .1 Install accessories at heights to meet barrier free compliance and in coordination with drawings. Confirm heights with Departmental Representative prior to installation.
- .2 Install and secure accessories rigidly in place as follows:
 - .1 Stud walls: install steel back-plate to stud prior to plaster or drywall finish. Provide plate with threaded studs or plugs.
 - .2 Hollow masonry units or existing plaster/drywall: use toggle bolts drilled into cell/wall cavity.
 - .3 Solid masonry, marble, stone or concrete: use bolt with lead expansion sleeve set into drilled hole.
 - .4 Toilet/shower compartments: use male/female through bolts.
- .3 Install grab bars on built-in anchors provided by bar manufacturer.
- .4 Use tamper proof screws/bolts for fasteners.
- .5 Fill units with necessary supplies shortly before final acceptance of building.
- .6 Install mirrors in accordance with Section 08 80 50 - Glazing.

3.3 SCHEDULE

- .1 Locate accessories where indicated on drawings. Exact locations determined by Departmental Representative.



Wall Reinforcement Details

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 06 40 00 – Architectural Woodwork
- .2 Section 09 21 16 – Gypsum Board Assemblies: Coordination with built-in appliances and adjacent wall construction.
- .3 Division 22 – Plumbing: Coordination of pipes and fittings and other materials.
- .4 Division 26 – Electrical: Coordination conduit, wiring and other materials.

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A167-99(2009), Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - .2 ASTM A240/A240M-16a, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels, and for General Applications.
- .2 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-C22.2 No.120-13, Refrigeration Equipment.
 - .2 CAN/CSA-C22.2 No.150-16, Microwave Ovens.
 - .3 CAN/CSA-C388-15, Energy Performance and Capacity of Household Microwave Ovens.

1.3 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 – Submittals:
 - .1 Include manufacturers name, type, model, year, dimensions, capacity and finishes for each appliance.
 - .2 Include details of operation, servicing, maintenance and recommended spare parts list.

1.4 QUALITY ASSURANCE

- .1 Obtain products from a qualified manufacturer having a service centre capable of providing training, parts, and emergency maintenance repairs within 50 km of project site.
- .2 Appliances shall be labelled in accordance with requirements of CSA, ULC, CGA and other standards acceptable to the Authorities Having Jurisdiction.
- .3 Provide appliances that carry labels indicating energy cost analysis (estimated annual operating costs) and efficiency information qualifying for labelling under the Energy Star Program.

1.5 WARRANTY

- .1 Provide manufacturer's standard form of warranty stating that each appliance specified will repaired or replaced that fail in materials or workmanship within manufacturers standard warranty period.

Part 2 Products

2.1 MANUFACTURERS

- .1 Subject to compliance with requirements specified in this section, and as established by the Basis-of-Design materials, manufacturers offering similar products that may be incorporated into the Work include the following:
 - .1 BOSCH, BSH Home Appliances Corporation
 - .2 Frigidaire, Electrolux Home Products Canada
 - .3 GE Appliances
 - .4 Maytag
 - .5 Whirlpool Corporation
- .2 Materials other than named products Basis-of-Design materials may be acceptable to the Departmental Representative; submit information in accordance with Section 01 62 00 – Product Options no later than seven (7) days prior to bid closing date and as follows:
 - .1 Proposed alternates shall match colour range and performance characteristics of named products.
 - .2 Proposed alternates found acceptable by Departmental Representative will be listed in an Addendum.
 - .3 The Departmental Representative is not obliged to accept any materials presented for their review and does not need to provide reasons for rejection of proposed alternates.
- .3 Substitutions for materials of this section will be considered after the close of bids in accordance with Section 01 62 00 – Product Options.

2.2 COOKING APPLIANCES

- .1 Range:
 - .1 Freestanding Electric Range:
 - .1 Size: 610 wide.
 - .2 Electric Burner Elements: Four Coil Type: 2 - 2400 W and 2 - 1250 W.
 - .3 Oven: One; having; baking and easy clean type with broiler in top of oven.
 - .4 Finish: Porcelain enamel steel with manufacturer's standard cook top; Colour: White.
- .2 Exhaust Hood:
 - .1 Type: 610 mm wide, under cabinet convertible range hood
 - .2 Exhaust fan: two-speed fan, 260 L/s, built into hood
 - .3 Fan Control: Hood-mounted, rocker switch with two speeds fan switch, with separate hood light control switch.
 - .4 Finish: baked enamel, white colour

2.3 REFRIGERATION APPLIANCES

- .1 Refrigerator/Freezer:

- .1 Type: Freestanding, frost-free one door refrigerator with freezer on top.
- .2 Dimensions: 23.4" x 59.8" x 26"
- .3 Storage Capacity: 10 cu. Ft.
 - .1 Fridge Storage: 2 sliding glass shelves, 1 fixed glass shelf, fixed full width door rack, adjustable half width door rack, 2 adjustable can racks, 2 clear crispers.
 - .2 Freezer storage: 2 fixed full width freezer door racks, full width freezer shelf.
- .4 Temperature Controls: Separate temperature controls for each compartment, and with switch for condensation control heating element at freezer opening.
- .5 Front Panel: Manufacturer's standard panels, White.

Part 3 Execution

3.1 EXAMINATION

- .1 Examine conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- .2 Examine roughing-in for piping and electrical systems to verify actual locations of piping and electrical connections before equipment installation.
- .3 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- .1 Install equipment in accordance with manufacturer's instructions.
- .2 Coordinate connection of mechanical and electrical services.
- .3 Securely anchor built-in units to supporting cabinets or countertops with concealed fasteners; verify that clearances are adequate for proper functioning and rough openings are completely concealed.
- .4 Place free-standing units in final locations after finishes have been completed in each area; verify that clearances are adequate to properly operate equipment.
- .5 Adjust equipment for smooth and proper operation.

3.3 CLEANING AND PROTECTION

- .1 Test each appliance specified in this Section to verify proper operation; make necessary adjustments.
- .2 Verify that accessories required have been furnished and installed.
- .3 Remove packing material from appliances and leave units in clean condition, ready for operation.

3.4 DEMONSTRATION

- .1 Engage a factory authorized service representative to train Departmental Representative's maintenance personnel to adjust, operate, and maintain appliances.

END OF SECTION

1. General

1.1. WORK INCLUDED

- .1 Conform to the requirements of Division 1, which applies to and forms part of all sections of the work.
- .2 The Specification is divided into Sections which are not intended to identify contractual limits between Sub-Contractors nor between the Contractor and his Sub-Contractors. The requirements of any one Section apply to all Sections. Refer to other Divisions and Sections to ensure a complete and operational system.
- .3 Provide mechanical components and accessories which may not be specifically shown on the Drawings or stipulated in the Specifications but are required to ensure complete and operational systems.

1.2. INTENT

- .1 Mention in the Specifications or indication on the Drawings of equipment, materials, operation and methods, requires provision of the quality noted, the quantity required, and the systems complete in every respect.
- .2 The Specifications are an integral part of the accompanying Drawings. Any item or subject omitted from one or the other, but which is either mentioned or reasonably implied, shall be considered as properly and sufficiently specified.
- .3 Be completely responsible for the acceptable condition and operation of all systems, equipment and components forming part of the installation or directly associated with it. Promptly replace defective material, equipment and part of equipment and repair related damages.

1.3. SECTIONS AFFECTED

- .1 These instructions apply to and form a part of all Mechanical Sections.

1.4. REGULATIONS

- .1 Work shall be performed in accordance with codes, rules, regulations, by-laws and requirements of the authorities having jurisdiction.
- .2 The plumbing and drainage systems shall comply with regulations respecting plumbing made under the National Plumbing Code and Albert Plumbing and Drainage Act except as modified by rules, regulations and by-laws of authorities having jurisdiction.
- .3 Natural gas systems shall be in accordance with the Gas Protection Act and Installation Code of Natural Gas Burning Appliances and Equipment Code CAN B-149.
- .4 These specifications are supplementary to the requirements above.
- .5 Drawings and specifications should not conflict with the above regulations but where there are apparent discrepancies the Contractor shall notify the Departmental representative.

1.5. PERMITS, FEES INSPECTION

- .1 Obtain all permits, make submissions, pay all fees and arrange for all inspections required for the work of this Division.

1.6. EXAMINATION OF SITE

- .1 Before submitting Bids, each trade shall examine the site to determine the conditions which may affect the proposed work. No claims for extra payment will be considered because of failure to fulfil this condition.

1.7. DRAWINGS, CHANGES AND INSTALLATION

- .1 The Drawings shall be considered to show the general character and scope of the work and not the exact details of the installation. The installation shall be complete with all accessories required for a complete and operational installation.
 - .2 The location, arrangement and connection of equipment and material as shown on the Drawings represents a close approximation to the intent and requirements of the work. The right is reserved by the Consultant to make reasonable changes required to accommodate conditions arising during the progress of the work, at no extra cost to the Departmental representative.
 - .3 In order to show more clearly the arrangement of the work, plans and sections do not show every valve, thermometer, pressure gauge or other system accessory. Refer to the Mechanical Standard Details and to the Specifications to determine the requirements.
 - .4 Certain Details indicated on the Drawings are general in nature and specific labelled detail references to each and every occurrence of use are not indicated, however, such details shall be applicable to every occurrence.
 - .5 All piping and ductwork in finished areas shall be concealed in ceiling spaces and shafts or chased into walls. No exposed piping or ductwork shall be installed in such areas unless specifically reviewed and accepted by the Consultant. No piping shall be concealed in outside walls.
 - .6 Vent pipes, exhaust hoods or other mechanical equipment mounted on the roof, or housing for such equipment shall not be closer to the edge of the roof than a distance equal to the height of the pipe, hood or equipment, unless specifically reviewed and accepted by the Consultant.
 - .7 The location and size of existing services shown on the Drawings are based on the best available information. The actual location of existing services shall be verified in the field before work is commenced. Particular attention shall be paid to buried services.
 - .8 Changes and modifications necessary to ensure co-ordination and to avoid interference and conflicts with other Trades, or to accommodate existing conditions, shall be made at no extra cost to the Departmental representative.
 - .9 Leave areas clear of piping and ducts where space is indicated as reserved for future
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equipment and equipment for other Trades.

- .10 Adequate space and provisions shall be left for removal of coils and servicing of equipment, with minimum inconvenience to the operation of systems.
- .11 Where equipment is shown to be 'roughed-in only' obtain accurate information from the Consultant before proceeding with the work.
- .12 Before fabricating ductwork or piping for installation, make certain that such items can be installed as shown on the Drawings without interfering with the structure or the work of other Trades. Any problems that cannot be solved in agreement with the other Trades affected shall be submitted for decision. If ductwork or piping is prefabricated prior to the investigation and reaching of a solution to possible interference problems, necessary changes in such prefabricated items shall be made at no extra cost to the Departmental representative.
- .13 Location of diffusers, grilles registers, thermostats, sprinklers and all other equipment shown on plans is diagrammatic. Layout of each device in finished areas is critical in terms of symmetry and location. Refer to Architectural Drawings and to site instructions in all regards. Any work not installed in the correct location (at the sole discretion of the Consultant) shall be remedied by this Contractor at his expense. This Contractor is responsible for mark-out of his work, fully coordinated with all other trades, in sufficient time for review by Consultant prior to rough-in. All mechanical and sprinkler services shall be located precisely.

1.8. INSTALLATION, INTERFERENCE AND SETTING DRAWINGS

- .1 Installation, interference and setting Drawings dimensioned and to scale, shall be submitted for review by the Consultant, as may be required or requested by the Departmental representative to make clear the work intended or to show its relation to adjacent work or to the work of other trades. When an alternative piece of equipment is to be substituted for equipment shown, Drawings of the area involved shall be prepared by this Division. Three copies of such Drawings shall be submitted for review, of which one will be retained by the Departmental representative. Electronic copies in PDF format are also acceptable.
 - .2 Installation working Drawings to 1:50 scale (1/4 in. equal to 1 ft.) for mechanical rooms showing plan and sections of the plant, services, bases, curbs, drains, motor terminals, shall be prepared by this Division.
 - .3 Interference Drawings are required for shafts, ceiling spaces, typical floors and wherever there is possible conflict with the positioning of mechanical equipment, piping or ductwork and architectural or structural features or the work of other trades.
 - .4 The design of the structural framing of the mechanical rooms and pipe spaces and major pipe run supports has been based on assumed loadings supplied during the design phase. Well ahead of the construction of the affected areas, prepare and submit Drawings for review by the Consultant showing the layout and weights of all finally selected mechanical equipment including details of concrete pads, concentrated pipe loads and point reactions of the equipment onto the structure.
 - .5 This Division shall prepare sleeving Drawings indicating the size and locations of openings required in concrete floor slabs, roof slabs/decks and walls for piping,
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ductwork and equipment. In case of failure to provide information in time (i.e. before the concrete is poured) any extras incurred shall be at the expense of this Division.

- .6 Work shall not proceed in areas involved until after final review of such Drawings has been obtained.

1.9. BID AND EQUIPMENT SUBSTITUTION

- .1 Submit with the bid, all information called for in section 00 and 01.
- .2 Materials and products specified by the name of the manufacturer, the brand or trade name, or catalogue reference, shall be the basis of the Bid price. These shall be provided under the Contract unless substitutions are proposed and accepted in accordance with the following procedures:
 - .1 Substitution may be proposed only when the clause or other approved manufacturer is used in the specification.
 - .2 The proposed substitution shall indicate product name, a complete product description and what difference, if any, will be made in the amount of the Bid price for the substitution.
- .3 Any alternative and/or substitute equipment listed shall be equal in performance and quality to that specified. If space, power, structural or any other requirements are different from the equipment specified, the cost of any changes shall be included for in the price.
- .4 The Departmental representative reserves the right to accept or reject any substitution without question.

1.10. MATERIALS

- .1 Make and quality of materials used in the construction of this work shall be subject to the approval of the Consultant.
- .2 Materials and equipment supplied by this Division shall be new and free from defects and shall be as specified by the manufacturer's name and catalogue reference.
- .3 Where a certain manufacturer's equipment has been specified by name or model number, the Contractor shall be responsible for ensuring that the performance and quality of any proposed alternative meets the specified equipment and that the same access or maintenance space is available for the alternative manufacturer's equipment and that piping, duct and electrical connections can be made at no extra cost to the Contract.

1.11. CO-OPERATION WITH OTHER DIVISIONS

- .1 Particular attention must be paid to the proximity of electrical conduit and cable to mechanical piping and equipment.
 - .2 Pipes transporting hot fluids shall be installed at least 150 mm (6 in.) away from pipes carrying cold fluids, unless approval from the Consultant is obtained to install services closer than 150 mm (6 in.).
 - .3 Electrical conduits shall not touch or be supported from piping or ductwork.
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- .4 Each Section shall confine itself to installing all materials in the spaces shown without encroaching upon space for materials installed under other Sections or Divisions. Where the space allocated to another Section or Division is encroached upon, the materials shall be relocated to their proper space allocation in such a manner to complete the work using space allocated to the various Sections and Divisions. Relocation of materials and work involved shall be paid for by the Section responsible for the encroachment at no extra cost to the Departmental representative.
- .5 Supply all items to be built in ample time for rapid progress of the work. Schedule and proceed with work as required to satisfy the construction schedule.
- .6 The Contractor shall confirm the available voltage for all single phase and three phase motors or other similar electrically driven equipment with the Electrical Division prior to ordering the equipment. Any discrepancy between the requirements identified within the Contract Documents and those of the Electrical Division shall be reported to the Consultant and the equipment shall be adjusted to suit the appropriate power requirements. Failure to perform this coordination prior to ordering of the motors or equipment shall result in correction at no additional cost to the Departmental representative.

1.12. TEMPORARY USE OF EQUIPMENT

- .1 Where the mechanical systems are operated during construction, the Mechanical Contractor shall maintain the system and equipment in proper operating condition.
- .2 Prior to application for substantial performance of the work as certified by the Consultant, the systems and equipment shall be returned to the initial new condition by replacing used air filters with new air filters, cleaning the air side of all coils in the air handling systems, replacing used belts in belt drives with new belts, lubricating all bearings according to manufacturer's factory standards and adjusting the thermostatic control system according to specifications and/or to suit the Departmental representative.

1.13. INTERRUPTION OF SERVICES

- .1 Any interruption of the mechanical services to any part of the building shall come at a time agreeable to the Departmental representative. Make all necessary arrangements with those concerned and include for any overtime required to ensure that the interruption is held to a minimum.
- .2 Testing and operation of major equipment shall be approved by the Departmental representative to avoid excessive utility charges. Such testing to be generally carried out after normal working hours or on weekends.
- .3 All such overtime work shall be carried out without additional cost to the Contract.

1.14. METRIC CONVERSIONS

- .1 Particular care shall be taken with imperial versus S.I. metric conversions. This applies to all services including, but not limited to, equipment, pipes, ductwork and site services in both new and existing installations.
 - .2 Conform to the Canadian Metric Practice Guide CAN/CSA-Z234.1-89.
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1.15. ALTERNATIVE, SEPARATE AND IDENTIFIED PRICES

- .1 Refer to section 00 and 01.

1.16. SCHEDULE, ACCESS, PROTECTION AND CLEAN-UP

- .1 Refer to section 00 and 01

1.17. HOUSEKEEPING PADS, CURBS AND SUPPORT PIERS

- .1 Provide concrete housekeeping pads, curbs and support piers under all floor mounted mechanical equipment and around all floor penetrations for pipes and ducts. Housekeeping pads and curbs shall be minimum 100 mm (4 in.) high unless detailed otherwise. Refer to the Drawings and Details for additional information.
- .2 Housekeeping pads, curbs and support piers under all floor mounted mechanical equipment and around all floor penetrations for pipes and ducts shall be provided by Division 3. This Division shall coordinate all sizes and locations for housekeeping pads and curbs. Provide dimensioned drawings for review by the Consultant. All housekeeping pads shall be minimum 100 mm (4 in.) high unless detailed otherwise. Refer to the Drawings and Details for additional information.

1.18. ASHRAE 90.1

- .1 All mechanical equipment shall comply with the minimum efficiency standards set out in ASHRAE 90.1 and the Model National Energy Code of Canada for Buildings. Submit all necessary information to substantiate conformance.

1.19. HOISTING FACILITIES

- .1 This Division shall provide its own hoisting facilities.
- .2 Hoisting facilities provided by General Contractor will be available for Subcontractors use at no cost. If hoist facilities are inadequate, then Sub-Contractors must provide his own. Sub- Contractors must inform General Contractors of requirements before tender closing date.

2. Products

2.1. NOT USED

3. Execution

3.1. NOT USED

END OF SECTION

1. General

1.1. ABBREVIATIONS

.1 Generally, the following abbreviations are used in this Division:

A.A.B.C.	-	Associated Air Balance Council
AAP	-	Alarm Annunciator Panel
A.B.M.A.	-	American Boiler Manufacturers Association
ACO	-	Acid Resistant Cleanout
AD	-	Acid Resistant Drawings
AFD	-	Acid Resistant Floor Drain
AFF	-	Above Finished Floor
A.G.A.	-	American Gas Association
A.M.C.A.	-	Air Moving and Conditioning Association
A.N.S.I.	-	American National Standards Institute
A.R.I.	-	Air-Conditioning and Refrigeration Institute
A.S.H.R.A.E.	-	American Society of Heating, Refrigerating and Air Conditioning Engineers
A.S.M.E.	-	American Society of Mechanical Engineers
A.S.T.M.	-	American Society for Testing and Materials
AV	-	Acid Resistant Vent
A.W.G.	-	American Wire Gauge
AWS	-	American Welding Society
A.W.W.A.	-	American Water Works Association
B.H.P.	-	Boiler Horsepower or Brake Horsepower
Btu/hr	-	British Thermal Units per Hour
B.W.G.	-	British Wire Gauge
CAD	-	Computer Aided Drafting
CAFV	-	Controllable Air Flow Venturis
CAP	-	College of American Pathologists
CCA	-	Chromated Copper Arsenate
C.E.M.A.	-	Canadian Electrical Manufacturer's Association
CEMS	-	Central Energy Management System
CCF	-	Central Computer Facility
cfm	-	Cubic Feet per Minute
C.G.A.	-	Canadian Gas Association
C.G.S.B.	-	Canadian General Standards Board
C.I.	-	Cast Iron
CPU	-	Central Processing Unit
C.R.N.	-	Canadian Registration Number
CSA	-	Canadian Standards Association
cu.ft.	-	Cubic Feet
cu.m.	-	Cubic Meter
db	-	Dry Bulb
dB	-	Decibel
dBA	-	A-weighted Decibel
DDC	-	Direct Digital Control
deg. C	-	Degrees Celsius
deg. F.	-	Degree Fahrenheit

dia.	- Diameter
DPDT	- Double Pull Double Throw
DPTX	- Differential Pressure Transmitters
EAP	- Excess Exhaust Alarm Panel
E.D.R.	- Equivalent Direct Radiation
EF	- Exhaust Fan
E.E.M.A.C.	- Electrical and Electronic Manufacturers Association of Canada
EEPROM	- Electrically Erasable Programmable Read-Only Memory
EMT	- Electrical Metallic Tubing
EP	- Electric Pneumatic
EPDM	- Ethylene Propylene Diene-Rubber
EPROM	- Electrically Programmable Read Only Memory
ERW	- Electric Resistance Welded
FACP	- Fire Alarm Control Panel
FDA	- Food and Drug Administration
F.E.	- Flexible Elastomeric
FHC	- Fume Hood Controller or Firehose Cabinet
F.L.A.	- Full Load Amps
fpm	- Feet per Minute
fps	- Feet per Second
F.M.	- Factory Mutual
ft.	- Foot or Feet
ga	- Gauge
gal	- Gallons
GFD	- Gallons per Square Feet per Day
G.P.D	- Gallons per Day
G.P.H.	- Gallons per Hour
GSS	- Galvanized Sheet Steel
h-cu.ft.	- Hour-cubic foot
HCFC	- HydroChloroFlourocarbons
HEPA	- High Efficiency Particulate Air
H.O.A.	- Hand/Off/Auto
HOT	- Hand Held Operator Terminal
H.S.S.	- Hollow Steel Sections
HTK	- Hood Termination Kit
hp	- High Pressure or Motor Horsepower
hz	- Hertz
I.A.O.	- Insurance Advisory Organization of Canada
I.C.U.	- Intensive Care Unit
(I.)G.P.H.	- (Imperial) Gallons per Hour
(I.)G.P.M.	- (Imperial) Gallons per Minute
in.	- Inch or Inches
kg	- Kilogram
kg/cu.m.	- Kilogram per cubic meter
kPa	- Kilopascals
KVA	- Kilovolt-amps
kW	- Kilowatts
lbs/cu.ft.	- Pounds per cubic foot
lbs/hr.	- Pounds per Hour
L	- Litre
L/s	- Litres per Second
LFC	- Laminar Flow Cabinets

LEDS	- Light Emitting Diode
LCP	- Laboratory Control Panel
lin.ft.	- Linear foot
lin.m.	- Linear meter
ma	- Milliamps
MAC	- Make-up Air Controller
mADC	- Milliamps Direct Circuit
M.B.H.	- 1000 British Thermal Units per Hour
M.C.C.	- Motor Control Centre
mm	- Millimetre
m	- Metre
m/s	- Metres per Second
mL	- Millilitre
MCP	- Motor Control Panel
M.O.V.	- Motor Over Voltage
mPa	- Millipascals
MSC	- Master Summing Controller
MSG	- Manufacturers' Standard Gauge
N.B.S.	- National Bureau of Standards
N.C.	- Noise Criterion as Defined by Graph in A.S.H.R.A.E.
NCCLS	- National Committee for Clinical Laboratory Standard
N.E.M.A.	- National Electrical Manufacturer's Association
N.F.P.A.	- National Fire Protection Association
NIM	- Network Interface Module
NIST	- National Institute of Standards and Technology
NIOSH	- National Institute of Occupancy Safety and Health
NPS	- American National Standard Straight Pipe Thread
N.P.S.H.	- Net Positive Suction Head
NPT	- American National Standard Taper Pipe Thread
No.	- Number
OAT	- Outside Air Temperature
O.B.C.	- Ontario Building Code
OC	- On Centre
OCP	- Operator Control Panel
OPSS	- Ontario Provincial Standard Specification
O.S. & Y.	- Outside Screw and Yoke
O.W.R.A.	- Ontario Water Resources Act
oz.	- Ounce or Ounces
PCU	- Personal Computer Unit
PE	- Pneumatic Electric
PIT	- Portable Interface Terminal
ph	- Hydrogen Ion Concentration
ppm	- Part per Million
psf	- Pounds per Square Foot
psi	- Pounds per Square Inch
psia	- Pounds per Square Inch Absolute
psig	- Pounds per Square Inch Gauge
PWM	- Pulse Width Modulation
PVC	- Polyvinyl Chloride
qt.	- Quart
RAH	- Return Air Humidity
Rh	- Relative Humidity

rpm	- Revolutions perMinute
RPU	- Remote Processing Unit
RPU-TU	- Remote Processing Unit for Terminal Units
SCR	- Silicone Controlled Rectifier
SMACNA	- Sheet Metal and Air Conditioning Contractors National
sp. in. wg.	- Static Pressure, Inches Water Gauge
S.P.D.T.	- Single Pull Double Throw
SPS	- Sash Position Sensor
s.s	- Stainless Steel
SF	- Supply Fan
SPS	- Sash Position Sensor
SPWM	- Sine-Coded Pulse Width Modulated
S.S.P.C.	- Steel Structures Painting Council (The Society of Protective
sq.m.	- Square Meter
STC	- Supply/Exhaust Tracking Controller
SWS	- Sidewall Velocity Sensors
T.D.S.	- Totally Dissolved Solids
TEFC	- Totally Enclosed Fan Cooled
TIG	- Tungsten Inert Gas
TKV-TWA	- Threshold Limit Value – Time Weighted Average
UACU	- Unitary Air Conditioning Units
U.L.	- Underwriter's Laboratories
U.L.C.	- Underwriter's Laboratories of Canada
um	- Ohm
USP	- United States Pharmacopoeial
U.S. gal.	- United States Gallons
USGPH	- United States Gallons per Hour
USGPM	- United States Gallons per Minute
VAC	- Volts Alternating Current
VACFH	- Closed Loop Variable Frequency Drive
VDC	- Volts Direct Current
VFD	- Variable Frequency Drive
VSC	- Variable Speed Controllers
VSD	- Variable Speed Drives
W	- Watt
W/cu.m.	- Watts per Cubic Meter
W/ft.	- Watts per Foot
W/m	- Watts per Meter
W/sq.in.	- Watts per Square Inch
W/sq.m.	- Watts per Square Meter
WC	- Water Closet
wb	- Wet Bulb
wg	- Water Gauge
WHMIS	- Workplace Hazardous Material Information System
WSP	- Working Steam Pressure
WOG	- Water, Oil, Gas

END OF SECTION

1. General

1.1. WORK INCLUDED

- .1 Conform to Section 21 05 00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

1.2. RELATED WORK SPECIFIED ELSEWHERE

- .1 Refer to Record Drawings in Section 01 77 00 CLOSEOUT PROCEDURES.

1.3. PRINTS

- .1 The Mechanical Contractor shall have at least two sets of white prints to mark the project progress, changes and deviations.

2. Products

1.4. NOT USED

2. Execution

2.1. DOCUMENTATION REQUIREMENTS

- .1 As the project progresses mark all changes and deviations from that shown on the drawings to the white prints.
 - .2 After inspection and approval of service lines in trenches, take as-built measurements, including all depths, prior to commencement of backfilling operations. It will not be sufficient to check off line locations. Take and record definitive measurements for each service line. Show locations and inverts of buried piping on the drawings and dimensioned from grid co-ordinates.
 - .3 Photograph all buried underground services prior to backfilling. Mark on prints photograph numbers.
 - .4 Keep drawings up-to-date during construction and in addition to field measurements include change orders, site instructions and all other changes. Drawings shall be available for review at all times.
 - .5 On completion of the work, forward to the Departmental representative the two sets of drawings indicating all such changes and deviations for review by the Consultant.
-

- .6 The project will remain incomplete and a holdback will be retained until satisfactory as-built drawings are provided.
- .7 Include a cost of \$1,200.00 for the transfer of marked up 'As Built' drawing information to AutoCAD and forwarding of the mechanical information to the departmental representative in the lump sum building construction cost.
- .8 Cost to be determined for the transfer of marked up above grade 'As Built' information to AutoCAD and forwarding of the mechanical information to the departmental representative. This clause does not apply if 'As Built' drawings are not required by the departmental representative.

END OF SECTION

1. General

1.1. WORK INCLUDED

- .1 Conform to Section 21 05 00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

1.2. RELATED WORK SPECIFIED ELSEWHERE

- .1 Refer to Section 01 33 00 – SUBMITTAL PROCEDURES.

END OF SECTION

1 GENERAL

1.1 GENERAL

- 1.1.1 This section covers items common to all sections of Mechanical Divisions (Divisions 21, 22, 23 and 25).

1.2 WITNESSING OF TESTS

- 1.2.1 The Consultant may witness selected starting, testing, adjusting, balancing and cleaning procedures.
- 1.2.2 Advise the Consultant in advance that starting, testing, adjusting, balancing or cleaning processes are ready to commence. Consult with the Consultant to determine which procedures he may elect to witness. Provide 7 day advanced notice prior to commencement of each procedure or series of procedures to allow the Consultant to arrange for witnessing of tests.

1.3 STARTING AND TESTING COSTS

- 1.3.1 Contractor to pay costs associated with starting, testing, adjusting, preparation for balancing and cleaning, including supply of instruments, equipment, supplies, and consumable materials.

1.4 START-UP REPORTS

- 1.4.1 Contractor shall provide start up reports for all equipment.
- 1.4.2 All start up reports must be completed and signed off by the contractors and manufacturers representative's.
- 1.4.3 The contractor is responsible for completing the check sheets as follows and as indicated on the attached sample:

Technical Data

Specified Data
Shop Drawing
Installed Verified
Date/Checked
by:

Consultant
Contractor
Contractor
Consultant
Contractor to sign when
shop drawing and
installed information is
completed

Signatures:	Contractor to sign when the check sheet is completed
Static Checks	Date/Checked by: Contractor to sign when the items listed and installation of the equipment or systems are complete and ready for the departmental representative to verify.
Signatures:	Contractor and Consultant to sign when the check sheet is completed.

1.5 REPORTS

- 1.5.1 Submit Contractor Start-Up Report forms in accordance with Mechanical Equipment/System Startup and Testing documenting starting and testing procedures performed, and observed tests results obtained.
- 1.5.2 Submit field reports in accordance with Mechanical Equipment/System Startup and Testing.

1.6 QUALITY ASSURANCE

- 1.6.1 Use personnel for starting, equipment and starting procedures who have experience in mechanical equipment and systems commissioning, and are able to interpret results of readings and tests and report state of systems in a clear and concise manner.

1.7 MANUFACTURER'S RECOMMENDATIONS

- 1.7.1 Prior to starting equipment or systems, obtain and review manufacturer's installation, starting and operating instructions. Read in conjunction with procedures specified herein.
- 1.7.2 Use manufacturer's and supplier's trained personnel where necessary to maintain validity of manufacturer's warranty.
- 1.7.3 Compare actual installation with manufacturer's recommended installation. Record discrepancies. Correct deviations detrimental to equipment performance prior to starting equipment.

1.8 REGULATORY REQUIREMENTS

- 1.8.1 Arrange for regulatory authorities to witness specified starting procedures that duplicate tests required by regulatory authorities.
 - 1.8.2 Obtain certificates of approval and for compliance with regulations from authorities having jurisdiction. Include copies of certificates with start-up reports.
-

2 PRODUCTS

2.1 NOT USED.

3 EXECUTION

3.1 INSPECTION

3.1.1 Do not conceal or cover equipment or systems until inspected, tested and approved by Departmental representative.

3.2 CHECK SHEETS, FIELD REPORTS AND DATA

3.2.1 Record all data gathered on site on start-up report forms.

3.2.2 Make copies of all starting and testing data before equipment and system start-up personnel leave site. Maintain one copy of all data taken during starting on site.

3.2.3 Maintain one copy of all final starting, testing, adjusting and balancing reports on site up to Substantial Completion of the Work for reference purposes.

3.3 COORDINATION

3.3.1 Prior to commencement of each particular testing procedure, coordinate all sub-trades, manufacturers, suppliers and other specialties to ensure all phases of work are properly completed. Establish necessary manpower requirements.

3.4 STARTING AND TESTING PHASES

3.4.1 Starting and testing program generally consists of following five distinct phases:

3.4.1.1 Pre-Starting: visual inspection

3.4.1.2 Starting: actual starting procedure.

3.4.1.3 Post-Starting: operational testing, adjusting or balancing and equipment run-in phase.

3.4.1.4 Substantial Completion of the Work: final cleaning, re-testing, and adjusting and maintenance.

3.4.1.5 Final Acceptance of the Work: re-testing and fine-tuning of system to prove all deficiencies have been corrected.

3.4.2 After each distinct phase of work has been completed, correct deficiencies before commencing the next phase.

END OF SECTION

1 GENERAL

1.1 SUMMARY

1.1.1 Section Includes:

- 1.1.1.1 Electrical motors drives and guards for mechanical equipment and systems.
- 1.1.1.2 Supplier and installer responsibility indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.
- 1.1.1.3 Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50 V which are related to control systems specified in Division 22 and 23. Refer to Division 26 for quality of materials and workmanship.
- 1.1.1.4 Sustainable requirements for construction and verification.

1.2 REFERENCES

- 1.2.1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
 - 1.2.1.1 ASHRAE 90.1-01, Energy Standard for Buildings except Low-Rise Residential Buildings (IESNA cosponsored; ANSI approved; Continuous Maintenance Standard).
- 1.2.2 Electrical Equipment Manufacturers' Association Council (EEMAC)
- 1.2.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - 1.2.3.1 Material Safety Data Sheets (MSDS).

1.3 QUALITY ASSURANCE

- 1.3.1 Regulatory Requirements: work to be performed in compliance with applicable Provincial/Territorial regulations.
- 1.3.2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

- 1.4.1 Packing, shipping, handling and unloading:
 - 1.4.1.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
 - 1.4.1.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
 - 1.4.2 Waste Management and Disposal:
-

- 1.4.2.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse or recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

2 PRODUCTS

2.1 GENERAL

- 2.1.1 Motors: Premium efficiency, in accordance with local Hydro company standards and to ASHRAE 90.1.

2.2 MOTORS

- 2.2.1 Provide motors for mechanical equipment as specified.
- 2.2.2 Motors under 1/2 HP: speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated.
- 2.2.3 Motors 1/2 HP and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rises 40°C, 3 phase, 208V, unless otherwise indicated.

2.3 TEMPORARY MOTORS

- 2.3.1 If delivery of specified motor will delay completion or commissioning work, install motor for temporary use. Work will only be accepted when specified motor is installed.

2.4 BELT DRIVES

- 2.4.1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.
- 2.4.2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise indicated.
- 2.4.3 For motors under 7.5 kW 10 HP: standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.
- 2.4.4 For motors 7.5 kW 10 HP and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.
- 2.4.5 Correct size of sheave determined during commissioning.
- 2.4.6 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.
- 2.4.7 Motor slide rail adjustment plates to allow for center line adjustment.
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- 2.4.8 Supply one set of spare belts for each set installed in accordance with Section 01 78 00- Closeout Submittals.

2.5 DRIVE GUARDS

- 2.5.1 Provide guards for unprotected drives.
- 2.5.2 Guards for belt drives;
 - 2.5.2.1 Expanded metal screen welded to steel frame.
 - 2.5.2.2 Minimum 1.2 mm thick sheet metal tops and bottoms.
 - 2.5.2.3 38 mm dia holes on both shaft centers for insertion of tachometer.
 - 2.5.2.4 Removable for servicing.
- 2.5.3 Provide means to permit lubrication and use of test instruments with guards in place.
- 2.5.4 Install belt guards to allow movement of motors for adjusting belt tension.
 - 2.5.4.1 "U" shaped, minimum 1.6 mm thick galvanized mild steel.
 - 2.5.4.2 Securely fasten in place.
 - 2.5.4.3 Removable for servicing.
- 2.5.5 Unprotected fan inlets or outlets:
 - 2.5.5.1 Wire or expanded metal screen, galvanized, 19 mm mesh.
 - 2.5.5.2 Net free area of guard: not less than 80% of fan openings.
 - 2.5.5.3 Securely fasten in place.
 - 2.5.5.4 Removable for servicing.

3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- 3.2.1 Fasten securely in place.
- 3.2.2 Make removable for servicing, easily returned into, and positively in position.

END OF SECTION

1 General

1.1 WORK INCLUDED

1.1.1 Conform to Section 21 05 00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

1.1.2 All power and control wiring from starters, fused and non-fused switches, whether mounted in M.C.C.'s or individually, to all mechanical devices and equipment shall be provided by this Division except where shown and specified under the Electrical Division.

1.1.3 All starters for devices supplied by this Division shall be provided by this Division except where shown and specified under the Electrical Division.

1.2 RELATED WORK SPECIFIED ELSEWHERE

1.2.1 All power wiring and starters for devices supplied by this Division shall be provided by the Electrical Division except where shown and specified under this Division. All control wiring shall be provided by this Division.

1.2.2 SUBMITTALS

1.2.3 Further to requirements of Section 21 05 00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS, submit Shop Drawings of following:

1.2.3.1 Submit an overload thermal element list with all supporting data for review prior to installation of the elements.

1.2.3.2 Submit samples of nameplates for review before manufacturing.

2 Products

2.1 DISCONNECT SWITCHES

2.1.1 Disconnect safety switches shall either be fusible or non-fusible safety switches and shall be heavy duty type A with quick-make, quick-break contacts, and shall be horsepower rated to match motor protected. Manufacturer shall be Canadian Westinghouse, Schneider, Klockner Moeller, Cutler Hammer or Siemens. Provide hole for padlock in off position.

2.1.2 Fuse clips shall be supplied with non-renewable type fuses suitably rated to motor nameplate current for proper short circuit protection. All fuse holders shall be suitable for HRC Class J time delay fuses. Supply three (3) additional sets of spare fuses for each size of fuse used.

2.1.3 Utilize switches of one manufacturer throughout the building.

2.2 MOTOR CONTROL CENTRES

- 2.2.1 All motor control centres shall be free standing E.E.,M.A.C.1 Class II, Type B construction in all areas without sprinklers and shall be E.E.M.A.C.-2 drip-proof in all areas with sprinklers as manufactured by Allen Bradley, Siemens, Klockner Moeller, Schneider, Cutler Hammer.
 - 2.2.2 All buswork shall be fully insulated and shall be copper, braced to withstand 40,000 AMP short circuit symmetrical.
 - 2.2.3 No more than 7 NEMA size 1 or smaller combination of standard starters shall be installed in one section. Leave space for a fire alarm shutdown relay compartment as required.
 - 2.2.4 All starters shall be complete with control transformer, pilot lights, and two normally open, normally closed auxiliary contacts. Separate pilot lights shall be used to indicate ON, OFF, LOW SPEED, and/or HIGH SPEED. Selector switches and pilot lights shall be heavy duty type. Provide high/low speed test positions in the hand mode for multi-speed motors. Starters smaller than size 1 shall not be used.
 - 2.2.5 Provide elementary wiring diagrams to Class 2B standards to indicate the control scheme. A separate elementary wiring diagram shall be provided for each fan or pump and the following shall be indicated in each wiring diagram:
 - 2.2.5.1 Breaker size Motor hp Motor F.L.A.
 - 2.2.5.2 Control transformer KVA Overloadsize
 - 2.2.5.3 Interlock scheme Remote connection, etc. Thermistors
 - 2.2.6 In each starter identify each wire and terminal with permanent number markings identical to the wiring diagrams.
 - 2.2.7 The latching relay, pilot light and the alarm contact shall be housed as part of the starter in the motor control starter.
 - 2.2.8 Size the overload thermal elements to the motor nameplate data and to the test curves (time/current/torque).
 - 2.2.9 Overload relays, thermistor relays, heater elements and other devices shall be sized to fully protect the motor for all starting and locked rotor conditions with the overloads remaining active in the circuit at all times.
 - 2.2.10 All three phase starters shall have 3 phase overload relays.
 - 2.2.11 All starters shall operate with 120 V control circuits. The control circuit fuse shall be on the secondary side of the control transformer.
 - 2.2.12 Provide an engraved lamacoid nameplate for the motor control centre and each individual starter within the motor control centre. M.C.C. identification shall be 50 mm (2 in.) high letters. All other identified shall be 6 mm (1/4 in.) high letters.
-

Typical Identification Plate for Motor Control Centre

First Line	-	M.C.C. #1
Second Line	-	Voltage/Phase/# of Wires
Third Line	-	Fed from main secondary switchboard
Fourth Line	-	In main electrical room

Typical Identification Plate for Individual Starters

First Line	-	Supply Fan SF-1
Second Line	-	Voltage/Phase/# of Wires

2.2.13 All nameplates shall be fastened with self-tapping screws.

2.3 INDIVIDUAL STARTERS

2.3.1 Individual starters shall meet all requirements specified for M.C.C.'s except as noted below.

2.3.2 Individually mounted manual starters shall generally be the toggle operated type with quick-make, quick-break mechanism, heavy duty sliding contacts in E.E.M.A.C. 1 general purpose enclosure in all areas without sprinklers and in E.E.M.A.C.-2 (drip proof) enclosure in all areas with sprinklers, pilot lights in cover and cover engraved with ON-TRIP-OFF positions.

2.3.3 Manual starters installed in finished areas shall be as above except suitable for flush mounting with stainless or bronze coverplates.

2.3.4 All magnetic starters individually mounted, standard or combination type, shall be for operation with a 120 V AC control transformer and coil, three phase overload protection, pilot lights, reset and pushbuttons or selector switches on the cover. All magnetic starters shall have auxiliary contacts.

2.3.5 All combination starters individually mounted shall be combination fusible type complete with pilot lights, on/off selector and reset button on cover. All combination starters shall have auxiliary contacts.

2.3.6 Provide an engraved lamaroid nameplate for each individual starter. Identification shall be 6 mm (1/4 in.) high letters.

Typical Identification Plate

First Line	-	Exhaust Fan EF-1
Second Line	-	208 V/3 ph/3 W
Third Line	-	Fed from splitter #1

3 Execution

3.1 INSTALLATION

3.1.1 All wiring and starters provided by this Division shall comply with the requirements of the Electrical Division of the Specifications.

- 3.1.2 Refer to Electrical Drawings and Specifications for work provided under that Division.
- 3.1.3 This Division shall review the shop Drawings for the motor starters submitted by the Electrical Division to ensure that all field connections are shown, the motor horsepower are correct and that the motor control schematics reflect all requirements.
- 3.1.4 Unless otherwise stated, this Section shall be responsible for the complete supply, installation and wiring of all starters, fused and non-fused switches and circuit breakers, auxiliary 120 V controls such as relays and pushbutton stations for the equipment supplied under other Sections of this Division.
- 3.1.5 Use non-fused disconnect switches for local equipment isolation only (e.g. fan motor downstream of fused starter in M.C.C.) all other disconnect shall be fused.
- 3.1.6 Where required provide a galvanized steel hood over switches, M.C.C.'s and individual starters. Hoods shall be suitably reinforced and securely supported from the structure.

END OF SECTION

1. General

1.1 WORK INCLUDED

1.1.1 Conform to the Section 21 05 00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

1.2 QUALITY ASSURANCE

1.2.1 The Variable Frequency Drive (VFD) manufacturing facility shall be ISO 9001 certified. The VFD shall be UL listed, Canadian UL listed and CSA listed.

1.2.2 Provide a minimum 100,000 hours mean time before failure (MTBF).

1.2.3 The manufacturer or their representatives shall be provided the project electrical power single line diagram, providing the data required by IEEE-519, to perform an analysis to initially demonstrate the supplied equipment will meet the IEEE standards after installation. If, as a result of the analysis, it is determined that additional filter equipment is required to meet the IEEE recommendations, then the cost of such equipment shall be included in the bid. A harmonic analysis shall be submitted with the approval drawings to verify compliance with the latest version of IEEE-519 voltage and current distortion limits as shown in table 10.2 and 10.3 at the point of common coupling (PCC). The PCC shall be defined as the consumer–utility interface or primary side of the main distribution transformer.

1.2.4 The term Variable Frequency Drive (VFD) shall be synonymous with Variable Speed Drives (VSD) and Adjustable Frequency Drives (AFD).

1.2.5 All Variable Frequency Drives for this project shall be of a single manufacturer for all fan and pump systems, including all components that require VFDs for air handling equipment, cooling towers, fluid coolers, pumps, etc.

1.3 RELATED WORK

1.3.1 For motors connected to variable frequency drives, refer to requirements of Section 21 05 13 – ELECTRIC MOTORS.

2. Products

1.4 GENERAL REQUIREMENTS

1.4.1 Variable frequency drives (VFD) shall be Danfoss FC102 VLTHVAC, Allan-Bradley PowerFlex 700, Schneider Electric Altivar 71 and ABB ACH550 as specified herein for the fans, pumps, heat recovery wheels, and cooling tower fans designated on the schedules or in the respective specification sections to be variable speed.

- 1.4.2 All standard and optional features shall be included within the VFD enclosure, unless otherwise specified. The VFD's UL listing shall allow it to be mounted in a plenum or other air handling compartments.
 - 1.4.3 The VFD shall be housed in a UL Type 1 ventilated enclosure for indoor applications, and Type 12 totally enclosed, gasketed enclosure for outdoor applications or if mounted in a plenum.
 - 1.4.4 The VFD shall be a digitally controlled drive, using, the Pulse Width Modulation (PWM) technology with sensorless vector control. It shall utilize IGBTs in its inverter section.
 - 1.4.5 The VFD shall allow the motor to produce full rated power at rated amps, RMS fundamental volts, and speed without using the motor's service factor when the motors rated voltage is applied to the VFD input.
 - 1.4.6 The VFD including all specified options shall be assembled by the ANSI/UL Standard 508 certified manufacturer for the building and assembly of option panels and the complete unit shall be tested to ANSI/UL Standard 508. Assembly of the option panels by a third-party panel shop shall not be acceptable. Where the components are separate, the appropriate CSA or C-UL stickers shall be applied to both the VFD and option panel. Both the VFD and option panel shall be manufactured in ISO 9001 certified facilities.
 - 1.4.7 The VFD shall have 5% DC link reactors on both the positive and negative rails of the DC bus to minimize power line harmonics. VFD's without DC link reactors shall provide a minimum 5% impedance input line reactor.
 - 1.4.8 The VFD's full load amp rating shall meet or exceed NEC Table 430-150. The VFD shall be able to provide full rated output current continuously, 110% of rated current for 60 seconds and 160% of rated current for up to 0.5 second while starting.
 - 1.4.9 The VFD shall be able to provide full torque at any selected frequency from 28 Hz to base speed to allow driving direct drive fans without derating.
 - 1.4.10 Input and output power circuit switching shall be able to be accomplished without interlocks or damage to the VFD. Switching rate may be up to 1 time per minute on the input and unlimited on the output. Disconnects located between the drive and the motor shall be interlocked into the VFD's safety circuitry.
 - 1.4.11 An automatic motor adaptation test algorithm shall measure motor stator resistance and reactance to optimize performance and efficiency. It shall not be necessary to run the motor or de-couple the motor from the load to run the test.
 - 1.4.12 VFD power components shall be designed for 600VAC where intended for 575V/600V service. Components designed for 480VAC installed on 575V/600V service shall not be acceptable.
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- 1.4.13 VFD shall minimize the audible motor noise through the use of an adjustable carrier frequency. The carrier frequency shall be automatically adjusted to optimize motor and VFD efficiencies while reducing motor noise.
- 1.4.14 VFD's output switching shall be maintained within the requirements of NEMA standard MG1 part 30, VFD's with output exceeding 1000V shall employ DVDT output filters.
- 1.4.15 VFD shall be complete with power disconnect where drive power can be completely shut down at the unit.

1.5 PROTECTIVE FEATURES

- 1.5.1 A minimum of Class 20 I2t electronic motor overload protection for single motor applications and thermal-mechanical overloads for multiple motor applications shall be provided.
- 1.5.2 Protection against input transients, loss of AC line phase, output short circuit, output ground fault, over-voltage, under-voltage, VFD over-temperature and motor over-temperature. The VFD shall display all faults in plain English. Codes shall not be acceptable.
- 1.5.3 Protect the VFD from sustained power or phase loss. The VFD shall provide full rated output with an input voltage as low as 90% of the nominal.
- 1.5.4 The VFD assembly including all required options shall be rated for 100,000amp interrupting capacity (AIC).
- 1.5.5 The VFD shall have built-in or externally mounted EMI electromagnetic filters to limit the EMI and RFI output from the VFD, designed to meet standard EN61800-3.
- 1.5.6 The VFD shall have a wide operating supply power range and shall continue to operate without faulting or tripping until the input voltage reaches at least 701 VAC on 600 volt systems and 300 VAC on 208/230 volt systems and 539 VAC on 460 volt systems.

1.6 INTERFACE FEATURES

- 1.6.1 Each VFD shall have the same operator's keypad, including digital display with Hand/Start, Off/Stop and Auto/Start, Help selector switches or buttons shall be provided to start and stop the VFD and determine the speed reference. The keypad shall be removable, capable of remote mounting and allow for uploading and downloading of parameter settings. The keypad shall include a built-in real time clock with date function. Speed Transfer between Hand and Auto shall be "bumpless."
-

- 1.6.2 Each VFD shall include an open system communication protocol interface, either BACnet as defined by ANSI/ASHRAE standard 135-2001 or LONWorks as defined by ANSI/CEA standard 709.1 for seamless integration with Section 25 05 01 – BAS General Requirements.
 - 1.6.3 Run permissive circuit shall be provided to accept a “system ready” signal to ensure that the VFD does not start until dampers or other auxiliary equipment are in the proper state for VFD operation. The run permissive circuit shall also be capable of sending an output signal as a start command to actuate external equipment before allowing the VFD to start.
 - 1.6.4 The VFD shall be able to be programmed to sense the loss of load and signal a no load/broken belt warning or fault.
 - 1.6.5 If the temperature of the VFD’s heat sink rises to 80 Deg. C. (176 Deg. C.), the VFD shall automatically reduce its carrier frequency to reduce the heat sink temperature. If the temperature of the heat sink continues to rise the VFD shall automatically reduce its output frequency to the motor. As the VFD’s heat sink temperature returns to normal, the VFD shall automatically increase the output frequency to the motor and return the carrier frequency to its normal switching speed.
 - 1.6.6 At least six programmable digital inputs shall be provided for interfacing with the systems control and safety interlock circuitry.
 - 1.6.7 Under smoke control or special fire mode conditions, the VFD shall be able to be programmed to automatically default to a preset speed or bypass.
 - 1.7 SERVICE CONDITIONS
 - 1.7.1 Ambient temperature, -10 Deg. C. to 40 Deg. C. (14 Deg. F. to 104 Deg. F.) without derating.
 - 1.7.2 0 to 95% relative humidity, non-condensing.
 - 1.7.3 Elevation to 1005 m (3300ft.) without derating.
 - 1.7.4 AC line voltage variation, -10 to +10% of nominal with full output.
 - 1.7.5 No side clearance shall be required for cooling of any units. All power and control wiring shall be done from the bottom.
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1.8 BYPASS

1.8.1 Provide a manual 3-contactor bypass, were indicated in schedules or specified, consisting of a door interlocked main fused disconnect pad lockable in the off position, a built-in motor starter and a four position DRIVE/OFF/BYPASS/TEST switch controlling three contactors. In the DRIVE position, the motor is operated at an adjustable speed from the VFD. In the OFF position, the motor and VFD are disconnected. In the BYPASS position, the motor is operated at full speed from the AC power line and power is disconnected from the VFD so that service can be performed. In the TEST position, the motor is operated at full speed from the AC line power while power is applied to the input of the VFD. This allows the VFD to be given an operational test while continuing to run the motor at full speed in bypass. In case of an external safety fault, a customer supplied normally closed dry contact shall be able to stop the motor whether in DRIVE or BYPASS mode. Supply VFD specific only fuses

1.8.1.1 .1 Service personnel shall be able to defeat the main power disconnect and open the bypass enclosure without disconnecting power. This shall be accomplished through the use of a specially designed tool and mechanism while meeting all local and national code requirements for safety.

1.8.2 Bypass shall be provided on the following systems:

1.8.2.1 .1 Cooling Towers Fans

3. Execution

1.9 INSTALLATION

1.9.1 Comply with manufacturer's installation instructions.

1.9.2 Provide a disconnect switch at the motor where required by the authorities having jurisdiction. Where such a switch is installed, provide an auxiliary contact or switch at the disconnect, mounted to open when the disconnect switch is opened and wired to a terminal strip in the VFD such that opening the disconnect switch initiates a drive shut down and prevents the drive from starting in either Line or Drive positions.

1.9.3 Locate and mount VFD panels in Mechanical Rooms and/or where shown on the Drawings.

1.9.4 Arrange for manufacturer's technical representative or local qualified representative to:

1.9.4.1 Inspect the installation of the drives and to start-up

1.9.4.2 Test and commission the drives. The VFD shall operate a dynamometer at full load and speed and shall be cycled during the test.

1.9.4.3 Be present during testing and commissioning performed under Section 25 01 10 – BAS General Requirements.

- 1.9.5 Measure the distortion of each phase at the load terminals of the branch breaker and report the results to the Consultant. Any deficiency shall be corrected and re-evaluated.
- 1.9.6 Implement a communication protocol for remote interface to match the communication protocol under Section 25 05 01 – BAS General Requirements.
- 1.9.7 BAS connection to drives provided under Section 25 05 01 – BAS General Requirements.
- 1.10 WARRANTY
 - 1.10.1 Warranty shall be 24 months from the date of Substantial Performance of the work. Warranty shall be on-site parts and labour inclusive.

END OF SECTION

1. General

1.1. WORK INCLUDED

- .1 Conform to Section 21 05 00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

1.2. SUBMITTALS

- .1 Shop Drawings: Further to requirements of Section 21 05 00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS, submit working ranges of thermometers and gauges with Shop Drawings.

2. Products

2.1. MATERIALS

- .1 Pipeline thermometers shall be complete with:
 - .1 Dust-tight stainless case and stem with 127 mm (5 in.) dial.
 - .2 Bi-metal type.
 - .3 Whiteface with black lettering
 - .4 Range normally 0 to 115 deg. C. (32 to 240 deg. F.) for hot water and -17 to 49 deg. C. (0 to 120 deg. F.) for chilled water but range shall suit maximum and minimum temperatures of location and be shown on shop drawings.
 - .5 Temperature marking in 1 deg. C. (2 deg. F.) increments in both imperial and metric scales.
 - .6 Eternal recalibration adjustment.
 - .7 Separable socket with extension neck as required for insulated pipe.
 - .8 Universal adjustable hinge
 - .9 Wells shall be registered with the provincial Boiler and Pressure Vessel Safety Branch and have a C.R.N. registration number.
 - .2 For ducts up to 750 mm (30 in.) in the largest dimension thermometers shall be similar to pipeline thermometers but with an additional perforated bulb guard and shall be flanged for mounting on ducts.
 - .3 For ducts over 750 mm (30 in.) in largest dimension thermometer shall be complete with:
 - .1 115 mm (4½ in.) diameter, cast aluminum case construction
 - .2 Black pointer
 - .3 Whiteface with black lettering
 - .4 Range normally 0 to 115 deg. C. (32 to 240 deg. F.) for heated supply air, 0 to 80 deg. C. (32 to 175 deg. F.) for cooled supply, mixed and return air and -40 to 90 deg. C. (-40 to 195 deg. F.) for outside air but range shall suit maximum and minimum temperature of location and shall be shown on Shop Drawings.
 - .5 Temperature marking in 1 deg. C. (2 deg. F.) increments in both imperial and metric
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- scales.
 - .6 Vapour filled
 - .7 1500 mm (60 in.) minimum length copper averaging bulb with bronze braided armour.
 - .8 Flanged formounting on ducts.
 - .9 For insulated ducts or plenums provide a bracket for mounting thermometer clear of insulation.
 - .4 Thermometers for remote reading shall be similar to duct thermometers specified above but with armoured extension capillary and bulb with separable well for pipelines or flanged duct connection for averaging bulb, as required.
 - .5 Pressure gauges shall be complete with:
 - .1 Dust-tight nominal 115 mm (4½ in.) dia. case, solid front complete with back blow-out to A.N.S.I. B40-1 Grade 2A Level Standards.
 - .2 Back-flanged where required.
 - .3 Black pointer
 - .4 White dial with black markings
 - .5 Dial range to cover twice the average working pressure of the equipment and shall be compound gauges on pump suction for all open systems.
 - .6 Clear lens
 - .7 Phosphor bronze bourdon tube, silver soldered.
 - .8 Brass or stainless steel movement, bronze or nylon brushed, scale and movement mounted independent of the case.
 - .9 Brass socket
 - .10 kPa and psi scales
 - .11 Provincial Boiler and Pressure Vessel Safety Branches registration number
 - .6 Manometers shall be inclined tube, differential type complete with:
 - .1 Adjustable scale of anodized aluminum or polished and chrome plated with black figure and graduations
 - .2 Range 0 to 0.5 kPa (0 to 2 in.) with 0.005 kPa (0.02 in.) graduations in both metric and imperial scales.
 - .3 Built in level vial
 - .4 Adjustable flanged base for mounting on duct or plenum
 - .5 Two static pressure tips, flanged for mounting on duct
 - .6 Two 1500 mm (60 in.) lengths of tubing
 - .7 Bottle of red gauge oil
 - .7 Manometers shall be Magnahelic gauge type in dust free case with black pointer. Gauge range shall be 2½ times the maximum filter resistance. Case shall be suitable for duct or plenum mounting. Provide bracket for mounting gauge on insulated ducts or plenums.
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- .8 Thermometers shall be Terice, Taylor, Weksler, Winters or Ashcroft.
- .9 Pressure gauges shall be Terice, Ashcroft, Morrison, Winters or Weksler.
- .10 Manometers shall be Airflow Developments or Dwyer.
- .11 Gauge glasses shall be Pyrex Red Line 12 mm (1/2 in.) equipped with leakproof pet cocks and ball check valves.

3. Execution

3.1. INSTALLATION

- .1 Locate all thermometers and pressure gauges so as to assure easy reading from the floor or platform.
 - .2 Where direct reading instruments cannot be satisfactorily located use a remote instrument.
 - .3 Locate remote instruments next to the point of the reading, on wall or structure.
 - .4 Each remote or panel mounted instrument shall have an engraved lamaroid nameplate identifying the system and service.
 - .5 Insert pipeline thermometer into tanks, equipment tapings or in pipeline using screwed tees or forged steel couplings, welded into the lines.
 - .6 Duct thermometers shall be attached to duct using sheet metal screws through thermometer flange.
 - .7 Insert pressure gauges into equipment tapings or in pipelines using screwed tees or forged steel couplings welded into the lines.
 - .8 Provide thermometers in the following locations in pipelines:
 - .1 In and out of each water coil or other coil, handling liquid, except individual reheat coils in ductwork.
 - .2 On each branch of 3 port control valves, excluding valves on fan coil, induction units, or individual reheat coils in ductwork.
 - .3 In and out of each heat exchanger, condenser, cooler or type of other heat exchanger.
 - .4 Each heating water return and each heating water supply for each main system
 - .5 Each hot or cold water storage tank
 - .6 And where specifically shown
 - .9 When a common supply header provides the same temperature water to many coils or to many zones, provide a thermometer on the common header only, rather than a
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thermometer on each branch.

- .10 For control valves with by-pass located thermometer in common pipe to allow for manual temperature control.
 - .11 Provide thermometers in the following locations in ducts or plenums:
 - .1 Upstream and downstream from each coil, spray or humidifier, except individual reheat coils in ductwork.
 - .2 On each of 3 ducts or plenums at mixing dampers
 - .3 Return air from each zone
 - .4 Outside air entering air handling units
 - .5 And where specifically shown
 - .12 Where a common duct or plenum provides the same temperature air to many zones, provide a thermometer on the common duct only, rather than at each branch of a zone.
 - .13 Provide test wells for thermometers where shown. Test wells shall be compatible with the thermometers used. Wells shall be registered with the Provincial Boiler and Pressure Vessel Safety Branch and have a C.R.N. registration number.
 - .14 Provide a Watts B6000 ball valve on the inlet to each gauge. In addition, install a coil syphon on each steam gauge. Install a pressure snubber on any gauge installed near a pump or in any location where damping is required to prevent rapid oscillation of the pointer. When the equipment is subject to vibration, mount the gauge on adjacent wall or on a mounting plate, supported from the floor.
 - .15 Provide pressure gauges in the following areas:
 - .1 City water line where it enters the building
 - .2 In and out of each pump
 - .3 In and out of all pressure reducing valves
 - .4 On each hot water supply and hot water return header
 - .5 Air cushion tank or expansion tank
 - .6 City water make-up line
 - .7 Each fire standpipe at highest fire hose cabinet
 - .8 In and out of each heat exchanger, condenser, cooler or type of other heat exchanger
 - .9 And where specifically shown
 - .16 Valved connections for pressure gauges shall be installed on each side of coils.
 - .17 Install manometer at each bank of filters to show the resistance to air flow through the filters. Where prefilters and final filters are mounted in a common frame it is only necessary to provide a single manometer to show the resistance across the total filter assembly.
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Where filters are separately mounted in individual frames provide a manometer for each set of filters.

- .18 Install gauge glasses on each fire water storage, expansion tank and where shown. Gauge glasses shall be full height of tank. Individual gauge glasses shall be a maximum of 450 mm (18 in.) high where more than one gauge glass is required to give full coverage on any tank, glasses shall overlap by a minimum of 150 mm (6 in.). Provide shut-off valves on all connections to gauge glasses.

END OF SECTION

1 GENERAL

- 1.1 THIS SECTION REFERENCES TO PLUMBING, HEATING AND FIRE PROTECTION PIPE HANGERS AND SUPPORTS AND APPLIES TO DIVISIONS 21, 22 AND 23.
- 1.2 REFERENCES
 - 1.2.1 ANSI B31.1-1983, (SI), Power Piping, (SI Edition).
 - 1.2.2 ANSI/MSS-SP-58-1983, Pipe Hangers and Supports - Materials, Design and Manufacture.
- 1.3 SHOP DRAWINGS AND PRODUCT DATA
 - 1.3.1 Submit shop drawings and product data in accordance with Section 21 05 00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
 - 1.3.2 Indicate on manufacturers catalogue literature the following:
 - 1.3.2.1 Upper attachment.
 - 1.3.2.2 Middle attachment.
 - 1.3.2.3 Pipe attachment.
 - 1.3.2.4 Riser clamps.
 - 1.3.2.5 Shields and saddles.
 - 1.3.2.6 Sway braces.
- 1.4 MAINTENANCE DATA
 - 1.4.1 Provide maintenance data for incorporation into manual specified in Section 21 05 00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

2 PRODUCTS

- 2.1 ACCEPTABLE MANUFACTURERS
 - 2.1.1 Supports and Hangers: E. H. Myatt & Co., Grinnell, Hunt Manufacturing, L.E. Taylor.
 - 2.2 GENERAL
 - 2.2.1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS-SP58.
 - 2.2.2 Support from top of structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.
 - 2.3 UPPER ATTACHMENTS
 - 2.3.1 Concrete:
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- 2.3.1.1 Inserts for cast-in-place concrete: galvanized steel wedge to MSS-SP58, type 18. ULC listed for pipe NPS 3/4 through NPS 8.
 - 2.3.1.1.1 Acceptable Material: Grinnell fig. 281.
 - 2.3.1.2 Carbon steel plate with clevis, for surface mount: malleable iron socket and expansion case and bolt. Minimum two expansion cases and bolts for each hanger.
 - 2.3.1.2.1 Acceptable Material: Grinnell, Plate Fig. 49, Socket fig. 290, Expansion Case fig. 117.
 - 2.3.2 Steel beam (bottom flange):
 - 2.3.2.1 Cold piping NPS 2 and under: malleable iron C clamp to MSS-SP58, type 19. ULC listed.
 - 2.3.2.1.1 Acceptable Material: Grinnell fig. 61.
 - 2.3.2.2 Cold piping NPS 2-1/2 and larger and all hot piping: malleable iron beam clamp to MSS-SP58, type 28 or 29. ULC listed.
 - 2.3.2.2.1 Acceptable Material: Grinnell fig. 229.
 - 2.3.3 Steel beam (top):
 - 2.3.3.1 Cold piping NPS 2 and under: malleable iron "top of beam" C clamp to MSS-SP58, type 19. ULC listed.
 - 2.3.3.1.1 Acceptable Material: Grinnell fig. 61.
 - 2.3.3.2 Cold piping NPS 2-1/2 and larger and all hot piping: steel jaw, hook rod with nut, spring washer and plain washer, to MSS-SP58, type 25. ULC listed.
 - 2.3.3.2.1 Acceptable Material: Grinnell fig. 227.
 - 2.3.4 Steel joist:
 - 2.3.4.1 Cold piping NPS 2 and under: steel washer plate with double locking nuts.
 - 2.3.4.1.1 Acceptable Material: Grinnell fig. 60.
 - 2.3.4.2 Cold piping NPS 2-1/2 and larger and all hot piping: steel washer plates with double locking nut, carbon steel clevis and malleable iron socket.
 - 2.3.4.2.1 Acceptable Material: Grinnell. washer plate, fig. 60; clevis, fig. 66; socket, fig. 290.
 - 2.3.5 Steel channel or angle (bottom):
 - 2.3.5.1 Cold piping NPS 2 and under; malleable iron C clamp to MSS-SP58, type 23. ULC listed.
 - 2.3.5.1.1 Acceptable Material: Grinnell fig. 86.
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- 2.3.5.2 Cold piping NPS 2-1/2 and larger and all hot piping; universal channel clamp. ULC listed.
 - 2.3.5.2.1 Acceptable Material: Grinnell fig. 226.
 - 2.3.6 Steel channel or angle (top):
 - 2.3.6.1 Cold piping NPS 2 and under; malleable iron "top of beam" C clamp to MSS-SP58, type 19. ULC listed.
 - 2.3.6.1.1 Acceptable Material: Grinnell fig. 61.
 - 2.3.6.2 Cold piping NPS 2-1/2 and larger and all hot piping; steel jaw, hook rod with nut, spring washer and plain washer, to MSS-SP58, type 25. ULC listed.
 - 2.3.6.2.1 Acceptable Material: Grinnell fig. 227.
 - 2.3.7 Carbon steel threaded rod black finish.
 - 2.3.8 Cold piping, steel or cast iron: hot piping steel, with less than 25 mm horizontal movement; hot piping, steel, with more than 300 mm middle attachment (rod) length: adjustable clevis to MSS-SP58, type 1. ULC listed.
 - 2.3.8.1 Acceptable Material: Grinnell fig. 260.
 - 2.3.9 Cold copper piping; hot copper piping with less than 25 mm horizontal movement; hot copper piping with more than 300 mm middle attachment (rod) length: adjustable clevis to MSS-SP58, type 1. Copperplated.
 - 2.3.9.1 Acceptable Material: Grinnell fig. CT-65.
 - 2.3.10 Suspended hot piping, steel and copper, with horizontal movement in excess of 25 mm; hot steel piping with middle attachment (rod) 300 mm or less; pipe roller to MSS-SP58, type 43.
 - 2.3.10.1 Acceptable Material: Grinnell fig. 174.
 - 2.3.11 Bottom supported hot piping, steel and copper: pipe roller stand to MSS-SP58, type 45.
 - 2.3.11.1 Acceptance Standard: Grinnell fig. 271.
 - 2.3.12 Steel or cast iron pipe: black carbon steel to MSS-SP58, type 42. ULC listed.
 - 2.3.12.1 Acceptable Material: Grinnell 261.
 - 2.3.13 Copper pipe: carbon steel copper finished to MSS-SP58, type 42.
 - 2.3.13.1 Acceptable Material: Grinnell fig. CT-121.
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2.4 SADDLES AND SHIELDS

2.4.1 Cold piping NPS 1-1/4 and over: protection shield with high density insulation under shield with uninterrupted vapor barrier.

2.4.1.1 Acceptable Material: Grinnell fig. 167.

2.4.2 Hot piping NPS 1-1/4 and over: protective saddle with insulation under saddle.

2.4.2.1 Acceptable Material: Grinnell fig. 160 to 166.

3 EXECUTION

3.1 HANGER SPACING

3.1.1 SPACING and middle attachment (rod) diameter as specified in paragraphs below or as in table below, whichever is more stringent.

3.1.1.1 Plumbing piping: most stringent requirements of Canadian Plumbing Code, Provincial Code, or authority having jurisdiction.

3.1.1.2 Fire protection: to applicable fire code.

3.1.1.3 Gas piping: up to NPS 1/2: every 1.8 m.

3.1.1.4 Copper piping: up to NPS 1/2: every 1.5 m.

3.1.1.5 Flexible joint roll groove pipe: in accordance with table below, but not less than one hanger at joints.

3.1.1.6 Within 300 mm of each horizontal elbow.

Pipe Size NPS Up to:	Rod Diameter	Maximum Steel	Spacing Copper
3/4	10 mm	2.1 m	1.8 m
1	10 mm	2.1 m	1.8 m
1-1/4	10 mm	2.1 m	1.8 m

Pipe Size NPS Up to:	Rod Diameter	Maximum Steel	Spacing Copper
1-1/2	10 mm	2.4 m	2.1 m
2	10 mm	3 m	2.7 m
2-1/2	10 mm	3.6 m	3 m
3	10 mm	3.6 m	3 m
3-1/2	10 mm	3.9 m	3.3 m
4	16 mm	4.8 m	3.3 m
5	16 mm	4.8 m	3.3 m
6	22 mm	5.1 m	3.3 m
8	22 mm	5.7 m	3.3 m
10	22 mm	6.6 m	3.3 m
12 & over	22 mm	6.7 m	3.3 m

3.2 HANGER INSTALLATION

3.2.1 Offset hanger so that rod is vertical in operating position.

3.2.2 Adjust hangers to equalize load.

END OF SECTION

1 GENERAL

1.1 REFERENCES

1.1.1 ANSI/NFPA 13-1987, Installation of Sprinkler Systems.

1.1.2 Alberta Building Code 2014.

1.2 SHOP DRAWINGS

1.2.1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.

1.2.2 Provide separate shop drawings for each isolated system complete with performance and product data.

1.2.3 Provide detailed drawings of all seismic control measures for equipment and piping.

2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

2.1.1 Vibration Isolation Material: Korfund, Masdom, Vibron, Vibro - Acoustics.

2.2 ELASTOMERIC PADS

2.2.1 Type P1 - neoprene waffle or ribbed; 9 mm minimum thick; 50 durometer; maximum loading 350 kPa.

2.2.2 Type P2 - rubber waffle or ribbed; 9 mm minimum thick; 30 durometer natural rubber; maximum loading 415 kPa.

2.2.3 Type P3 - neoprene-steel-neoprene; 9 mm minimum thick neoprene bonded to 1.71 mm steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 350 kPa.

2.2.4 Type P4 - rubber-steel-rubber; 9 mm minimum thick rubber bonded to 1.71 mm steel plate;

2.2.5 30 durometer natural rubber, waffle or ribbed; holes sleeved with isolation washers; maximum loading 415 kPa.

2.3 SPRING MOUNT

2.3.1 Zinc or cadmium plated hardware; housings coated with rust resistant paint.

2.3.2 Type M2 - stable open spring: support on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad.

- 2.3.3 Type M3 - stable open spring: 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad, bonded under isolator and on isolator top plate; levelling bolt for rigidly mounting to equipment.
- 2.3.4 Type M4 - restrained stable open spring: supported on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad; built-in resilient limit stops, removable spacer plates.
- 2.3.5 Type M5 - enclosed spring mounts with snubbers for isolation up to 950 kg maximum.

2.4 HANGERS

- 2.4.1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30E arc without metal to metal contact.
- 2.4.2 Type H1 - neoprene - in-shear, molded with rod isolation bushing which passes through hanger box.
- 2.4.3 Type H2 - stable spring, elastomeric washer, cup with molded isolation bushing which passes through hanger box.
- 2.4.4 Type H3 - stable spring, elastomeric element, cup with molded isolation bushing which passes through hanger box.
- 2.4.5 Type H4 - stable spring, elastomeric element with precompression washer and nut with deflection indicator.

3 EXECUTION

3.1 INSTALLATION

- 3.1.1 Install vibration isolation equipment in accordance with manufacturers instructions and adjust mountings to level equipment.
 - 3.1.2 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.
 - 3.1.3 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm minimum static deflection as follows:
 - 3.1.3.1 up to NPS 4: first 3 points of support. NPS 5 to NPS 8: first 4 points of support. NPS 10 and Over: first 6 points of support.
 - 3.1.3.2 First point of support shall have a static deflection of twice deflection of isolated equipment, but not more than 50 mm.
 - 3.1.4 Where isolation is bolted to floor use vibration isolation rubber washers.
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3.2 ISOLATION SCHEDULE

<u>Equipment Description</u>	<u>Equipment No.</u>	<u>Isolation</u>	<u>Deflection Type</u>	<u>Comments Static (mm)</u>
Unit Heaters	All	UH1, UH-2	15 mm	--
Pumps	P-1 to P-13	P-1, P-2	-	-

Make-up Air unit	MUA1	MUA1	-	
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<u>Equipment Description</u>	<u>Equipment No.</u>	<u>Isolation</u>	<u>Deflection Type</u>	<u>Comments Static (mm)</u>
In-Line Exhaust Fans	All	All	-	-

END OF SECTION

1 GENERAL

1.1 SCOPE

- 1.1.1 Notwithstanding the Rules, Regulations, and Trade Definitions of the Alberta Construction Tendering System, all Mechanical Identification shall be included in the Mechanical scope of work.

1.2 REFERENCES

- 1.2.1 CAN/CGSB-1.60-M89, Enamel, Interior, Gloss, Alkyd Type.
- 1.2.2 CAN/CGSB-24.3-92, Identification and Classification of Piping Systems.

2 PRODUCTS

2.1 MANUFACTURERS NAMEPLATES

- 2.1.1 Provide metal nameplate on each piece of equipment, mechanically fastened complete with raised or recessed letters.
- 2.1.2 Indicate size, equipment model, manufacturer's name, serial number, voltage, cycle, phase and power of motors.

2.2 SYSTEM NAMEPLATES

2.2.1 Colour:

- 2.2.1.1 Hazardous: red letters, white background.
- 2.2.1.2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).

2.2.2 Construction:

- 2.2.2.1 3 mm thick, laminated plastic or white anodized aluminum, matte finish, square corners, letters accurately aligned and machine engraved into core.

2.2.3 Sizes:

- 2.2.3.1 Conform to following table:

Size	Dimensions	No of	Letter
#	(mm x mm)	Lines	Height (mm)
1	10 x 50	1	3
2	13 x 75	1	5
3	13 x 75	2	3
4	20 x 100	1	8
5	20 x 200	1	8
6	20 x 100	2	5

7	25 x 125	1	12
8	25 x 125	2	8
9	35 x 200	1	20

- 2.2.3.2 Use average of 25 letters/numbers (maximum) per nameplate.
- 2.2.3.3 Use size #6 for terminal cabinets and control panels.
- 2.2.3.4 Use size #9 for equipment in mechanical rooms.

2.3 PIPING AND DUCTING

2.3.1 General:

- 2.3.1.1 Use painted stencils for labels and flow arrows for all insulated and non-insulated piping.
- 2.3.1.2 Identify pipes and ducts with striped bands and symbols.
- 2.3.1.3 Piping and ductwork painting to be done by painting sub-contractor to the requirements of Division 9.

2.3.2 Sizes:

2.3.2.1 Legend: block capitals to following table:

Outside Dia. of Pipe or Insulation mm	Size of Letters mm
30	13
50	19
150	32
250	63
Over 250	88

2.3.2.2 Primary colour bands:

- 2.3.2.2.1 At valves and fittings: 500 mm long.
- 2.3.2.2.2 Elsewhere: 1000 mm long.

2.3.2.3 Secondary colour bands: 50 mm wide, 75 mm in from one end of primary colour band.

2.3.2.4 Arrows:

- 2.3.2.4.1 Outside diameter of pipe/duct/insulation 75 mm and greater: 150 mm long x 50 mm high.
- 2.3.2.4.2 Outside diameter of pipe/duct/insulation less than 75 mm: 100 mm long x 50 mm high.
- 2.3.2.4.3 Use double headed arrows where flow is reversible.

2.3.3 Colours:

2.3.3.1 Where not covered by table below, submit legend, primary and secondary classification colours to Departmental representative for approval.

2.3.4 Table:

2.3.4.1 Pipe and Duct identification.

Classification	<u>Pipe/Duct Colour</u>	<u>Symbol</u>
Heating Water Supply Pipe	Yellow	HWS
Heating Water Return Pipe	Yellow	HWR
Domestic Cold Water Pipe	Dark Green	DCW
Domestic Hot Water Supply Pipe	Light Grey	DHWS
Domestic Hot Water Return Pipe	Dark Grey	DHWR
Drain Pipe	Black	
Glycol Supply Pipe	Orange	GLY.S
Glycol Return Pipe	Orange	GLY.R
Chilled Water	Light Green	CW
Low Pressure Steam	White	STM-LP
Gas Pipe (Low Pressure)	Dark Blue	NAT.GAS
Gas Pipe (Medium Pressure)	Yellow	NAT.GAS
Sprinkler Pipe	Red	SPR.
Fire Standpipe	Red	STANDPIPE
Refrigerant Pipe	Silver	FREON
Supply Air Duct		S/A
Return Air Duct		R/A
Exhaust Air Duct		E/A

2.3.4.2 Legend and arrows:

2.3.4.2.1 Black or white to contrast with primary colour.

2.3.4.2.2 Fire protection: white on red background. Stopped here

2.3.5 Fire protection system:

2.3.5.1 Concealed piping: paint complete system red (by Division 9) and identify.

2.3.6 Natural gas:

- 2.3.6.1 Paint entire system as per Pipe and Duct Identification Schedule.
Coordinate painting with Division 9.

2.3.7 All other piping and ducting: paint where exposed in mechanical rooms (by Division 9) and identify completely.

2.3.8 Low voltage control wiring installed by Division 15: to Section 15994 – BAS General Requirements.

2.4 Valves AND CONTROLLERS

- 2.4.1 Brass tags with 12 mm stamped code lettering and numbers filled with black paint.

2.5 CONTROLS IDENTIFICATION

- 2.5.1 Identify all systems, equipment, components, controls and sensors with laminated plastic tag indicating point identification name, point address (program name), control panel, control panel location.

- 2.5.2 Inscription to identify function and, (where applicable) fail-safe position.

3 EXECUTION

3.1 GENERAL

- 3.1.1 Provide ULC and or CSA registration plates, as required by respective agency.

3.2 LOCATION OF NAMEPLATES

- 3.2.1 In conspicuous location to facilitate easy reading from operating floor and to properly identify equipment and/or system.
- 3.2.2 Provide stand-offs for nameplates on hot surfaces and insulated surfaces.
- 3.2.3 Do not insulate or paint over plates.

3.3 PIPING

- 3.3.1 Identify all piping using primary color bands, secondary color bands and pipe marker legend text.
- 3.3.2 Locations:
 - 3.3.2.1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, and tunnels so that at least one is clearly visible from any one viewpoint in operating areas or walking aisles and not at more than 10 m intervals.
 - 3.3.2.2 Adjacent to all changes in direction.

- 3.3.2.3 At least once in each small room through which piping passes.
- 3.3.2.4 On both sides of visual obstruction or where run is difficult to follow.
- 3.3.2.5 On both sides of any separation such as walls, floors and partitions.
- 3.3.2.6 Where piping is concealed in pipe chase, ceiling space, gallery or other confined space, at entry and leaving points and adjacent to each access opening.
- 3.3.2.7 At beginning and end points of each run and at each piece of equipment in run.
- 3.3.2.8 At point immediately upstream of major manually operated or automatically controlled valves. Where this is not possible, place identification as close to valve as possible, preferably on upstream side.
- 3.3.2.9 Legend to be easily and accurately readable from usual operating areas and all readily accessible points.
- 3.3.2.10 Plane of legend to be approximately at right angles to most convenient line of sight with consideration of operating positions, lighting conditions, reduced visibility of colour or legends caused by dust and dirt and risk of physical damage.

3.4 DUCTWORK

- 3.4.1 Identify all ductwork by name and indicate direction of flow using arrows.
 - 3.4.2 Stencil over final finish only.
 - 3.4.3 Locations of ductwork identification:
 - 3.4.3.1 On long straight runs in open areas in boiler rooms so that at least one is clearly visible from any one viewpoint in operating areas or walking isles and not at more than 10 m intervals.
 - 3.4.3.2 Adjacent to all changes in direction.
 - 3.4.3.3 At least once in each small room through which ductwork passes.
 - 3.4.3.4 On both sides of visual obstruction or where run is difficult to follow.
 - 3.4.3.5 On both sides of any separation such as walls, floors and partitions.
 - 3.4.3.6 Where ductwork is concealed in duct chase, gallery or other confined space, at entry and leaving points and adjacent to each access opening.
 - 3.4.3.7 At beginning and end points of each run and at each piece of equipment in run.
 - 3.4.3.8 At point immediately upstream of major manually operated or automatically controlled dampers. Where this is not possible, place identification as close to damper as possible, preferably on upstream side.
 - 3.4.3.9 Legend to be easily and accurately readable from usual operating areas and all readily accessible points.
 - 3.4.3.10 Plane of legend to be approximately at right angles to most convenient line of sight with consideration of operating positions, lighting conditions, reduced visibility of colour or legends caused by dust and dirt and risk of physical damage.
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3.4.3.11 Beside each access door.

3.5 VALVES AND CONTROLLERS

3.5.1 Secure tags with non-ferrous chains or closed "S" hooks for valves and operating controllers except at plumbing fixtures and radiation.

3.5.2 Consecutively number valves in system.

END OF SECTION

1 General

1.1 WORK INCLUDED

1.1.1 Conform to Section 21 05 00– GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

1.1.2 Nameplates for systems such as thermostatic controls, are covered in the Articles specifying the equipment.

1.1.3 Every piece of equipment shall have a nameplate.

1.2 SUBMITTALS

1.2.1 Submit samples of nameplates before installation.

2 Products

2.1 MATERIALS

2.1.1 The nameplates shall be a minimum of 2 mm (3/32 in.) thick laminated phenolic plastic. Minimum size shall be 100 mm (4 in.) long x 50 mm (2 in.) wide with maximum size to suit nomenclature required. Nameplate shall be with black face and white centre and with 5 mm (7/32 in.) high lettering engraved through to the white lamination.

2.1.2 The nameplates shall have the equipment type and name as indicated in the Equipment Schedules.

2.1.3 The nameplates shall have the service and area of the building served (e.g. Chilled Water – South Zone).

3 Execution

3.1 INSTALLATION

3.1.1 Nameplates shall be securely fastened with screws or brass chains in a conspicuous place on the equipment.

END OF SECTION

1. General

1.1. WORK INCLUDED

- .1 Conform to Section 21 05 00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

1.2. SUBMITTALS

- .1 Submit samples of charts and numbering system before installation.

2. Products

2.1. MATERIALS

- .1 Tags shall be square colour coded phenolic with engraved numbers and/or letters as required. Tags shall be a minimum of 25 mm (1 in.) square and maximum to suit numbering system. Numbers shall be nominally 9 mm (3/8 in.) high. Letters shall be nominally 6 mm (1/4 in.) high.
- .2 Number and nameplates for standpipe and sprinkler system supervisory and main operating valves shall be minimum 2 mm (3/32 in.) thick laminated phenolic plastic and a minimum 125 mm (5 in.) long x 100 mm (4 in.) wide with red face and white centre. Lettering shall be a minimum 9 mm (3/8 in.) high with maximum to suit local authorities and shall be engraved through to the white lamination. Each nameplate shall contain the system name, service and valve number.
- .3 For all other valves on standpipe and sprinkler system not required to have laminated number and nameplates, provide plastic tags as specified above.
- .4 Abbreviations and colour code shall be as shown on Standard Details.

3. Execution

3.1. INSTALLATION

- .1 Tags and nameplates shall be attached to the valve body or handle with brass hooks or chains.
 - .2 All valves shall be provided with tags, other than valves on convectors, induction units or other space heating, cooling units and valves on plumbing fixtures. Provide a chart or charts, indicating location, service and zone of each valve. This work shall be coordinated between the various Mechanical Sections to prevent overlapping of numbering systems.
 - .3 Provide separate charts for all fire system nameplates and tags.
 - .4 For extension and/or alterations to existing systems, provide new charts conforming in appearance to the existing charts.
 - .5 Co-ordinate valve identification with pipe and ductwork identification.
 - .6 Roof drains used for restricting or controlling the flow of water from the roof or acting as an overflow shall be affixed with an identification label "Control Flow Roof Drain – Do Not
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Remove Restriction Device”.

- .7 Charts shall be set in metal picture frames with a clear acrylic front and fastened securely where directed by Consultant or Departmental representative.
- .8 All valve tag numbers for all systems shall be shown on the As-Built Drawings.

END OF SECTION

1 General

1.1 WORK INCLUDED

- 1.1.1 Conform to Section 21 05 00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
- 1.1.2 Submit Drawings showing size, type and location of all access doors, for review, before installation.

2 Products

2.1 MATERIALS

- 2.1.1 Access doors shall be Acudor, or Mifab Manufacturing Inc.
 - 2.1.2 Doors in solid walls shall be with a 14 U.S. gauge, prime painted steel door panel, rust resistant concealed hinges, flanged frame, and screwdriver operated lock. Acudor Model UF 5000 or Mifab Model UA.
 - 2.1.3 Doors in plaster partitions or ceilings shall be with a 16 US gauge, prime painted steel recessed door panel with metal lath for the acceptance of plaster finish, concealed hinges, metal lath frame, and screwdriver operated lock. Acudor model AP 5010 or Mifab Model CAD-PL.
 - 2.1.4 Doors in drywall partitions or ceilings shall be 16 US gauge, prime painted steel recessed door panel for the acceptance of a drywall insert, concealed hinges, drywall bead frame, and screwdriver operated lock. Acudor model DW 5015 or Mifab Model CAD-DW.
 - 2.1.5 Doors in drywall partitions or ceilings shall be 14 US gauge, prime painted steel flush door panel, concealed hinges, drywall bead frame, and screwdriver operated lock. Acudor model DW 5040 or Mifab Model MDW.
 - 2.1.6 Access doors in fire rated walls or ceilings shall be ULC labeled with insulated door panel, concealed hinge, self closing, self latching, flanged frame, and prime painted. Provide master key operated catch in areas accessible to the public. Acudor Model FW 5050 or Mifab MPFR.
 - 2.1.7 Doors in tiled walls or ceilings shall be 16 US gauge, stainless steel, type 304 with #4 satin finish, concealed hinges, wall frame and screw driver operated lock. Acudor Model UF 5000 or Mifab Model UA-SS.
 - 2.1.8 Doors for medium and high security applications in solid walls shall be 10 US gauge door with minimum 4 mm (3/16 in.) welded angle frame with heavy duty butt hinges welded to the door and frame with master keyed cylinder lock provided by the Departmental representative. Acudor Model SD 6000 or Mifab Model MI-SADH.
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- 2.1.9 Minimum size of doors shall be 300 mm x 450 mm (12 in. x 18 in.). Wherever possible 600 mm x 600 mm (24 in. x 24 in.) doors shall be used.

3 Execution

3.1 INSTALLATION

- 3.1.1 All parts of the installation requiring periodic maintenance shall be accessible. Wherever valves, dampers and other appurtenances are concealed by building construction, access doors shall be furnished by this Section and installed under the respective Trade Sections (i.e. masonry, plaster, drywall, tile, etc.) This Section is responsible for the proper location of the access doors.
- 3.1.2 Wall mounted plumbing fixtures with back water connection shall have an adjacent access door.
- 3.1.3 Wherever possible, items requiring access shall be located in easily accessible areas (i.e. exposed or T-bar ceilings).
- 3.1.4 Group items in order to minimize the number of access doors required.
- 3.1.5 Each access door shall be installed to provide complete access to equipment for maintenance and servicing.
- 3.1.6 Make any changes to locations of access doors as directed by the Consultant.
- 3.1.7 The final installed locations of all access doors shall be shown on the As-Built Record Drawings.

END OF SECTION

1. General

1.1. WORK INCLUDED

- .1 Conform to Section 21 05 00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
- .2 This Section governs requirements for all excavating and backfilling Work required for the installation of buried storm drains, sanitary sewers, gas lines, water lines, and appurtenances associated with such services. Excavation and backfill includes all work within building footprint (plan), and extends to a point 1500 mm (5 ft. 0 in.) beyond face of building foundation line.
- .3 Contractor shall include all excavation price in the Contract Documents.

1.2. RELATED WORK SPECIFIED ELSEWHERE

- .1 Removing subgrade materials for service trenches inside and outside building perimeter, for general grade adjustments, and backfilling of trenches from top of bedding up to bottom of slab-on-grade – under Division 31.
- .2 Dewatering of Site (Division 31)
- .3 Finish grading and spreading of topsoil (Division 32)

1.3. SUBMITTALS

- .1 Provide Shop Drawings indicating proposed method of bedding and backfilling.

2. Products

2.1. SOILS

- .1 To the requirements for Granulars "A", "B" (Type 1), "M" and "Select Subgrade Material"; Ontario Provincial Standard Specifications (OPSS), Form No. 1010 for Granulars "A", "B", "M" and "Select Subgrade" material.
 - .2 Requirements for Pea Gravel: Granular, well-graded clean rounded pea gravel or stone with not more the 2% material that will pass 75 um (No. 200) sieve, maximum 6 mm (¼ in.), containing not other deleterious material, and subject to testing that specified density can be achieved without compaction.
 - .3 Requirements for Sand Fill: Uniform quality and unwashed river sand or any clean sand containing less than 5% organic materials, clay or silt (passing 125 um sieve) is acceptable. It can contain a limited amount of small stones or rocks as it comes from the pit. Sharp, clean, coarse sand, water washed, free from clay, salts and organic matter, and in accordance with CSA A179-93 for masonry sand is also acceptable.
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3. Execution

3.1. INSTALLATION

- .1 All excavation and backfilling for all services shall be in accordance with Division 31
- .2 Refer to Section 31 20 00.
- .3 Protection:
 - .1 Provide protection to existing structures and services. Be responsible for rectifying any damage to existing structures and services resulting from this operation.
- .4 Excavation in Soil:
 - .1 Where rough excavation is carried, perform all layout work for trenches required under this Division, including verification of trench depths and slopes. Work in close cooperation with excavating trades that remove subgrade to within 6 in. (150 mm) of the correct and final trench depth
 - .2 Perform the final excavation to the correct trench invert to permit proper bedding as detailed in the Drawings. Excavation carried below the correct inverts shall be backfilled with 2000 psi (13.5 mPa) concrete to the underside of the pipe lines, unless otherwise directed in writing.
- .5 Excavation in rock:
 - .1 All excavation in rock is taken to a minimum of 150 mm (6 in.) below the correct pipe invert. This Division shall use a bedding material as detailed in the Standard Drawings to the correct trench invert.
- .6 Backfilling
 - .1 Backfill with sand from the bottom of the trench or excavation up to a point 300 mm (12 in.) above the top of service line or appurtenance.
 - .2 Backfill pipe trenches with sand to a depth 300 mm (12 in.) above the pipe. The sand shall be thoroughly tamped around and over the pipes in 150 mm (6 in.) layers.
 - .3 Backfill up to top of subgrade.
 - .4 Backfill the remainder of trench or excavation up to top of subgrade or bottom of floor slabs on grade.

END OF SECTION

1 General

1.1 WORK INCLUDED

- 1.1.1 Conform to Section 21 05 00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- 1.2.1 Firestopping and smoke seals within mechanical assemblies (i.e. inside ducts, dampers, etc.) with the exception of sleeves shown for future use installed in fire or smoke rated partitions shall be the responsibility of Mechanical Division. All other firestopping and smoke seals of mechanical services are part of Mechanical Division.

2 Products

2.1 MATERIALS

- 2.1.1 Sleeves passing through stud partitions shall be 0.75 mm (0.0299 in. - 22 G.S.G.) steel.
 - 2.1.2 Sleeves passing through concrete or masonry partitions shall be Schedule 40 steel pipe.
 - 2.1.3 Sleeves passing through floors in finished areas and concealed spaces may be sheet metal or
 - 2.1.4 Sleeves for pipes passing through exterior foundation walls shall be pre-manufactured molded non-metallic HDPE equal to PSI-Thunderline Model CS Century-Line. Each sleeve assembly shall have end caps manufactured of the same material as the sleeve and installed at each end to prevent deformation during the concrete pour.
 - 2.1.4.1 The annular space between the service pipe and the sleeve shall be a modular EPDM seal element, reinforced nylon polymer pressure plates, joined with ASTM B633 carbon steel bolts with zinc dichromate and corrosion inhibiting coating equal to PSI- Thunderline Link-Seal Model C wall seal.
 - 2.1.4.2 A reinforced concrete bridge shall be installed between the wall and the adjacent undisturbed soil.
 - 2.1.5 Firestopping and smoke seal systems shall be in accordance with CAN4-S115 – Standard Method of Fire Tests for Firestop Systems, CAN/ULC-S101 – Standard Methods for Fire Endurance Tests of Building Construction and Materials, ASTM E119 – Standard Test Methods for Fire Tests of Building and Construction Materials, and ASTM E814 – Standard Test for Fire Tests of Through-Penetration Firestop Stops.
 - 2.1.5.1 Unless noted otherwise “F” and “T” ratings are shown on the drawings.
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- 2.1.5.2 Systems shall be asbestos free and maintain an effective barrier against flame, smoke, and gases in accordance with CAN4-S115 and shall not exceed opening sizes for which they are intended.
- 2.1.5.3 Firestopping and smoke seals at openings around mechanical services shall be an elastomeric seal for sound and vibration control.
- 2.1.5.4 Fire resistance rating of firestopping assembly shall not be less than the fire resistance rating of surrounding floor or wall assembly.
- 2.1.5.5 Service penetration assemblies shall be ULC certified in accordance with CAN4-S115 and listed in ULC Guide No. 40 U19.
- 2.1.5.6 Service penetration firestop components shall be ULC certified in accordance with CAN4-S115 and listed in ULC Guide No. 40 U19.13 and ULC Guide No. 40 U19.15.
- 2.1.6 Firestopping and smoke seals shall be by Hilti, Tremco/Royal Quickstop, or 3M.
- 2.1.7 Escutcheons shall be satin finish stainless steel or satin finish chrome or nickel plated brass, with non-ferrous set screws. Do not use stamped steel split plates. Split cast plates with screw locks may be used. For escutcheons for plumbing fixtures refer to Section 22 42 01

2.2 - FIXTURES AND TRIM.

- 2.2.1 Provide adequate bracing for support of sleeves during concrete and masonry work. For floors and walls with a fire resistance rating, build fire damper assemblies into structure to attain fire rated construction, in a manner acceptable to the governing authorities.
- 2.2.2 Cover exposed duct sleeves in finished areas with 1.42 mm (0.0561 in. - 18 G.S.G.) galvanized sheet steel in the form of duct collars. Fix in position with non-ferrous metal screws.
- 2.2.3 Counter flashing for roof penetrations shall be commercial quality galvanized sheet steel to ASTM A653/A653M-02, 0.70 mm (0.0276 in. - 24 G.S.G.) minimum thickness, Z275 275 zinc coated by hot dip process.

3 Execution

3.1 INSTALLATION

- 3.1.1 Arrange for all chases and formed openings in walls and floors as required by the Mechanical Division for the mechanical services. These chases and openings shall not be larger than necessary to accommodate the equipment and services. Advise on these requirements well in advance, before the concrete is poured and the walls are built. All necessary sleeves and inserts shall be supplied by this Division.
 - 3.1.2 Chases and openings not located in accordance with the above provisions shall be made at the expense of this Division. Cutting of structural members shall not be permitted without specified written acceptance of the Consultant.
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- 3.1.3 Provide sleeves for all service penetrations through walls, partitions, floor slabs, plenums and similar barriers.
- 3.1.4 Sleeves shall be sized to maintain insulation and vapour barrier around all pipes and ducts for all service penetrations. Coordinate thickness requirements with Section 21 07 00 – MECHANICAL INSULATION.
- 3.1.5 For sleeves through barriers without a fire resistance rating, for non-insulated pipe, fill the annular space between the service and the sleeve with fire rated insulation as specified in Section 21 07 00 – MECHANICAL INSULATION and caulk around the edges with smoke and acoustic sealant.
- 3.1.6 Firestopping and smoke seal material and components shall be installed in accordance with the ULC certification and manufacturers instructions. Examine the sizes and conditions of the cavities to be filled to determine the correct thicknesses and installation of materials. All substrates and surfaces in contact with firestopping materials shall be dry and prepared in accordance with the Manufacturers instructions at appropriate ambient conditions.
- 3.1.7 Where holes are core drilled in existing structures, sleeves shall be provided as specified complete with a combination puddle/anchor flange bolted to the floor. Seal watertight between the flange and the floor.
- 3.1.8 Provide escutcheons at all penetrations of piping into finished areas, and at insulated pipes, make the escutcheons large enough to fit around the insulation.
- 3.1.9 Counter flash vertical duct penetrations through roof at intersection of roof curb and duct.

END OF SECTION

1 General

1.1 WORK INCLUDED

- 1.1.1 Conform to Section 21 05 00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
- 1.1.2 Openings required for mechanical services for new construction shall be in accordance with Section 21 05 83 – SLEEVES AND ESCUTCHEONS. This Section shall apply for openings required in existing construction or where sleeves for mechanical services have been omitted in new construction in error.
- 1.1.3 Include for all cutting and patching for all mechanical services for holes and openings with dimensions up to 200 mm (8 in.) in size and related patching.

2 Products

2.1 MATERIALS

- 2.1.1 All services shall be carried out by professional workers experienced in the cutting and patching work to be done.

3 Execution

3.1 INSTALLATION

- 3.1.1 Locate all openings in non structural elements requiring cutting and patching in a timely manner to avoid unnecessary cutting. All openings shall be shown on Drawings and submitted to the Consultant for review. No holes through structure shall be permitted prior to review by the Structural Consultant.
 - 3.1.2 Core drilling for individual services shall be by this Division. Cut all openings no larger than is required for the services.
 - 3.1.3 Locate all openings in structure elements requiring cutting and patching and x-ray the structure to obtain Structural Consultant's approval prior to cutting or core drilling of existing structure. Make adjustments to location of openings as required to minimize cutting of rebar and completely avoid electrical conduit.
 - 3.1.3.1 Cut holes through slabs only.
 - 3.1.3.2 Do not cut holes through beams.
 - 3.1.3.3 Holes to be cut are 200 mm (8 in.) (diameter) or smaller only.
 - 3.1.3.4 Maintain at least 100 mm (4 in.) clear from all beam faces. Space at least 3 hole diameters on Centre.
 - 3.1.3.5 For holes that are required closer than 25% of slab span from the supporting beam face, use cover meter above the slab to clear slab top bars.
 - 3.1.3.6 For holes that are required within 50% of slab span, use cover meter underside of slab to clear slab bottom bars.
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- 3.1.3.7 X-rays shall be performed by a qualified technician, in a safe manner and in accordance with all applicable regulations governing this activity.
- 3.1.4 Obtain written approval from the Structural Consultant before cutting or core drilling any openings or holes.
- 3.1.5 Patch all openings after services have been installed to match the surrounding finishes.

END OF SECTION

1. General

1.1. WORK INCLUDED

- .1 Conform to Section 21 05 00 - GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
- .2 Provide shop drawings with technical data on all types of insulation to be installed.
- .3 Provide two samples of each type of insulation indicating where each is to be used and a sample of a typical vapour barrier dam. Samples shall be mounted on boards. One shall be kept at the Contractor's site office and the other shall be turned over to the Departmental representative.

2. Products

2.1. MATERIALS

- .1 Fibreglass insulation shall be Owens-Corning, Certainteed, Manson, Johns Manville, Knauf or Fibrex.
 - .1 Duct insulation shall be rigid board vapour seal 48 kg/cu.m. (3 lbs/cu.ft.) density duct insulation with factory applied vapour barrier. Flexible duct insulation shall be 24 kg/cu.m. (1-1/2 lbs/cu.ft.) type with vapour barrier.
 - .2 Pipe insulation shall be preformed sectional fibreglass or mineral fibre insulation with factory applied all service jacket.
 - .3 Insulation for linear radiant heating panels shall be 12 kg/cu.m. (3/4 lb.cu.ft.) density fibreglass batt insulation with foil back.
 - .2 Flexible elastomeric insulation for ducts exterior to the building shall be Armacell with Tuffcoat 25 surface or Nomaco K-Flex with R-374 protective coating.
 - .3 Extruded polystyrene insulation for ducts exterior to the building shall be Dow Weathermate Styrofoam insulation board.
 - .4 Mineral Fibre Board Thermal insulation for ducts exterior to the building shall be Roxul RXL 80 125 kg/cu.m. (8 lbs/cu.ft.) density board insulation with factory applied reinforced foil vapour barrier.
 - .5 Foamglass insulation shall be Pittsburgh-Corning.
 - .6 Flexible elastomeric insulation shall be Armacell or Nomaco with adhesive applied to both surfaces to be joined. Flexible elastomeric insulation shall not be used on pipes that are electrically traced.
 - .7 Insulation jacket for services and ductwork exterior to the building, and for indoor components such as valves, pump, meters, etc. shall be Childers or Armacell field applied U.V. protected mesh reinforced mastic.
 - .1 Mastic shall be equal to Childers VI-CRYL CP-10/11 weather barrier coating. Finish shall be white.
 - .2 Sealant for areas where mastic meets adjoining insulated or uninsulated surfaces or dissimilar weather proofing materials shall be equal to Childers CP-76.
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- .3 Glass fibre reinforcing mesh for thickness control and strength at joint interfaces in field applied mastic on exterior ductwork insulation shall be equal to Childers CHIL-GLAS # 10.
- .8 High temperature insulation shall be 232 kg/ cu.m. (14.5 lbs/cu.ft.) Johns Manville Thermo-12 Gold molded, asbestos free, non-combustible, abuse-resistant pipe and block insulation composed of hydrous calcium silicate meeting ASTM C533, Type I for operating temperatures up to 649 Deg. C. (1200 Deg. F.).
- .1 Tie Wire shall be 16 gauge (0.045mm) stainless steel with twisted endons on maximum 300mm (12 in.) centres.
- .9 High temperature insulation shall be Roxul SturdiRock molded, non-combustable, mineral wool fibre pipe insulation.
- .10 Corner beads and channels at floor line shall be 0.4 mm (28 ga.) galvanized sheet metal.
- .11 Fire retardant lagging coating shall be Chil-Seal CP-50 by Childers Products Company or Monsey Bakor equivalent.
- .12 Vapour barrier dam shall be Chil-perm CP30 with fibreglass cloth reinforcing.
- .13 All cements and adhesives shall be as recommended by the manufacturer of the insulation. Insulation, insulation jacket, canvas and adhesive shall be fire retardant with a flame spread rating not to exceed 25 and a smoke developed rating not to exceed 50 when tested in accordance with CAN/ULC-S102-M.
- .14 P.V.C. fitted jackets and covers shall have a flame spread rating not to exceed 25 and a smoke developed rating not to exceed 50 when tested in accordance with CAN/ULC-S102-M.
- .15 Aluminum Jacket shall be 0.51mm (24 B&S Gauge - 0.0201 in) this sheet, embossed finish, with longitudinal slip joints and 50mm (2 in.) laps, die shaped fitting covers with factory applied moisture barrier.
- .16 Fire resistant duct insulation shall be Royal Quickstop Quickwrap, 3M Fire Barrier Duct Wrap, CL4Fire, or Unifrax Corporation FyreWrap to meet the requirements of NFPA 96. Product shall meet flame spread rating of 25 and smoke developed rating of 50. Insulation product shall be complete with all manufacturers standard fastenings, including (where applicable) aluminum foil tape, filament tape, banding materials, pins, cup-head weld pins, and speed clips for a ULC listed installation.

3. Execution

3.1. INSTALLATION

- .1 Install insulation in accordance with the manufacturer's printed installation instructions unless noted otherwise.
 - .2 Insulation thicknesses and conductivities shall meet or exceed the minimum standards set out in ASHRAE 90.1 (refer to Table 1 following) and as specified herein for the services covered.
 - .3 Apply insulation to clean, dry surfaces only while ambient temperature is at least 10 deg. C. (50 deg. F.).
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- .4 Commence application of insulation following required testing of piping, ductwork, and apparatus where such items are to be covered.
 - .5 Recover all insulation, where exposed to view and not concealed in ceiling spaces or pipe spaces with 6 oz. canvas pasted on. Apply two coats of fire retardant lagging finish.
 - .6 Where approved by the Consultant, as an alternative to the above, recover all piping insulation with a PVC jacket and preformed PVC elbows and fittings sealed with adhesive. PVC shall not be used on steam, medium and high temperature hot water piping or piping services that will be painted.
 - .7 Cover all piping insulation external to the building and where specifically shown with field applied mesh reinforced mastic.
 - .8 Where vapour barrier dams are called for, terminate the insulation and seal the vapour barrier to the pipe or ductwork using a mesh embedded in a vapour barrier mastic. Provide dams at valves, fittings used for servicing, groups of other types of fittings, irregular shaped objects at floor and wall penetrations, and at 15 m (50 ft.) intervals of straight pipe or straight ductwork for the following services: water piping that is less than 80 deg. F., including but not limited to the following:
 - .1 Domestic cold water piping
 - .2 Chilled water piping
 - .3 Glycol piping
 - .4 Condenser water pipe piping
 - .5 and exterior ductwork
 - .9 Terminate insulation on pipes passing through fire rated walls or floors, and fit tight to the fire stop material.
 - .10 Irregular shaped objects such as strainers, pipe system filters, cyclone separators, blowdown valves and other accessories requiring servicing, on insulated piping, shall be insulated with removable caps or sections. All edges shall be sealed between pipe and vapour barrier and held in place with stainless steel straps. Finish all insulation smooth, making the outline of pipe insulation a true circular and concentric shape. Shape the outline of fitted insulation to blend with adjacent covering.
 - .11 On piping systems specified to be insulated, include insulation on valves, flanges, couplings and unions.
 - .12 Do not use staples to secure joints of insulation jackets.
 - .13 Hot Services
 - .1 Heating water services, heating glycol, low pressure steam and condensate piping shall have glass fibre preformed pipe insulation. Refer to Table 1 for required insulation thicknesses.
 - .2 On hot services, insulate valves, fittings, couplings, unions, flanges and all other appurtenances through which water or steam passes, using mitred sections of preformed insulation of a thickness equal to the adjoining pipe insulation, and securely wire in place. Over mitred section, apply one coat of field applied mesh reinforced mastic. Finish services with a vapour barrier using two full brush coats of vapour seal
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adhesive. Cover with canvas or PVC jacket.

- .3 Apply glass fibre or mineral fibre (RN to check) preformed vapour barrier jacket pipe insulation to domestic hot water piping. Refer to Table 1 following for required insulation thickness. Apply with all joints butted firmly together, and bond securely, sealing flaps by pasting down to give a smooth finish.
- .4 Apply 50 mm (2 in.) thick mineral fiber tank wrap insulation (wired on) to the following:
 - .1 All domestic hot watertanks
 - .2 Heating water tanks
 - .3 Shell and tube heatexchangersRecover with canvas. Provide removable sections at access doors/manholes and all components requiring servicing.
- .5 Insulate all hot gas piping in conditioned spaces with preformed glassfibre insulation. Cover exterior piping with field applied mesh reinforced mastic.

.14 Cold Services

- .1 Protect insulation by means of sheet steel shields at each hanger or support on the following:
 - .1 All sizes of chilled water
 - .2 All sizes of condenser water pipes.
 - .3 Domestic cold water piping 75 mm (3 in.) and largerProvide foamglass, Thermo-12 or calcium silicate insulation inserts the full length of shields at all hangers and supports.
- .2 For domestic cold water piping less than 75 mm (3 in.) where hangers on cold water lines penetrate vapour barrier make sure the penetration is properly sealed with insulation and vapour barrier continued up hanger a further 75 mm (3 in.).
- .3 Where sheet metal shields are used refer to Section 21 05 29 – HANGERS AND SUPPORTS.
- .4 Apply 12 mm (1/2 in.) thick, preformed glass fibre pipe insulation with vapour barrier jacket or 12 mm (1/2 in.) thick flexible elastomeric insulation to all domestic cold water and chilled drinking water piping. Insulate the first 4500 mm (15 ft.) of the standpipe and/or sprinkler main.
- .5 On cold water service valves, water meters, drain valves, vent connections, thermometer wells, pressure gauges and other irregular shaped objects, apply flexible elastomeric sheet insulation, thickness to suit service, cut and mitre as necessary, and attach with adhesive and stainless steel banding. Bond and seal edges of insulation to the adjacent surfaces and finish with field applied mesh reinforced mastic.
- .6 Apply 50 mm (2 in.) thick rigid glass fibre insulation tank wrap by wiring or banding onto all chilled water storage tanks. Apply vapour barrier of foil faced flame resistant Kraft paper or aluminum foil, and recover with canvas. Apply insulation to legs/supports. Provide removable sections at access doors/manholes and all components requiring servicing. As an alternative to the above, provide 50 mm (2 in.) thick Flexible elastomeric sheet insulation.
- .7 The following cold service piping shall have glass fibre dual temperature pipe insulation:
 - .1 Chilled water
 - .2 Chemical feed piping for evaporative fluid cooler basin.Refer to the Table 1 for required insulation thicknesses.

- .8 Piping in air handling or air conditioning units. Insulate with 25 mm (1 in.) thick flexible elastomeric insulation and cover with field applied mesh reinforced mastic.
 - .9 Insulate refrigerant suction lines with 12 mm (1/2 in.) flexible elastomeric insulation. Cover exterior piping with field applied mesh reinforced mastic.
 - .15 Chilled water, spray coil and domestic pumps. Adhere 25 mm (1 in.) thick flexible elastomeric insulation.
 - .16 Pipe serving chilled water pumps, spray water pumps and domestic water pumps located inside air handling or air conditioning units shall be covered with 25 mm (1 in.) thick flexible elastomeric insulation.
 - .17 Drainage Piping
 - .1 Cover cast iron bell and spigot drainage pipe 75 mm (3 in.) and smaller with 12 mm (1/2 in.) preformed glass fibre pipe insulation, and finish with vapour barrier jacket. Cover the bell and spigot joint with a 12 mm (1/2 in.) thick flexible elastomeric insulation band that overlaps the fibreglass insulation 300 mm (12 in.) beyond joint in each direction. Seal band to the fibreglass insulation. Apply 25 mm (1 in.) thick insulation for all larger pipes.
 - .2 Storm Drainage piping to be insulated:
 - .1 Roof drain sump
 - .2 All horizontal or sloping storm piping
 - .3 All elbows connecting the horizontal storm drainage piping to the vertical leaders
 - .4 Where the roof drain is less than 3000 mm (10 ft.) from the vertical leader, insulate the first 3000 mm (10 ft.) of pipe closest to the roof drain and the exposed portion of the roof drain.
 - .3 Sanitary drainage piping to be insulated:
 - .1 Sanitary drainage pipes from urinals
 - .2 Floor drains from air conditioning apparatus
 - .3 Carrying chilled condensate to closest branch or main.
 - .4 All piping passing through high humidity area
 - .5 Sanitary drainage pipe from barrier free lavatories
 - .18 Ductwork and Equipment
 - .1 Ductwork and equipment internal to the building within conditioned spaces shall have 25 mm (1 in.) thick rigid glass fibre duct insulation with vapour barrier. In concealed spaces and on round duct smaller than 600 mm (24 in.) insulation may be 38mm (1-1/2 in.) flexible type with vapour barrier. Flexible duct connections do not require insulation except where a factory applied insulation has been specified with the flexible duct connection.
 - .2 Butt join insulation and attach with pins and speed washers, one per 0.186 sq.m. (2 sq.ft.), but not more than 450 mm (18 in.) apart in any direction. Apply fire resistive adhesive in 100 mm (4 in.) wide strips on 300 mm (12 in.) centres. Seal all joints with adhesive and apply vapour barrier tape. Install pins of suitable length for the thickness of insulation and clip flush after final installation of washers. Tack weld pins to sheet metal.
 - .3 On exposed insulation in mechanical rooms, increase thickness as necessary to give 12 mm (1/2 in.) thickness over flanges and angles. Provide corner beads to protect corners to a height of 2135 mm (84 in.) above floor and provide channels at floor line to
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- finish off insulation on apparatus.
- .4 Insulation Contractor to coordinate with sheet metal contractor to ensure duct insulation is applied prior to ductwork being installed to underside of slabs, beams or other services or behind other duct risers and shafts.
- .19 The following ductwork and equipment shall be insulated:
- .1 Apparatus casings
 - .2 Outside and mixed air plenums
 - .3 Outside and mixed air ductwork, including ducts to and from independent ERVs
 - .4 Heating and cooling coil sections of ductwork and plenums
 - .5 Supply ductwork in equipment rooms.
 - .6 Exhaust and relief air ductwork. Plenums and/or casings from 1500 mm (60 in.) upstream of shut-off dampers to connection to exterior wall or roof
 - .7 Exhaust, relief and supply and return air ductwork, plenums and/or casings through non-air conditioned or unheated internal space. Use 50 mm (2 in.) thickness.
 - .8 For LEED projects, all supply air ductwork (variable volume or constant volume systems) from fans to any terminal grille or diffuser.
 - .9 Silencers and fan capacity monitors. Insulate to suit the service and location.
- .20 Insulate diesel exhaust system with two layers of 50 mm (2 in.) thick calcium silicate insulation with staggered joints, wired on. Cover the entire length of the insulation with an aluminum jacket. Form expansion joints with slip joints extending 300 mm (12 in.) past the flange at each end of the joint.
- .21 Chillers. Insulate in accordance with the manufacturer's printed insulation instructions, and insulate all components shown or noted in the instructions. Insulate evaporator, water heads, suction connections and auxiliary water piping of centrifugal water chillers. Use 25 mm (1 in.) thick flexible elastomeric insulation. Insulate auxiliary water piping as per chilled water piping. Provide removable sections of insulation at all components that require servicing, and secure with stainless steel straps.
- .22 Indoor cooling towers: Cover with 25 mm (1 in.) thick rigid duct insulation with vapour barrier on room side. Seal all joints vapour tight. For access panels and other similar items, apply insulation to be removable with the access panel, using both adhesive and clips. Cover with field applied mesh reinforced mastic.
- .23 Plate type heat exchangers. Enclose hot surfaces in a removable galvanized steel box using 25 mm (1 in.) thick rigid insulation board. Construct box using flanged, bolted and gasketed joints, with sections removable for servicing the heat exchanger. Bolt box to floor base around the heat exchanger. Construction shall be similar to built-up air plenums. For cold surfaces use 25 mm (1 in.) thick Flexible elastomeric insulation, installed in sections with all joints sealed, using an installation method similar to that used on chillers. Insulate plate heat exchangers when both services are insulated. Insulate shell and tube heat exchangers when the service in the shell is insulated.
- .24 Radiant heating panel. Install 50 mm (2 in.) fibreglass batt insulation with foil back above all active linear radiant heating panels.
- .25 Fire resistant duct insulation shall be applied directly onto the ductwork and plenums in strict accordance with the manufacturer's instructions and Listing. Tested to ULC Standard for Internal Grease Duct Testing and ISO standard 6944 as a gypsum shaft alternative per NFPA 96 guidelines.
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.26 TABLE 1: MINIMUM PIPE INSULATION THICKNESS/PERFORMANCE (BASED ON ASHRAE 90.1 AND NATIONAL ENERGY CODE FOR BUILDINGS)
Fluid Design

Operating	Insulation Conductivity			Nominal Pipe Diameter – mm (in)				
Temp. range [°C] (°F)	Conductivity [W(m-K)] (h-ft²-°F Btu-in)	Mean Rating Temp °C (°F)	Runouts ^b Up to 50 (2)	25 (1) And less	32-50 (1-1/4 to 2)	65-100 (2-1/2 to 4)	125- 150 (5 – 6)	200 (8) And up
Heating Systems (Steam, Steam Condensate, Heating Glycol and Heating Water)								
Above 177	0.049	121	38	65	65	75	87	87
Above (350)	(0.34)	(250)	(1.5)	(2.5)	(2.5)	(3.0)	(3.5)	(3.5)
122-177	0.045	93	38	50	65	65	87	87
(251-350)	(0.31)	(200)	(1.5)	(2.0)	(2.5)	(2.5)	(3.5)	(3.5)
94-121	0.043	66	25	38	38	50	50	87
(201-250)	(0.30)	(150)	(1.0)	(1.5)	(1.5)	(2.0)	(2.0)	(3.5)
61-93	0.042	52	25	25	25	38	38	38
(141-200)	(0.29)	(125)	(1.0)	(1.0)	(1.0)	(1.5)	(1.5)	(1.5)
41-60	0.040	38	25	25	25	25	38	38
(105-140)	(0.28)	(100)	(1.0)	(1.0)	(1.0)	(1.0)	(1.5)	(1.5)
Domestic and Service Hot Water Systems ^c								
41 and Greater	0.040	38	25	25	25	38	38	38
(105) and Greater	(0.28)	(100)	(1.0)	(1.0)	(1.0)	(1.5)	(1.5)	(1.5)
Cooling Systems (Chilled Water, Chilled Glycol, Brine and Refrigerant)								
5-13	0.039	24	25	25	25	25	25	25
(40-60)	(0.27)	(75)	(1.0)	(1.0)	(1.0)	(1.0)	(1.0)	(1.0)
Below 4.4	0.039	24	25	25	38	38	38	38
Below (40)	(0.27)	(75)	(1.0)	(1.0)	(1.5)	(1.5)	(1.5)	(1.5)

^a Piping installed exterior to the building shall meet the minimum insulation requirements of Heating Systems with a fluid design operating temperature above 177 Deg. C. (350 Deg. F.).

^b Runouts to individual terminal units not exceeding 3.7 m (12 ft.) in length

^c Applies to recirculating sections of service or domestic hot water systems and first 2.4 m (8 ft.) from storage tank for non-recirculating systems.

END OF SECTION

1. General

1.1. WORK INCLUDED

- .1 Conform to Section 21 05 00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
- .2 Conform to Section 21 05 02 – RECORD DRAWINGS.
- .3 Conform to Section 21 05 03 – SHOP DRAWINGS.
- .4 Conform to Section 21 08 03 – OPERATING AND MAINTENANCE INSTRUCTIONS.
- .5 Conform to Section 23 05 93 – TESTING, ADJUSTING & BALANCING (TAB).
- .6 Conform to Section 23 05 94 – PRESSURE TESTING OF DUCTED AIR SYSTEMS.
- .7 Conform to Section 25 05 01 – BAS GENERAL REQUIREMENTS.
- .8 The commissioning process for the Mechanical Systems shall include:
 - .1 Verification that the installation meets the requirements of the contract documents.
 - .2 Verification that the systems performance meets the design intent.
 - .3 Provision of building operator training.
 - .4 Provision of as-built documentation, operating and maintenance manuals, and systems operating manuals.
- .9 The Contractor, Consultant and Commissioning Agent shall provide the services to complete the process. The execution portion of this Section defines the areas of responsibility.
- .10 Provide labour, equipment and material to conduct the Contractor commissioning process as outlined in this Section.
- .11 The Departmental representative will hire a Commissioning Agent who will provide services identified in the article within this Section.
- .12 An Independent Testing and Balancing Contractor will provide the services identified in the Sections for "Testing and Balancing of Water and Air Systems".

2. Products

2.1. MATERIALS

- .1 The Contractor and manufacturers shall provide all instrumentation and equipment necessary to conduct the tests as specified in the Mechanical Sections. The Contractor shall advise the Consultant or Commissioning Agent of instrumentation to be used and the dates the instruments were calibrated.
-

3. Execution

3.1. INSTALLATION

- .1 This Section describes the commissioning process to be performed by the Contractor. The process shall provide a high level of quality control during the construction.
 - .2 The commissioning process shall consist of:
 - .1 Shop Drawings/Record Drawings
 - .2 Installation inspection and equipment verification
 - .3 Plumbing and drainage system testing
 - .4 Testing of piping systems
 - .5 Independent Contractor balancing of water systems
 - .6 Testing of air systems
 - .7 Independent Contractor balancing of air systems
 - .8 Testing of equipment and systems
 - .9 Building Automation System Commissioning
 - .10 Commissioning Agent performance testing
 - .11 Commissioning meetings
 - .12 Operating and maintenance manuals
 - .13 Training
 - .14 Systems acceptance

3.2. INSTALLATION INSPECTION AND EQUIPMENT VERIFICATION

- .1 The Contractor shall complete the equipment verification forms for each piece of equipment. The completed forms shall be forwarded to the Consultant for review and be included in the operating and maintenance manual.

3.3. TEST FORMS AND VERIFICATION FORMS

- .1 The Commissioning Agent will prepare a test form manual, which will contain a form for every test identified in the Specification. A copy of this manual will be given to the Contractor, the General Contractor and the Consultant.
- .2 The forms shall be signed by either the authorities, the Consultant or the Commissioning Agent.
- .3 Test forms and verification forms have been included with this Section. Obtain approval from the Consultant if the Contractor wishes to use different forms.

3.4. PLUMBING AND DRAINAGE SYSTEM TESTING

- .1 The plumbing and drainage system shall be tested in accordance with Section 23 05 93.1.3.
 - .2 The Contractor shall notify the Building Inspector when systems are available for testing. The Contractor shall document all tests performed and shall arrange for the Building
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Inspector to sign the forms for tests completed.

3.5. TESTING OF PIPING SYSTEMS

- .1 Test all piping systems in accordance with Section 23 05 93 – TESTING, ADJUSTING & BALANCING (TAB).
- .2 All tests for the systems shall be performed in the presence of the Consultant or the Commissioning Agent.

3.6. TESTING OF AIR SYSTEMS

- .1 Conform with Section 23 05 94 – PRESSURE TESTING OF DUCTED AIR SYSTEMS.
- .2 All tests shall be performed in the presence of the Consultant or the Commissioning Agent.

3.7. TESTING OF EQUIPMENT AND SYSTEMS

- .1 Conform to Section 21 08 03 – OPERATING AND MAINTENANCE INSTRUCTIONS
- .2 The Contractor shall hire the services of the manufacturers technicians to test the equipment and associated systems. The technician shall record the results of the tests on the testing forms. The tests shall be witnessed by the Consultant or the Commissioning Agent. When the tests have been completed satisfactorily the technician and witnessing authority shall sign the forms.
- .3 Should equipment or systems fail a test, the test shall be repeated after repairs or adjustments have been made. The additional tests shall be witnessed by the Consultant or the Commissioning Agent.
- .4 Tests which have not been witnessed shall not be accepted and shall be repeated.

3.8. COMMISSIONING MEETINGS AND SCHEDULING

- .1 The Contractor shall include the schedule for all tests and equipment start-up tests in the construction schedule.
- .2 The commissioning meetings shall occur during the regular construction meetings. The testing schedules and results of all tests shall be reviewed.

3.9. OPERATING AND MAINTENANCE MANUALS

- .1 Conform to Section 21 08 03 – OPERATING AND MAINTENANCE INSTRUCTIONS.
- .2 Submit Operating and Maintenance Manuals to Commissioning Agent for review.

3.10. OPERATOR TRAINING

- .1 Conform to Section 21 08 03 – OPERATING AND MAINTENANCE INSTRUCTIONS.
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- .2 Submit Operating and Maintenance manuals to Commissioning Agent for review.
 - .3 The training shall be conducted in a classroom and at the equipment or system.
 - .4 Training will begin when the operating and maintenance manuals have been delivered to the Departmental representative and reviewed by the Consultant.
 - .5 Submit a course outline to the Consultant before training commences. Provide course documentation for up to eight people.
 - .6 Each training session will be structured to cover:
 - .1 The operating and maintenance manual
 - .2 Operating procedures
 - .3 Maintenance procedures
 - .4 Trouble-shooting procedures
 - .5 Spare parts required
 - .7 The training sessions will be scheduled and coordinated by the Commissioning Agent. The Commissioning Agent will video tape the session.
 - .8 Training shall be provided for the following systems:

System	Minimum Training Times
Chillers	4 hours
Boilers	3 hours
Packaged air handling units	4 hours
Life safety & fire protection systems	3 hours
Building Automation System	8 hours
The mechanical system	16 hours
 - .9 Refer to Section 25 05 01 – BAS GENERAL REQUIREMENTS.
 - .10 The training requirement for the mechanical system shall include a walk-through of the building by the Contractor. During the walk through the Contractor shall:
 - .1 Identify equipment
 - .2 Identify starters associated with equipment
 - .3 Identify valves and balancing dampers
 - .4 Identify access doors
 - .5 Review general maintenance of equipment
 - .6 Review drain locations in pipework systems
 - .7 Identify maintenance items
 - .11 When each training session has been completed with the Departmental representative, the Commissioning Agent will sign the associated form to verify completion.
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3.11. COMMISSIONING AGENT

- .1 A Commissioning Agent will be hired by the Departmental representative.
- .2 The Commissioning Agent responsibilities shall include:
 - .1 Preparing the commissioning plan
 - .2 Coordinating with the Contractor to schedule tests
 - .3 Preparing a test form manual
 - .4 Witnessing selected tests
 - .5 Receiving all test forms
 - .6 Conducting performance test
 - .7 Coordinating the Contractors training
 - .8 Attend commissioning meetings
 - .9 Preparing the systems operating manuals
- .3 The Contractor shall co-ordinate and co-operate with the Commissioning Agent.

3.12. PERFORMANCE TESTING

- .1 The Commissioning Agent will conduct performance tests on each mechanical system to verify that the design intent performance has been met. The performance tests will cover all seasonal modes. The Commissioning Agent will visit the building in six months to retest the systems.
- .2 The Contractor shall provide assistance to the Commissioning Agent and have personnel available during the performance testing procedures during construction and the warranty period.
- .3 Performance testing will begin when all mechanical systems have been completed, tested by the Contractor reviewed by the Consultant and substantial completion has been achieved.

3.13. COMMISSIONING PROCESS ALLOCATION

- .1 The commissioning process shall be allocated a value equal to 8% of the contract. This value shall be itemized in the Statement of Prices which forms the basis for progress payment for the various portions of work. The Contractors may draw from this allocation as the commissioning process is completed.
 - .1 The Contractors shall submit all test and verification forms. The Consultant will use these forms to calculate a percentage complete.
 - .2 The Contractor may claim up to 5% of the contract, as per Schedule of Breakdown, on a monthly basis, from this allocation leading up to performance testing. The remaining 3% shall not be paid out until the performance testing, O&M manuals and training have been completed satisfactorily.

The commissioning process allocation shall be broken down as follows:

.1	Shop Drawings	0.50%
.2	Installation inspection and equipment verification	0.50%
.3	Plumbing and drainage system testing	0.50%
.4	Testing of piping systems	0.50%
.5	Independent Contractor balancing of water systems	0.25%
.6	Testing of air systems	0.50%
.7	Independent Contractor balancing of air systems	0.25%
.8	Testing of equipment and systems (system start-up)	0.50%
.9	BAS commissioning	1.00%
.10	Commissioning Agent Performance Testing	2.00%
.11	Operating and Maintenance Manuals	0.50%
.12	Training	0.50%
.13	Record Drawings	0.50%

END OF SECTION

1. General

1.1. WORK INCLUDED

- .1 Conform to Section 21 05 00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

2. Products

NOT USED

3. Execution

3.1. INSTALLATION

- .1 Clean thoroughly all fixtures and equipment from grease, dirt, plaster or any other foreign material. Chrome-plated fittings, piping and trim shall be polished upon completion.
- .2 Any dirt, rubbish, or grease on walls, floors or fixtures accumulated from the work of the Mechanical Division shall be removed promptly from the premises by this Division.
- .3 Fixtures and equipment shall be properly protected from damage during the construction period and shall be cleaned and polished in accordance with manufacturer's directions. Motors and equipment bearings shall be protected with plastic sheets, tied or taped in place. Aluminum fin heating or cooling elements shall be protected with cardboard covers.
- .4 Any unpainted steel surfaces, installed for longer than one year prior to the completion date, shall be prime coated under this Division.
- .5 During construction protect all services and equipment from dirt and debris, by using temporary caps over the open ends of pipes ductwork and equipment connections.
- .6 All equipment installed or stored on site shall be maintained in accordance with manufacturers recommended instructions (i.e. rotate shafts on fans, pumps, etc).
- .7 Refinish and restore to the original condition and appearance all mechanical equipment which has sustained damage to the manufacturer's prime and finish coats of enamel or paint. Materials and workmanship shall be equal to the manufacturers original.

END OF SECTION

1. General

1.1. WORK INCLUDED

- .1 Conform to Section 21 05 00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
- .2 Comply with all requirements of Section 21 05 02 – RECORD DRAWINGS.
- .3 Comply with all requirements of Section 21 05 03 – SHOP DRAWINGS.
- .4 Comply with all requirements of Section 21 08 00 – COMMISSIONING.
- .5 Comply with all requirements of Section 01 78 00 – CLOSEOUT SUBMITTALS.

2. Products

2.1. REQUIREMENTS FOR MANUALS

- .1 Three copies of complete and approved operating and maintenance instructions for all mechanical equipment and systems shall be supplied before substantial completion. Manuals shall be also submitted in electronic format. Electronic manuals shall be prepared in Adobe PDF format with all sections bookmarked for quick reference and submitted on DVD.
 - .2 Binders shall be three-ring, hard-cover, loose-leaf type and identified on the binding edges as "Maintenance Instructions and Data Book", for this project.
 - .3 Terminology used in all the Sections shall be consistent.
 - .4 Volume One shall contain the master index of all systems, the name of the Contractor, Mechanical Sub-Contractors and the date of substantial performance for the Contract.
 - .5 Volume One shall contain a section with all necessary warranty information.
 - .6 Each binder shall have a complete index for all volumes.
 - .7 Each binder shall be no more than half filled.
 - .8 There shall be a separate section for all materials used on the project which fall under the WHMIS legislation. There shall be a hazard data sheet for each of the materials.
 - .9 There shall be a separate section for all Insurance Certificates, Test Certificates, Verification Forms and Test Forms.
 - .10 All relevant information relating to a system or product shall be contained within one binder.
 - .11 The manual sections shall follow the specification sections.
 - .12 Any diagrams, installation drawings, flow charts, etc. shall be mechanically reduced while
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maintaining full legibility to standard page size. If this cannot be achieved they shall be carefully folded and contained within a clear plastic wallet within the manual.

2.2. DATA FOR MANUALS

- .1 Equipment data shall contain:
 - .1 Operating instructions
 - .2 Operating conditions such as temperature and pressure
 - .3 Location of equipment
 - .4 Maintenance instructions and schedules for one year routine
 - .5 Recommended list of spare parts
 - .6 Lubrication schedule
 - .7 A trouble shooting table showing where to look for problems under various conditions of malfunction
 - .8 All wiring diagrams
 - .9 Equipment operating curves
 - .10 Equipment nameplate data and serial numbers
- .2 System data shall contain:
 - .1 A listing of all systems
 - .2 A valve schedule and locations
 - .3 Equipment name tags
 - .4 Filter schedule
 - .5 An electric pipe tracing schedule including location and electrical service location
 - .6 Cleaning, maintaining and preserving instructions for all material, products and surfaces. Include warnings of harmful cleaning, maintaining and preserving practices.
- .3 Sub-Contractor manuals are required for:
 - .1 BAS
 - .2 Water treatment
 - .3 Sprinkler system
 - .4 Water and air balancing
- .4 As-built documentation shall contain:
 - .1 Reviewed As-Built Shop Drawings
 - .2 As-Built Construction Drawings
 - .3 Originals of Test Forms
 - .4 Originals of Test Certificates

2.3. ASSET SPREADSHEET

- .1 The Mechanical Contractor shall provide the following information on an excel spreadsheet to be provided by the Landlord:
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- .1 Asset Name
 - .2 Manufacturer
 - .3 Model Number
 - .4 Serial Number.
- .2 The above information shall be provided for the following mechanical equipment:
- .1 boilers and boiler burners
 - .2 domestic water heaters
 - .3 unit heaters
 - .4 forced flow units
 - .5 heat exchangers
 - .6 fans
 - .7 pumps
 - .8 tanks
 - .9 meters

2.4. OPERATING INSTRUCTIONS

- .1 Instruct the Departmental representative's representative in all aspects of the operation and maintenance of systems and equipment.
 - .2 Comply with all requirements of Section 21 08 00 – COMMISSIONING, for duration of tests.
 - .3 Instruct the Departmental representative for a minimum of five (5) working days.
 - .4 Arrange for and pay for the services of engineers and other manufacturers representatives required for instruction on the systems and the equipment as requested by the Consultant and/or the Departmental representative.
 - .5 At the time of final inspection, provide a sheet for each system and piece of equipment showing the date instructions were given. Each sheet shall show the duration of instruction, name of persons receiving instruction, other persons present (manufacturer's representative, Consultant, etc.), system or equipment involved and signature of the Departmental representative's staff stating that they understood the system installation, operating and maintenance requirements. This information shall be inserted in the manuals after all instructions have been completed.
 - .6 Review information with the Departmental representative's representative to ensure that all information required has been provided.
 - .7 Mechanical equipment and systems included in the instruction requirements are:
 - .1 Heating water generators and associated equipment
 - .2 Automatic controls and instrumentation
 - .3 Water treatment and cleaning
 - .4 Life safety and fire protection
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- .5 Noise and vibration
- .6 Heating water distribution systems
- .7 Air handling distribution and components
- .8 Miscellaneous ventilation systems
- .9 Storm, sanitary and domestic water pumping and distribution system

2.5. TRIAL USAGE

- .1 The Departmental representative shall be permitted trial usage of systems or parts of systems for the purpose of testing and learning operational procedures. Trial usage shall not affect the warranties nor be construed as acceptance, and no claim for damage shall be made against the Departmental representative for any injury or breakage to any part or parts due to the tests, where such injuries or breakage are caused by a weakness or inadequacy of parts, or by defective materials or workmanship of any kind.

3. Execution

NOT USED

END OF SECTION

1. GENERAL

1.1 RELATED REQUIREMENTS

1.1.1 Section 21 05 00 – General Instructions for Mechanical Sections.

1.1.2 Section 01 33 00 – Submittal Procedures.

1.2 REFERENCES

1.2.1 ANSI/NFPA 10-1988, Portable Fire Extinguishers.

1.2.2 CAN4-S508-M83, Rating and Fire Testing of Fire Extinguishers.

1.3 SHOP DRAWINGS AND PRODUCT DATA

1.3.1 Submit shop drawings and product data in accordance with Section 01 33 00 – Submittal Procedures.

1.4 MAINTENANCE DATA

1.4.1 Provide maintenance data for incorporation into manual specified in Section 01 33 00 – Submittal Procedures.

2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

2.1.1 Extinguishers: Ansul, Flag, Kidd, Pyrene, Pyro-Chem.

2.1.2 Fire Extinguisher Cabinets: CFH Industries, Impaction Fire quip Inc., National Fire Equipment, Wholesale Fire and Rescue Ltd.

2.2 MULTI-PURPOSE DRY CHEMICAL EXTINGUISHERS (FOR GENERAL USE)

2.2.1 Stored pressure rechargeable type with hose and shut-off nozzle, ULC labeled for A, B and C class protection. Size 4.5 kg or as indicated. Provide ULC 2A rated fire extinguisher for residential units.

2.3 BICARBONATE EXTINGUISHERS (FOR HOME EC. & FOOD TYPE AREAS)

2.3.1 Stored pressure rechargeable type with hose and shut-off nozzle, ULC labeled for bicarbonate. Sizes 4.5 kg.

2.4 CARBON DIOXIDE EXTINGUISHERS (FOR COMPUTER AREAS)

2.4.1 Insulated handle, hose and horn discharge assembly, self-closing lever or squeeze- grip operation, fully charged, ULC labeled for B and C class protection. Sizes 4.5 kg.

2.5 EXTINGUISHER BRACKETS

- 2.5.1 Type recommended by extinguisher manufacturer, provide bracket inside each cabinet.

2.6 CABINETS

- 2.6.1 Semi - recessed cabinet.

- 2.6.1.1 Cabinet Constructed of 1.6 mm thick steel with 100 mm recess adjustable front and a 50 mm turnback., 180 degree opening door of 2.5 mm thick steel with latching device.

- 2.6.1.2 Cabinet to maintain fire resistive rating of construction in which it occurs.

- 2.6.1.3 Cabinet door: with 6mm georgian glass panel.

- 2.6.1.4 Finish:

- 2.6.1.4.1 Tub: prime coat

- 2.6.1.4.2 Door and Frame: No. 4 brushed stainless steel.

- 2.6.1.5 Acceptable material: WFR model FEC -
1. 2.6.1.5.1

2.7 IDENTIFICATION

- 2.7.1 Identify extinguishers in accordance with recommendations of ANSI/NFPA 10.

- 2.7.2 Attach bilingual tag or label to extinguishers, indicating month and year of installation. Provide space for service dates.

3 EXECUTION

3.1 INSTALLATION

- 3.1.1 Install or mount extinguishers in cabinets or on brackets as indicated.

- 3.1.2 Mounting height to be 1500 mm to the top of the cabinet or bracket.

END OF SECTION

1 GENERAL

1.1 RELATED REQUIREMENTS

- 1.1.1 Section 21 05 00: General Instructions for Mechanical Sections.
- 1.1.2 Section 01 33 00: Submittal Procedures.
- 1.1.3 Section 22 42 01: Plumbing Fixtures and Trim.
- 1.1.4 Section 07 84 00: Fire Stopping and Smoke Seals.

1.2 REFERENCE STANDARDS

- 1.2.1 Do plumbing specialties and accessories work in accordance with Alberta Plumbing Code and local authority having jurisdiction except where specified otherwise.

1.3 SHOP DRAWINGS

- 1.3.1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.
- 1.3.2 Submit product data in accordance with Division one
- 1.3.3 Indicate dimensions, construction details and materials for all equipment.

2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- 2.1.1 Floor Drains: Ancon, Jay R. Smith, Zurn
 - 2.1.2 Cleanouts: Ancon, Jay R. Smith, Zurn
 - 2.1.3 Hydrants: Ancon, Jay R. Smith, Zurn , Woodford
 - 2.1.4 Water hammer Arrestors: Amtrol, Ancon, Roto-Tech Smith, Wade, Zurn
 - 2.1.5 Back Flow Preventors: Watts, Conbraco, Febco.
 - 2.1.6 Hose Bibbs: Emco, Crane, Waltec, Cambridge Brass
 - 2.1.7 Water Make up Assembly: Taco, Watts, Armstrong
 - 2.1.8 Trap Seal Primers: Ancon, Jay R. Smith, Zurn , Crane
 - 2.1.9 Strainers: Armstrong, Braukmann, Crane, Leitch, Toyo
 - 2.1.10 Trench Drain: NDS, Zurn, ACO.
 - 2.1.11 Sediment Interceptor: Watts, Zurn
-

2.2 FLOOR DRAINS

2.2.1 Type I: (general use) cast iron body round, adjustable head, nickel bronze strainer, integral seepage pan, and clamping collar, primer tapping.

2.2.1.1 Acceptable Material: Watts FD-100-C.

2.2.2 Type II: (combination funnel floor drain) cast iron body with integral seepage pan, clamping collar, nickel-bronze adjustable head strainer with integral funnel.

2.2.2.1 Acceptable Material: Watts FD-100-C-EG.

2.2.3 Note, floor drains with trap primers are to be put in only where required by code.

2.3 ROOF DRAINS

2.3.1 Type I: (standard roof drain) cast iron with aluminum mushroom dome, under - deck clamp to suit roof construction, flashing clamp ring with integral gravel stop.

2.3.1.1 Acceptable Materials: Watts RD100.

2.4 CLEANOUTS

2.4.1 Cleanout plugs (cast iron): heavy CI male ferrule with brass screws and threaded brass or bronze plug. Sealing-caulked lead seat or neoprene gasket.

2.4.1.1 Acceptable Materials: Watts CO-100-C-R.

2.4.2 Access covers:

2.4.2.1 Wall access: Standard access door and/or face or wall type, stainless steel with flush head securing screws.

2.4.2.1.1 Acceptable Materials: Watts.

2.4.2.2 Floor access: (cleanout) round cast box with anchor lugs and:

2.4.2.2.1 Plugs: bolted bronze with neoprene gasket.

2.4.2.2.2 Cover for unfinished concrete floors: nickel bronze round or square, gasket, vandal-proof screws.

- Acceptable Materials: Watts CO-100-C-R.

2.4.2.2.3 Cover for terrazo finish: polished brass with recessed cover for filling with terrazo, vandal-proof locking screw.

- Acceptable Materials: Watts CO-100-C-U-1.

2.4.2.2.4 Cover for tile and linoleum floors: polished brass with recessed cover for linoleum or tile infill, complete with vandal-proof locking screws:

- Acceptable Materials: Watts CO-100-C-T-1.
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2.4.2.2.5 Cover for carpeted floors: polished brass with deep flange cover for carpet infill, complete with carpet markerscrew.

- Acceptable Materials: Watts CO-100-RC-1.

2.5 HYDRANTS

2.5.1 Concealed non-freeze wall hydrant with NPS 19mm hose outlet. Removable operating key and vacuum breaker. Chrome finish.

2.5.2 Acceptable Materials: Watts HY-725-CR.

2.6 WATER HAMMER ARRESTORS

2.6.1 Stainless steel construction, piston type only: to Plumbing and Drainage Institute Standard PDI-WH 201-77.

2.7 BACK FLOW PREVENTERS

2.7.1 Protect entire potable water distribution system against contamination due to back flow from non-potable sources as indicated and as required by applicable plumbing codes and local authorities. Back flow preventer, reduced pressure principle type: to CSA B64.10-M1981.

2.8 HOSE BIBBS

2.8.1 Bronze construction complete with hose thread spout replaceable composition disc, and chrome plated in finished areas.

2.8.2 Acceptable Materials: Crane C5046

2.9 WATER MAKE-UP ASSEMBLY

2.9.1 Pressure reducing valve type complete with integral strainer, gate valve, pressure gauges between inlet and outlet and pressure relief valve on reduced pressure side.

2.9.2 Acceptable Materials: Taco 323 and 327

2.10 STRAINERS

2.10.1 860 kPa gauge pressure Y type strainer with 20 mesh, monel, bronze or stainless steel removable screen.

2.10.2 50 mm nominal and under, bronze, and screwed with brass cap.

2.10.2.1 Acceptable Materials: Crane 988 - 2

2.10.3 65 mm nominal and over, cast iron, flanged with bolted cap.

2.10.3.1 Acceptable Materials: Crane 989 - 2
2.10.3.1.12.12

2.10.3.1.2

2.11 TRAPS

2.11.1 Cast iron body deep seal traps, threaded, hub, or spigot on inlet.

2.12 SEDIMENT INTERCEPTOR

2.12.1 Solids and sediments interceptor shall be recessed, epoxy coated steel solids interceptor with gasketed epoxy coated steel skid-proof cover secured with hex head center bolt(s), removable sediment basket, and no hub connection.

2.13 FIRE STOPPING

2.13.1 Fire stopping related to mechanical installation shall be the responsibility of the mechanical contractor. Refer to section 07 84 00 for product requirement. Fire stopping contractor shall be ULC approved.

3 EXECUTION

3.1 CLEANOUTS

3.1.1 In addition to those required by code, install at base of all soil and waste stacks, and rainwater leaders and where indicated.

3.1.2 Bring cleanouts to wall or finished floor unless serviceable from below floor.

3.1.3 Building drain cleanout and stack base cleanouts: line size to maximum NPS 4.

3.2 HYDRANTS

3.2.1 Install non freeze wall hydrant 600 mm above finished grade unless otherwise indicated.

3.3 WATER HAMMER ARRESTORS

3.3.1 Install on branch supplies to each fixture or group of fixtures and where indicated.

3.4 BACK FLOW PREVENTION

3.4.1 Install approved type of back flow prevention device, and or vacuum breaker in accordance with manufacturers instructions, as indicated and as required by applicable plumbing codes and local authorities to protect entire potable water system against contamination due to backflow from non-potable sources. Install generally on the following; make-up water on boilers, and glycol systems; plumbing systems, fire protection water, and all equipment connected to domestic water sources requiring protection.

3.4.2 Pipe discharge to nearest drain.

3.4.3 The following Table I and Table II indicates the acceptable devices for specific equipment:

TABLE I
INTERNAL BUILDING PROTECTION

<u>Description of Cross Connection</u>	<u>Protection of Fixture</u>	<u>Additional Premise Isolation</u>
* Connection to Sewer Pipe	AG	
* Heating and Cooling System with Chemical Additives	RP	
* Heating Equipment	DCVA	
* Hose Bibbs	AVB or HCVB	
* Flexible shower heads	AVB	
* Kitchen Equipment	AVB	
Backflow Control - Devices		
Air Gap (AG)		
Reduced Pressure Principle Backflow Prevention Assembly (RP)		
Double Check Valve Assembly (DCVA)		
Pressure Vacuum Breaker (PVB)		
Atmospheric Vacuum Breaker (AVB)		
Hose Connection Vacuum Breaker (HCVB)		
Dual Check with Atmospheric Port (DCAP)		
Dual Check Valve (DuC)		

3.5 HOSE BIBBS

- 3.5.1 Install at bottom of all risers, at low points to drain systems, and as indicated and under sinks in washrooms.

3.6 WATER MAKE-UP ASSEMBLY

- 3.6.1 Install in accordance with manufacturers instructions. Provide on hot water heating systems, glycol heating systems and as indicated.
- 3.6.2 Pipe relief valve to nearest drain.

3.7 TRAP SEAL PRIMERS

- 3.7.1 Install on floor drains only as required by code.

3.8 STRAINERS

- 3.8.1 Install in accordance with manufacturers' instructions. Allow sufficient room to remove basket.

3.9 FIRE STOPPING

- 3.9.1 Fire stopping related to mechanical installation shall be the responsibility of the mechanical contractor. Refer to section 07 84 00 for installation requirement. Fire stopping contractor shall be ULC approved.

END OF SECTION

1. General

1.1. WORK INCLUDED

- .1 Conform to Section 21 05 00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

2. Products

2.1. MATERIALS

- .1 Size shall be as shown on Drawings.

3. Execution

3.1. INSTALLATION

- .1 Water meter will be supplied by the local authorities. Include for the cost of supply and installation of accessories and incidental components necessary for a complete and functioning meter installation, including valved by-pass.

END OF SECTION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section describes the requirements for general-duty valves for domestic water and sewer systems.
- B. A complete listing of all acronyms and abbreviations are included in Section 21 05 01 - ABBREVIATIONS.

1.2 RELATED WORK

- A. Section 21 05 00 - GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
- B. Section 01 33 00 – SUBMITTAL PROCEDURES.

1.3 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
 - B. American Society of Mechanical Engineers (ASME):
 - A112.14.1-2003.....Backwater Valves
 - C. American Society of Sanitary Engineering (ASSE):
 - 1001-2008Performance Requirements for Atmospheric Type Vacuum Breakers
 - 1003-2009Performance Requirements for Water Pressure Reducing Valves for Domestic Water Distribution Systems
 - 1011-2004Performance Requirements for Hose Connection Vacuum Breakers
 - 1013-2011Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Principle Fire Protection Backflow Preventers
 - 1015-2011Performance Requirements for Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies
 - 1017-2009Performance Requirements for Temperature Actuated Mixing Valves for Hot Water Distribution Systems
 - 1020-2004Performance Requirements for Pressure Vacuum Breaker Assembly
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- 1035-2008Performance Requirements for Laboratory Faucet Backflow Preventers
- 1069-2005Performance Requirements for Automatic Temperature Control Mixing Valves
- 1070-2004Performance Requirements for Water Temperature Limiting Devices
- 1071-2012Performance Requirements for Temperature Actuated Mixing Valves for Plumbed Emergency Equipment
- D. American Society for Testing and Materials (ASTM):
- A126-2004(R2009).....Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
- A276-2013a.....Standard Specification for Stainless Steel Bars and Shapes
- A536-1984(R2009).....Standard Specification for Ductile Iron Castings
- B62-2009.....Standard Specification for Composition Bronze or Ounce Metal Castings
- B584-2013.....Standard Specification for Copper Alloy Sand Castings for General Applications
- E. International Code Council (ICC):
- IPC-2012International Plumbing Code
- F. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS):
- SP-25-2008Standard Marking Systems for Valves, Fittings, Flanges and Unions
- SP-67-2011Butterfly Valves
- SP-70-2011Gray Iron Gate Valves, Flanged and Threaded Ends
- SP-71-2011Gray Iron Swing Check Valves, Flanged and Threaded Ends
- SP-80-2013Bronze Gate, Globe, Angle, and Check Valves
- SP-85-2011Gray Iron Globe & Angle Valves, Flanged and Threaded Ends
- SP-110-2010Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
- G. National Environmental Balancing Bureau (NEBB):
- 7th Edition 2005Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems
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- H. NSF International (NSF):
 - 61-2012Drinking Water System Components – Health Effects
 - 372-2011Drinking Water System Components – Lead Content
- I. University of Southern California Foundation for Cross Connection Control and Hydraulic Research (USC FCCCHR):
 - 9th EditionManual of Cross-Connection Control

1.4 SUBMITTALS

- A. Submittals, including number of required copies, shall be submitted in accordance with Section 21 05 03 - SHOP DRAWINGS.
 - B. Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 22 05 23 - VALVES – PLUMBING”, with applicable paragraph identification.
 - C. Manufacturer's Literature and Data Including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.
 - 1. Ball Valves.
 - 2. Gate Valves.
 - 3. Butterfly Valves.
 - 4. Balancing Valves.
 - 5. Check Valves.
 - 6. Globe Valves.
 - 7. Water Pressure Reducing Valves and Connections.
 - 8. Backwater Valves.
 - 9. Backflow Preventers.
 - 10. Chainwheels.
 - 11. Thermostatic Mixing Valves.
 - D. Test and Balance reports for balancing valves.
 - E. Complete operating and maintenance manuals including wiring diagrams, technical data sheets and information for ordering replaceable parts:
 - 1. Include complete list indicating all components of the systems.
 - 2. Include complete diagrams of the internal wiring for each item of equipment.
 - 3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.
 - 4. Piping diagrams of thermostatic mixing valves to be installed.
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- F. Completed System Readiness Checklist provided by the Commissioning Agent and completed by the Contractor, signed by a qualified technician and dated on the date of completion.
- G. Submit training plans and instructor qualifications.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Valves shall be prepared for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set angle, gate, and globe valves closed to prevent rattling.
 - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 - 5. Set butterfly valves closed or slightly open.
 - 6. Block check valves in either closed or open position.
- B. Valves shall be prepared for storage as follows:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew point temperature.
- C. A sling shall be used for large valves. The sling shall be rigged to avoid damage to exposed parts. Hand wheels or stems shall not be used as lifting or rigging points.

PART 2 - PRODUCTS

2.1 VALVES, GENERAL

- A. Asbestos packing and gaskets are prohibited.
 - B. Bronze valves shall be made with dezincification resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc shall not be permitted.
 - C. Valves in insulated piping shall have 50 mm or DN50 (2 inch) stem extensions and extended handles of non-thermal conductive material that allows operating the valve without breaking the vapor seal or disturbing the insulation. Memory stops shall be fully adjustable after insulation is applied.
 - D. Exposed Valves over 65 mm or DN65 (2-1/2 inches) installed at an elevation over 3.6 m (12 feet) shall have a chain-wheel attachment to valve hand-wheel, stem, or other actuator.
 - E. All valves used to supply potable water shall meet the requirements of NSF 61 and NSF 372.
 - F. Bio-Based Materials: For products designated by the USDA's Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit <http://www.biopreferred.gov>.
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2.2 SHUT-OFF VALVES

A. Cold, Hot and Re-circulating Hot Water:

1. 50 mm or DN50 (2 inches) and smaller: Ball, MSS SP-110, Ball valve shall be full port three piece or two piece with a union design with adjustable stem package. Threaded stem designs are not allowed. The ball valve shall have a SWP rating of 1035 kPa (150 psig) and a CWP rating of 4138 kPa (600 psig). The body material shall be Bronze ASTM B584, Alloy C844. The ends shall be non-lead solder.
2. Less than 100 mm DN100 (4 inches): Butterfly shall have an iron body with EPDM seal and aluminum bronze disc. The butterfly valve shall meet MSS SP-67, type I standard. The butterfly valve shall have a SWP rating of 1380 kPa (200 psig). The valve design shall be lug type suitable for bidirectional dead-end service at rated pressure. The body material shall meet ASTM A536, ductile iron.
3. 100 mm DN100 (4 inches) and larger:
 - a. Class 125, OS&Y, Cast Iron Gate Valve. The gate valve shall meet MSS SP-70 type I standard. The gate valve shall have a CWP rating of 1380 kPa (200 psig). The valve materials shall meet ASTM A126, grey iron with bolted bonnet, flanged ends, bronze trim, and positive-seal resilient solid wedge disc. The gate valve shall be gear operated for sizes under 200 mm or DN200 (8 inches) and crank operated for sizes 200 mm or DN200 (8 inches) and above.
 - b. Single flange, ductile iron butterfly valves: The single flanged butterfly valve shall meet the MSS SP-67 standard. The butterfly valve shall have a CWP rating of 1380 kPa (200 psig). The butterfly valve shall be lug type, suitable for bidirectional dead-end service at rated pressure without use of downstream flange. The body material shall comply with ASTM A536 ductile iron. The seat shall be EPDM with stainless steel disc and stem.
 - c. Grooved end, ductile iron butterfly valves. The grooved butterfly valve shall meet the MSS SP-67 standard. The grooved butterfly valve shall have a CWP rating of 1380 kPa (200 psig). The valve materials shall be epoxy coated ductile iron conforming to ASTM A536 with two piece stainless steel stem, //Buna-N//EPDM// encapsulated ductile iron disc, and EPDM seal. The butterfly valve shall be gear operated.

- B. Reagent Grade Water: Valves for reagent grade, reverse osmosis, or deionized water service shall be ball type of same material as used for pipe.
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2.3 BALANCING VALVES

- A. Hot Water Re-circulating, 75 mm or DN75 (3 inches) and smaller manual balancing valve shall be of bronze body, brass ball construction with glass and carbon filled TFE seat rings and designed for positive shutoff. The manual balancing valve shall have differential pressure read-out ports across the valve seat area. The read out ports shall be fitting with internal EPT inserts and check valves. The valve body shall have 8 mm or DN8 NPT (1/4 inch NPT) tapped drain and purge port. The valves shall have memory stops that allow the valve to close for service and then reopened to set point without disturbing the balance position. All valves shall have calibrated nameplates to assure specific valve settings.
- B. Larger than 75 mm or DN75 (3 inches): Manual balancing valves shall be of heavy duty cast iron flanged construction with 861 kPa (125 psig) flange connections. The flanged manual balancing valves shall have either a brass ball with glass and carbon filled TFE seal rings or fitted with a bronze seat, replaceable bronze disc with EPDM seal insert and stainless steel stem. The design pressure shall be 1200 kPa (175 psig) at 121 degrees C (250 degrees F).

2.4 CHECK VALVES

- A. 75 mm or DN75 (3 inches) and smaller shall be Class 125, bronze swing check valves with non-metallic disc suitable for type of service. The check valve shall meet MSS SP-80 Type 4 standard. The check valve shall have a CWP rating of 1380 kPa (200 psig). The check valve shall have a Y pattern horizontal body design with bronze body material conforming to ASTM B62, solder joints, and PTFE or TFE disc.
- B. 100 mm or DN100 (4 inches) and larger:
 - 1. Check valves shall be Class 125, iron swing check valve with lever and weight closure control. The check valve shall meet MSS SP-71 Type I standard. The check valve shall have a CWP rating of 1380 kPa (200 psig). The check valve shall have a clear or full waterway body design with gray iron body material conforming to ASTM A126, bolted bonnet, flanged ends, bronze trim.
 - 2. All check valves on the discharge side of submersible sump pumps shall have factory installed exterior level and weight with sufficient weight to prevent the check valve from hammering against the seat when the sump pump stops.

2.5 GLOBE VALVES

- A. 75 mm or DN75 (3 inches) or smaller: Class 150, bronze globe valve with non-metallic disc. The globe valve shall meet MSS SP-80, Type 2 standard. The globe valve shall have a CWP rating of 2070 kPa (300 psig). The valve material shall be bronze with integral seal and union ring bonnet
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conforming to ASTM B62 with solder ends, copper-silicon bronze stem, PTFE or TFE disc, and malleable iron hand wheel.

- B. Larger than 75 mm or DN75 (3 inches): Similar to above, except with cast iron body and bronze trim, Class 125, iron globe valve. The globe valve shall meet MSS SP-85, Type 1 standard. The globe valve shall have a CWP rating of 1380 kPa (200 psig). The valve material shall be gray iron with bolted bonnet conforming to ASTM A126 with flanged ends, bronze trim, and malleable iron handwheel.

2.6 WATER PRESSURE REDUCING VALVE AND CONNECTIONS

- A. 75 mm or DN75 (3 inches) or smaller: The pressure reducing valve shall consist of a bronze body and bell housing, a separate access cover for the plunger, and a bolt to adjust the downstream pressure. The pressure reducing valve shall meet ASSE 1003. The bronze bell housing and access cap shall be threaded to the body and shall not require the use of ferrous screws. The assembly shall be of the balanced piston design and shall reduce pressure in both flow and no flow conditions. The assembly shall be accessible for maintenance without having to remove the body from the line.
- B. 100 mm or DN100 (4 inches) and larger: The pressure reducing valve shall consist of a flanged cast iron body and rated to 1380 kPa (200 psig). The valve shall have a large elastomer diaphragm for sensitive response. The pressure reducing valve shall meet ASSE 1003.
- C. The regulator shall have a tap for pressure gauge.
- D. The regulator shall have a temperature rating of 100 degrees C (212 degrees F) for hot water or hot water return service. Pressure regulators shall have accurate pressure regulation to 6.9 kPa (+/- 1 psig).
- E. Setting: Entering water pressure, discharge pressure, capacity, size, and related measurements shall be as shown on the drawings.
- F. Connections Valves and Strainers: Shut off valves shall be installed on each side of reducing valve and a bypass line equal in size to the regulator inlet pipe shall be installed with a normally closed globe valve. A strainer shall be installed on inlet side of, and same size as pressure reducing valve. A pressure gage shall be installed on the inlet and outlet of the valve.

2.7 BACKWATER VALVE

- A. The backwater valve shall have a cast iron body, automatic thermoplastic type valve seat and flapper suited for water service. The flapper shall be slightly open during periods of non-operation. The pressure reducing valve shall meet ASME A112.14.1. The cleanout shall be

extended to the finish floor and fit with a threaded countersunk plug. A clamping device shall be included when the cleanout extends through the waterproofing membrane.

- B. When the backwater valve is installed greater than 600 mm (24 inches) below the finish floor elevation, a pit or manhole large enough for a repair person can enter to service the backwater valve shall be installed.

2.8 BACKFLOW PREVENTERS

- A. A backflow prevention assembly shall be installed at any point in the plumbing system where the potable water supply comes in contact with a potential source of contamination. The backflow prevention assembly shall be approved by the University of Southern California Foundation for Cross Connection Control and Hydraulic Research (USCFCCC).
- B. The reduced pressure principle backflow prevention assembly shall be ASSE listed 1013 with full port OS&Y positive-seal resilient gate valves and an integral relief monitor switch. The main body and access cover shall be epoxy coated ductile iron conforming to ASTM A536 grade 4. The seat ring and check valve shall be the thermoplastic type suited for water service. The stem shall be stainless steel conforming to ASTM A276. The seat disc shall be the elastomer type suited for water service. The checks and the relief valve shall be accessible for maintenance without removing the device from the line. An epoxy coated wye type strainer with flanged connections shall be installed on the inlet. Reduced pressure backflow preventers shall be installed in the following applications.
 - 1. Deionizers.
 - 2. Sterilizers.
 - 3. Stills.
 - 4. Dialysis, Deionized or Reverse Osmosis Water Systems.
 - 5. Water make up to heating systems, cooling tower, chilled water system, generators, and similar equipment consuming water.
 - 6. Water service entrance from loop system.
 - 7. Dental equipment.
 - 8. Power washer.
 - 9. Medical equipment.
 - 10. Process equipment.
 - 11. Autopsy, on each hot and cold water outlet at each table or sink.
 - 12. Reclaimed water systems.

- C. The pipe applied or integral atmospheric vacuum breaker shall be ASSE listed 1001. The main body shall be cast bronze. The seat disc shall be the elastomer type suited for water service. The device shall be accessible for maintenance without removing the device from the service line. The installation shall not be in a concealed or inaccessible location or where the venting of water from the device during normal operation is deemed objectionable. Atmospheric vacuum breakers shall be installed in the following applications.
1. Hose bibs and sinks with threaded outlets.
 2. Disposers.
 3. Showers (telephone/handheld type).
 4. Hydrotherapy units.
 5. All kitchen equipment, if not protected by air gap.
 6. Ventilating hoods with wash down system.
 7. Film processor.
 8. Detergent system.
 9. Fume hoods.
 10. Glassware washers.
 11. Service sinks (integral with faucet only).
 12. Laundry tubs (integral with faucet only).
 13. Sitz baths.
- D. The hose connection vacuum breaker shall be ASSE listed 1011. The main body shall be cast brass with stainless steel working parts. The diaphragm and disc shall be the elastomer type suited for water service. The device shall permit the attachment of portable hoses to hose thread outlets. Hose connection vacuum breakers shall be installed in the following locations requiring non-continuous pressure:
1. Hose bibbs and wall hydrants.
- E. The pressure vacuum breaker shall be ASSE listed 1020. The main body shall be brass. The disc and O-ring seal shall be the elastomer type. The valve seat and disc float shall be the thermoplastic type. Tee handle or lever handle shut-off ball valves. Test cocks for testing and draining where freezing conditions occur. All materials shall be suitable for water service. The device shall be accessible for maintenance without removing the device from the service line. The installation shall not be in a concealed or inaccessible location or where the venting of water from the device during normal operation is deemed objectionable. Pressure vacuum breakers shall be
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installed in the following locations requiring continuous pressure and no backpressure including equipment with submerged inlet connections:

1. Lawn Irrigation.
- F. The laboratory faucet vacuum breaker shall be ASSE listed 1035. The main body shall be cast brass. Dual check valves with stainless steel working parts. The diaphragm and disc shall be the elastomer type suited for water service. The device shall permit the attachment of portable hoses to laboratory faucets for non-continuous pressure applications.
- G. The double check backflow prevention assembly shall be ASSE listed 1015 and supply with full port, OS&Y, positive-seal, resilient gate valves. The main body and access cover shall be epoxy coated ductile iron conforming to ASTM A536 grade. The seat ring and check valve shall be the thermoplastic type suited for water service. The stem shall be stainless steel conforming to ASTM A276. The seat disc shall be the elastomer type suited for water service. The first and second check valve shall be accessible for maintenance without removing the device from the line. Double check valves shall be installed in the following location requiring continuous pressure subject to backpressure and backsiphonage conditions.
1. Lawn Irrigation.
 2. Food Processing Equipment.
 3. Laundry equipment.

2.9 CHAINWHEELS

- A. Valve chain wheel assembly with sprocket rim brackets and chain shall be constructed according to the following:
1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
 2. Attachment: For connection to //ball// //butterfly// valve stem.
 3. Sprocket rim with chain guides: //Ductile or cast iron// //Aluminum// //Bronze// of type and size required for valve with zinc coating.
 4. Chain: //Hot dipped galvanized steel// //Stainless steel// of size required to fit sprocket rim.

2.10 THERMOSTATIC MIXING VALVES

- A. Thermostatic Mixing Valves shall comply with the following general performance requirements:
1. Shall meet ASSE requirements for water temperature control.
 2. The body shall be cast bronze or brass with corrosion resistant internal parts preventing scale and biofilm build-up. Provide chrome-plated finish in exposed areas.
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3. No special tool shall be required for temperature adjustment, maintenance, replacing parts and disinfecting operations.
4. Valve shall be able to be placed in various positions without making temperature adjustment or reading difficult.
5. Valve finish shall be chrome plated in exposed areas.
6. Valve shall allow easy temperature adjustments to allow hot water circulation. Internal parts shall be able to withstand disinfecting operations of chemical and thermal treatment of water temperatures up to 82°C (180°F) for 30 minutes or 50 mg/L (50 ppm) chlorine residual concentration for 24 hours.
7. Parts shall be easily removed or replaced without dismantling the valves, for easy scale removal and disinfecting of parts.
8. Valve shall have a manual adjustable temperature control with locking mechanism to prevent tampering by end user. Outlet temperature shall be visible to ensure outlet temperature does not exceed specified limits, particularly after thermal eradication procedures.
9. Provide mixing valves with integral check valves with screens and stop valves.

B. Master Thermostatic Water Mixing Valves:

1. Application: Tempered water distribution from hot water source.
2. Standard: ASSE 1017.
3. Pressure Rating: 861 kPa (125 psig).
4. Type: Exposed-mounting or Cabinet-type, as indicated, thermostatically controlled water mixing valve.
5. Connections: Flanged or threaded union inlets and outlet.
6. Valve Finish: Chrome plated.//
7. Cabinet: Factory-fabricated, stainless steel, for recessed or surface mounting and with hinged, stainless-steel door.//
8. Thermometers shall be provided to indicate mixed water temperature.
9. Provide a high temperature alarm device to detect mixing valve failure.//

C. Hi-Lo Water-Mixing-Valve Assemblies:

1. Application: Tempered water distribution from hot water source covering a wide range of flow.
 2. Description: Factory-fabricated, cabinet-type or exposed-mounting, thermostatically controlled, water-mixing-valve assembly in two-valve parallel arrangement including pressure regulators, pressure gages and thermometer.
-

-
3. Large-Flow Parallel: Master thermostatic water mixing valve and downstream pressure regulator with pressure gages on inlet and outlet.
 4. Small-Flow Parallel: Master thermostatic water mixing valve.
 5. Master Thermostatic Mixing Valves: Comply with ASSE 1017.
 6. Water Regulator(s): Comply with ASSE 1003. Include pressure gage on inlet and outlet.
 7. Component Pressure Ratings: 861 kPa (125 psig) minimum, unless otherwise indicated.
 8. Cabinet: Factory-fabricated, stainless steel, for recessed or surface mounting and with hinged, stainless-steel door.//
 9. Connections: Soldered or threaded union inlets and outlet.
 10. Thermometers shall be provided to indicate mixed water temperature.
 11. Provide a high temperature alarm device to detect mixing valve failure.//
- D. Automatic Water Temperature Control Mixing Valves:
1. Application: Gang plumbing fixtures point-of-use when no other mixing at fixtures occurs.
 2. Standard: ASSE 1069.
 3. Pressure Rating: 861 kPa (125 psig).
 4. Type: Thermostatically controlled water mixing valve set at 43 degrees C (110 degrees F).
 5. Connections: Threaded union or soldered inlets and outlet.
 6. Thermometers shall be provided to indicate mixed water temperature.
 7. Upon cold water supply failure the hot water flow shall automatically be reduced to 0.5 gpm maximum.
 8. Provide a high temperature alarm device to detect mixing valve failure.//
- E. Water Temperature Limiting Devices:
1. Application: Single plumbing fixture point-of-use such as sinks or lavatories.
 2. Standard: ASSE 1070.
 3. Pressure Rating: 861 kPa (125 psig).
 4. Type: Thermostatically controlled water mixing valve set at 43 degrees C (110 degrees F).
 5. Connections: Threaded union, compression or soldered inlets and outlet.
 6. Upon cold water supply failure the hot water flow shall automatically be reduced to 0.2 gpm maximum.
- F. Temperature Activated Mixing Valves:
1. Application: Emergency eye/face/drench shower equipment.
 2. Standard: ASSE 1071.
-

3. Pressure Rating: 861 kPa (125 psig).
4. Type: Thermostatically controlled water mixing valve set at 24-30 degrees C (75-85 degrees F).
5. Connections: Soldered or threaded union inlets and outlet.
6. Cabinet: Factory-fabricated, stainless steel, for recessed or surface mounting and with hinged, stainless-steel door.
7. Thermometers shall be provided to indicate mixed water temperature.
8. Upon cold water supply failure the hot water flow shall automatically be reduced to 0.5 gpm maximum.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Valve interior shall be examined for cleanliness, freedom from foreign matter, and corrosion. Special packing materials shall be removed, such as blocks, used to prevent disc movement during shipping and handling.
- B. Valves shall be operated in positions from fully open to fully closed. Guides and seats shall be examined and made accessible by such operations.
- C. Threads on valve and mating pipe shall be examined for form and cleanliness.
- D. Mating flange faces shall be examined for conditions that might cause leakage. Bolting shall be checked for proper size, length, and material. Gaskets shall be verified for proper size and that its material composition is suitable for service and free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Valves shall be located for easy access and shall be provide with separate support. Valves shall be accessible with access doors when installed inside partitions or above hard ceilings.
- C. Valves shall be installed in horizontal piping with stem at or above center of pipe.
- D. Valves shall be installed in a position to allow full stem movement.
- E. Install chain wheels on operators for //ball// //butterfly// //gate// and //globe// valves NPS 100 mm or DN100 (4 inches) and larger and more than 3.6 m (12 feet) above floor. Chains shall be extended to 1524 mm (60 inches) above finished floor.
- F. Check valves shall be installed for proper direction of flow and as follows:
 1. Swing Check Valves: In horizontal position with hinge pin level and on top of valve.

- G. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction. Locate backflow preventers in same room as connected equipment or system.
 - 1. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
- H. Install pressure gages on outlet of backflow preventers.
- I. Do not install bypass piping around backflow preventers.
- J. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets.
 - 1. Install thermometers if specified.
 - 2. Install cabinet-type units recessed in or surface mounted on wall as specified.
- K. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no cost to the Government.

3.3 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Calibrated balancing valves.
 - 2. Master, thermostatic, water mixing valves.
 - 3. Manifold, thermostatic, water-mixing-valve assemblies.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.

3.4 ADJUSTING

- A. Valve packing shall be adjusted or replaced after piping systems have been tested and put into service but before final adjusting and balancing. Valves shall be replaced if persistent leaking occurs.
 - B. Set field-adjustable flow set points of balancing valves and record data. Ensure recorded data represents actual measured or observed conditions. Permanently mark settings of valves and other adjustment devices allowing settings to be restored. Set and lock memory stops. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
-

- C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.
- D. Testing and adjusting of balancing valves shall be performed by an independent NEBB Accredited Test and Balance Contractor. A final settings and flow report shall be submitted to the VA Contracting Officer's Representative (COR).

3.6 DEMONSTRATION AND TRAINING

- A. Provide services of manufacturer's technical representative to instruct VA Personnel in operation and maintenance of the system.

END OF SECTION

1 GENERAL

1.1 REFERENCED SECTIONS

- 1.1.1 Section 21 05 00 – General Instructions for Mechanical Sections.
- 1.1.2 Section 23 05 23 – Valves.
- 1.1.3 Section 23 05 93 - Testing, Adjusting and Balancing (TAB).

1.2 REFERENCES

- 1.2.1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
 - 1.2.1.1 ANSI/ASME B16.15-85(R1994), Cast Bronze Threaded Fittings, Classes 125 and 250.
 - 1.2.1.2 ANSI/ASME B16.18-84(R1994), Cast Copper Alloy Solder Joint Pressure Fittings.
 - 1.2.1.3 ANSI/ASME B16.22-95, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
 - 1.2.1.4 ANSI/ASME B16.24-91, Cast Copper Alloy Pipe Flanges and Flanged Fittings, Class 150 and 300.
- 1.2.2 American Society for Testing and Materials (ASTM)
 - 1.2.2.1 ASTM A307-00, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
 - 1.2.2.2 ASTM B88M-99, Specification for Seamless Copper Water Tube (Metric).
 - 1.2.2.3 ASTM F492-95, Specification for Propylene and Polypropylene (PP) Plastic- Lined Ferrous Metal Pipe and Fittings.
- 1.2.3 American Water Works Association (AWWA)
 - 1.2.3.1 .1 ANSI/AWWA C111/A21.11-00, Rubber Gasket Joints for Ductile-Iron and Fittings.
- 1.2.4 Manufacturer's Standardization of the Valve and Fittings Industry (MSS)
 - 1.2.4.1 MSS-SP-67-95, Butterfly Valves.
 - 1.2.4.2 MSS-SP-70-98, Cast Iron Gate Valves, Flanged and Threaded Ends.
 - 1.2.4.3 MSS-SP-71-97, Cast Iron Swing Check Valves Flanged and Threaded Ends.
 - 1.2.4.4 MSS-SP-80-97, Bronze Gate, Globe, Angle and Check Valves.

1.3 SUBMITTALS

- 1.3.1 Submit test reports in accordance with Section 23 05 93.
-

- 1.3.2 Provide maintenance data for incorporation into manual specified in Section 21 08 03 – Operating and Maintenance Instructions.

2 PRODUCTS

2.1 PIPING

- 2.1.1 Domestic hot, cold and recirculation systems, within building.

- 2.1.1.1 Above ground: copper tube, hard drawn, type L: to ASTM B88M.
- 2.1.1.2 Buried or embedded: copper tube, soft annealed, type K: to ASTM B88M, in long lengths and with no buried joints.
- 2.1.1.3 Pex-A piping may be used for all potable distribution and in suite systems 3”(75mm) and smaller within the following pressure and temperature ratings 200F/80PSI, 18F/100PSI, 73.4F/160PSI. Fitting to be cold expansion (F1960) type. Insert fittings or fitting that restrict flow are not permitted. Install and support the piping per manufacturer’s installation guide. Manufacturer to provide a 25 year product consequential damage warranty for systems installed per the manufacturer’s installation guide. Standard of desing – Uponor Aquapex and Propex fittings.

2.2 FITTINGS

- 2.2.1 Bronze pipe flanges and flanged fittings, Class 150 and 300: to ANSI/ASME B16.24.
- 2.2.2 Cast bronze threaded fittings, Class 125 and 250: to ANSI/ASME B16.15.
- 2.2.3 Cast copper, solder type: to ANSI/ASME B16.18.
- 2.2.4 Wrought copper and copper alloy, solder type: to ANSI/ASME B16.22.

2.3 JOINTS

- 2.3.1 Rubber gaskets, 1.6 mm thick: to ANSI/AWWA C111/A21.11.
- 2.3.2 Bolts, nuts, hex head and washers: to ASTM A307, heavy series.
- 2.3.3 Solder: 95/5 tin copper alloy.
- 2.3.4 Teflon tape: for threaded joints.
- 2.3.5 Dielectric connections between dissimilar metals: isolating flanges.

2.4 VALVES

- 2.4.1 Refer to Section 23 05 23.

2.5 PROTECTIVE CONDUIT

- 2.5.1 Plastic drainage pipe, type DWV, to Section 22 13 16 - Drainage Waste and Vent Piping.
-

3 EXECUTION

3.1 INSTALLATION

- 3.1.1 Install in accordance with Canadian Plumbing Code, Provincial Plumbing Code and local authority having jurisdiction.
- 3.1.2 Install pipe work in accordance with Section 23 05 73 - Installation of Pipe Work, supplemented as specified herein.
- 3.1.3 Assemble piping using fittings manufactured to ANSI standards.
- 3.1.4 Install CWS piping below and away from HWS and HWC and other hot piping so as to maintain temperature of cold water as low as possible.
- 3.1.5 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.
- 3.1.6 Buried tubing:
 - 3.1.6.1 Lay in well compacted washed sand in accordance with AWWA Class B bedding.
 - 3.1.6.2 Bend tubing without crimping or constriction. Minimize use of fittings.
 - 3.1.6.3 Install buried tubing located under building slab in protective conduit (except floor drain trap primer piping)

3.2 PRESSURE TESTS

- 3.2.1 Conform to requirements of Section 21 05 00.
- 3.2.2 Test pressure: greater of 1 1/2 times maximum system operating pressure or 860 kPa.

3.3 FLUSHING AND CLEANING

- 3.3.1 Flush entire system for 8 h. Ensure outlets flushed for 2 h. Let stand for 24 h, then draw one sample off longest run. Submit to testing laboratory to verify that system is clean. Let system flush for additional 2 h, then draw off another sample for testing.

3.4 PRE-START-UP INSPECTIONS

- 3.4.1 Systems to be complete, prior to flushing, testing and start-up.
 - 3.4.2 Verify that system can be completely drained.
 - 3.4.3 Ensure that pressure booster systems are operating properly.
 - 3.4.4 Ensure that air chambers, expansion compensators are installed properly.
-

3.5 DISINFECTION

- 3.5.1 Flush out, disinfect and rinse system to requirements of authority having jurisdiction and approval of Consultant.
- 3.5.2 Upon completion, provide laboratory test reports on water quality for Consultant approval.

3.6 START-UP

- 3.6.1 Timing: Start up after:
 - 3.6.1.1 Pressure tests have been completed.
 - 3.6.1.2 Disinfection procedures have been completed.
 - 3.6.1.3 Certificate of static completion has been issued.
 - 3.6.1.4 Water treatment systems operational.
- 3.6.2 Provide continuous supervision during start-up.
- 3.6.3 Start-up procedures:
 - 3.6.3.1 Establish circulation and ensure that air is eliminated.
 - 3.6.3.2 Check pressurization to ensure proper operation and to prevent water hammer, flashing and/or cavitation.
 - 3.6.3.3 Check control, limit, safety devices for normal and safe operation.
- 3.6.4 Rectify start-up deficiencies.

3.7 PERFORMANCE VERIFICATION

- 3.7.1 Timing:
 - 3.7.1.1 After pressure and leakage tests and disinfection completed, and certificate of completion has been issued by authority having jurisdiction.
 - 3.7.2 Procedures:
 - 3.7.2.1 Verify that flow rate and pressure meet Design Criteria.
 - 3.7.2.2 TAB Hot Water Recirc in accordance with Section 23 05 93 - Testing Adjusting and Balancing (TAB).
 - 3.7.2.3 Adjust p r e s s u r e regulating valves while withdrawal is maximum and inlet pressure is minimum.
 - 3.7.2.4 Sterilize DCW and DHWR systems for Legionella control.
 - 3.7.2.5 Verify performance of temperature controls.
 - 3.7.2.6 Verify compliance with safety and health requirements.
-

3.7.2.7 Check for proper operation of water hammer arrestors. Run one outlet for 10 seconds, then shut off water immediately. If water hammer occurs, replace water hammer arrestor or re-charge air chambers. Repeat for outlets and flush valves.

3.7.2.8 Confirm water quality consistent with supply standards, verifying that no residuals remain as a result of flushing and/or cleaning.

3.7.3 Reports:

3.7.3.1 In accordance with Section 21 08 00 - Commissioning, using report forms.

3.7.3.2 Include certificate of water flow and pressure tests conducted on incoming water service, demonstrating adequacy of flow and pressure.

END OF SECTION

1 GENERAL

1.1 RELATED REQUIREMENTS

1.1.1 Section 21 05 00 – General Instructions for Mechanical Sections.

1.1.2 Section 01 33 00 – Submittal Procedure.

1.1.3 Electrical.

1.2 SHOP DRAWINGS AND PRODUCT DATA

1.2.1 Submit shop drawings and product data in accordance with Section 01 33 00 – Submittal Procedure.

1.2.2 Indicate:

1.2.2.1 Equipment, including connections, fittings, control assemblies and ancillaries. Identify whether factory or field assembled.

1.2.2.2 Wiring and schematic diagrams.

1.2.2.3 Dimensions and recommended installation.

1.2.2.4 Pump performance and efficiency curves.

1.3 MAINTENANCE DATA

1.3.1 Provide maintenance data for incorporation into manual specified in Section 01 33 00 – Submittal Procedure.

1.3.2 Data to include:

1.3.2.1 Manufacturers name, type, model year, capacity and serial number.

1.3.2.2 Details of operation, servicing and maintenance.

1.3.2.3 Recommended spare parts list with names and addresses.

2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

2.1.1 Circulating Pumps: Armstrong, Bell and Gossett, Darling, Taco, Liberty Pumps, Grundfos. Contact for alternate approval.

2.2 DOMESTIC HOT WATER CIRCULATING PUMPS

2.2.1 Capacity: as indicated.

2.2.2 Construction: closed-coupled, in-line centrifugal, all bronze construction, stainless steel shaft, stainless steel or bronze shaft sleeve, two oil lubricated bronze sleeves or ball bearings. Design for 860 kPa wp and 105 Deg. C continuous service.

2.2.3 Motor: drip-proof, with thermal overload protection.

2.2.4 Acceptable material: Armstrong.

3 EXECUTION

3.1 INSTALLATION

3.1.1 Make piping and electrical connections to pump and motor assembly and controls as indicated.

3.1.2 Ensure pump and motor assembly do not support piping.

3.1.3 Confirm pump rotation is correct.

3.1.4 Set up and adjust controls.

END OF SECTION

1 GENERAL

1.1 RELATED SECTIONS

- 1.1.1 Section 23 05 73 - Installation of Pipe Work.
- 1.1.2 Section 21 05 00 - General Instructions for Mechanical Sections.

1.2 SCOPE

- 1.2.1 This section applies to sanitary and storm piping within the building and under the building within the building foundation footprint.

1.3 REFERENCES

1.3.1 American Society for Testing and Materials (ASTM)

- 1.3.1.1 ASTM B32, Specification for Solder Metal.
- 1.3.1.2 ASTM B306, Specification for Copper Drainage Tube (DWV).
- 1.3.1.3 ASTM C564, Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- 1.3.1.4 ASTM C1053 - Borosilicate Glass Pipe and Fittings for Drain, Waste, and Vent (DWV) Applications.
- 1.3.1.5 ASTM D2235, Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
- 1.3.1.6 ASTM D2564, Specification for Solvent Cements for Poly(Vinyl-Chloride) (PVC) Plastic Piping Systems.
- 1.3.1.7 ASTM D4101, Standard Specification for Polypropylene Injection and Extrusion Materials
- 1.3.1.8 ASTM F1412, Standard Specification for Polyolefin Pipe and Fittings for Corrosive Waste Drainage Systems

1.3.2 Canadian Standards Association (CSA)

- 1.3.2.1 CAN/CSA-B70, Cast Iron Soil Pipe, Fittings and Means of Joining.
- 1.3.2.2 CAN/CSA-B125, Plumbing Fittings.
- 1.3.2.3 CSA-B1800 Series, ABS Drain, Waste and Vent Pipe and Pipe
- 1.3.2.4 CSA-B181.2, PVC Drain, Waste and Vent Pipe and Pipe Fittings.
- 1.3.2.5 CSA-B181.3, Polyolefin Laboratory Drainage System
- 1.3.2.6 CSA-B182.1, Plastic Drain and Sewer Pipe and Pipe Fittings.
- 1.3.2.7 CSA-B182.11, Recommended Practice for the Installation of Thermoplastic Drain, Storm, and Sewer Pipe and Fittings

1.4 SUBMITTALS

- 1.4.1 Submit test reports in accordance with Section 01 33 00.
 - 1.4.2 Provide maintenance data for incorporation into manual specified in Section 21 08 03.
-

2 PRODUCTS

2.1 COPPER TUBE AND FITTINGS

2.1.1 Above ground sanitary storm and vent Type DWV to: ASTM B306.

2.1.1.1 Fittings.

2.1.1.1.1 Cast brass: to CAN/CSA-B125.

2.1.1.1.2 Wrought copper: to CAN/CSA-B125.

2.1.1.2 Solder: to ASTM B32.

2.2 CAST IRON PIPING AND FITTINGS

2.2.1 Above ground sanitary storm and vent: to CAN/CSA-B70.

2.2.1.1 Joints.

2.2.1.1.1 Mechanical joints: neoprene or butyl rubber compression gaskets with stainless steel clamps.

2.3 PLASTIC PIPING AND FITTINGS

2.3.1 For buried sanitary and storm drainage piping:

2.3.1.1 ABS type DWV to CSA-B181.1.

2.3.1.1.1 Joints: solvent weld to ASTM D2235.

2.3.1.2 PVC type DWV to CSA-B181.2.

2.3.1.2.1 Joints: solvent weld to ASTM D2564.

2.3.2 For buried storm drainage piping:

2.3.2.1 PVC drain line piping to CSA-B182.1.

2.3.2.1.1 Joints up to NPS 6: solvent weld.

2.3.2.1.2 Joints over NPS 8 and over: gasket bell.

3 EXECUTION

3.1 INSTALLATION

3.1.1 Install in accordance with Section 23 05 73, and as specified herein.

3.1.2 Install in accordance with CSA-B182.11, Canadian Plumbing Code, Provincial Plumbing Code and local authority having jurisdiction.

3.1.3 Hang all piping buried under structural slabs. Hangers to attach to structural slab using stainless steel clevis and hanger rod assembly.

3.2 TESTING

3.2.1 Pressure test buried systems before backfilling.

3.2.2 Perform ball test on all underground piping prior to burial. Schedule for Consultant to witness test.

3.2.3 Hydraulically test to verify grades and freedom from obstructions.

3.3 PERFORMANCE VERIFICATION

3.3.1 Cleanouts:

3.3.1.1 Ensure accessible and that access doors are correctly located.

3.3.1.2 Open, cover with linseed oil and re-seal.

3.3.1.3 Verify that cleanout rods can probe as far as the next cleanout, at least.

3.3.2 Test to ensure traps are fully and permanently primed.

3.3.3 Storm water drainage:

3.3.3.1 Verify domes are secure.

3.3.3.2 Verify provisions for movement of roof system.

3.3.4 Ensure that fixtures are properly anchored, connected to system and effectively vented.

3.3.5 Ensure pipe identification is completed.

END OF SECTION

1 GENERAL

1.1 REFERENCES

1.1.1 ASTM International Inc.

1.1.1.1 ASTM B32-08, Standard Specification for Solder Metal.

1.1.1.2 ASTM B306-02, Standard Specification for Copper Drainage Tube (DWV).

1.1.1.3 ASTM C564-03a, Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

1.1.2 Canadian Standards Association (CSA International).

1.1.2.1 CAN/CSA-B70-06, Cast Iron Soil Pipe, Fittings and Means of Joining.

1.1.2.2 CAN/CSA-B125.3-05, Plumbing Fittings.

1.1.3 Green Seal Environmental Standards (GSES)

1.1.3.1 Standard GS-36-00, Commercial Adhesives.

1.2 DELIVERY, STORAGE AND HANDLING

1.2.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

1.2.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

1.2.3 Packaging Waste Management: remove for reuse or recycling all pallets, crates, and packaging materials in accordance with Section 01 74 21 - Waste Management.

2 PRODUCTS

2.1 COPPER TUBE AND FITTINGS

2.1.1 Above ground sanitary and vent Type DWV to: ASTM B306.

2.1.1.1 Fittings.

2.1.1.1.1 Cast brass: to CAN/CSA-B125.3.

2.1.1.1.2 Wrought copper: to CAN/CSA-B125.3.

2.1.1.2 Solder: tin-lead, 50:50, type 50A lead free, tin to ASTM B32.

2.2 CAST IRON PIPING AND FITTINGS

2.2.1 Above ground sanitary, storm and vent: to CAN/CSA-B70.

2.2.2 Joints:

- 2.2.2.1 Mechanical joints:
 - 2.2.2.1.1 Neoprene or butyl rubber compression gaskets with stainless steel clamps.

3 EXECUTION

3.1 APPLICATION

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

3.2 INSTALLATION

- 3.2.1 In accordance with Section 23 05 73 - Installation of Pipework.
- 3.2.2 Install in accordance with National Plumbing Code and local authority having jurisdiction.

3.3 TESTING

- 3.3.1 Pressure test buried systems before backfilling.
- 3.3.2 Hydraulically test to verify grades and freedom from obstructions.

3.4 PERFORMANCE VERIFICATION

- 3.4.1 Cleanouts:
 - 3.4.1.1 Ensure accessible and that access doors are correctly located.
 - 3.4.1.2 Open, cover with linseed oil and re-seal.
 - 3.4.1.3 Verify that cleanout rods can probe as far as the next cleanout, at least.
- 3.4.2 Test to ensure traps are fully and permanently primed.
- 3.4.3 Storm water drainage:
 - 3.4.3.1 Verify domes are secure.
 - 3.4.3.2 Ensure weirs are correctly sized and installed correctly.
 - 3.4.3.3 Verify provisions for movement of roof system.
- 3.4.4 Ensure that fixtures are properly anchored, connected to system and effectively vented.
- 3.4.5 Affix applicable label (storm, sanitary, vent, pump discharge etc.) c/w directional arrows every floor or 4.5 m (whichever is less).

END OF SECTION

1 General

1.1 WORK INCLUDED

- 1.1.1 Conform to Section 21 05 00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

2 Products

Drain water heat recovery system shall be as per following specifications:

1. Drain pipe made of high quality copper DWV tube, manufactured in accordance with ASTM B306 – available diameters are 2", 3", 4" and 6".
2. Fresh water connections are either 3/4" or 1" type L copper tube, compliant with ASTM B88.
3. Four or six copper type L coils (which conform to ASTM B88) flattened and wrapped in parallel to provide excellent efficiency and no noticeable pressure loss.
4. Certified according to the CSA B55.2 Standard for safety and quality.
5. Performance tested and labelled according to the CSA B55.1 Standard.
6. Each unit pressure tested to 160 PSI for quality control prior to shipping.
7. Minimum wall cavity required dimensions by nominal diameter:
 - a. 2" Waste pipe – 3"x6.5"
 - b. 3" Waste pipe – 3.75"x7.5"
 - c. 4" Waste pipe – 4.75"x8"
 - d. 6" Waste pipe – 6.75"x9"

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Roof drains.
 - 2. Miscellaneous storm drainage piping specialties.
 - 3. Cleanouts.
 - 4. Backwater valves.
 - 5. Trench drains.
 - 6. Channel drainage systems.
 - 7. Through-penetration firestop assemblies.
 - 8. Flashing materials.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 ROOF DRAINS

Refer to Roof Drains under 22 05 00 SECTION

2.2 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

- A. Downspout Adaptors:
 - 1. Description: Manufactured, gray-iron casting, for attaching to horizontal-outlet, parapet roof drain and to exterior, sheet metal downspout.
 - 2. Size: Inlet size to match parapet drain outlet.
- B. Downspout Boots:
 - 1. Description: Manufactured, ASTM A 48/A 48M, gray-iron casting, with strap or ears for attaching to building; NPS 4 (DN 100) outlet; and shop-applied bituminous coating.

2. Size: Inlet size to match downspout and NPS 4 (DN 100) outlet.

C. Conductor Nozzles:

1. Description: Bronze body with threaded inlet and bronze wall flange with mounting holes.
2. Size: Same as connected conductor.

2.3 CLEANOUTS

- A. Refer to Cleanouts under 22 05 00

2.4 TRENCH DRAINS AND CHANNEL DRAINS

A. Trench Drains:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Zurn Plumbing Products Group; Specification Drainage Operation; [Z664] [Z665] [Z667] or comparable product by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Tyler Pipe.
 - e. Watts Water Technologies, Inc.
 - f. Klassik Drain
 - g. ACO Drain
2. Standard: ASME A112.6.3, for trench drains.
3. Body Material: Cast iron.
4. Flange: Anchor with weep holes
5. Clamping Device: Required.
6. Outlet: Side
7. Grate Material: stainless steel.
8. Grate Finish: Primed ready to be Painted
9. Dimensions of Frame and Grate: Refer architectural drawings.
10. Top-Loading Classification: Heavy Duty.

2.5 FLASHING MATERIALS

- A. Copper Sheet: ASTM B 152/B 152M, 12 oz./sq. ft. (3.7 kg/sq. m or 0.41-mm thickness).
- B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch (1.01-mm) minimum thickness unless otherwise indicated. Include G90 (Z275) hot-dip galvanized, mill-phosphatized finish for painting if indicated.
- C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil (1.01-mm) minimum thickness.
- D. Fasteners: Metal compatible with material and substrate being fastened.
- E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

- F. Solder: ASTM B 32, lead-free alloy.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions.
 - 1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
 - 2. Install expansion joints, if indicated, in roof drain outlets.
 - 3. Position roof drains for easy access and maintenance.
- B. Install downspout adapters on outlet of back-outlet parapet roof drains and connect to sheet metal downspouts.
- C. Install downspout boots at grade with top 6 inches (152 mm) above grade. Secure to building wall.
- D. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.
- E. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface unless otherwise indicated.
- F. Assemble channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.
- G. Install sleeve flashing device with each conductor passing through floors with waterproof membrane.

3.2 CONNECTIONS

- A. Comply with requirements for piping specified in Section 221413 "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of 6.0-lb/sq. ft. (30-kg/sq. m) lead sheets, 0.0938-inch (2.4-mm) thickness or thicker. Solder joints of 4.0-lb/sq. ft. (20-kg/sq. m) lead sheets, 0.0625-inch (1.6-mm) thickness or thinner.
 - 2. Copper Sheets: Solder joints of copper sheets.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching the pipe size, with a minimum length of 10 inches (250 mm) and with skirt or flange extending at least 8 inches (200 mm) around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around sleeve.

- 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section describes the requirements for domestic hot water heat exchangers including thermometers and all necessary accessories, connections and equipment.
- B. Application is for indirect water heating utilizing steam or hot water as a medium, and can be used for heat recovery or solar systems for pre-heating water prior to primary water heating equipment.
- C. A complete listing of all acronyms and abbreviations are included in Section 21 05 01 - ABBREVIATIONS.

1.2 RELATED WORK

- A. Section 21 05 03 – SHOP DRAWINGS.
- B. Section 22 05 19 – WATER METER.
- C. Section 22 05 23 – VALVES – PLUMBING.
- D. Section 23 07 15 – THERMAL INSULATION FOR PIPING.
- E. Section 22 11 16 – DOMESTIC WATER PIPING.
- F. Section 22 11 23 – PUMPS – PLUMBING.

1.3 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
 - B. American Society for Heating, Refrigerating and Air Conditioning Engineers (ASHRAE):
90.1 (2013).....Energy Standard for Buildings Except Low-Rise Residential
Buildings
 - C. American National Standard Institute (ANSI):
Z21.22B-2001 (R2008)Relief Valves for Hot Water Supply Systems
 - D. American Society of Mechanical Engineers (ASME):
ASME Boiler and Pressure Vessel Code –
BPVC Section IV-2013.....Rules for Construction of Heating Boilers
BPVC Section VIII-1-2013Rules for Construction of Pressure Vessels, Division 1
Form U-1Manufacturer's Data Report for Pressure Vessels
B1.20.1-2013.....Pipe Threads, General Purpose (Inch)
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- B16.5-2013.....Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24
Metric/Inch Standard
- B16.24-2011.....Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes
150, 300, 600, 900, 1500, and 2500
- PTC 25.3-02.....Pressure Relief Devices
- E. National Fire Protection Association (NFPA):
70-2011National Electrical Code (NEC)
- F. NSF International (NSF):
61-2012Drinking Water System Components – Health Effects
372-2011Drinking Water System Components – Lead Content
- G. Underwriter Laboratories (UL):
207-2013Standard for Refrigerant-Containing Components and
Accessories, Nonelectrical
778-2002Standard for Motor-Operated Water Pumps

1.4 SUBMITTALS

- A. Submittals, including number of required copies, shall be submitted in accordance with Section 21 05 03 – SHOP DRAWINGS.
- B. Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 22 35 00 – DOMESTIC WATER HEAT EXCHANGERS”, with applicable paragraph identification.
- C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.
1. Heat Exchangers.
 2. Heat Reclaimers.
 3. Pressure and Temperature Relief Valves.
 4. Steam Control Valves.
 5. Heating Hot Water Control Valves.
 6. Thermometers.
 7. Pressure Gages.
 8. Vacuum Breakers.
 9. Safety Valves.
 10. Expansion Tanks.
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11. Heat Traps.
- D. A form U-1 or other documentation stating compliance with the ASME Boiler and Pressure Vessel Code.
- E. Shop drawings shall include wiring diagrams for power, signal and control functions.
- F. Submit documentation indicating compliance with applicable requirements of ASHRAE 90.1, Unfired Storage Tanks, for Service Water Heating.
- G. Complete operating and maintenance manuals including wiring diagrams, technical data sheets and information for ordering replaceable parts:
 1. Include complete list indicating all components of the systems.
 2. Include complete diagrams of the internal wiring for each item of equipment.
 3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

1.5 QUALITY ASSURANCE

- A. Equipment components in contact with potable water shall meet compliance requirements in documents NSF 61 and NSF 372.
- B. Comply with American Society of Heating, Refrigerating and Air- Conditioning Engineers (ASHRAE) 90.1 for efficiency performance.
- C. The heat exchanger shall be certified and labeled by an independent testing agency.
- D. Circulating pump shall be installed per NFPA 70.
- E. Bio-Based Materials: For products designated by the USDA's Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit <http://www.biopreferred.gov>.

PART 2 - PRODUCTS

2.1 CIRCULATING DOMESTIC WATER HEAT EXCHANGERS

- A. A packaged double wall unit with hot water storage tank shall be provided with circulator, heat exchanger coil, controls, sacrificial anode, and specialties. The domestic water heat exchanger with circulator shall be based upon a standard flow arrangement with water from bottom of storage tank circulated across the heat exchanger coil and returned to tank. The vessel shall be ASME BPVC Section VIII-1, fabricated with a pressure rating of 1035 kPa (150 psig). Tank shall comply with NSF 61 and NSF 372 for barrier materials for potable-water tank linings. Provide with access for cleaning and disinfection.
 - B. A hot water outlet shall be included at the top of the tank.
 - C. A temperature sensor shall be located inside the storage tank.
 - D. A circulating pump complying with UL 778, all bronze construction, overhung impeller, and
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separately coupled inline pump shall be included. The pump shall have mechanical seals. The working pressure shall be rated at 861 kPa (125 psig).

- E. The stand shall be factory fabricated for floor mounting.
- F. The tappings (openings) shall be factory fabricated of materials compatible with the tank and in accordance with appropriate ASME standards for piping connections, pressure and temperature relief valve, pressure gauge, thermometer, drain valve, anode rods and controls. The openings shall be in accordance with ASME standards listed below:
 - 1. 50 mm or DN50 (2 inch) and smaller: Threaded ends according to ASME B1.20.1.
 - 2. 65 mm or DN65 (2-1/2 inch) and larger: Flanged ends according to ASME B16.5 for steel and stainless steel flanges, and according to ASME B16.24.
- G. Shell fiberglass insulation shall comply with ASHRAE 90.1 and suitable for operating temperature, with jacket. The entire shell and nozzles shall be completely surrounded except connections and controls.
- H. The heat exchanger coils shall be constructed from copper or copper alloy and fabricated in a helix wound configuration for heating hot water medium. The pressure rating shall be equal to or greater than the steam or water supply pressure plus 50 percent, but not less than 1035 kPa (150 psig).
- I. The temperature controls shall be based upon an adjustable temperature transmitter that operates a control valve and is capable of maintaining outlet water temperature within 2 degrees C (4 degrees F) of setting of 60 degrees C (140 degrees F). Heaters shall be capable of raising the discharge temperature to 77-82 degrees C (170-180 degrees F) for thermal eradication.
- J. Safety control shall be automatic, high temperature limit shutoff device.
- K. The relief valves shall be ASME rated and stamped for combination temperature and pressure relief valves.

2.2 THERMOMETERS

- A. Thermometers shall be rigid stem or remote sensing, scale or dial type with an aluminum, black metal, stainless steel, or chromium plated brass case. The thermometer shall be back connected, red liquid (alcohol or organic-based) fill, vapor, bi-metal or gas actuated, with 225 mm (9 inches) high scale dial or circular dial 50 to 125 mm (2 to 5 inches) in diameter graduated from 4 to 100 degrees C (40 to 210 degrees F), with two-degree graduations guaranteed accurate within one scale division. The socket shall be separable, double-seat, micrometer-fittings, with extension neck not less than 65 mm (2 1/2 inches) to clear tank or pipe covering. The thermometer shall be suitable for 20 mm (3/4 inch) pipe threads. Thermometers may be console-mounted with sensor installed in separate thermometer well.

2.3 SAFETY VALVES FOR SHELL AND COIL HEATERS

- A. Separate combination pressure/temperature relief valves shall be provided on each water heater.
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- B. A double solenoid safety system shall be provided for each shell and coil heater to function as a safety over temperature prevention system. System shall consist of aquastat, pilot light, solenoid safety valve and solenoid water safety valve located in the control circuit. The aquastat shall be set at 60 degrees C (140 degrees F).

2.4 DOMESTIC HOT WATER EXPANSION TANKS

- A. A steel pressure rated tank constructed with welded joints and factory installed butyl rubber diaphragm shall be installed as scheduled. The air precharge shall be set to minimum system operating pressure at tank.
- B. The tappings shall be factory fabricated steel, welded to the tank and include ASME B1.20.1 pipe thread.
- C. The interior finish shall comply with NSF 61 and NSF 372 for barrier materials for potable water tank linings and the liner shall extend into and through the tank fittings and outlets.
- D. The air charging valve shall be factory installed.

2.5 HEAT TRAPS

- A. Heat traps shall be installed in accordance with ASHRAE 90.1 unless provided integrally with the heaters.

2.6 COMBINATION TEMPERATURE AND PRESSURE RELIEF VALVES

- A. The combination pressure and temperature relief Valve shall be ANSI Z21.22 and ASME rated and constructed of all brass or bronze with a self-closing reseating valve. The relief valves shall include a relieving capacity greater than the heat input and include a pressure setting less than the water heater's working pressure rating. Sensing element shall extend into storage tank.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The water heaters shall be installed on concrete bases..
 - B. The water heaters shall be installed level and plumb and securely anchored.
 - C. Water heaters shall be installed and connected in accordance with manufacturer's written instructions with manufacturer's recommended clearances.
 - D. All pressure and temperature relief valves discharge shall be piped to nearby floor drains with air gap or break.
 - E. Thermometers and isolation valves shall be installed on water heater inlet and outlet piping and shall be positioned such that they can be read by an operator or staff standing on floor or walkway.
 - F. The thermostatic control shall be set for a minimum setting of 60 degrees C (140 degrees F) for storage heaters and regulated to a maximum discharge temperature of 54 degrees C (130 degrees F) for distribution to personnel.
 - G. Shutoff valves shall be installed on the domestic water supply piping to the water heater and on the domestic hot water outlet piping.
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- H. All manufacturer's required clearances shall be maintained.
 - I. The domestic water heaters shall be installed with seismic restraint devices.
 - J. A combination temperature and pressure relief valve shall be installed at the top portion of the storage tank. The sensing element shall extend into the tank. The relief valve outlet drain piping shall discharge by positive air gap into a floor drain.
 - K. Piping type heat traps shall be installed on the inlet and outlet piping of the domestic water heater storage tanks, unless provided integrally with the tanks.
 - L. Water heater drain piping shall be installed as indirect waste to spill by positive air gap into open drains or over floor drains. Hose end drain valves shall be installed at low points in water piping for gas fueled domestic hot water heaters without integral drains.
 - M. Dielectric unions shall be provided if there are dissimilar metals between the water heater connections and the attached piping.
 - N. Provide vacuum breakers per ANSI Z21.22 on the inlet pipe if the water heater is bottom fed.
 - O. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no cost to the Government.

3.2 LEAKAGE TEST

- A. Before piping connections are made, the water heaters shall be tested at a hydrostatic pressure of 1380 kPa (200 psig) for water heaters rated at less than 1103 kPa (160 psig) and 1654 kPa (240 psig) for units with an maximum working pressure of 1103 kPa (160 psig) or over. Any failed test shall be corrected and the water heater shall be replaced with a new unit at no additional cost to the VA.

3.3 PERFORMANCE TEST

- A. Ensure that all of the remote water outlets will have a minimum of 43 degrees C (110 degrees F) and a maximum of 49 degrees C (120 degrees F) water flow at all times. If necessary, make all correction to balance the return water system or reset the thermostat to make the system comply with design requirements.

3.4 STARTUP AND TESTING

- A. As recommended by product manufacturer and listed standards and under actual or simulated operating conditions, tests shall be conducted to prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with each integrated system.
 - B. The tests shall include system capacity, control function, and alarm functions.
 - C. When any defects are detected, correct defects and repeat test at no additional costs to the Government.
 - D. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the Contracting Officer's Representative and Commissioning Agent. Provide a minimum of 7 days prior to notice.
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3.6 DEMONSTRATION AND TRAINING

- A. Provide services of manufacturer's technical representative to instruct VA Personnel in operation and maintenance of the system.

END OF SECTION

1 GENERAL

1.1 RELATED REQUIREMENTS

1.1.1 Section 21 05 00: General Instructions for Mechanical Sections.

1.1.2 Section 01 33 00: Submittal Procedure

1.2 REFERENCE STANDARDS

1.2.1 Do the work in accordance with CAN3-B45 Series-M81 and CSA B125-1975 except where specified otherwise.

1.2.2 ANSI A117.1: Accessible and Usable Buildings and Facilities

1.3 PRODUCT DATA

1.3.1 Submit product data in accordance with Section 01 33 00 – Submittal Procedure.

1.4 MAINTENANCE DATA

1.4.1 Provide maintenance data for incorporation into manual specified in Section 21 08 03 – Operating and Maintenance Instructions.

1.4.2 Data to include:

1.4.2.1 Description of equipment giving manufacturers name, type, model, year and capacity.

1.4.2.2 Details of operation, servicing and maintenance.

1.4.2.3 Recommended spare parts list.

1.5 FIXTURES AND TRIM

1.5.1 Architectural drawings to govern in determination of number and location of fixtures.

1.5.2 Fixtures to be product of one manufacturer and of same type in any one washroom or location.

1.5.3 Trim to be product of one manufacturer and of same type in any one washroom or location.

1.5.4 Exposed plumbing brass to be chrome plated.

2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

2.1.1 Water Closets and Urinals: American Standard, Crane, Kohler.

- 2.1.2 Flush Valves: Zurn, Sloan, Delta
- 2.1.3 Stainless Steel Sinks: Waltec Sinkwear, American Standard, Arista Newman.
- 2.1.4 Molded Sinks: Fiat, Cambridge Brass (molded sinks), Zurn.
- 2.1.5 Stainless Steel Drinking Fountains: Haws, Brooks, Sunroc, Elkay.
- 2.1.6 rim: Crane, Cambridge Brass (Delta), Waltec, Zurn & Sloan flush valves.
- 2.1.7 Mixing Valves: Leonard, Symmons, Lawler, Bradley.

2.2 FIXTURE SUPPLIES

- 2.2.1 Chrome plated rigid fixture supplies with screwdriver stops, reducers and escutcheons on each service to each fixture.

2.3 CHAIR CARRIERS

- 2.3.1 Provide for all wall mounted plumbing fixtures, factory manufactured floor mounted chair carrier systems.

2.4 FIXTURE TRAPS

- 2.4.1 Brass P traps complete with cleanouts on all fixtures which do not have built-in traps.

2.5 ROUGHING-IN OF FIXTURES

- 2.5.1 Rough-in for equipment by others complete with valved supplies, wastes and vents, capped.

3 EXECUTION

3.1 FIXTURE INSTALLATION

- 3.1.1 Connect fixtures complete with supplies with isolation stops and drains, trapped, supported level and square. Hot water faucets shall be on left. Fixtures on outside walls to have supplies from floor; other fixtures to be served from wall.
 - 3.1.2 Fixture Mounting heights to be as follows:
 - 3.1.2.1 Urinals: 375 mm AFF.
 - 3.1.2.2 Drinking Fountains: 675 mm AFF from finished floor to rim.
 - 3.1.2.3 Wall Hung Lavs: 780 mm from finished floor to rim.
 - 3.1.2.4 Physically Handicap: Fixtures designed for handicap accessibility to be mounted at height in compliance with ABC.
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- 3.1.3 Provide backflow protection where required on all potable water connections to all fixtures and or equipment to prevent contamination to potable water source due to backflow in full compliance with Plumbing codes and local authorities.

END OF SECTION

1 GENERAL

1.1 GENERAL

- 1.1.1 This section covers items common to all sections of Mechanical Divisions (Divisions 21, 22 and 23).

1.2 REQUIREMENTS INCLUDED

- 1.2.1 Procedures for demonstration and instruction of equipment and systems to Departmental representative's personnel.

1.3 DESCRIPTION

- 1.3.1 Demonstrate scheduled operation and maintenance of equipment and systems to Departmental representative's personnel with initial instructions two weeks prior to date of substantial performance with additional instructions scheduled as specified.
- 1.3.2 Departmental representative will provide list of personnel to receive instructions, and will coordinate their attendance at agreed-upon times.

1.4 QUALITY CONTROL

- 1.4.1 When specified in individual Sections, require manufacturer to provide authorized representative to demonstrate operation of equipment and systems, instruct Departmental representative's personnel, and provide a written report that indicates that demonstration and instructions have been completed.

1.5 SUBMITTALS

- 1.5.1 Submit schedule of time and date for demonstration of each item of equipment and each system two weeks prior to designated dates, for Departmental representative's approval.
- 1.5.2 Submit reports within one week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.
- 1.5.3 Give time and date of each demonstration, with a list of persons present.
- 1.5.4 Provide reports for inclusion in operating and maintenance manuals in accordance with Section 01 33 00 - Submittals.

1.6 CONDITIONS FOR DEMONSTRATIONS

- 1.6.1 Equipment has been inspected and put into operation in accordance with Section 21 05 00 – General Instructions for Mechanical Section and Section 01 33 00 - Submittals.
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1.6.2 Testing, adjusting, and balancing has been performed in accordance with Section 23 05 93 - Testing, Adjusting and Balancing (TAB) and equipment and systems are fully operational.

1.6.3 Provide copies of completed operation and maintenance manuals for use in demonstrations and instructions.

1.7 PREPARATION

1.7.1 Verify that conditions for demonstration and instructions comply with requirements.

1.7.2 Verify that designated personnel are present.

1.8 DEMONSTRATION AND INSTRUCTIONS

1.8.1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment at scheduled agreed upon times, at the equipment or designated location.

1.8.2 Instruct personnel in all phases of operation and maintenance using operation and maintenance manuals as the basis of instruction.

1.8.3 Review contents of manual in detail to explain all aspects of operation and maintenance.

1.8.4 Prepare and insert additional data in operations and maintenance manuals when the need for additional data becomes apparent during instructions.

1.9 TIME ALLOCATED FOR INSTRUCTIONS

1.9.1 The amount of time required for instruction of each item of equipment or system shall be as follows:

1.9.1.1 Site Services: 2 hours instruction.

1.9.1.2 Plumbing Systems: 4 hours of instruction.

1.9.1.3 Fire Protection Systems: 3 hours of instruction.

1.9.1.4 Ventilation and Air Conditioning Systems: 6 hours of instruction.

1.9.1.5 Control Systems: 24 hours of instruction. Instructions to be carried out in 6 periods of 4 hours each scheduled with the departmental representative.

END OF SECTION

1 GENERAL

1.1 GENERAL

- 1.1.1 This section covers items common to all sections of Mechanical Divisions (Divisions 21, 22 and 23).

1.2 INTENT

- 1.2.1 Inspect, start and test each piece of mechanical equipment and system. Verify that equipment and systems have been properly installed and are operating at a level that meets specified requirements.

1.3 FACTORY TRAINED REPRESENTATIVES

- 1.3.1 Use factory trained representatives and submit manufacturer's check sheets for starting following specialty equipment:

- 1.3.1.1 Air handling units.
- 1.3.1.2 Boilers.
- 1.3.1.3 Control components.
- 1.3.1.4 Chemical cleaning and treatment.
- 1.3.1.5 Pumps.

- 1.3.2 Use manufacturers factory trained personnel where required to maintain manufacturer's warranty.

2 EXECUTION

2.1 FLUID HANDLING EQUIPMENT – PUMPS

2.1.1 Pre-Starting:

- 2.1.1.1 Verify that installation is as drawn and specified and in accordance with manufacturer's Recommendations.
 - 2.1.1.2 Complete manufacturer's installation and start-up check sheets and include following items on check sheets:
 - 2.1.1.2.1 Pump is level. Pump is properly aligned and installed to manufacturers recommendations.
 - 2.1.1.2.2 Isolation valves, strainers, check valve, pressure gauges, by-pass filter and flow meter are installed properly.
 - 2.1.1.2.3 Pump suction has sufficient length of straight run piping.
 - 2.1.1.2.4 Air has been completely bled off piping system.
 - 2.1.1.2.5 Expansion tank is charged and on-line.
 - 2.1.1.2.6 Strainers have clean screens in place.
 - 2.1.1.2.7 Where specified for large pumps, check pump base vibration isolation and flexible connections on water pipes are properly installed.
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- 2.1.1.2.8 Nameplate is readily visible.
- 2.1.1.2.9 Check clearance space is adequate for pump servicing and removal.

2.1.2 Starting:

- 2.1.2.1 Start as recommended by manufacturer.
- 2.1.2.2 Fill out start-up sheets and attach copy with Contractor Start-Up Report.
- 2.1.2.3 Check impeller is rotating in correct direction.

2.1.3 Post Starting:

- 2.1.3.1 Run-in pumps for minimum 12 continuous hours.
- 2.1.3.2 Ensure flows through parallel pumps are equally balanced.
- 2.1.3.3 Ensure mechanical seals do not leak, or packing gland type seals are wetted.
- 2.1.3.4 Check pump NPSH - net positive suction head.
- 2.1.3.5 Where vibration isolation is specified, check for correct static deflection of unit vibration isolators, and that start up and shut down deflection is within resilience limits of isolators and flexible connections.
- 2.1.3.6 Verify that motor has sufficient air flow through casing to provide cooling.

2.1.4 Pre-Interim Acceptance:

- 2.1.4.1 Clean strainers.
- 2.1.4.2 Replace shaft seals if pump has been used to degrease system.

2.2 FLUID HANDLING EQUIPMENT - COILS

2.2.1 Pre-Starting:

- 2.2.1.1 Verify that installation is as drawn and specified and in accordance with manufacturer's recommendations.
 - 2.2.1.2 Complete manufacturer's installation and start-up check sheets and include following items on check sheets:
 - 2.2.1.2.1 Pipe connections have been correctly made for counter current heat exchange between air and fluid.
 - 2.2.1.2.2 Clearances have been provided and piping is flanged for easy removal and servicing.
 - 2.2.1.2.3 Coil air vent and drain valve and dead leg drain valves have been provided.
 - 2.2.1.2.4 Coil is sloped to ensure complete drain down.
 - 2.2.1.2.5 Pressure and temperature tapings, Pete's plugs, have been provided.
 - 2.2.1.2.6 Fins inspected and combed straight as required.
 - 2.2.1.2.7 Cooling coil drain pan and trapped drain line installed correctly.
 - 2.2.1.2.8 Labels are clearly visible
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2.2.1.2.9 Control valve piping is connected for correct flow through valve body and for required fail safe action of valve.

2.2.2 Starting:

2.2.2.1 Check operation of cooling coil condensate drain with supply fan at maximum airflow. Ensure that condensate will drain away against maximum suction pressure of supply fan. Check for and eliminate condensate carry over at maximum air velocity.

2.2.3 Pre-Interim Acceptance: not applicable.

2.3 FLUID HANDLING EQUIPMENT - MISCELLANEOUS

2.3.1 Gauges and Thermometers:

2.3.1.1 Confirm all gauges and thermometers can be read from the floor level and are installed as recommended by manufacturer.

2.3.1.2 Calibrate.

2.3.2 Verify following equipment is installed as recommended by manufacturer. Fill out manufacturer's start-up sheets:

2.3.2.1 PRVs.

2.3.2.2 Air eliminators.

2.3.2.3 Strainers.

2.3.2.4 Check valves.

2.3.2.5 Balancing valves.

2.3.2.6 Plumbing fixtures.

2.3.2.7 Backflow preventers.

2.3.2.8 Vacuum breakers.

2.4 AIR HANDLING EQUIPMENT - AIR HANDLING UNITS

2.4.1 Pre-Starting:

2.4.1.1 Check that installation is as drawn and specified and in accordance with manufacturer's recommendations.

2.4.1.2 Complete manufacturer's installation and start-up check sheets including following:

2.4.1.2.1 Fresh and Recirculation air motorized dampers, operation and size.

2.4.1.2.2 Filters.

2.4.1.2.3 Check that fan base vibration isolation and flexible connections to ductwork are properly installed.

2.4.1.2.4 Special features, access doors, liners, inlet vanes, labels.

- 2.4.1.3 Lubricate bearings on fans as recommended by manufacturer. Ensure fan wheels rotate in correct direction without binding. Adjust belts to proper alignment and tension.
- 2.4.1.4 Vacuum clean air systems.
- 2.4.1.5 Ensure temporary filters are installed. Never operate system without filters installed.
- 2.4.1.6 Ensure all balancing and fire dampers are open and ductwork is complete. For VAV systems ensure at least 60% of boxes are open.
- 2.4.1.7 Ensure all coils are in operation. If outside air temperature is less than 2°C ensure coils are dry or filled with glycol.
- 2.4.1.8 On parallel fan systems ensure backdraft dampers are installed.
- 2.4.1.9 Ensure electrical connections are complete and system disconnects are within sight of unit.
- 2.4.1.10 Ensure controls are operational.
- 2.4.1.11 Ensure inlet and discharge duct geometry is correct.

2.4.2 Starting:

- 2.4.2.1 Follow manufacturer's recommendations.

2.4.3 Post-Starting:

- 2.4.3.1 Start fan and check for vibration free operation.
- 2.4.3.2 Check for correct static deflection of unit vibration isolators, and that start-up and shut down deflection is within resilience limits.
- 2.4.3.3 Run for one day and check filters, coils, and humidifier for bypass. Seal as required.
- 2.4.3.4 Check that bearings are not overheating.

2.4.4 Pre-Interim Acceptance:

- 2.4.4.1 Replace temporary filters with permanent filters.
- 2.4.4.2 Vacuum clean heating and cooling coils.
- 2.4.4.3 Lubricate bearings.
- 2.4.4.4 Check belts for tension and wear.

2.5 AIR HANDLING EQUIPMENT - FANS

2.5.1 Pre-Starting:

- 2.5.1.1 Check that installation is as drawn and specified and in accordance with manufacturer's recommendations.
- 2.5.1.2 Complete manufacturer's installation and start-up check sheets including following:
 - 2.5.1.2.1 Backdraft dampers.
 - 2.5.1.2.2 Accessories.
 - 2.5.1.2.3 Special features.

2.5.1.2.4 Check that fan base vibration isolation and flexible connections to ductwork are properly installed.

2.5.1.3 Lubricate bearings on fans as recommended by manufacturer.

2.5.1.4 Ensure fan wheels rotate in correct direction without binding.

2.5.1.5 Adjust belts to proper alignment and tension.

2.5.1.6 Ensure ductwork and fan casing is free of dirt or foreign material.

2.5.1.7 Ensure electrical connections are complete and disconnect is within sight of fan.

2.5.1.8 Ensure inlet and discharge duct geometry is correct.

2.5.2 Starting:

2.5.2.1 Follow manufacturer's recommendations.

2.5.3 Post-Starting:

2.5.3.1 Start fan, for variable speed fans run up to maximum speed, and check for vibration free operation.

2.5.3.2 Check for correct static deflection of unit vibration isolators, and that start-up and shut down deflection is within resilience limits.

2.5.3.3 Check that bearings are not over heating.

2.5.4 Pre-Interim Acceptance:

2.5.4.1 Lubricate bearings.

2.5.4.2 Check belts for tension and wear.

2.6 AIR HANDLING EQUIPMENT - UNIT AND CABINET HEATERS

2.6.1 Pre-Starting:

2.6.1.1 Check each installation is as drawn and specified and in accordance with manufacturer's recommendations. Check following:

2.6.1.1.1 Piping connections.

2.6.1.1.2 Unit vibration isolation.

2.6.1.1.3 Ducting connections.

2.6.1.1.4 Controls.

2.6.1.1.5 Disconnect switches.

2.6.1.1.6 Unit clean.

2.6.2 Starting: as recommended by manufacturer.

2.6.3 Pre-Interim Acceptance: not applicable.

2.7 MISCELLANEOUS EQUIPMENT - TANKS

2.7.1 Pre-Starting:

- 2.7.1.1 Verify that installation is as drawn and specified and in accordance with manufacturer's recommendations. Check following:
 - 2.7.1.1.1 Tank is level on housekeeping base.
 - 2.7.1.1.2 No visible damage to vessel.
 - 2.7.1.1.3 Check PRVs for correct operation and specified relief pressure. Adjust as required.
 - 2.7.1.1.4 Clearances have been provided and piping is flanged for easy removal and servicing.
 - 2.7.1.1.5 Labels are clearly visible.
 - 2.7.1.1.6 Controls, gauges, alarm devices, etc. are operational.
 - 2.7.1.1.7 Access ports/manholes provided.
 - 2.7.1.1.8 Piping sizes - inlet/outlet are correct.
 - 2.7.1.1.9 Lining is intact and not damaged.
 - 2.7.1.1.10 Tank has dielectric unions on piping connections.

2.7.2 Starting: not applicable.

2.7.3 Post-Starting:

- 2.7.3.1 Verify operation of:
 - 2.7.3.1.1 Drain line.
 - 2.7.3.1.2 Make-up line if applicable.
 - 2.7.3.1.3 Gauge glass.
 - 2.7.3.1.4 Diaphragm if applicable.

2.7.4 Pre-Interim Acceptable: not applicable.

2.8 MISCELLANEOUS EQUIPMENT – FIRE EXTINGUISHERS

- 2.8.1 Check the number, make, model and capacity of each portable fire extinguisher.
- 2.8.2 Check the pressure drop on each extinguisher over 20 day period. Replace units losing charge.
- 2.8.3 Check that all cabinets are clean and door latch functions correctly.

2.9 OPERATIONAL TESTS

- 2.9.1 Operational tests are to be conducted to demonstrate that equipment and systems meet specified performance only after mechanical installations have been completed and pressure tested. Notify the Balancer and Consultant as soon as conditions permit. Make changes, repairs, adjustments, and replacements required as tests may indicate.
 - 2.9.2 Conduct pre-operational tests, processes and inspections in presence of the Consultant if so requested by the Departmental representative.
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- 2.9.3 Conduct final operational tests in presence of the Consultant. Vary loads to illustrate start-up and shut down sequences. Simulate emergency conditions for safety shut downs, with automatic and manual reset. Repair and retest defects until satisfactory results are achieved. Make final adjustments to suit exact building conditions.

2.10 AIR SYSTEMS

- 2.10.1 Inspect air systems including ductwork layout, support, and vibration isolation before pressure testing any section of ductwork. Notify Consultant when work is ready for inspection.
- 2.10.2 Pressure test sections of ductwork, in accordance with Section 23 05 94, prior to application of insulation or concealment. Include pressure testing of ductwork on commissioning schedule and notify Consultant prior to any system pressure tests.
- 2.10.3 Air Handling Unit: start-up and performance verification using manufacturer's representative. Provide 6 working days notice to the Consultant
- 2.10.4 Start up coil circulators, humidifier spray pumps, exhaust air systems, etc.
- 2.10.5 Demonstrate operation of mixing section, blender, filters, freeze protect, fire alarm interlocks, etc.
- 2.10.6 If necessary provide and change pulley drives to correct volume up or down on constant volume systems, and to correct volume up on variable volume systems.
- 2.10.7 Complete and submit Air Systems Start-up report as specified in General Mechanical Starting and Testing Requirements.
- 2.10.8 Conduct Mechanical Systems Demonstration and Instruction in accordance with Section 23 01 30.

2.11 HYDRONIC SYSTEMS

- 2.11.1 Inspect piping layout, pipe support, expansion provisions, slope for draining and venting, vibration isolation, etc. before pressure testing any section of pipe. Notify Consultant when work is ready for inspection.
 - 2.11.2 Pressure test sections of pipe, in accordance with Section 23 08 01, prior to application of insulation or to concealment.
 - 2.11.3 Pressure test each completed system, in accordance with Section 23 08 01, before any equipment is started. Notify Consultant 6 working days prior to any system pressure test.
 - 2.11.4 Start-up pumps.
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- 2.11.5 Heating appliance: perform start-up and performance verification using manufacturer=s representative. Provide 6 working days notice to the Consultant.
 - 2.11.6 Notify Consultant and Balancing contractor when the systems are ready for rough balancing. The systems will be rough balanced to ensure fluid circulation in every circuit. Cooling systems will be rough balanced by velocity or pressure drop measurements at each circuit or component. Heating system will be rough balanced by temperature drop measurement.
 - 2.11.7 Chemically clean water filled system in accordance with Section 23 25 13. Notify representative six (6) working days prior to any system cleaning.
 - 2.11.8 Chemically treat water filled systems in accordance with Section 23 25 13.
 - 2.11.9 Notify the Consultant and Balancing Contractor when systems are ready for final balancing.
 - 2.11.10 Check system for fluid or pump noise in pipes. Rectify as necessary.
 - 2.11.11 Provided the flow rate exceeds that specified, shave impeller on pumps larger than 1.5 kW if current draw exceeds motor full load amps or if there is excess flow which results in excessive pipe noise in adjacent occupied areas.
 - 2.11.12 Complete and submit Hydronic systems Start-up report as specified in Section 23 01 50.
 - 2.11.13 Conduct Mechanical Equipment and Systems Demonstration and Instruction in accordance with Section 23 01 30
 - 2.12 CONTROL SYSTEMS
 - 2.12.1 Pressure test completed pneumatic system, in accordance with Section 21 05 05, before any equipment is started. Notify Consultant six (6) working days prior to system pressure test.
 - 2.12.2 Start-Up and performance test control air compressor and drier.
 - 2.12.3 Check start/stop schedules, alarms, etc. in accordance with Controls Specifications.
 - 2.12.4 Commence trial use period in accordance with Controls Specifications.
 - 2.13 DOMESTIC WATER SYSTEMS
 - 2.13.1 Inspect domestic water systems including piping layout, pipe support, expansion provisions, and slope for draining and venting, before pressure testing any section of pipe. Notify Consultant when work is ready for inspection.
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- 2.13.2 Pressure test sections of pipe, in accordance with Section 21 05 05, prior to application of insulation or to concealment.
- 2.13.3 Pressure test each completed system, in accordance with Section 21 05 05, before any equipment is started. Notify Consultant six (6) working days prior to any system pressure test.
- 2.13.4 Start domestic hot water systems' circulator pumps.
- 2.13.5 Domestic hot water heating appliance: Perform start-up and performance verification using manufacturer's representative. Provide 6 working days notice to the Consultant.
- 2.13.6 Balance Domestic Hot Water system return circulation circuits by temperature drop measurement.
- 2.13.7 Sterilize Domestic water systems in accordance with Section 22 11 16. Notify Consultant 6 working days prior to any system sterilization.
- 2.13.8 Ensure all air chambers and expansion compensators are properly installed.
- 2.13.9 Ensure entire system can be completely drained.
- 2.13.10 Check operation of water hammer arrestors. Let one outlet run for ten seconds, then shut water off quickly. If water hammer occurs, replace water hammer arrestor. Repeat for each outlet and flush valve.
- 2.13.11 Complete and submit Domestic Water systems Start-up report as specified in Mechanical Equipment/System Startup and Testing.
- 2.13.12 Conduct Mechanical Equipment and Systems Demonstration and Instruction in accordance with Section 23 01 30.

2.14 PLUMBING DRAINAGE SYSTEMS

- 2.14.1 Inspect plumbing drainage systems including above ground drainage piping layout, pipe support, slope, venting, before pressure testing or concealing any section of the work. Notify Consultant when work is ready for inspection.
 - 2.14.2 Hydraulically test above ground installations within buildings in accordance with Section 21 05 05. Notify Consultant 6 working days prior to any system pressure test.
 - 2.14.3 Ensure all traps are fully primed.
 - 2.14.4 Ensure all fixtures are properly anchored and connected to system.
 - 2.14.5 Flush each valve, drain each sink and operate each fixture to ensure drainage and trap anti-siphon venting is effective.
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- 2.14.6 Open each cleanout, cover with linseed oil and reseal each cleanout. Ensure each cleanout is fully accessible and access doors are properly installed. Check cleanouts after building finishes (flooring, wall covering) have been installed.
- 2.14.7 Ensure roof drain metal domes are installed. Ensure storm piping is free of debris or roof insulation ballast. Remove caps as required. Verify insulation on piping is as specified in Section 23 07 15.
- 2.14.8 Complete and submit Drainage systems Start-up report.
- 2.14.9 Conduct Mechanical Equipment and Systems Demonstration and Instruction in accordance with Mechanical Equipment/System Startup and Testing.

END OF SECTION

1 GENERAL

1.1 RELATED DOCUMENTS

- 1.1.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

1.2.1 Section Includes:

- 1.2.1.1 Flexible-hose packless expansion joints and loops.
- 1.2.1.2 Alignment guides and anchors.

1.3 PERFORMANCE REQUIREMENTS

- 1.3.1 Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.
- 1.3.2 Capability: Products to absorb 200 percent of maximum axial movement between anchors.

1.1 ACTION SUBMITTALS

1.3.3 Product Data: For each type of product indicated.

- 1.3.4 Delegated-Design Submittal: For each anchor and alignment guide indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation. Engineer seal shall be valid in the jurisdiction of the project.

- 1.3.4.1 Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
- 1.3.4.2 Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
- 1.3.4.3 Alignment Guide Details: Detail field assembly and attachment to building structure.
- 1.3.4.4 Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

1.4 INFORMATIONAL SUBMITTALS

1.4.1 Welding certificates.

1.4.2 Product Certificates: For each type of expansion joint, from manufacturer.

1.5 CLOSEOUT SUBMITTALS

1.5.1 Maintenance Data: For expansion joints to include in maintenance manuals.

1.6 QUALITY ASSURANCE

1.6.1 Welding Qualifications: Qualify procedures and personnel according to the following:

1.6.1.1 AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.6.1.2 ASME Boiler and Pressure Vessel Code: Section IX.

2 PRODUCTS

2.1 PACKLESS EXPANSION JOINTS

2.1.1 Flexible-Hose Packless Expansion Joints:

2.1.1.1 Manufacturers: Subject to compliance with requirements, provide products by one of the following :

2.1.1.1.1 Flex-Hose Co., Inc.

2.1.1.1.2 Flexicraft Industries.

2.1.1.1.3 Flex Pression Ltd.

2.1.1.1.4 Metraflex, Inc.

2.1.1.1.5 Mason Industries, Inc.; Mercer Rubber Co.

2.1.2 Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.

2.1.3 Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.

2.1.4 Expansion Joints for Copper Tubing NPS 2 and Smaller: Copper-alloy fittings with solder-joint or threaded end connections.

2.1.4.1 Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F and 340 psig at 450 deg F ratings.

2.1.4.2 Bronze hoses and double-braid bronze sheaths with 700 psig at 70 deg F and 500 psig at 450 deg F ratings.

2.1.5 Expansion Joints for Copper Tubing NPS 2-1/2 to NPS 4: Copper-alloy fittings with threaded end connections.

2.1.5.1 Stainless-steel hoses and single-braid, stainless-steel sheaths with 300 psig at 70 deg F and 225 psig at 450 deg F ratings.

2.1.5.2 Stainless-steel hoses and double-braid, stainless-steel sheaths with 420 psig at 70 deg F and 315 psig at 450 deg F ratings.

- 2.1.6 Expansion Joints for Steel Piping NPS 2 and Smaller: Carbon-steel fittings with threaded end connections.
 - 2.1.6.1 Stainless-steel hoses and single-braid, stainless-steel sheaths with 450 psig at 70 deg F and 325 psig at 600 deg F ratings.
 - 2.1.6.2 Stainless-steel hoses and double-braid, stainless-steel sheaths with 700 psig at 70 deg F and 515 psig at 600 deg F ratings.
- 2.1.7 Expansion Joints for Steel Piping NPS 2-1/2 to NPS 6: Carbon-steel fittings with flanged or weld end connections.
 - 2.1.7.1 Stainless-steel hoses and single-braid, stainless-steel sheaths with 200 psig at 70 deg F and 145 psig at 600 deg F ratings.
 - 2.1.7.2 Stainless-steel hoses and double-braid, stainless-steel sheaths with 275 psig at 70 deg F and 200 psig at 600 deg F ratings.
- 2.1.8 Expansion Joints for Steel Piping NPS 8 to NPS 12: Carbon-steel fittings with flanged or weld end connections.
 - 2.1.8.1 Stainless-steel hoses and single-braid, stainless-steel sheaths with 125 psig at 70 deg F and 90 psig at 600 deg F ratings.
 - 2.1.8.2 Stainless-steel hoses and double-braid, stainless-steel sheaths with 165 psig at 70 deg F and 120 psig at 600 deg F ratings.
- 2.1.9 Expansion Joints for Steel Piping NPS 14 and Larger: Carbon-steel fittings with flanged or weld end connections.
 - 2.1.9.1 Stainless-steel hoses and double-braid, stainless-steel sheaths with 165 psig at 70 deg F and 120 psig at 600 deg F ratings.

2.2 ALIGNMENT GUIDES AND ANCHORS

2.2.1 Alignment Guides:

- 2.2.1.1 Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 2.2.1.1.1 Advanced Thermal Systems, Inc.
 - 2.2.1.1.2 Flex-Hose Co., Inc.
 - 2.2.1.1.3 Flexicraft Industries.
 - 2.2.1.1.4 Flex-Weld, Inc.
 - 2.2.1.1.5 Hyspan Precision Products, Inc.
 - 2.2.1.1.6 Metraflex, Inc.
 - 2.2.1.1.7 Mason Industries, Inc.; Mercer Rubber Co.

- 2.2.1.2 Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding spider for bolting to pipe.

- 2.2.1.2.1 Shell must be sized to accommodate insulation.

2.2.2 Anchor Materials:

- 2.2.2.1 Steel Shapes and Plates: ASTM A 36/A 36M.
- 2.2.2.2 Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
- 2.2.2.3 Washers: ASTM F 844, steel, plain, flat washers.
- 2.2.2.4 Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.
 - 2.2.2.4.1 Stud: Threaded, zinc-coated carbon steel.
 - 2.2.2.4.2 Expansion Plug: Zinc-coated steel.
 - 2.2.2.4.3 Washer and Nut: Zinc-coated steel.
- 2.2.2.5 Chemical Fasteners: Insert-type-stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.
 - 2.2.2.5.1 Bonding Material: ASTM C 881/C 881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
 - 2.2.2.5.2 Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud unless otherwise indicated.
 - 2.2.2.5.3 Washer and Nut: Zinc-coated steel.

3 EXECUTION

3.1 EXPANSION-JOINT INSTALLATION

- 3.1.1 Install expansion joints of sizes matching sizes of piping in which they are installed.
- 3.1.2 Install rubber packless expansion joints according to FSA-NMEJ-702.

3.2 PIPE LOOP AND SWING CONNECTION INSTALLATION

- 3.2.1 Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.
 - 3.2.2 Connect risers and branch connections to mains with at least five pipe fittings including tee in main.
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3.2.3 Connect risers and branch connections to terminal units with at least four pipe fittings including tee in riser.

3.2.4 Connect mains and branch connections to terminal units with at least four pipe fittings including tee in main.

3.3 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

3.3.1 Install alignment guides to guide expansion and to avoid end-loading and torsional stress.

3.3.2 Install two guides on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.

3.3.3 Attach guides to pipe and secure guides to building structure.

3.3.4 Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

3.3.5 Anchor Attachments:

3.3.5.1 Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

3.3.5.2 Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP- 69, Type 24, U-bolts bolted to anchor.

3.3.6 Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.

3.3.6.1 Anchor Attachment to Steel Structural Members: Attach by welding.

3.3.6.2 Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.

3.3.7 Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION

1 GENERAL

1.1 REFERENCES

1.1.1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)

1.1.1.1 ANSI/ASME B1.20.1-1983(R2006), Pipe Threads, General Purpose (Inch).

1.1.1.2 ANSI/ASME B16.18-2001, Cast Copper Alloy Solder Joint Pressure Fittings.

1.1.2 ASTM International

1.1.2.1 ASTM A276-08, Standard Specification for Stainless Steel Bars and Shapes.

1.1.2.2 ASTM B62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.

1.1.2.3 ASTM B283-08a, Standard Specification for Copper and Copper Alloy Die Forgings (Hot-Pressed).

1.1.2.4 ASTM B505/B505M-08a, Standard Specification for Copper-Base Alloy Continuous Castings.

1.1.3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)

1.1.3.1 MSS-SP-25-1998, Standard Marking System for Valves, Fittings, Flanges and Unions.

1.1.3.2 MSS-SP-80-2008, Bronze Gate Globe, Angle and Check Valves.

1.1.3.3 MSS-SP-110-1996, Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

1.2.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

1.2.2 Product Data:

1.2.2.1 Provide manufacturer's printed product literature and data sheets for equipment and systems and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

1.3.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

2.1.1 Crane, Toyo, Red & White, Kitz, and Grinnell

2.2 MATERIALS

2.2.1 Valves:

- 2.2.1.1 Except for specialty valves, to be single manufacturer.
- 2.2.1.2 Products to have CRN registration numbers.

2.2.2 End Connections:

- 2.2.2.1 Connection into adjacent piping/tubing:
 - 2.2.2.1.1 Steel pipe systems: screwed ends to ANSI/ASME B1.20.1.
 - 2.2.2.1.2 Copper tube systems: solder ends grooved ends to ANSI/ASME B16.18.

2.2.3 Lockshield Keys:

- 2.2.3.1 Where lockshield valves are specified, provide 10 keys of each size: malleable iron cadmium plated.

2.2.4 Gate Valves:

- 2.2.4.1 Requirements common to gate valves, unless specified otherwise:
 - 2.2.4.1.1 Standard specification: MSS SP-80.
 - 2.2.4.1.2 Bonnet: union with hexagonal shoulders.
 - 2.2.4.1.3 Connections: screwed with hexagonal shoulders.
 - 2.2.4.1.4 Inspection and pressure testing: to MSS SP-80. Tests to be hydrostatic.
 - 2.2.4.1.5 Packing: non-asbestos.
 - 2.2.4.1.6 Handwheel: non-ferrous.
 - 2.2.4.1.7 Handwheel Nut: bronze to ASTM B62.
 - 2.2.4.2 NPS 2 and under, non-rising stem, solid wedge disc, Class 150:
 - 2.2.4.3 Body: with long disc guides, screwed bonnet with stem retaining nut.
 - 2.2.4.3.1 Operator: handwheel.
 - 2.2.4.3.2 Basis of Design: Crane 437
 - 2.2.4.4 NPS 2 1/2 – 8, non-rising stem, inside screw, iron trim, solid wedge disc:
 - 2.2.4.5 Body and multiple-bolted bonnet: with bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re-assembly, Class 125.
 - 2.2.4.5.1 Disc: Solid offset taper wedge, bronze to ASTM B62.
 - 2.2.4.5.2 Seat Rungs: Renewable Bronze to ASTM B62, screwed into body.
 - 2.2.4.5.3 Stem: bronze to ASTM B62.
 - 2.2.4.5.4 Disc: solid offset taper wedge, cast iron to ASTM A125 Class B, secured to wrought steel stem.
 - 2.2.4.5.5 Seat: integral with body
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- 2.2.4.5.6 Stem: wrought steel.
- 2.2.4.5.7 Operator: manual gear
- 2.2.4.5.8 Basis of Design: Crane 461 ½.

2.2.5 Globe Valves:

- 2.2.5.1 Requirements common to globe valves, unless specified otherwise:
 - 2.2.5.1.1 Standard specification: MSS SP-80.
 - 2.2.5.1.2 Bonnet: union with hexagonal shoulders.
 - 2.2.5.1.3 Connections: screwed with hexagonal shoulders.
 - 2.2.5.1.4 Pressure testing: to MSS SP-80. Tests to be hydrostatic.
 - 2.2.5.1.5 Stuffing box: threaded to bonnet with gland follower, packing nut, high grade non-asbestos packing.
 - 2.2.5.1.6 Handwheel: non-ferrous.
 - 2.2.5.1.7 Handwheel Nut: bronze to ASTM B62.
- 2.2.5.2 NPS 2 and under, composition disc, Class 150:
- 2.2.5.3 Body and bonnet: union bonnet.
 - 2.2.5.3.1 Disc and seat: renewable rotating PTFE disc in easily removable disc holder, regrindable bronze seat, loosely secured to bronze stem to ASTM B505.
 - 2.2.5.3.2 Operator: handwheel and lockshield.
 - 2.2.5.3.3 Basis of Design: Crane 7TF
- 2.2.5.4 NPS 2 ½ - 10, OSY
- 2.2.5.5 Body: with multiple-bolted bonnet.
 - 2.2.5.5.1 Bonnet-yoke gasket: non-asbestos.
 - 2.2.5.5.2 Disc: Bronze to ASTM B62, fully guided from bottom, securely yet freely connected to stem from swivel action and accurate engagement with disc.
 - 2.2.5.5.3 Seat Ring: Renewable, regrindable, screw into body.
 - 2.2.5.5.4 Stem: bronze to ASTM B62.
 - 2.2.5.5.5 Operator: Manual gear.
 - 2.2.5.5.6 Basis of Design: Crane 351.

2.2.6 Check Valves:

- 2.2.6.1 Requirements common to check valves, unless specified otherwise:
 - 2.2.6.1.1 Standard specification: MSS SP-80.
 - 2.2.6.1.2 Connections: screwed with hexagonal shoulders.
 - 2.2.6.2 NPS 2 and under, swing type, bronze disc:
 - 2.2.6.3 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.
 - 2.2.6.3.1 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: tetflon.
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2.2.6.3.2 Basis of Design: Crane 141 TF

2.2.6.4 Swing check valves, NPS 2 ½ - 8 Class 150

2.2.6.5 Body and bolted cover: cast iron to ASTM A126 Class b with tapped and plugged opening on each side for hinge pin.

2.2.6.5.1 Flanged ends: 2 mm raised face with serrated finish.

2.2.6.5.2 Disc: rotating for extended life.

- Up to NPS 3: bronze to ASTM B61.

- NPS 4-8: Iron faced with ASTM B61 bronze.

2.2.6.5.3 Seat Rings: Renewable bronze to ASTM B61, screwed into body.

2.2.6.5.4 Hinge Pin, bushings: renewable, bronze to ASTM B61

2.2.6.5.5 Hinge: Galvanized malleable iron

2.2.6.5.6 Identification tag: Fastened to cover.

2.2.6.5.7 Basis of Design: Crane 141 TF

2.2.7 Ball Valves:

2.2.7.1 NPS 2 and under:

2.2.7.1.1 Body and cap: cast high tensile bronze to ASTM B62.

2.2.7.1.2 Pressure rating: Class 125 2760-kPa CWP 4140-kPa CWP, 860kPa steam.

2.2.7.1.3 Connections: screwed ends to ANSI B1.20.1 and with hexagonal shoulders solder ends to ANSI.

2.2.7.1.4 Stem: tamperproof ball drive.

2.2.7.1.5 Stem packing nut: external to body.

2.2.7.1.6 Ball and seat: replaceable stainless steel hard chrome solid ball and Teflon seats.

2.2.7.1.7 Stem seal: TFE with external packing nut.

2.2.7.1.8 Operator: removable lever handle.

3 EXECUTION

3.1 INSTALLATION

3.1.1 Install rising stem valves in upright position with stem above horizontal.

3.1.2 Remove internal parts before soldering.

3.1.3 Install valves with unions at each piece of equipment arranged to allow servicing, maintenance, and equipment removal.

END OF SECTION

1 GENERAL

1.1 THIS SECTION COVERS ITEMS COMMON TO ALL SECTIONS OF MECHANICAL DIVISIONS (DIVISIONS 21, 23 AND 25).

1.2 REFERENCED SECTIONS

1.2.1 Section 21 05 00 – General Instructions for Mechanical Section

1.2.2 Section 21 05 29 – Bases, Hangers and Supports.

1.2.3 Section 23 25 13 – HVAC Water Treatment.

1.2.4 Section 23 05 93 – Testing, Adjusting and Balancing (TAB)

1.3 REFERENCE

1.3.1 Canadian General Standards Board (CGSB)

1.3.1.1 CAN/CGSB-1.181-Ready-Mixed Organic Zinc-Rich Coating.

2 PRODUCTS

2.1 NOT USED

3 EXECUTION

3.1 CONNECTIONS TO EQUIPMENT

3.1.1 In accordance with manufacturer's instructions unless otherwise indicated.

3.1.2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.

3.1.3 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.

3.2 CLEARANCES

3.2.1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer.

3.2.2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment, and components.

3.3 DRAINS

3.3.1 Install piping with grade in direction of flow except as indicated or specified otherwise.

3.3.2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.

- 3.3.3 Pipe each drain valve discharge separately to above floor drain. Discharge to be visible.
 - 3.3.4 Drain valves: NPS 3/4 ball valves unless indicated otherwise, with hose end male thread, cap and chain.
 - 3.4 AIR VENTS
 - 3.4.1 Install manual air vents at high points in piping systems.
 - 3.4.2 Install isolating ball valve at each air vent.
 - 3.5 DIELECTRIC COUPLINGS
 - 3.5.1 General: Compatible with system, to suit pressure rating of system.
 - 3.5.2 Locations: Where dissimilar metals are joined.
 - 3.5.3 NPS 2 and under: brass adapters or bronze valves.
 - 3.5.4 Over NPS 2: Isolating flanges.
 - 3.6 3.6 PIPEWORK INSTALLATION
 - 3.6.1 Support piping in accordance with Section 23 05 29.
 - 3.6.2 Screwed fittings to be jointed with Teflon tape.
 - 3.6.3 Protect openings against entry of foreign material.
 - 3.6.4 Install so that equipment can be isolated and removed without interruption to operation of any other equipment or systems.
 - 3.6.5 Assemble piping using fittings manufactured to ANSI standards.
 - 3.6.6 Saddle type branch fittings may be not be used.
 - 3.6.7 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.
 - 3.6.8 Install concealed pipework so as to minimize furring space, maximize headroom, conserve space.
 - 3.6.9 Except where indicated otherwise, slope piping in direction of flow for positive drainage and venting.
 - 3.6.10 Except where indicated, install so as to permit separate thermal insulation of each pipe.
 - 3.6.11 Group piping wherever possible.
 - 3.6.12 Ream pipes, remove scale and other foreign material before assembly.
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3.6.13 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.

3.6.14 Provide for thermal expansion as indicated and specified.

3.6.15 Valves:

3.6.15.1 Install in accessible locations.

3.6.15.2 Remove interior parts before soldering.

3.6.15.3 Install with stems above the horizontal position unless otherwise indicated.

3.6.15.4 Valves to be accessible for maintenance without removing adjacent piping.

3.6.15.5 Install balancing valves in bypass around control valves where indicated.

3.6.15.6 Use isolation valves for shut-off and to isolate equipment, part of systems, branch take-offs, or vertical risers.

3.6.16 Check Valves:

3.6.16.1 Install silent check valves on discharge of pumps and in vertical pipes with downward flow and elsewhere as indicated.

3.6.16.2 Install swing check valves in horizontal lines and elsewhere as indicated.

3.7 SLEEVES

3.7.1 General: Install where pipes pass through masonry, concrete structures, fire rated assemblies, and elsewhere as indicated.

3.7.2 Material: Schedule 40 black steel pipe.

3.7.3 Construction: Foundation walls and where sleeves extend above finished floors - to have annular fins continuously welded on at mid-point.

3.7.4 Sizes: 6 mm minimum clearance all round between sleeve and uninsulated pipe or between sleeve and insulation.

3.7.5 Installation:

3.7.5.1 Concrete, masonry walls, concrete floors on grade: Terminate flush with finished surface.

3.7.5.2 Other floors: Terminate 25 mm above finished floor.

3.7.5.3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.

3.7.6 Sealing:

3.7.6.1 Foundation walls and below grade floors: Fire retardant, waterproof non- hardening mastic.

3.7.6.2 Elsewhere: Provide space for firestopping. Maintain fire rating integrity.

3.7.6.3 Sleeves installed for future use: Fill with lime plaster or other easily removable filler.

3.7.6.4 Ensure no contact between copper pipe or tube and sleeve.

3.8 ESCUTCHEONS

3.8.1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.

- 3.8.2 Construction: One piece type with set screws. Chrome or nickel plated brass or type 302 stainless steel.
- 3.8.3 Sizes: Outside diameter to cover opening or sleeve. Inside diameter to fit around pipe or outside of insulation if so provided.

3.9 PREPARATION FOR FIRESTOPPING

- 3.9.1 Material and installation within annular space between pipes, ducts, insulation and adjacent fire separation to Division 07.
- 3.9.2 Uninsulated unheated pipes not subject to movement: No special preparation.
- 3.9.3 Uninsulated heated pipes subject to movement: Wrap with non-combustible smooth material to permit pipe movement without damaging firestopping material or installation.
- 3.9.4 Insulated pipes and ducts: Ensure integrity of insulation and vapour barriers.

3.10 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

- 3.10.1 Advise Consultant 48 hours minimum prior to performance of pressure tests.
- 3.10.2 Pework: Test as specified in relevant sections of Mechanical Divisions.
- 3.10.3 Maintain specified test pressure without loss for four 4 hours minimum unless specified for longer period of time in relevant sections of Mechanical Divisions
- 3.10.4 Prior to tests, isolate equipment and other parts that are not designed to withstand test pressure or media.
- 3.10.5 Conduct tests in presence of Consultant when requested.
- 3.10.6 Bear costs for repairs or replacement, retesting, and making good. Consultant to determine whether repair or replacement is appropriate.
- 3.10.7 Insulate or conceal work only after approval and certification of tests by Consultant

3.11 FLUSHING AND CLEANING OF PIPING SYSTEMS

- 3.11.1 HVAC piping systems: in accordance with Section 23 25 13.

3.12 START-UP OF HYDRONIC SYSTEMS

- 3.12.1 After cleaning is completed and system is filled:
 - 3.12.1.1 Establish circulation and expansion tank level, set pressure controls.
 - 3.12.1.2 Ensure all air is removed.
 - 3.12.1.3 Check pumps to be free from air, debris, possibility of cavitation when system is at design temperature.
 - 3.12.1.4 Dismantle system pumps used for cleaning, inspect, replace worn parts,
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- install new gaskets and new set of seals.
 - 3.12.1.5 Clean out strainers repeatedly until system is clean.
 - 3.12.1.6 Commission water treatment systems as specified Section 23 25 13.
 - 3.12.1.7 Check water level in expansion tank with cold water with circulating pumps OFF and again with pumps ON.
 - 3.12.1.8 Repeat with water at design temperature.
 - 3.12.1.9 Check pressurization to ensure proper operation and to prevent water hammer, flashing, cavitation. Eliminate water hammer and all other noises.
 - 3.12.1.10 Bring system up to design temperature and pressure slowly over a 48 hour
 - 3.12.1.11 Perform TAB as specified Section 23 05 93.
 - 3.12.1.12 Adjust pipe supports, hangers, springs as necessary.
 - 3.12.1.13 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.
 - 3.12.1.14 Re-tighten all bolts, etc. using torque wrench, to compensate for heat-caused relaxation. Repeat several times during commissioning.
 - 3.12.1.15 Check operation of drain valves.
 - 3.12.1.16 Adjust valve stem packings as systems settle down.
 - 3.12.1.17 Fully open all balancing valves (except those that are factory-set).
 - 3.12.1.18 Check operation of over-temperature protection devices on circulating pumps.

END OF SECTION

1.1 RELATED REQUIREMENTS

1.1.1 This section covers items common to all sections of Mechanical Divisions (Divisions 21, 23 and 25).

1.1.2 Section 21 05 00 – General Instructions for Mechanical Sections.

1.1.3 Section 01 33 00 – Submittal Procedure.

1.2 TAB AGENCY

1.2.1 General:

1.2.1.1 All work described in this section to be performed by independent TAB Agency.

1.2.2 Certification:

1.2.2.1 Current member in good standing of AABC NEBB, certified to perform specified services.

1.2.2.2 Departmental representative to approve within 90 days after award of Contract.

1.2.2.3 Submit documentation to confirm qualifications, experience of TAB Agency personnel.

1.2.3 Quality assurance:

1.2.3.1 Perform TAB under direction of supervisor qualified by AABC NEBB to standards of NEBB AABC.

1.2.4 Co-ordination:

1.2.4.1 Co-ordinate all work specified in this Section.

1.2.4.2 Provide all facilities required by TAB Agency in order to carry out work of this Section.

1.2.5 Adequacy of work for TAB:

1.2.5.1 TAB Agency to review contract documents before work is started and confirm in writing to Departmental representative adequacy of provisions for TAB and all other aspects of installation pertinent to TAB.

1.2.6 Approved balancing firms: Hydro-Air, Environmetrics, Big Sky Balancing.

1.3 GENERAL

1.3.1 TAB: means to test, adjust and balance all systems to perform in accordance with Contract Documents.

- 1.3.2 Follow start-up procedures as recommended by manufacturer unless otherwise specified.
- 1.3.3 Special start-up procedures may be specified elsewhere.
- 1.3.4 Notify Departmental representative 7 days prior to start of TAB.
- 1.3.5 Operate all systems to permit TAB to be performed.
- 1.3.6 TAB to apply to systems, equipment and related controls specified in Mechanical Division.
- 1.3.7 Reference organization standards:
 - 1.3.7.1 Do TAB over entire operating range in accordance with most stringent conditions of this specification and standard of following organization.
 - 1.3.7.1.1 AABC (Associated Air Balance Council).
 - 1.3.7.1.2 NEBB (National Environmental Balancing Bureau).
 - 1.3.7.1.3 SMACNA (Sheet Metal & Air Conditioning Contractors National Association).
 - 1.3.7.1.4 ASHRAE (American Society of Heating, Refrigerating and Air Conditioning Engineers).
- 1.3.8 Start TAB only when building is essentially completed, including:
 - 1.3.8.1 Installation of ceilings, doors, windows and other construction affecting TAB.
 - 1.3.8.2 Application of sealing, caulking and weather stripping.
 - 1.3.8.3 All pressure, leakage and other tests specified elsewhere in Div. 15 completed.
 - 1.3.8.4 All provisions for TAB are installed and operational.
 - 1.3.8.5 Start-up, verification for proper, safe and normal operation of mechanical and associated electrical and control systems affecting TAB including, but not limited to, the following:
 - 1.3.8.5.1 Proper thermal overload protection in place for electrical equipment.
 - 1.3.8.5.2 Air Systems:
 - Filters in place and in clean condition.
 - Duct systems clean of debris.
 - Air shafts, ceiling plenums are airtight to within specified tolerances.
 - Correct fan rotation.
 - Fire and volume dampers in place and open.
 - Coil fins cleaned and combed.
 - Access doors closed and duct end caps in place.
 - All outlets installed and connected.
 - 1.3.8.5.3 Liquid Systems:
 - Flushed, filled and vented.

- Correct pump rotation.
- Strainer baskets in place and in clean condition.
- Service and balance valves open.
- Liquid treatment system operable.

1.3.9 Accuracy tolerances:

1.3.9.1 Do TAB to following tolerances of design values:

1.3.9.1.1 HVAC systems: Plus 5%; minus 5%.

1.3.9.1.2 Hydronic systems: Plus or minus 10%.

1.3.9.2 As original tolerances.

1.3.9.3 Measurements to be accurate to within plus or minus 2 % of actual values.

1.3.10 Instrument calibration: to be in accordance with TAB referenced organization standard, but within 3 months of commencement of TAB.

1.3.10.1 .1 Provide proof of calibration to Consultant.

1.3.11 Submittals prior to commencement of TAB:

1.3.11.1 Proposed methodology and procedures for performing TAB.

1.3.11.2 Proposed check lists and report forms.

1.3.11.3 List of instrumentation, including details and certificates of calibration.

1.3.12 Report:

1.3.12.1 Format to be in accordance with TAB referenced organization standard, but using SI units.

1.3.12.2 Report to include record as built full system schematics showing results of TAB.

1.3.12.3 Submit, prior to formal submission of TAB reports, for checking and approval by Consultant, sample of rough TAB sheets. Include:

1.3.12.3.1 Details of instruments used.

1.3.12.3.2 Details of TAB procedures employed.

1.3.12.3.3 Calculations procedures.

1.3.12.3.4 Summaries.

1.3.12.4 Submit 6 copies of TAB reports, each in "D" ring binders, complete with index tabs for verification and approval of Consultant

1.3.13 Verification:

1.3.13.1 Reported measurements shall be subject to verification by Consultant
Provide instrumentation and manpower to verify results of up to 30 % of all reported measurements. Number and location of verified measurements to be at discretion of Consultant.

1.3.13.2 Bear costs to repeat TAB, as required, to satisfaction of Consultant

1.3.14 Settings: lock and permanently mark settings as required by reference standard.

- 1.3.15 Completion: TAB to be considered complete only when final reports are approved by Consultant.

1.4 AIR MOVING SYSTEMS

- 1.4.1 General: measurements as required by referenced organization standards, including, but not limited to, following:

1.4.1.1 Measurements:

- 1.4.1.1.1 Air velocity.
- 1.4.1.1.2 Static pressure.
- 1.4.1.1.3 Velocity pressure.
- 1.4.1.1.4 Temperature:
 - Wet bulb.
 - Dry bulb.
- 1.4.1.1.5 Cross sectional area.
- 1.4.1.1.6 RPM.
- 1.4.1.1.7 Electrical power:
 - Voltage
 - Current draw.
- 1.4.1.1.8 Noise and vibration.

1.4.1.2 Location of equipment measurements:

- 1.4.1.2.1 Inlet and outlet of each:
- Fan.
 - Coil.
 - Filter.
 - Damper.
 - Other auxiliary equipment.

1.4.1.3 Location of system measurements at:

- 1.4.1.3.1 Main ducts.
- 1.4.1.3.2 Main branch ducts.
- 1.4.1.3.3 Sub-branch ducts.
- 1.4.1.3.4 Each supply, exhaust and return air inlet and outlet.
- 1.4.1.3.5 Other auxiliary equipment.
- 1.4.1.3.6 All areas served by system.

1.5 HYDRONIC SYSTEMS

- 1.5.1 General: measurements as required by referenced standards, including, but not limited to, following:

1.5.1.1 Measurements:

- 1.5.1.1.1 Flow.
 - 1.5.1.1.2 Pressure.
 - 1.5.1.1.3 Temperature.
-

- 1.5.1.1.4 Specific gravity.
- 1.5.1.1.5 RPM.
- 1.5.1.1.6 Electrical power:
 - Voltage.
 - Current draw.
- 1.5.1.2 Location of equipment measurements:
 - 1.5.1.2.1 Inlet and outlet of each:
 - Heat exchanger (primary and secondary sides).
 - Coil.
 - Boiler.
 - Fluid cooler.
 - Pump.
 - PRV.
 - Control valve.
 - Make-up (water).
 - Other auxiliary equipment.
- 1.5.1.3 Location of system measurements at:
 - 1.5.1.3.1 Supply and return of each primary and secondary loop of following hydronic systems:
 - Heat pump loop.
 - Heating water.
- 1.5.1.4 Consider glycol systems as hydronic for purposes of this section.

1.6 OTHER MECHANICAL SYSTEMS

1.6.1 Plumbing:

- 1.6.1.1 Flush valves: adjust for proper operation to suit actual site pressure conditions.

1.6.2 Fire protection systems:

- 1.6.2.1 .1 To Alberta Building Code.

1.7 BUILDING GENERALLY

- 1.7.1 Adjust pressure and air flow conditions at exit doors, elevator shafts, stairwells, and smoke control zones.
- 1.7.2 Measure DBT, WBT, %RH, air velocity, air flow patterns, and noise data in occupied zone of all occupied areas.

1.8 DOMESTIC HOT WATER RECIRC SYSTEM

- 1.8.1 General: for purposes of this specification, consider DHW recirc system to be similar to hydronic system and perform TAB accordingly.
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- 1.8.1.1 Location of equipment measurement:
 - 1.8.1.1.1 Inlet and outlet of each:
 - Tank.
 - Heater.
 - Pump.
- 1.8.1.2 Location of system measurements at each:
 - 1.8.1.2.1 Main.
 - 1.8.1.2.2 Branch main.
 - 1.8.1.2.3 Branch.
 - 1.8.1.2.4 Sub-branch.

END OF SECTION

1 GENERAL

1.1 SUMMARY

1.1.1 Section Includes:

- 1.1.1.1 Materials and methods for pressure testing ducts over 5 m in length, forming part of a supply, return or exhaust ductwork system directly or indirectly connected to air handling equipment.

1.2 REFERENCES

1.2.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

- 1.2.1.1 Material Safety Data Sheets (MSDS).

1.2.2 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)

- 1.2.2.1 SMACNA HVAC Air Duct Leakage Test Manual, 1985.

1.3 QUALITY ASSURANCE

1.3.1 Pre-Installation Meetings:

- 1.3.1.1 Convene pre-installation meeting one week prior to beginning work of this Section
 - 1.3.1.1.1 Verify project requirements.
 - 1.3.1.1.2 Review installation and substrate conditions.
 - 1.3.1.1.3 Co-ordination with other building subtrades.
 - 1.3.1.1.4 Review manufacturer's installation instructions and warranty requirements.

2 PRODUCTS

2.1 TEST INSTRUMENTS

2.1.1 Test apparatus to include:

- 2.1.1.1 Fan capable of producing required static pressure.
- 2.1.1.2 Duct section with calibrated orifice plate mounted and accurately located pressure taps.
- 2.1.1.3 Flow measuring instrument compatible with the orifice plate.
- 2.1.1.4 Calibration curves for orifice plates used.
- 2.1.1.5 Smoke bombs for visual inspections. (if requested)

2.1.2 Test apparatus: accurate to within +/- 3 % of flow rate and pressure.

3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 TEST PROCEDURES

- 3.2.1 Maximum lengths of ducts to be tested consistent with capacity of test equipment.
- 3.2.2 Section of duct to be tested to include:
 - 3.2.2.1 Fittings, branch ducts, tap-ins.
- 3.2.3 Repeat tests until specified pressures are attained. Bear costs for repairs and repetition to tests.
- 3.2.4 Base partial system leakage calculations on SMACNA HVAC Air Duct Leakage Test Manual.
- 3.2.5 Seal leaks that can be heard or felt, regardless of their contribution to total leakage.

3.3 SITE TOLERANCES

- 3.3.1 System leakage tolerances specified are stated as percentage of total flow rate handled by system. Pro-rate specified system leakage tolerances. Leakage for sections of duct systems: not to exceed total allowable leakage.
- 3.3.2 Leakage tests on following systems not to exceed specified leakage rates.
 - 3.3.2.1 Small duct systems up to 250 Pa: leakage 2%.
 - 3.3.2.2 Large low pressure duct systems up to 500 Pa: leakage 2%.
- 3.3.3 Evaluation of test results to use surface area of duct and pressure in duct as basic parameters.

3.4 TESTING

- 3.4.1 Test ducts before installation of insulation or other forms of concealment.
 - 3.4.2 Test after seals have cured.
 - 3.4.3 Test when ambient temperature will not affect effectiveness of seals, and gaskets.
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3.5 TESTED SYSTEMS

3.5.1 The following air systems to be pressure tested:

- 3.5.1.1 Main supplier air ductwork, 3 locations as directed by the Engineer.
- 3.5.1.2 Main exhaust air ductwork, 3 locations as directed by the Engineer.

END OF SECTION

1 GENERAL

1.1 REFERENCES

- 1.1.1 ASTM C411-82(1987), Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
- 1.1.2 CAN4-S102-M83, Surface Burning Characteristics of Building Materials and Assemblies.
- 1.1.3 ANSI/NFPA 90A-1985, Air Conditioning and Ventilating Systems, Installation of.
- 1.1.4 ANSI/NFPA 90B-1984, Warm Air Heating and Air Conditioning Systems.
- 1.1.5 CGSB 51-GP-10M-76, Thermal Insulation, Mineral Fibre, Block or Board, for Ducting, Machinery and Boilers.
- 1.1.6 CGSB 51-GP-11M-76, Thermal Insulation, Mineral Fibre, Blanket for Piping, Ducting, Machinery and Boilers.
- 1.1.7 CGSB 51-GP-52M-77, Vapour Barrier Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

1.2 DEFINITIONS

- 1.2.1 For purposes of this section:

- 1.2.1.1 "CONCEALED" - insulated mechanical services and equipment in hung ceilings and non-accessible chases and furred spaces.
 - 1.2.1.2 "EXPOSED" - will mean "not concealed" as defined herein.

2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- 2.1.1 Insulating Materials: Knauff, Manson, Fibreglas, Manville
- 2.1.2 Adhesives: Armstrong, Childers, Foster, S.Fattal Thermo canvas.
- 2.1.3 Canvas Covering Material: Alpha Maritex, Clairmont Diplag, S. Fattal Thermocanvas.
- 2.1.4 Fasteners: Duro Dyne, Clip Pin.

2.2 GENERAL

- 2.2.1 All components of insulation system to have maximum flame spread rating of 25 and maximum smoke developed rating of 50 in accordance with CAN4-S102.
 - 2.2.2 Materials to be tested in accordance with ASTM C411.
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2.2.3 All mineral fiber insulation to be faced with factory applied foil covering.

2.3 D-2 MINERAL FIBER BLANKET WITH VAPOUR BARRIER

2.3.1 Application: on round ducting, either cold or dual temperature:

2.3.1.1 Exhaust air ducts.

2.3.1.2 Combustion air intake ducts.

2.3.1.3 Outside air intake ducts.

2.3.2 Material:

2.3.2.1 CGSB 51-GP-11M, mineral fiber blanket; CGSB 51-GP-52M for vapour barrier.

2.3.3 Thickness

2.3.3.1 50 mm on intake, combustion, and exhaust ducts

2.4 D-4 MINERAL FIBER RIGID WITH VAPOUR BARRIER

2.4.1 Application: on cold or dual temperature rectangular ducting:

2.4.1.1 Exhaust air ducts.

2.4.1.2 Combustion air intake ducts.

2.4.1.3 Outside air intake ducts.

2.4.2 Material:

2.4.2.1 CGSB 51-GP-10M, rigid mineral fiber board; CGSB 51-GP-52M vapour barrier, jacket and facing material.

2.4.3 Thickness:

2.4.3.1 Two 25 mm layers on intake, combustion, and exhaust ducts.

2.5 FASTENINGS

2.5.1 Tape: self adhesive, 100 mm wide, aluminum, ULC labelled for less than 25 flame spread and less than 50 smoke developed.

2.5.2 Contact adhesive: quick-setting.

2.5.2.1 Acceptable material: Foster 85-20 asbestos free.

2.5.3 Lap seal adhesive: quick-setting for joints and lap sealing of vapour barriers.

2.5.3.1 Acceptable material: Foster 85-75 asbestos free.

2.5.4 For Canvas:

- 2.5.4.1 Washable adhesive for cementing canvas lagging cloth to duct insulation.
- 2.5.4.2 Acceptable material: Foster asbestos free.

2.5.5 Pins.

- 2.5.5.1 Weld pins 4 mm diameter, with 35 mm diameter head for installation through the insulation. Length to suit thickness of insulation.
- 2.5.5.2 Acceptable Material: Duro Dyne.
- 2.5.5.3 Weld pins 2 mm diameter, for installation prior to applying insulation. Length to suit thickness of insulation. Nylon retain clips 32 mm square.
- 2.5.5.4 Acceptable Material: Duro Dyne pins with spotter clips as required.

2.6 JACKETS

2.6.1 Canvas.

- 2.6.1.1 Apply in exposed areas indoors: ULC listed plain weave, cotton fabric at 220 g/m².

3 EXECUTION

3.1 APPLICATION

- 3.1.1 Apply insulation after required tests have been completed and approved by Consultant. Insulation and surfaces shall be clean and dry when installed and during application of any finish. Apply insulation materials, accessories and finishes to manufacturer's recommendations and as specified.
- 3.1.2 Vapour barriers and insulation to be unbroken over full length of duct or surface, without penetration for hangers, standing duct seams and without interruption at sleeves and supports.
- 3.1.3 Use stand-offs for all duct mounted control accessories.
- 3.1.4 Apply 1.0 mm thick galvanized sheet metal corners to all ductwork in mechanical rooms.

3.2 INSTALLATION

3.2.1 General:

- 3.2.1.1 Install in accordance with ANSI/NFPA 90A and ANSI/NFPA 90B.
 - 3.2.1.2 Adhere and seal vapour barrier using vapour seal adhesives.
 - 3.2.1.3 Stagger longitudinal and horizontal joints, on multilayered insulation.
 - 3.2.1.4 Seal all joints and seams in jacketing to ensure weather tight finish on ductwork located outdoors.
-

3.2.2 Mechanical fastenings:

- 3.2.2.1 On rectangular ducts, use 50% coverage of insulating cement and weld pins at not more than 200 mm centres, but not less than 2 rows per side and bottom.

3.3 SCOPE

- 3.3.1 Completely insulate all ducts listed Part 2 - Products unless otherwise indicated.
- 3.3.2 Insulate outdoor air intakes from outdoors to make-up air and ventilation units.
- 3.3.3 Insulate exhaust ducts for 5 metres back from termination to outdoors.
- 3.3.4 Supply air ducts from ventilation units do not require external insulation.

END OF SECTION

1 General

1.1 SUMMARY

1.1.1 Section Includes:

- 1.1.1.1 Thermal insulation for piping and piping accessories in commercial type applications.

1.2 REFERENCES

1.2.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

- 1.2.1.1 ASHRAE Standard 90.1-01, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).

1.2.2 American Society for Testing and Materials International (ASTM)

- 1.2.2.1 ASTM B209M-04, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate Metric.
- 1.2.2.2 ASTM C335-04, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
- 1.2.2.3 ASTM C411-04, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
- 1.2.2.4 ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
- 1.2.2.5 ASTM C533-2004, Calcium Silicate Block and Pipe Thermal Insulation.
- 1.2.2.6 ASTM C547-2003, Mineral Fiber Pipe Insulation.
- 1.2.2.7 ASTM C795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
- 1.2.2.8 ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

1.2.3 Canadian General Standards Board (CGSB)

- 1.2.3.1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- 1.2.3.2 CAN/CGSB-51.53-95, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts

1.2.4 Department of Justice Canada (Jus)

- 1.2.4.1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.
 - 1.2.4.2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
 - 1.2.4.3 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.
-

1.2.5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

1.2.5.1 Material Safety Data Sheets (MSDS).

1.2.6 Manufacturer's Trade Associations

1.2.6.1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004).

1.2.7 Underwriters' Laboratories of Canada (ULC)

1.2.7.1 CAN/ULC-S102-03, Surface Burning Characteristics of Building Materials and Assemblies.

1.2.7.2 CAN/ULC-S701-01, Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.2.7.3 CAN/ULC-S702-1997, Thermal Insulation, Mineral Fibre, for Buildings

1.2.7.4 CAN/ULC-S702.2-03, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

1.3 DEFINITIONS

1.3.1 For purposes of this section:

1.3.1.1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.

1.3.1.2 "EXPOSED" - will mean "not concealed" as specified.

1.3.2 TIAC ss:

1.3.2.1 CRF: Code Rectangular Finish.

1.3.2.2 CPF: Code Piping Finish.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

1.4.1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.

1.4.2 Product Data:

1.4.2.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

1.4.3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

- 1.4.3.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.5 QUALITY ASSURANCE

1.5.1 Qualifications:

- 1.5.2 Installer: specialist in performing work of this Section and have at least three(3) years successful experience in this size and type of project.

1.5.3 Health and Safety:

- 1.5.3.1 Do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.

2 Products

2.1 FIRE AND SMOKE RATING

- 2.1.1 In accordance with CAN/ULC-S102.

- 2.1.1.1 Maximum flame spread rating: 25.
- 2.1.1.2 Maximum smoke developed rating: 50.

2.2 INSULATION

- 2.2.1 Mineral fibre specified includes glass fibre, rock wool, slag wool.

- 2.2.2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C335.

- 2.2.3 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket.

- 2.2.3.1 Mineral fibre: to CAN/ULC-S702.
- 2.2.3.2 Jacket: to CGSB 51-GP-52Ma.
- 2.2.3.3 Maximum "k" factor: to CAN/ULC-S702.

- 2.2.4 TIAC Code C-2: mineral fibre blanket faced with without factory applied vapour retarder jacket (as scheduled in PART 3 of this section).

- 2.2.4.1 Mineral fibre: to CAN/ULC-S702.
- 2.2.4.2 Jacket: to CGSB 51-GP-52Ma.
- 2.2.4.3 Maximum "k" factor: to CAN/ULC-S702.

- 2.2.5 TIAC Code A-6: flexible unicellular tubular elastomer.
-

- 2.2.5.1 Insulation: with vapour retarder jacket.
- 2.2.5.2 Jacket: to CGSB 51-GP-52Ma.
- 2.2.5.3 Certified by manufacturer: free of potential stress corrosion cracking corrodants.

2.3 INSULATION SECUREMENT

- 2.3.1 Tape: self-adhesive, aluminum, plain reinforced, 50 mm wide minimum.
- 2.3.2 Contact adhesive: quick setting.
- 2.3.3 Canvas adhesive: washable.
- 2.3.4 Tie wire: 1.5 mm diameter stainless steel.
- 2.3.5 Bands: stainless steel, 19mm wide, 0.5 mm thick.

2.4 CEMENT

- 2.4.1 Thermal insulating and finishing cement:
 - 2.4.1.1 Air drying on mineral wool, to ASTM C449/C449M.

2.5 VAPOUR RETARDER LAP ADHESIVE

- 2.5.1 Water based, fire retardant type, compatible with insulation.

2.6 JACKETS

- 2.6.1 Polyvinyl Chloride (PVC):
 - 2.6.1.1 One-piece moulded type and sheet to CAN/CGSB-51.53 with pre-formed shapes as required.
 - 2.6.1.2 Colours: White
 - 2.6.1.3 Minimum service temperatures: -20°C.
 - 2.6.1.4 Maximum service temperature: 65°C.
 - 2.6.1.5 Moisture vapour transmission: 0.02 perm.
 - 2.6.1.6 Fastenings:
 - 2.6.1.6.1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
 - 2.6.1.6.2 Tacks.
 - 2.6.1.6.3 Pressure sensitive vinyl tape of matching colour.

3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 PRE-INSTALLATION REQUIREMENT

- 3.2.1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.
- 3.2.2 Surfaces clean, dry, free from foreign material.

3.3 INSTALLATION

- 3.3.1 Install in accordance with TIAC National Standards.
- 3.3.2 Apply materials in accordance with manufacturers instructions and this specification.
- 3.3.3 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.
- 3.3.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - 3.3.4.1 Install hangers, supports outside vapour retarder jacket.
- 3.3.5 Supports, Hangers:
 - 3.3.5.1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.4 INSTALLATION OF ELASTOMERIC INSULATION

- 3.4.1 Insulation to remain dry. Overlaps to manufacturers instructions. Ensure tight joints.
- 3.4.2 Provide vapour retarder as recommended by manufacturer.

3.5 PIPING INSULATION SCHEDULES

- 3.5.1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
 - 3.5.2 TIAC Code: A-3.
 - 3.5.2.1 Securements: Tape at 300 mm on centre.
 - 3.5.2.2 Seals: VR lap seal adhesive, VR lagging adhesive.
 - 3.5.2.3 Installation: TIAC Code: 1501-C.
-

3.5.3 TIAC Code: A-6.

- 3.5.3.1 Insulation securements: Glue
- 3.5.3.2 Seals: lap seal adhesive, lagging adhesive.
- 3.5.3.3 Installation: TIAC Code: 1501-C

3.5.4 TIAC Code: C-2 with without vapour retarder jacket.

- 3.5.4.1 Insulation securements: Glue.
- 3.5.4.2 Seals: lap seal adhesive, lagging adhesive.
- 3.5.4.3 Installation: TIAC Code: 1501-C.

3.5.5 Thickness of insulation as listed in following table.

- 3.5.5.1 Run-outs to individual units and equipment not exceeding 4000 mm long. Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.

Application	Temp °C	TIAC code	Pipe sizes (NPS) and insulation thickness	1 ¼ to 2	2 ½ to 4	5 to 6	8	Up to 12
Domestic HWS & RECIRC	All	A-1	25mm	25mm	25mm	38mm	38mm	38mm
Domestic CWS (includes soft water)	All	A-3	25mm	25mm	25mm	25mm	25mm	25mm
RWL and RWP	All	25	25mm	25mm	25mm	25mm	25mm	25mm

- 3.5.6 All rain water leaders concealed in ceiling spaces are to be insulated for 3m from drain or wall discharge.

3.5.7 Finishes:

- 3.5.7.1 Exposed in mechanical rooms: PVC jacket.
- 3.5.7.2 Concealed, indoors: canvas on valves, fittings. No further finish.
- 3.5.7.3 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.
- 3.5.7.4 Installation: to appropriate TIAC code CRF/1 through CPF/5.

END OF SECTION

1 GENERAL

1.1 RELATED REQUIREMENTS

1.1.1 Section 21 05 00 – General Instructions for Mechanical Sections.

1.1.2 Section 01 33 00 – Submittal Procedure.

1.2 REFERENCES

1.2.1 ASTM C411-82(1987), Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

1.2.2 CAN4-S102-M83, Surface Burning Characteristics of Building Materials and Assemblies.

1.2.3 ANSI/NFPA 90A-1985, Air Conditioning and Ventilating Systems, Installation of.

1.2.4 ANSI/NFPA 90B-1984, Warm Air Heating and Air Conditioning Systems.

1.2.5 CGSB 51-GP-10M-76, Thermal Insulation, Mineral Fibre, Block or Board, for Ducting, Machinery and Boilers.

1.2.6 CGSB 51-GP-11M-76, Thermal Insulation, Mineral Fibre, Blanket for Piping, Ducting, Machinery and Boilers.

1.2.7 CGSB 51-GP-52M-77, Vapour Barrier Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

1.2.8 CAN/CGSB-51.2-M88, Thermal Insulation, Calcium Silicate, for Piping, Machinery and Boilers.

1.2.9 CAN/CGSB-51.12-M86, Cement, Thermal Insulating and Finishing.

1.2.10 CAN/CGSB-51.40-M80, Thermal Insulation, Flexible, Elastomeric, Unicellular, Sheet and Pipe Covering.

1.2.11 CAN/CGSB-51.65-M86, Thermal Insulation, Mineral Fibre, Blanket for D.H.W. Heaters.

1.2.12 ASTM C177-85, Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.

1.3 DEFINITIONS

1.3.1 For purposes of this section:

1.3.1.1 "CONCEALED" - insulated mechanical services and equipment in hung ceilings and non-accessible chases and furred spaces.

1.3.1.2 "EXPOSED" - will mean "not concealed" as defined herein.

2 PRODUCTS

2.1 GENERAL

2.1.1 All components of insulation system to have maximum flame spread rating of 25 and maximum smoke developed rating of 50 in accordance with CAN4-S102.

2.1.2 Materials to be tested in accordance with ASTM C411.

2.2 ACCEPTABLE MANUFACTURERS

2.2.1 Glass fiber Insulating Materials: Fibreglas, Manson, Knauf.

2.2.2 Adhesive: Armstrong, Childers, Foster.

2.2.3 Canvas Jacket: Alpha - Maritex, Clairmont Diplag, S. Fattal.

2.3 E-1 MINERAL FIBER BLANKET HOT CURVED SURFACES 20 TO 400 DEG.C

2.3.1 Materials:

2.3.1.1 CGSB 51-GP-11M, mineral fiber blanket.

2.3.1.2 Acceptable material: Fibreglas.

2.3.2 Thermal Conductivity "k" shall not exceed 0.040 W/m.Deg.C at 24 deg.C mean temperature when tested in accordance with ASTM C177.

2.3.3 Applications and thickness:

	<u>Service</u>	<u>Thickness</u>
2.3.3.1	Boiler & water heater breeching	50 mm

2.4 FASTENINGS

2.4.1 Tape: self adhesive 100 mm wide.

2.4.2 Contact adhesive: quick-setting.

2.4.2.1 Acceptable material: Foster 85-20 asbestos free, 5m sq./L.

2.4.3 Lap seal adhesive: quick-setting for joints and lap sealing of vapour barriers.

2.4.3.1 Acceptable material: Foster 85-75 asbestos free, 6 m sq./L.

2.4.4 Adhesive for canvas:

2.4.4.1 Washable, for cementing canvas to equipment insulation.

- 2.4.4.2 Acceptable material: Foster 30-36 asbestos free 1.25 m sq./L.
- 2.4.5 Steel wire: 1.5 mm diameter galvanized annealed.
- 2.4.6 Stainless steel wire: 1.5 mm diameter, type 316.
- 2.4.7 Steel bands: 12 x 0.4 mm galvanized steel.
- 2.4.8 Aluminum bands: 12x.6.

2.5 JACKETS

- 2.5.1 Canvas.
 - 2.5.1.1 Application:
 - 2.5.1.1.1 Boiler, humidifier & water heater breeching.
 - 2.5.1.2 Material: ULC listed, plain weave, cotton fabric, at 220 g/m².
 - 2.5.1.3 Acceptable material: S. Fattal Thermo canvas.

3 EXECUTION

3.1 APPLICATION

- 3.1.1 Apply insulation after all tests have been completed and approved by Consultant
- 3.1.2 Surface to be clean and dry during installation of insulation and finishes.
- 3.1.3 If not specified herein, application to be to manufacturer's recommendations.
- 3.1.4 Maintain uninterrupted integrity of vapour barrier.
- 3.1.5 Apply high density insulation under supports and hangers.

3.2 INSTALLATION

- 3.2.1 Install in accordance with ANSI/NFPA 90A and ANSI/NFPA 90B.
 - 3.2.2 Insulation supports where welding or bolting is permitted:
 - 3.2.2.1 Angle anchors: weld or bolt to equipment at lowest point of insulation. Thereafter, locate every 4.5 m vertically.
 - 3.2.2.2 Welded steel clips: at 200 mm maximum on centres, but not less than 2 rows per side.
 - 3.2.3 Insulation:
 - 3.2.3.1 Multi-layered: staggered butt joints and expansion joints in insulation, secured with wire or bands at 400 mm on centre intervals.
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- 3.2.4 Expansion joints in insulation: leave 25 mm space in each layer at 7 m intervals. Pack space lightly with Type E-1 flexible mineral insulation.
- 3.2.5 Insulation at bolts, studs, nuts, instrumentation: bevel to permit removal without damage to insulation or finish.
- 3.2.6 Fastenings: secure insulation with stainless steel wire galvanized steel wire steel bands aluminum bands at 900 mm on centre before application of finishing cement.
- 3.2.7 Vapour barriers: adhere and seal with vapour seal adhesive.
- 3.2.8 Finishes:
 - 3.2.8.1 Canvas: sewn and pasted on to all insulation and over cement finishes. Seams inconspicuously placed.
 - 3.2.8.2 Final surface: to be clean, smooth, ready for painting.

END OF SECTION

1 **General**

1.1 REFERENCES

1.1.1 American Society for Testing and Materials International (ASTM)

1.1.1.1 ASTM E202-04, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

1.2 CLEANING AND START-UP OF MECHANICAL PIPING SYSTEMS

1.2.1 In accordance with Section 23 08 02 - Cleaning and Protection.

1.3 STEAM CONDENSATE SYSTEMS - PERFORMANCE VERIFICATION (PV)

1.3.1 Perform systems performance verification after cleaning is completed and system is in full operation.

1.3.2 When systems are operational, perform following tests:

1.3.2.1 Conduct full scale tests at maximum design flow rates, temperatures and pressures for continuous consecutive period of 48 hours to demonstrate compliance with design criteria.

1.3.2.2 Verify performance of condensate system return pumps as specified, recording system pressures, temperatures, fluctuations by simulating maximum design conditions and varying.

1.3.2.2.1 Pump operation.

1.3.2.2.2 Boiler operation.

1.3.2.2.3 Control pressure failure.

1.3.2.2.4 Maximum heating demand.

1.3.2.2.5 Boiler failure.

1.3.2.2.6 Outdoor reset. Re-check heat exchanger output supply temperature at 100% and 50% reset, maximum water temperature.

1.4 SANITARY AND STORM DRAINAGE SYSTEMS

1.4.1 Ensure that traps are fully and permanently primed.

1.4.2 Ensure that fixtures are properly anchored, connected to system.

1.4.3 Cleanouts: refer to Section 22 42 01 - Plumbing Fixtures and Trim.

1.4.4 Roof drains:

1.4.4.1 Refer to Section 22 42 01 - Plumbing Fixtures and Trim.

1.4.4.2 Remove caps as required.

2 **Products**

2.1 NOT USED

3 **Execution**

3.1 NOT USED

END OF SECTION

1 General

1.1 WORK INCLUDED

- 1.1.1 Conform to Section 21 05 00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

2 Products

2.1 NOT USED

3 Execution

3.1 INSTALLATION

- 3.1.1 Clean thoroughly all fixtures and equipment from grease, dirt, plaster or any other foreign material. Chrome-plated fittings, piping and trim shall be polished upon completion.
- 3.1.2 Any dirt, rubbish, or grease on walls, floors or fixtures accumulated from the work of the Mechanical Division shall be removed promptly from the premises by this Division.
- 3.1.3 Fixtures and equipment shall be properly protected from damage during the construction period and shall be cleaned and polished in accordance with manufacturer's directions. Motors and equipment bearings shall be protected with plastic sheets, tied or taped in place. Aluminum fin heating or cooling elements shall be protected with cardboard covers.
- 3.1.4 Any unpainted steel surfaces, installed for longer than one year prior to the completion date, shall be prime coated under this Division.
- 3.1.5 During construction protect all services and equipment from dirt and debris, by using temporary caps over the open ends of pipes ductwork and equipment connections.
- 3.1.6 All equipment installed or stored on site shall be maintained in accordance with manufacturers recommended instructions (i.e. rotate shafts on fans, pumps, etc).
- 3.1.7 Refinish and restore to the original condition and appearance all mechanical equipment which has sustained damage to the manufacturer's prime and finish coats of enamel or paint. Materials and workmanship shall be equal to the manufacturers original.

END OF SECTION

1 General

1.1 WORK INCLUDED

- 1.1.1 Conform to Section 21 05 00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
- 1.1.2 Comply with all requirements of Section 21 05 02 – RECORD DRAWINGS.
- 1.1.3 Comply with all requirements of Section 21 05 03 – SHOP DRAWINGS.
- 1.1.4 Comply with all requirements of Section 21 08 00 – COMMISSIONING.
- 1.1.5 Comply with all requirements of Section 01 78 00 – CLOSEOUT SUBMITTALS.

2 Products

2.1 REQUIREMENTS FOR MANUALS

- 2.1.1 Three copies of complete and approved operating and maintenance instructions for all mechanical equipment and systems shall be supplied before substantial completion. Manuals shall be also submitted in electronic format. Electronic manuals shall be prepared in Adobe PDF format with all sections bookmarked for quick reference and submitted on DVD.
 - 2.1.2 Binders shall be three-ring, hard-cover, loose-leaf type and identified on the binding edges as "Maintenance Instructions and Data Book", for this project.
 - 2.1.3 Terminology used in all the Sections shall be consistent.
 - 2.1.4 Volume One shall contain the master index of all systems, the name of the Contractor, Mechanical Sub-Contractors and the date of substantial performance for the Contract.
 - 2.1.5 Volume One shall contain a section with all necessary warranty information.
 - 2.1.6 Each binder shall have a complete index for all volumes.
 - 2.1.7 Each binder shall be no more than half filled.
 - 2.1.8 There shall be a separate section for all materials used on the project which fall under the WHMIS legislation. There shall be a hazard data sheet for each of the materials.
 - 2.1.9 There shall be a separate section for all Insurance Certificates, Test Certificates, Verification Forms and Test Forms.
 - 2.1.10 All relevant information relating to a system or product shall be contained within one binder.
 - 2.1.11 The manual sections shall follow the specification sections.
-

- 2.1.12 Any diagrams, installation drawings, flow charts, etc. shall be mechanically reduced while maintaining full legibility to standard page size. If this cannot be achieved they shall be carefully folded and contained within a clear plastic wallet within the manual.

2.2 DATA FOR MANUALS

2.2.1 Equipment data shall contain:

- 2.2.1.1 Operating instructions
- 2.2.1.2 Operating conditions such as temperature and pressure
- 2.2.1.3 Location of equipment
- 2.2.1.4 Maintenance instructions and schedules for one year routine
- 2.2.1.5 Recommended list of spare parts
- 2.2.1.6 Lubrication schedule
- 2.2.1.7 A trouble shooting table showing where to look for problems under various conditions of malfunction
- 2.2.1.8 All wiring diagrams
- 2.2.1.9 Equipment operating curves
- 2.2.1.10 Equipment nameplate data and serial numbers

2.2.2 System data shall contain:

- 2.2.2.1 A listing of all systems
- 2.2.2.2 A valve schedule and locations
- 2.2.2.3 Equipment name tags
- 2.2.2.4 Filter schedule
- 2.2.2.5 An electric pipe tracing schedule including location and electrical service location
- 2.2.2.6 Cleaning, maintaining and preserving instructions for all material, products and surfaces. Include warnings of harmful cleaning, maintaining and preserving practices.

2.2.3 Sub-Contractor manuals are required for:

- 2.2.3.1 BAS
- 2.2.3.2 Water treatment
- 2.2.3.3 Sprinkler system
- 2.2.3.4 Water and air balancing

2.2.4 As-built documentation shall contain:

- 2.2.4.1 Reviewed As-Built Shop Drawings
 - 2.2.4.2 As-Built Construction Drawings
 - 2.2.4.3 Originals of Test Forms
 - 2.2.4.4 Originals of Test Certificates
-

2.3 ASSET SPREADSHEET

2.3.1 The Mechanical Contractor shall provide the following information on an excel spreadsheet to be provided by the Landlord:

- 2.3.1.1 Asset Name
- 2.3.1.2 Manufacturer
- 2.3.1.3 Model Number
- 2.3.1.4 Serial Number.

2.3.2 The above information shall be provided for the following mechanical equipment:

- 2.3.2.1 Air conditioning equipment
- 2.3.2.2 heat pumps
- 2.3.2.3 chillers
- 2.3.2.4 cooling towers
- 2.3.2.5 boilers and boiler burners
- 2.3.2.6 domestic water heaters
- 2.3.2.7 unit heaters
- 2.3.2.8 forced flow units
- 2.3.2.9 heat exchangers
- 2.3.2.10 humidifiers
- 2.3.2.11 fans
- 2.3.2.12 pumps
- 2.3.2.13 tanks
- 2.3.2.14 meters

2.4 OPERATING INSTRUCTIONS

2.4.1 Instruct the Departmental representative's representative in all aspects of the operation and maintenance of systems and equipment.

2.4.2 Comply with all requirements of Section 21 08 00 – COMMISSIONING, for duration of tests.

2.4.3 Instruct the Departmental representative for a minimum of five (5) working days.

2.4.4 Arrange for and pay for the services of engineers and other manufacturers' representatives required for instruction on the systems and the equipment as requested by the Departmental representative.

- 2.4.5 At the time of final inspection, provide a sheet for each system and piece of equipment showing the date instructions were given. Each sheet shall show the duration of instruction, name of persons receiving instruction, other persons present (manufacturer's representative, Consultant, etc.), system or equipment involved and signature of the Departmental representative's staff stating that they understood the system installation, operating and maintenance requirements. This information shall be inserted in the manuals after all instructions have been completed.
- 2.4.6 Review information with the Departmental representative's representative to ensure that all information required has been provided.
- 2.4.7 Mechanical equipment and systems included in the instruction requirements are:
 - 2.4.7.1 Chillers and associated equipment
 - 2.4.7.2 Heating water generators and associated equipment
 - 2.4.7.3 Automatic controls and instrumentation
 - 2.4.7.4 Water treatment and cleaning
 - 2.4.7.5 Life safety and fire protection
 - 2.4.7.6 Noise and vibration
 - 2.4.7.7 Condenser water distribution system
 - 2.4.7.8 Chilled water distribution systems
 - 2.4.7.9 Heating water distribution systems
 - 2.4.7.10 Air handling distribution and components
 - 2.4.7.11 Miscellaneous ventilation systems
 - 2.4.7.12 Diesel generator fuel supply and ventilation
 - 2.4.7.13 Humidification systems
 - 2.4.7.14 Storm, sanitary and domestic water pumping and distribution system

2.5 TRIAL USAGE

- 2.5.1 The Departmental representative shall be permitted trial usage of systems or parts of systems for the purpose of testing and learning operational procedures. Trial usage shall not affect the warranties nor be construed as acceptance, and no claim for damage shall be made against the Departmental representative for any injury or breakage to any part or parts due to the tests, where such injuries or breakage are caused by a weakness or inadequacy of parts, or by defective materials or workmanship of any kind.

3 Execution

3.1 NOT USED

END OF SECTION

1 General

1.1 RELATED REQUIREMENTS

- 1.1.1 Mechanical Equipment Systems Starting and Testing: Section 23 01 50
- 1.1.2 Ductwork Specialties: Section 23 31 13
- 1.1.3 Duct Accessories: Section 23 33 00
- 1.1.4 Filters: Section 23 41 13

1.2 REFERENCE DOCUMENTS

- 1.2.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):
 - 1.2.1.1 ASHRAE 52.2-2077: Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size
- 1.2.2 Sheet Metal and Air Conditioning National Contractors Association (SMACNA):
 - 1.2.2.1 SMACNA IAQ: Guideline for Occupied Building Under Construction

1.3 QUALITY ASSURANCE

- 1.3.1.1 The Minister may hire an independent agency to review duct cleaning procedures prior to starting work and perform spot check review of work to determine that duct cleaning has been effectively executed.

1.4 SUBMITTALS

- 1.4.1 Perform duct system cleaning using a firm specializing in this type of work. Submit the following information prior to commencing work:
 - 1.4.1.1 List of at least five projects of similar size and scope completed by the firm.
 - 1.4.1.2 Name of the superintendent that will be responsible for executing the work and his experience with projects of this scope.
- 1.4.2 Submit an outline of the work scope for each air handling system with procedures, equipment, materials and schedule prior to commencing work.
- 1.4.3 Submit a Certificate of Completion stating that duct cleaning [and disinfection] has been completed as specified in this section.

1.5 DEFINITIONS

- 1.5.1 Air system: includes central equipment; supply, return and 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.
-

1.6 PROTECTION

- 1.6.1 Protect furniture, equipment and flooring in close proximity to the work area with clean protective coverings.
- 1.6.2 Take precautions to ensure that dust and debris do not spread outside of duct system during the cleaning process.

2 Products

2.1 MATERIALS

- 2.1.1 Temporary Filters: 3 ply filter element to protect equipment during cleaning operation, meeting either of the following:
 - 2.1.1.1 35% dust spot efficiency to ASHRAE 52.1.
 - 2.1.1.2 MERV-8 to ASHRAE 52.2.
- 2.1.2 Access Ports Covers: reusable, positive locking cover for access ports. Maximum flame spread rating of 0. Friction fit plastic plugs and tape are not acceptable access port cover materials.

3 Execution

3.1 DUCT SYSTEM CLEANING

- 3.1.1 Commence duct system cleaning after completion of ductwork installation and before air handling systems are started.
 - 3.1.2 Install temporary filters in the following locations:
 - 3.1.2.1 Behind all grilles and diffusers.
 - 3.1.2.2 In front of all duct coils.
 - 3.1.2.3 At inlet of all terminal high velocity units to protect pitot openings.
 - 3.1.3 Clean all ductwork, plenums, coils and air handling equipment with compressed air and mechanical agitation devices or compressed air and high power suction equipment.
 - 3.1.4 Do not use mechanical brushes on acoustic lined ductwork.
 - 3.1.5 Clean diffusers and grilles.
 - 3.1.6 Remove all filters after a settling period of not less than two days or more than five days after vacuum procedure is complete. Ensure the number of filters removed is equal to the number of filters installed.
 - 3.1.7 Seal all ductwork outlets and plenum openings with polyethylene sheet cover after duct system has been cleaned.
 - 3.1.8 Mark positions of all balancing dampers prior to start of cleaning work, and return
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dampers to pre-cleaning positions after cleaning has been completed.

- 3.1.9 Repeat duct cleaning procedures on all duct sections found not satisfactory by independent test agency hired by the Minister.

END OF SECTION

1 GENERAL

1.1 REFERENCE STANDARDS

- 1.1.1 CAN4-S102-M83, Surface Burning Characteristics of Building Materials and Assemblies.
- 1.1.2 CGSB 51-GP-9M-76, Thermal Insulation, Mineral Fibre, Sleeving for Piping and Round Ducting.
- 1.1.3 CGSB 51-GP-11M-76, Thermal Insulation, Mineral Fibre, Blanket for Piping, Ducting, Machinery and boilers.
- 1.1.4 CAN/CGSB-51.12-M86, Cement, Thermal Insulating and Finishing.
- 1.1.5 CAN/CGSB-51.40-M80, Thermal Insulation, Flexible, Elastomeric, Unicellular, Sheet and Pipe Covering.
- 1.1.6 CGSB 51-GP-52M-77, Vapour Barrier Jacket and Facing Materials for Pipe, Duct and Equipment Thermal Insulation.
- 1.1.7 CGSB 51-GP-53M-77, Jacketing, Polyvinyl Chloride Sheet for Insulating Pipes, Vessels and Round Ducts.
- 1.1.8 CSA HA Series-M1980, CSA Standards for Aluminum and Aluminum Alloys.
- 1.1.9 ASTM C335-84, Test Method for Steady-State Heat Transfer Properties of Horizontal Pipe Insulations.

1.2 DEFINITIONS

- 1.2.1 For purposes of this of this section:
 - 1.2.1.1 "CONCEALED" - insulated mechanical services and equipment in hung ceilings and non accessible chases and furred spaces.
 - 1.2.1.2 "EXPOSED" - will mean "not concealed" as defined herein.

2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- 2.1.1 Mineral Fibre Insulation Material: Fibreglas, Manson, Knauf, Manville.
- 2.1.2 Adhesives: Armstrong, Foster, Childers.
- 2.1.3 Canvas Jacket: Alpha Maritex, Clairmont, Diplag, S. Fattal Thermocanvas.

2.2 GENERAL

- 2.2.1 All components of insulation system to have maximum flame spread rating of 25 and maximum smoke developed rating of 50 in accordance with CAN4-S102.
- 2.2.2 Material to be tested in accordance with ASTM C411.
- 2.2.3 All glass and mineral fiber insulation material to be factory bonded to an all purpose aluminum foil jacket.

2.3 P-1 FORMED MINERAL FIBER

- 2.3.1 Application: for piping valves and fittings on:
 - 2.3.1.1 Heating water (includes glycol).
- 2.3.2 Materials:
 - 2.3.2.1 CGSB 51-GP-9M, rigid mineral fiber sleeving for piping.
- 2.3.3 Thermal conductivity "k" shall not exceed 0.034 W/m. Deg.C at 24 Deg.C mean temperature when tested in accordance with ASTM C335.
- 2.3.4 Thickness: 25 mm

2.4 FASTENINGS

- 2.4.1 For insulation systems P-1:
 - 2.4.1.1 Tape: self adhesive aluminum, ULC labelled for less than 25 flame spread and less than 50 smoke developed.
 - 2.4.1.1.1 Acceptable material: Fattal Insultape.
 - 2.4.1.2 Lap Seal Adhesive: quick-setting adhesive for joints and lap sealing of vapour barriers.
 - 2.4.1.2.1 Standard of Acceptance: Foster 85-75 asbestos free.
 - 2.4.1.3 Lagging adhesive: fire resistant coating.
 - 2.4.1.3.1 Standard of acceptance: Foster 30-36 asbestos free.

2.5 INSULATION CEMENT

- 2.5.1 To CAN/CGSB-51.12-M86

2.6 JACKETS

2.6.1 Canvas

2.6.1.1 Apply in exposed areas: ULC listed plain weave, cotton fabric at 220 g/sq.m.

2.6.1.2 On concealed valves and fittings: ULC listed plain weave cotton fabric at 120 g/sq.m.

3 EXECUTION

3.1 APPLICATION

3.1.1 Apply insulation after required tests have been completed and approved by Consultant. Insulation and surfaces shall be clean and dry when installed and during application of any finish. Apply insulation materials, accessories and finishes in accordance with manufacturer's recommendations and as specified herein.

3.1.2 On piping with insulation and vapour barrier, install high density insulation above hanger shield. Maintain integrity of vapour barrier over full length of pipe without interruption at sleeves, fittings and supports.

3.2 INSTALLATION

3.2.1 Install in accordance with ANSI/NFPA 90A and ANSI/NFPA 90B.

3.2.2 Preformed: sectional insulation up to NPS 12.

3.2.3 Multi-layered: use staggered butt joint construction.

3.2.4 Vertical pipe over NPS 3: Insulation supports welded or bolted to pipe directly above lowest pipe fitting. Thereafter, locate on 4.5 m centres.

3.2.5 Expansion joints in insulation: terminate single layer and each layer of multiple layers in a straight cut at intervals recommended by manufacturer. Leave void of 25 mm between terminations. Pack void tightly with P-3 flexible mineral insulation.

3.2.6 Seal and finish exposed ends and other terminations with insulating cement.

3.2.7 Expansion joints in piping: provide for adequate movement of expansion joint without damage to insulation or finishes.

3.2.8 Orifice plate mounting flanges, flanges and unions at equipment, expansion joints, valves, other components requiring regular maintenance:

3.2.8.1 on hot piping systems: omit insulation and bevel away from studs and nuts to permit use of tools without damage to insulation or install insulation and finish to permit easy disassembly and replacement without damage to adjacent insulation and finishes.

3.2.8.2 on cold piping systems: insulate all cold surfaces, ensure complete continuity of vapour barrier, and install insulation and finish to permit easy disassembly and replacement without damage to adjacent insulation and finishes.

3.3 FASTENINGS

- 3.3.1 Secure pipe insulation by tape at each end and center of each section, but not more than 900 mm on centers.

3.4 INSULATION SCOPE

- 3.4.1 Unless indicated otherwise, completely insulate all piping, fittings, valves and accessories forming part of and connected to all systems listed generally in Part 2 - Products.

END OF SECTION

1 GENERAL

1.1 RELATED REQUIREMENTS

1.1.1 Section 25 01 00 – General Instructions for Mechanical Sections.

1.1.2 Section 01 33 00 – Submittal Procedure.

1.2 REFERENCES

1.2.1 ANSI B16.5-1981, Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and other Special Alloys.

1.2.2 ANSI B16.18-1984, Cast Copper Alloy Solder Joint Pressure Fittings.

1.2.3 ANSI B16.20-1973, Ring-Joint Gaskets and Grooves for Steel Pipe Flanges.

1.2.4 ANSI B16.21-1978, Non-metallic Flat Gaskets for Pipe Flanges.

1.2.5 ANSI B16.22-1980, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.

1.2.6 ANSI B18.2.1-1981, Square and Hex Bolts and Screws.

1.2.7 ASTM A47M-84, Specification for Ferritic Malleable Iron Castings.

1.2.8 ASTM A53-87b, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.

1.2.9 ASTM A120-84, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated (Galvanized) Welded and Seamless, for Ordinary Uses.

1.2.10 ASTM B32-87, Specification for Solder Metal.

1.2.11 ASTM B75M-86, Specification for Seamless Copper Tube Metric.

1.2.12 CAN/CGA B149.1-00, Natural Gas Installation Code.

1.2.13 CSA W47.1-1983, Certification of Companies for Fusion Welding of Steel Structures.

1.3 PRODUCT DATA

1.3.1 Submit product data in accordance with Section 01 33 00 – Submittal Procedure.

1.3.2 Indicate on manufacturers catalogue literature following: - valves.

1.4 MAINTENANCE DATA

1.4.1 Provide maintenance data for incorporation into manual specified in Section 01 33 00 – Submittal Procedure.

2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

2.1.1 Pressure Regulators: Fischer, Singer, Watts.

2.2 PIPE

2.2.1 Steel pipe: to ASTM A120 ASTM A53, Schedule 40, seamless as follows:

2.2.1.1 NPS 1/2 to 2, screwed.

2.2.1.2 NPS 2 1/2 and over, plain end.

2.3 JOINTING MATERIAL

2.3.1 Screwed fittings: pulverized lead paste.

2.3.2 Welded fittings: to CSA W47.1.

2.3.3 Flange gaskets: to ANSI B16.21 or ANSI B16.20.

2.3.4 Soldered: to ASTM B32, tin antimony 95:5.

2.4 FITTINGS

2.4.1 Steel pipe fittings, screwed, flanged or welded:

2.4.1.1 Malleable iron: screwed, banded, Class 150.

2.4.1.2 Steel pipe flanges and flanged fittings: to ANSI B16.5.

2.4.1.3 Steel butt-welding fittings.

2.4.1.4 Unions: malleable iron, brass to iron, ground seat, to ASTM A47M.

2.4.1.5 Bolts and nuts: to ANSI B18.2.1.

2.4.1.6 Nipples: Schedule 40, to ASTM A53.

2.5 VALVES

2.5.1 Provincial Code approved, lubricated plug or ball type.

3 EXECUTION

3.1 PIPING

3.1.1 Install in accordance with applicable Provincial Codes.

3.1.2 Install in accordance with CAN1-B149.1-00.

3.1.3 Assemble piping using fittings manufactured to ANSI standards.

3.1.4 Connect to equipment in accordance with manufacturer's instruction unless otherwise indicated.

3.1.5 Slope piping down in direction of flow to low points.

3.1.6 Install drip points:

3.1.6.1 At all low points in piping system.

3.1.6.2 At each connection to equipment.

3.1.7 Use eccentric reducers at pipe size change installed to provide positive drainage.

3.1.8 Provide clearance for access and for maintenance.

3.1.9 Ream pipes, clean scale and dirt, inside and out.

3.1.10 Install piping to minimize pipe dismantling for equipment removal.

3.2 VALVES

3.2.1 Install valves with stems upright or horizontal unless otherwise approved by Consultant.

3.2.2 Install valves at all branch take-offs to isolate each piece of equipment, and as indicated.

3.3 TESTING

3.3.1 Test system in accordance with CAN1-B149.1-00.

3.4 PURGING

3.4.1 Purge after pressure test in accordance with CAN1-B149.1-00.

END OF SECTION

1 GENERAL

1.1 SECTION INCLUDES

1.1.1 Pipe and pipe fittings for:

- 1.1.1.1 Heating water piping system.
- 1.1.1.2 Glycol water piping system.
- 1.1.1.3 Equipment drains and overflows.

1.1.2 Valves:

- 1.1.2.1 Gate valves.
- 1.1.2.2 Globe or angle valves.
- 1.1.2.3 Ball valves.
- 1.1.2.4 Plug valves.
- 1.1.2.5 Check valves.

1.2 RELATED SECTIONS

1.2.1 Section 01 33 00 – Submittal Procedure

1.3 REFERENCES

- 1.3.1 ASME - Boiler and Pressure Vessel Codes, SEC 9 - Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.
 - 1.3.2 ASME B16.3 - Malleable Iron Threaded Fittings Class 50 and 300.
 - 1.3.3 ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
 - 1.3.4 ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - 1.3.5 ASME B31.9 - Building Services Piping.
 - 1.3.6 ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
 - 1.3.7 ASTM A234 - Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
 - 1.3.8 ASTM B32 - Solder Metal.
 - 1.3.9 ASTM B88 - Seamless Copper Water Tube.
 - 1.3.10 ASTM F708 - Design and Installation of Rigid Pipe Hangers.
 - 1.3.11 AWS A5.8 - Brazing Filler Metal.
 - 1.3.12 AWWA C111 - Rubber-Gasket Joints for Ductile Iron and Grey-Iron Pressure Pipe and Fittings.
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1.3.13 MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacture.

1.3.14 MSS SP69 - Pipe Hangers and Supports - Selection and Application.

1.3.15 MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

1.4 SYSTEM DESCRIPTION

1.4.1 Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

1.4.2 Use of grooved mechanical couplings and fasteners is not acceptable.

1.4.3 Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.

1.4.4 Use dielectric connections whenever jointing dissimilar metals.

1.4.5 Provide pipe hangers and supports to MSS SP69 unless indicated otherwise.

1.4.6 Use isolation valves for shut-off and to isolate equipment, part of systems, or vertical risers.

1.4.7 Use silent check valves on discharge of pumps.

1.4.8 Use plug valves for throttling and balancing service.

1.4.9 Use ball valves in heating water systems interchangeably with gate valves up to 40 mm.

1.4.10 Use 20 mm ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment.

1.4.11 Butterfly valves are NOT permitted on all piping.

1.5 SUBMITTALS

1.5.1 Welders Certificate: Include welders certification of compliance with ASME SEC 9.

1.5.2 Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

1.6 PROJECT RECORD DOCUMENTS

1.6.1 Submit to Section 01 33 00.

1.6.2 Record actual locations of valves on record drawings.

1.7 OPERATION AND MAINTENANCE DATA

1.7.1 Submit to Section 01 33 00.

1.7.2 Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.8 QUALIFICATIONS

1.8.1 Welders: Certify to ASME SEC 9.

1.9 REGULATORY REQUIREMENTS

1.9.1 Conform to ASME B31.9 code for installation of piping system.

1.9.2 Welding Materials and Procedures: Conform to ASME SEC 9 and applicable provincial labour regulations.

1.9.3 Provide certificate of compliance from authority having jurisdiction indicating approval of welders.

1.10 DELIVERY, STORAGE, AND HANDLING

1.10.1 Deliver, store, protect and handle products to site to Division One

1.10.2 Accept valves on site in shipping containers with labeling in place. Inspect for damage.

1.10.3 Provide temporary protective coating on cast iron and steel valves.

1.10.4 Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

1.10.5 Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.11 ENVIRONMENTAL REQUIREMENTS

1.11.1 Do not install underground piping when bedding is wet or frozen.

1.12 EXTRA MATERIALS

1.12.1 Provide two repacking kits for each size and valve type.

2 PRODUCTS

2.1 HEATING WATER AND GLYCOL PIPING, ABOVE GROUND

2.1.1 Parkade hydronic piping

- 2.1.1.1 Steel Pipe: ASTM A53, Schedule 40, sizes 50 mm and over, 10mm wall for sizes 300mm and over, black.
- 2.1.1.2 Fittings: ASTM B16.3, malleable iron or ASTM A234, forged steel welding type fittings.
- 2.1.1.3 Joints: Threaded, or AWS D1.1, welded, flanged with Garlock or Durlon gaskets (no rubber gasket material allowed).

2.1.2 Main floor and above hydronic piping

2.1.2.1 PEX-A PIPING AND FITTING

2.1.3.1 Performance Requirements: PEX-a piping and fittings shall meet the following pressure and temperature ratings:

- .1 200 degrees F (93 degrees C) at 80 psi (551 kPa).
- .2 180 degrees F (82 degrees C) at 100 psi (689 kPa).
- .3 73.4 degrees F (23 degrees C) at 160 psi (1,102 kPa).

2.1.3.2 Plastic Pipe and Fittings:

- .1 PEX-a (Engle-method Crosslinked Polyethylene) Piping: Uponor Wirsbo hePEX , ASTM 876 with oxygen-diffusion barrier that meets DIN 4726.
- .2 PEX-a Fittings, Elbows and Tees (1/2 inch through 3 inch nominal pipe size): ASTM F1960 cold-expansion fitting manufactured from the following material types:
 - UNS No. C69300 Lead-free (LF) Brass.
 - 20 percent glass-filled polysulfone as specified in ASTM D6394.
 - Unreinforced polysulfone (group 01, class 1, grade 2) as specified in ASTM D6394.
 - Polyphenylsulfone (group 03, class 1, grade 2) as specified in ASTM D6394
 - Blend of polyphenylsulfone (55-80%) and unreinforced polysulfone (rem.) as specified in ASTM D6394.
 - Reinforcing cold-expansion rings shall be manufactured from the same source as PEX-a piping manufacturer and marked "F1960".

2.1.2.3 PEX-a Fittings (1 inch through 4 inch nominal pipe size): SDR9 compression type fitting consisting of a double O-ring insert with a compression sleeve tightened around the pipe and insert.

2.1.2.4 Plastic-to-Metal Transition Fittings:

- .1 Manufacturer: Provide fittings from the same manufacturer of the

piping.

- .2 Threaded Brass to PEX-a Transition: One-piece brass fitting with male or female threaded adapter and F1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring. Typically used for PEX sizes 3 inch and below.
- .3 Brass Sweat to PEX-a Transition: One-piece brass fitting with sweat adapter and F1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring. Typically used for PEX sizes 3 inch and below.
- .4 Dezincification-resistant (DZR) Brass to PEX-a Transition: Male NPT thread and PEX compression fitting. Editor: Typically used for PEX sizes 1 inch through 4 inch.

2.1.2.5 Plastic-to-Metal Transition Unions:

- .1 Manufacturer: Provide unions from the same manufacturer of the piping.
- .2 Threaded Brass to PEX-a Union: One-piece brass fitting with male or female threaded adapter and F1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring. Typically used for PEX sizes 3 inch and below.
- .3 Brass Sweat to PEX-a Union: One-piece brass fitting with sweat adapter and F1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring. Typically used for PEX sizes 3 inch and below.

2.1.2.6 Piping Applications:

- .1 Hot-water heating piping, aboveground (3 inch and below) shall be the following: PEX-a piping, with F1960 cold-expansion fittings.
 - .2 Hot-water heating piping, aboveground (3-1/2 inch through 4 inch) shall be the following: PEX-a piping, with compression fittings.
 - .3 Hot-water heating piping installed below ground and within slabs shall be any of the following:
 - 3 inch and below: Sleeved PEX-a piping with engineered polymer (EP) polyphenylsulfone F1960 cold-expansion fittings. Use the fewest possible joints and install per manufacturer's recommendations.
 - 1 inch through 2 inch: Pre-insulated PEX-a piping with multi-layer, closed-closed cell PEX-foam insulation and a corrugated HDPE jacket with engineered polymer (EP) polyphenylsulfone F1960 cold-expansion fittings. Use the fewest possible joints and install per manufacturer's recommendations.
 - 1 inch through 4 inch: Pre-insulated PEX-a piping with multi-layer, closed-cell, PEX-foam insulation and a corrugated HDPE jacket with compression fitting. Use the fewest possible joints and install per manufacturer's recommendations.
 - .4 Chilled-water piping, aboveground (3 inch and below) shall be the following: PEX-a piping, with F1960 cold-expansion fittings.
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- .5 Chilled-water piping, aboveground (3-1/2 inch through 4 inch) shall be the following: PEX-a piping, with compression fittings.
 - .6 Chilled-water piping installed below ground and within slabs, except when there is glycol solution, shall be any of the following:
 - 3 inch and below: Sleeved PEX-a piping with engineered polymer (EP) polyphenylsulfone F1960 cold-expansion fittings. Use the fewest possible joints and install per manufacturer's recommendations.
 - 1 inch through 2 inch: Pre-insulated PEX-a piping with multi-layer, closed-closed cell PEX-foam insulation and a corrugated HDPE jacket with engineered polymer (EP) polyphenylsulfone F1960 cold-expansion fittings. Use the fewest possible joints and install per manufacturer's recommendations.
 - 1 inch through 4 inch: Pre-insulated PEX-a piping with multi-layer, closed-closed cell PEX-foam insulation and a corrugated HDPE jacket with compression fitting. Use the fewest possible joints and install per manufacturer's recommendations.
 - .7 Condenser-water piping, aboveground (3 inch and below) shall be the following: PEX-a piping, with F1960 cold-expansion fittings.
 - .8 Condenser-water piping, aboveground (3-1/2 inch through 4 inch) shall be the following: PEX-a piping, with compression fittings.
 - .9 Condenser-water piping installed below ground and within slabs shall be any of the following:
 - 3 inch and below: Sleeved PEX-a piping with engineered polymer (EP) polyphenylsulfone F1960 cold-expansion fittings. Use the fewest possible joints and install per manufacturer's recommendations.
 - 1 inch through 2 inch: Pre-insulated PEX-a piping with multi-layer, closed-closed cell PEX-foam insulation and a corrugated HDPE jacket with engineered polymer (EP) polyphenylsulfone F1960 cold-expansion fittings. Use the fewest possible joints and install per manufacturer's recommendations.
 - 1 inch through 4 inch: Pre-insulated PEX-a piping with multi-layer, closed-closed cell PEX-foam insulation and a corrugated HDPE jacket with compression fitting. Use the fewest possible joints and install per manufacturer's recommendations.
 - .10 Makeup-water piping, aboveground (3 inch and below) shall be the following: PEX-a piping, with F1960 cold-expansion fittings.
 - .11 Makeup-water piping, aboveground (3-1/2 inch through 4 inch) shall be the following: PEX-a piping, with compression fittings.
 - .12 Makeup-water piping installed below ground and within slabs shall be any of the following:
 - 3 inch and below: Sleeved PEX-a piping with engineered polymer (EP) polyphenylsulfone F1960 cold-expansion fittings. Use the fewest
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possible joints and install per manufacturer's recommendations.

- 1 inch through 2 inch: Pre-insulated PEX-a piping with multi-layer, closed-closed cell PEX-foam insulation and a corrugated HDPE jacket with engineered polymer (EP) polyphenylsulfone F1960 cold-expansion fittings. Use the fewest possible joints and install per manufacturer's recommendations.
- 1 inch through 4 inch: Pre-insulated PEX-a piping with multi-layer, closed-closed cell PEX-foam insulation and a corrugated HDPE jacket with compression fitting. Use the fewest possible joints and install per manufacturer's recommendations.

2.2 EQUIPMENT DRAINS AND OVERFLOWS

2.2.1 Copper Tubing: ASTM B88, Type L, hard drawn.

2.2.1.1 Fittings: ASME B16.18, cast brass, or ASME B16.22 solder wrought copper.

2.2.1.2 Joints: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 220 to 280 degrees C.

2.2.2 Steel: ASTM Sch 40, screwed joints.

2.2.3 Plastic.

2.2.4 To suit application.

2.3 PIPE HANGERS AND SUPPORTS

2.3.1 Conform to MSS SP58, MSS SP69 and MSS SP89.

2.3.2 Hangers for Pipe Sizes 13 to 38 mm: Malleable iron or Carbon steel, adjustable swivel, split ring.

2.3.3 Hangers for Cold Pipe Sizes 50 mm and Over: Carbon steel, adjustable, clevis.

2.3.4 Hangers for Hot Pipe Sizes 50 to 100 mm: Carbon steel, adjustable, clevis.

2.3.5 Hangers for Hot Pipe Sizes 150 mm and Over: Adjustable steel yoke, cast iron roll, double hanger.

2.3.6 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

2.3.7 Multiple or Trapeze Hangers for Hot Pipe Sizes 150 mm and Over: Steel channels with welded spacers and hanger rods, cast iron roll.

2.3.8 Wall Support for Pipe Sizes to 76 mm: Cast iron hook.

- 2.3.9 Wall Support for Pipe Sizes 100 mm and Over: Welded steel bracket and wrought steel clamp.
- 2.3.10 Wall Support for Hot Pipe Sizes 150 mm and Over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
- 2.3.11 Vertical Support: Steel riser clamp.
- 2.3.12 Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- 2.3.13 Floor Support for Hot Pipe Sizes to 100 mm: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- 2.3.14 Floor Support for Hot Pipe Sizes 150 mm and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
- 2.3.15 Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- 2.3.16 Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
- 2.3.17 Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 UNIONS, FLANGES, AND COUPLINGS

2.4.1 Unions for Pipe 50 mm and Under:

- 2.4.1.1 Ferrous Piping: 1034 kPa malleable iron, threaded.
- 2.4.1.2 Copper Pipe: Bronze, soldered joints.

2.4.2 Flanges for Pipe Over 50 mm:

- 2.4.2.1 Ferrous Piping: 1034 kPa forged steel, slip-on.
- 2.4.2.2 Copper Piping: Bronze.
- 2.4.2.3 Gaskets: 1.6 mm thick preformed. "Garlock" or "Durlon" brand gasket materials only. Rubber gasket materials not allowed.

2.4.3 Dielectric Connections:

- 2.4.3.1 Up to 50mm: brass threaded to solder pipe adaptors.
- 2.4.3.2 Over 50mm: isolating flanges.

2.5 GATE VALVES

2.5.1 Up To and Including 50 mm:

- 2.5.1.1 Acceptable Material:
 - 2.5.1.1.1 Threaded:

- Crane fig. 438
- Red & White fig. 293
- Grinnell fig. 3010.
- Lunkenheimer fig. 2125

2.5.1.1.2 Soldered:

- Crane fig. 1334
- Red & White fig 299
- Grinnell fig. 3010 SJ.
- Lunkenheimer fig. 2131

2.5.1.2 Class 125, Bronze body, bronze trim, screwed inside or union bonnet, rising stem, handwheel, inside screw with backseating stem, solid wedge disc, alloy seat rings, threaded or soldered ends.

2.5.2 Over 50 mm – rising stem:

2.5.2.1 Acceptable Material:

2.5.2.1.1 Crane fig. 465 ½ .

2.5.2.1.2 Red & White fig. 421E.

2.5.2.1.3 Grinnell fig. 6020A

2.5.2.1.4 Lunkenheimer fig. 1430

2.5.2.2 Class 125, iron body, bronze trim, bolted bonnet, rising stem, handwheel, outside screw and yoke, solid wedge disc with bronze seat rings, flanged ends.

2.5.3 Over 50 mm – non-rising stem:

2.5.3.1 Acceptable Material:

2.5.3.1.1 Crane fig. 461

2.5.3.1.2 Red & White fig. 415E.

2.5.3.1.3 Grinnell fig. 6060A.

2.5.3.1.4 Lunkenheimer fig. 1428

2.5.3.2 Class 125, iron body, bronze trim, bolted bonnet, non-rising stem, handwheel, solid wedge disc with bronze seat rings, flanged ends.

2.6 GLOBE OR ANGLE VALVES

2.6.1 Up To and Including 50 mm:

2.6.1.1 Acceptable Material:

2.6.1.1.1 Crane fig. 5TF.

2.6.1.1.2 Red & White fig. 220A.

2.6.1.1.3 Grinnell fig. 3210.

2.6.1.1.4 Lunkenheimer fig. 2900.

2.6.1.2 Bronze body, bronze trim, union or screwed bonnet, rising stem and handwheel, inside screw with backseating stem, renewable PTFE composition disc and bronze seat, threaded ends.

2.6.2 Over 50 mm:

2.6.2.1 Acceptable Material:

2.6.2.1.1 Crane fig. 351.

2.6.2.1.2 Red & White fig. 400A.

2.6.2.1.3 Grinnell fig. 6200A

2.6.2.1.4 Lunkenheimer fig. 1123.

2.6.2.2 Iron body, bronze trim, bolted bonnet, rising stem, handwheel, outside screw and yoke, rotating plug-type disc with renewable seat ring and disc, flanged ends.

2.7 BALL VALVES

2.7.1 Up To and Including 40 mm:

2.7.1.1 Acceptable material:

2.7.1.1.1 Soldered:

- Crane fig. CSC 9222
- Red & White fig. 5049A
- Grinnell fig. 171S.
- Lunkenheimer fig. 746FS.

2.7.1.1.2 Threaded:

- Crane fig. CSC 9202
- Red & White fig. 5044A
- Grinnell fig. 171N.
- Lunkenheimer fig. 746F.

2.7.1.2 Bronze two-piece body, full port, chrome plated brass ball, Teflon seats and stuffing box ring, lever handle, soldered or threaded ends.

2.8 PLUG VALVES

2.8.1 Up to 50 mm:

2.8.1.1 Manufacturers:

2.8.1.1.1 DeZurik PEC series.

2.8.1.1.2 Grinnell fig. 152

2.8.1.1.3 Keystone figs. 541

2.8.1.2 Cast iron body and plug, full port opening, pressure lubricated, Teflon packing, threaded ends.

2.8.1.3 Operator: Each plug valve with a wrench with set screw.

2.8.2 Over 50 mm:

2.8.2.1 Manufacturers:

2.8.2.1.1 DeZurik PEC series.

2.8.2.1.2 Grinnell fig. 152

2.8.2.1.3 Keystone figs. 590 & 591

2.8.2.2 Cast iron body and plug, full port opening, pressure lubricated, Teflon packing, flanged ends.

2.8.2.3 Operator: Each plug valve with a wrench with set screw.

2.9 SWING CHECK VALVES

2.9.1 Up To and Including 50 mm:

2.9.1.1 Acceptable materials:

2.9.1.1.1 Threaded:

- Crane fig. 41TF
- Toyo fig. 236T.
- Grinnell fig. 3310.

2.9.1.1.2 Soldered:

- Red & White fig. 237T.
- Grinnell fig. 3310SJ.

2.9.1.2 Class 125 bronze body, bronze trim, bronze rotating swing disc, with Teflon composition disc, solder or threaded ends.

2.9.2 Over 50 mm:

2.9.2.1 Manufacturers:

2.9.2.1.1 Crane fig. 373.

2.9.2.1.2 Red & White fig. 435A.

2.9.2.1.3 Grinnell fig. 6300A.

2.9.2.1.4 Lunkenheimer fig. 1790.

2.9.2.2 Class 125 iron body, bronze trim, bronze or bronze faced rotating swing disc, renewable disc and seat, flanged ends.

2.10 SILENT CHECK VALVES

2.10.1 50 to 100mm

- 2.10.1.1 Manufacturers:
 - 2.10.1.1.1 Val Matic 1400 series.
 - 2.10.1.1.2 Grinnell figs. 402 - 404.
- 2.10.1.2 Iron body, bronze trim, in-line wafer style with stainless steel spring, bronze disc and seat, wafer ends.

2.10.2 Over 100 mm

- 2.10.2.1 Manufacturers:
 - 2.10.2.1.1 Val Matic 1800 series.
 - 2.10.2.1.2 Grinnell figs. 406 - 410.
- 2.10.2.2 Iron body, bronze trim, in-line globe style with stainless steel spring, bronze disc and seat, lug ends.

2.11 GLYCOL CHARGING

- 2.11.1 Fill glycol system with clean diluted water and 50% uninhibited propylene glycol by weight. Pre-mix solution to required proportions before introduction into piping system.
- 2.11.2 Acceptable Material: Dowfrost.

3 EXECUTION

3.1 PREPARATION

- 3.1.1 Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- 3.1.2 Remove scale and dirt on inside and outside before assembly.
- 3.1.3 Prepare piping connections to equipment with flanges or unions.
- 3.1.4 Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
- 3.1.5 After completion, fill, clean, and treat systems. Refer to Section 01 33 00.

3.2 PRODUCT APPLICATION

- 3.2.1 All piping in mechanical room, pipe riser and heating water pipes 65mm and above shall be cast iron with either welded, thread or groove connection and fitting. Provide separate price to replace above mentioned piping to PEX-a.
 - 3.2.2 Heating water pipes for snow melt system to be cast iron.
 - 3.2.3 Main and branch piping 50mm and under shall be PEX-a c/w fittings. on floor.
 - 3.2.4 All piping in residential suite shall be PEX-a.
-

3.3 INSTALLATION

- 3.3.1 Install to manufacturer's instructions.
 - 3.3.2 Install heating water, glycol to ASME B31.9.
 - 3.3.3 Route piping in orderly manner, parallel to building structure, and maintain gradient.
 - 3.3.4 Install piping to conserve building space, and not interfere with use of space.
 - 3.3.5 Group piping whenever practical at common elevations.
 - 3.3.6 Sleeve pipe passing through partitions, walls and floors.
 - 3.3.7 Slope piping and arrange to drain at low points.
 - 3.3.8 Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
 - 3.3.9 Inserts:
 - 3.3.9.1 Provide inserts for placement in concrete formwork.
 - 3.3.9.2 Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - 3.3.9.3 Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 100 mm.
 - 3.3.9.4 Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 - 3.3.9.5 Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab. Recess nut and plate into slab and grout where flush finish is required.
 - 3.3.10 Pipe Hangers and Supports:
 - 3.3.10.1 Install to MSS SP89.
 - 3.3.10.2 Support horizontal piping as scheduled.
 - 3.3.10.3 Install hangers to provide minimum 13 mm space between finished covering and adjacent work.
 - 3.3.10.4 Place hangers within 300 mm of each horizontal elbow.
 - 3.3.10.5 Use hangers with 38 mm minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 - 3.3.10.6 Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
 - 3.3.10.7 Provide copper plated hangers and supports for copper piping.
 - 3.3.10.8 Prime coat or cadmium plate exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
-

- 3.3.11 Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 01 33 00.
- 3.3.12 Provide access where valves and fittings are not exposed. Provide access doors to Section 01 33 00 to access through non-accessible ceilings and walls.
- 3.3.13 Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
- 3.3.14 Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
- 3.3.15 Install valves with stems upright or horizontal, not inverted.

3.4 SCHEDULES

3.4.1 Hanger Rod:

PIPE SIZE (mm)	MAX. HANGER SPACING (m)	ROD DIAMETER (mm)
12 to 32	2	9
38 to 50	3	9
62 to 75	3	13
100 to 150	3	15
200 to 300	4.25	22
350 and Over	6	25
PVC (All Sizes)	1.8	9

- 3.4.2 Valves: provide valves in accordance with the following schedule in each service location described below and in all locations indicated on the drawings.

<u>Service</u>	<u>Valve Type</u>
Equipment isolation	Ball, Gate**
Vertical riser isolation	Ball, Gate**
Branch line isolation	Ball, Gate**
Air vent isolation	Ball
Terminal heat transfer unit isolation	Ball, Gate,
Equipment drains	Ball w/ hose bibb and cap
Riser drains	Ball w/ hose bibb and cap
Terminal heat transfer zone drains	Ball w/ hose bibb and cap

Strainer blowdown drains

Ball w/ hose bibb and cap

Pump discharge check valves

Silent check

Other check valve locations

Swing check

Balancing

Eccentric plug complete
with flow venture.

Control valve bypass

Eccentric plug complete
with flow venture.

Notes:

** Over 50mm, in mechanical rooms use rising stem valves,
outside of mechanical rooms use non-rising stem valves.

END OF SECTION

1 GENERAL

1.1 REFERENCES

- 1.1.1 ASME Section VIII for Unfired Pressure Vessels, 1992.
- 1.1.2 ASTM A 47M-90, Specification for Ferritic Malleable Iron Castings.
- 1.1.3 ASTM A 278M-93, Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 345 °C.
- 1.1.4 ASTM A 516/A 516M-90, Specification for Pressure Vessel Plates, Carbon Steel, for Moderate and Lower Temperature Service.
- 1.1.5 ASTM A 536-84(1993), Specification for Ductile Iron Castings.
- 1.1.6 ASTM B 62-93, Specification for Composition Bronze or Ounce Metal Castings.
- 1.1.7 CSA B51-M95, Boiler, Pressure Vessel, and Pressure Piping Code.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- 1.2.1 Submit shop drawings and product data in accordance with Section 01 33 00 – Submittal Procedure.
- 1.2.2 Indicate on manufacturers catalogue literature: Expansion tanks, air vents, separators, valves, strainers, flow meters.

1.3 MAINTENANCE DATA

- 1.3.1 Provide maintenance data for incorporation into manual specified in Section 01 33 00 – Submittal Procedure.

2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- 2.1.1 Expansion tanks: Clemmer, Westeel, ITT, Armstrong.
 - 2.1.2 Automatic air vents: Maid-O-Mist, Watts, Armstrong.
 - 2.1.3 Air separator: Airtrol, Amtrol, Bell & Gossett, Expanflex, Taco.
 - 2.1.4 Pressure relief valves: Bell & Gossett, Singer, Taco, Watts.
 - 2.1.5 Pressure reducing valves: Watts, (no equals).
 - 2.1.6 Flow meters: Dietrich, Gerand, Presso, Taco, Measurell.
-

2.1.7 Suction diffusers: Armstrong, Bell & Gossett, Taco.

2.2 HYDRO – PNEUMATIC TYPE EXPANSION TANK

2.2.1 Horizontal steel expansion tank with separate tapings for all connection indicated on drawings.

2.2.2 Capacity: as indicated.

2.2.3 Size: as indicated.

2.2.4 Working pressure: 860 kPa with ASME stamp and certification.

2.2.5 Air charge to 105 kPa (initial fill pressure of system).

2.2.6 Acceptable material: Clemmer.

2.3 AUTOMATIC AIR VENT

2.3.1 Standard float vent: brass body and NPS 1/4 connection and rated at 860 kPa working pressure, installed complete with ball type isolation valves..

2.3.1.1 Acceptable material: Maid-O-Mist.

2.4 AIR SEPARATOR - IN-LINE

2.4.1 Working pressure: Cast iron flanged body, internal baffles, threaded top port for industrial air vent connection. Rated at 860 kPa working pressure.

2.4.2 Size: Full line size.

2.4.3 Acceptable material: Taco.

2.5 PIPE LINE STRAINER

2.5.1 NPS 2 and under: bronze body to ASTM B 62-93, screwed connections, stainless steel screen with 1.2 mm perforations.

2.5.1.1 Acceptable material: Sarco BT.

2.5.2 NPS 2 to NPS 4: cast iron body to ASTM A 278M-93, Class 30, ANSI 125 flanged connections, stainless steel screen with 1.2 mm perforations.

2.5.2.1 Acceptable material: Sarco CI-125.

2.5.3 NPS 4 and over: cast iron body to ASTM A 278M-93, Class 30, ANSI 125 flanged connections, stainless steel screen with 3.0 mm perforations.

2.5.3.1 Acceptable material: Sarco F-125.

2.5.4 Blowdown connection: NPS 1.

2.5.5 Minimum working pressure: 860 kPa.

2.6 PRESSURE SAFETY RELIEF VALVES

2.6.1 ASME rated, internal spring, external lever, cast brass body, bronze and teflon trim, threaded connections, rated to 1720 kPa working pressure.

2.6.1.1 Acceptable materials: Watts 174A.

2.7 COMBINATION BALANCE VALVE / FLOW METER

2.7.1 NPS 2 and under:

2.7.1.1 Class 125, 860 kPa, brass body, chrome-plated brass ball, teflon seat and stem seals, fixed calibrated brass orifice meter, memory locking device, differential pressure measurement ports, metal tag identification tag showing orifice size, location, flow rate, and pressure differential.

2.7.1.2 Acceptable material: Gerand Balvalve-Indicator.

3 EXECUTION

3.1 GENERAL

3.1.1 Install as indicated and to manufacturer's recommendations.

3.1.2 Pipe drains and blow off connections to above nearest drain, glycol to be piped to glycol storage tank.

3.1.3 Maintain proper clearance to permit service and maintenance.

3.1.4 Should deviations beyond allowable clearances arise, request and follow Consultant's directive.

3.1.5 Check shop drawings for conformance of all tapings for ancillaries and for equipment operating weights.

3.2 STRAINERS

3.2.1 Install in horizontal or down flow lines.

3.2.2 Ensure clearance for removal of basket.

3.2.3 Install ahead of each pump and as indicated.

3.2.4 Install ahead of each automatic control valve larger than NPS 1 except at radiation and as indicated.

3.3 AIR VENTS

3.3.1 Install at high points of systems.

3.3.2 Install ball valve on automatic air vent inlet.

3.4 EXPANSION TANKS

3.4.1 Adjust expansion tank pressure to ensure minimum positive pressure of 30 Kpa at highest elevation.

3.5 PRESSURE SAFETY RELIEF VALVES

3.5.1 Provide at all locations required by applicable codes and to the requirements of the authorities having jurisdiction.

3.5.2 Pipe discharge to above nearest drain; glycol system to be piped to glycol storage tank.

3.6 FLOW MEASURING STATION

3.6.1 Up to and including 50mm:

3.6.1.1 Install combination balance valve/flow meter as specified in part 2.

3.6.2 Above 50mm:

3.6.2.1 Install in series with all balancing valves at locations indicated on drawings.

3.6.3 Install to manufacturer's instructions and in accordance with the following: Install flow measuring elements a minimum of 10 straight pipe diameters upstream and 3 pipe diameters downstream of elbows. Flow straightening vanes may be used to reduce these clearances if installed in accordance with the manufacturer's instructions.

3.6.4 Where the available straight pipe length does not permit the installation of a Venturi flow measuring element, an elbow flow meter may be used in its place.

3.7 AIR SEPARATORS

3.7.1 Install on each closed loop piping system on main line near discharge of circulation pump.

END OF SECTION

1 GENERAL

1.1 RELATED REQUIREMENTS

1.1.1 Section 21 05 00 – General Instructions for Mechanical Sections.

1.1.2 Section 01 33 00 – Submittal Procedure.

1.2 REFERENCES

1.2.1 ASTM A53-90b, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

1.2.2 ASTM A105/A105M-91, Specification for Forgings, Carbon Steel, for Piping Components.

1.3 PRODUCT DATA

1.3.1 Submit product data in accordance with Section 01 33 00 – Submittal Procedure.

1.3.2 Indicate for each item as applicable:

1.3.2.1 Manufacturer, model number, line contents, pressure and temperature rating.

1.3.2.2 Movement handled; axial, lateral, angular and the amounts of each.

1.3.2.3 Nominal size and dimensions including details of construction and assembly.

1.4 MAINTENANCE DATA

1.4.1 Provide maintenance data for incorporation into manual specified in Section 01 33 00 – Submittal Procedure.

1.4.2 Data to include:

1.4.2.1 Servicing requirements, including any special requirements, stuffing box packing, lubrication and recommended procedures.

2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

2.1.1 Flexible Connections: Annaconda, Badger, Flexonics, Flexpipe, United, Mueller.

2.2 FLEXIBLE CONNECTION

2.2.1 Application: to suit motion as indicated.

2.2.2 Minimum length in accordance with manufacturer's recommendations to suit offset as indicated.

- 2.2.3 Inner hose: stainless steel corrugated.
- 2.2.4 Braided wire mesh stainless steel outer jacket.
- 2.2.5 Diameter and type of end connection: as indicated.
- 2.2.6 Operating conditions:
 - 2.2.6.1 Working pressure: 1034 kPa.
 - 2.2.6.2 Working temperature: 93 203 deg.C.
 - 2.2.6.3 To match system requirements.
- 2.2.7 Acceptable materials: Flexonics.

3 EXECUTION

3.1 INSTALLATION

- 3.1.1 Install expansion joints with cold setting, as indicated as instructed by Consultant. Make record of cold settings.
- 3.1.2 Install expansion joints and flexible connections in accordance with manufacturer's instructions.
- 3.1.3 Install pipe anchors and guides as indicated. Anchors to withstand 150% of axial thrust.

END OF SECTION

1 GENERAL

1.1 RELATED REQUIREMENTS

1.1.1 Section 21 05 00 – General Instructions for Mechanical Sections.

1.1.2 Section 01 33 00 – Submittal Procedure.

1.1.3 Section 23 05 93 – Testing Adjusting and Balancing (TAB).

1.2 SHOP DRAWINGS AND PRODUCT DATA

1.2.1 Submit shop drawings and product data in accordance with Section 01 33 00 – Submittal Procedure.

1.2.2 Submit manufacturer's detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories and controllers.

1.2.3 Submit product data of pump curves for review showing point of operation.

1.2.4 Indicate piping, valves and fittings shipped loose by packaged equipment supplier, showing their final location in field assembly.

1.3 MAINTENANCE DATA

1.3.1 Provide maintenance data for incorporation into manual specified in Section 01 33 00 – Submittal Procedure.

1.4 MAINTENANCE MATERIALS

1.4.1 Provide maintenance materials in accordance with Section 01 33 00 – Submittal Procedure.

1.4.2 Furnish following spare parts: one set of pump seals for each pump type.

2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

2.1.1 Base Mounted Pumps: Armstrong, Bell & Gossett, Taco, Myers, Liberty pumps, Grundfos. Contact for alternate approval.

2.1.2 Vertical Inline Pumps: Armstrong, Bell & Gossett, Taco, Myers, Liberty pumps, Grundfos. Contact for alternate approval.

2.2 VERTICAL IN-LINE CIRCULATORS

2.2.1 Volute: cast iron radially split, with tapped openings for venting, draining and gauge connections, with screwed or flanged suction and discharge connections.

- 2.2.2 Impeller: brass or bronze.
- 2.2.3 Shaft: stainless steel with bronze sleeve bearing, integral thrust collar.
- 2.2.4 Seal assembly: mechanical for service to 135 Deg.C.
- 2.2.5 Coupling: rigid self-aligning.
- 2.2.6 Motor: resilient mounted, drip proof, sleeve bearing, 1750 r/min, kW as indicated.
- 2.2.7 Capacity: as indicated.
- 2.2.8 Design pressure: 1200 kPa.

2.3 SINGLE SUCTION BASE MOUNTED CENTRIFUGAL PUMP

- 2.3.1 General: bronze fitted cast steel pump complete with motor.
- 2.3.2 Base: common cast iron or fabricated steel with drip rim and tapping for drain connection.
- 2.3.3 Volute: bronze, radially split, end suction, flanged suction and discharge, with drain plug and vent cock, suction and discharge pressure gauge tapings.
- 2.3.4 Impeller: bronze, enclosed type, keyed drive with locking nut or screw.
- 2.3.5 Shaft: stainless steel with two point support, machined shoulders for ball bearing mounting.
- 2.3.6 Seal assembly: mechanical lubricated.
- 2.3.7 Coupling: flexible self-aligning.
- 2.3.8 Motor: EEMAC Class B, squirrel cage induction, 1,725 r/min. continuous duty, drip proof, ball bearing, maximum temperature rise 50°C.
- 2.3.9 Capacity: as indicated.
- 2.3.10 Design pressure: 1200 kPa.

3 EXECUTION

3.1 INSTALLATION

- 3.1.1 In-line Circulators: install as indicated by flow arrows. Support at inlet and outlet flanges or unions. Install with bearing lubrication points accessible.
 - 3.1.2 Ensure that pump body does not support piping or equipment. Provide stanchions or hangers for this purpose. Refer to manufacturer's installation instructions for details.
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- 3.1.3 Pipe drain tapping to floor drain.
- 3.1.4 Install volute venting pet cock in accessible location.
- 3.1.5 Check rotation prior to start-up.
- 3.1.6 Install pressure gauge test cocks.
- 3.1.7 Base mount pumps to come complete with suction diffuser.

END OF SECTION

1 General

1.1 WORK INCLUDED

- 1.1.1 Conform to Section 21 05 00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

2 Products

2.1 MATERIALS

- 2.1.1 All pressure relief valves shall be code rated for the service and shall be approved under Canadian Interprovincial Boiler Inspection Regulations.
- 2.1.2 Pressure relief valves shall be Spirax Sarco or approved equal.

3 Execution

3.1 INSTALLATION

- 3.1.1 Relief valve on hot water heating system shall operate at (pressure shown) 207 kPa (30 psi) pressure unless noted otherwise.

END OF SECTION

1 GENERAL

1.1 REFERENCES

- 1.1.1 ANSI/ASME Boiler and Pressure Vessel Code, Section VII-1992.

1.2 SHOP DRAWINGS

- 1.2.1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedure.
- 1.2.2 Indicate the following: Equipment, and schematic hook up, degreasing and cleaning material and methods, and chemical treatment materials.

1.3 OPERATIONS AND MAINTENANCE DATA

- 1.3.1 Provide operation and maintenance data for incorporation into manual specified in Section 01 33 00 – Submittal Procedure.
- 1.3.2 Include following:
 - 1.3.2.1 Log sheets as recommended by manufacturer for review.

1.4 CERTIFICATION

- 1.4.1 Submit written reports to the Consultant containing results of tests taken every seven days after completion of chemical treatment. Reports shall be done every seven days for a minimum period of 35 days.
- 1.4.2 Chemical Treatment Agency to provide monthly site visits (12 minimum) within the warranty year to check the treatment, take samples, analyze and recommend proper addition of treatment. Provide written reports to the Departmental representative after each site visit with a copy to the Consultant.

1.5 GENERAL REQUIREMENTS

- 1.5.1 Obtain the services of a qualified Consultant specializing in system cleaning, chemical treatment, chemical feed equipment, and professional services, and who has been active in the water treatment business for a minimum of five years to:
 - 1.5.1.1 Supervise all cleaning procedures and chemical additives.
 - 1.5.1.2 Draw samples from each particular system and submit samples to Consultant /Departmental representative for final approval at the following stages.
 - 1.5.1.2.1 Cleaner in
 - 1.5.1.2.2 Final flush
 - 1.5.1.2.3 Treated water final
 - 1.5.1.3 Instruct the Departmental representative in the application and control of all phases of the water treatment programs including testing procedures and interpretation.
-

- 1.5.1.4 Provide periodic written reports indicating the status of each system before final acceptance.
- 1.5.1.5 Provide all necessary documentation of products and equipment to comply with all relevant WHMIS and OHAS regulations.
- 1.5.2 All MSDS must clearly state all components of the products supplied. MSDS showing only hazardous materials shall be considered as incomplete.
- 1.5.3 Maintenance data for water treatment equipment for incorporation into maintenance manual shall be provided.
- 1.5.4 One year supply of chemical for each system and softener salt shall be provided.
- 1.5.5 For each type of system one set of basic test equipment complete with carrying case and reagents for chemicals supplied shall be provided. Required specialized or supplementary equipment shall be included.

2 PRODUCTS

2.1 CHEMICAL TREATMENT AGENCY

- 2.1.1 Chemical Treatment Agency shall provide all permanently installed equipment, chemicals, instruction, site supervision, testing and certification services so as to fully comply with the intent of this specification section.
- 2.1.2 Acceptable Chemical Manufacturer: G.E. Betz Water Technologies, Gardian – IPCO.
- 2.1.3 Acceptable Agency: Specified Technical Sales Ltd. (no equals)

2.2 POT FEEDER

- 2.2.1 Welded steel: Pressure rating: 1400 kPa. Temperature rating: 120EC

2.3 CHEMICAL FEED PIPING

- 2.3.1 Schedule 80, black steel.

2.4 TANKS

- 2.4.1 Polyethylene: high density, moulded, with liquid level graduations, cover and stainless steel stand.

2.5 CLOSED LOOP HYDRONIC HEATING SYSTEMS

- 2.5.1 Closed Water System Chemical Feed Equipment
-

- 2.5.1.1 Hot water heating, and glycol systems to have a bypass pot feeder installed across the circulation pump. Feeder shall have a minimum capacity of 7.6 litres (2 Imp. Gallons) and be of steel construction with a working pressure of 1035 kPa (150 psig). Feeder shall be complete with valve kit containing isolating valves, drain valve, and air venting valve.
- 2.5.1.2 Hot water heating, and glycol systems to have an "in-line" filter for removal of particulate matter. Filter cartridges are to be of the 10 micron rating, 30 of which are to be supplied. A petcock shall be installed for pressure relief of the canister for filter replacement. A sight flow indicator shall be installed to determine filter condition.
- 2.5.1.3 The filter canister shall be a 20 mm (3/4") AMF Cuno CT101 or equal.
- 2.5.1.4 Filter and flow indicator shall be installed in an accessible location and not more than 1.5 m (60") above floor level.

2.5.2 Closed Water System Chemicals

- 2.5.2.1 Provide sufficient molybdate-amine based corrosion inhibitor to achieve and inhibitor level of 100 ppm (as molybdenum).

2.5.3 Glycol Water Treatment Equipment

- 2.5.3.1 Provide 135 litres (30 IG) polyethylene reservoir tank on each glycol system.
- 2.5.3.2 Provide 110 V, 1/2 HP gear pump for each glycol system to facilitate the transfer of glycol from the reservoir tank to the system.
- 2.5.3.3 Glycol used shall be a premixed (50/50) blend of distilled water and uninhibited propylene glycol.

2.6 SUPPLY OF CHEMICALS

- 2.6.1 Provide one year supply. Chemicals to be compatible with each type of system specified.
- 2.6.2 Provide 66 litres of Optiguard MCM 4280 for steam humidification system.

2.7 TEST EQUIPMENT

- 2.7.1 Provide, for each type of system specified herein, one set of basic test equipment complete with carrying case and reagents for chemicals supplied. Include required specialized or supplementary equipment.

2.8 TANKS

- 2.8.1 Polyethylene: high density, moulded, with liquid level graduations, cover and stand.
-

3 EXECUTION

3.1 GENERAL APPLICATION

- 3.1.1 Install HVAC water treatment systems in accordance with ASME Boiler Code Section VII, and requirements and standards of authorities having jurisdiction, except where specified otherwise.
- 3.1.2 Ensure adequate clearances to permit performance of servicing and maintenance of equipment.
- 3.1.3 Application of pipe cleaning chemicals and cleaning procedures shall be done by Mechanical trade under direct supervision of chemical treatment supplier.
- 3.1.4 Repeat flush cycles described herein as many times as necessary or whatever part of cycle is deemed necessary by Consultant if system fluid and strainers indicates that the system is dirty during Warranty Period.
- 3.1.5 Piping systems and connected products damaged or fouled as a result of operating systems before chemical cleaning shall be replaced or cleaned without cost to Departmental representative.

3.2 WATER TREATMENT SERVICES

- 3.2.1 Provide water treatment monitoring and consulting services for period of one year after system start-up. Service to include:
 - 3.2.1.1 Initial water analysis and treatment recommendations.
 - 3.2.1.2 System start-up assistance.
 - 3.2.1.3 Operating staff training.
 - 3.2.1.4 Visit plant every 5 days during period of operation and as required until system stabilizes, and advise on treatment system performance.
 - 3.2.1.5 Provide necessary recording charts and log sheets for one year operation.
 - 3.2.1.6 Provide necessary laboratory and technical assistance.
 - 3.2.1.7 Instructions and advice to operating staff to be clear, concise and in writing.

3.3 BASIC REQUIREMENTS

- 3.3.1 Application of pipe cleaning chemicals and cleaning procedures shall be carried out by Mechanical trade under direct supervision of chemical treatment supplier.
 - 3.3.2 Repeat flush cycles described herein as many times as necessary or whatever part of cycle is deemed necessary by Consultant if system fluid and strainers indicates that the system is dirty during Warranty Period.
 - 3.3.3 Piping systems and connected products damaged or fouled as a result of operating systems before chemical cleaning shall be replaced or cleaned without cost to Departmental representative.
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3.4 CLOSED LOOP HYDRONIC SYSTEM CLEANING PROCEDURE

- 3.4.1 Chemically clean equipment in accordance with manufacturer's printed installation instructions.
 - 3.4.2 Bypass all air handling unit coils, heat exchangers, cabinet unit heaters and unit heaters during cleaning and flushing.
 - 3.4.3 Remove or bypass all control valves during cleaning and flushing.
 - 3.4.4 Meter system volume during fill and report volume to Consultant and Departmental representative.
 - 3.4.5 Chemically clean piping system in the following order.
 - 3.4.5.1 Before commencing with Stage I cleaning procedure:
 - 3.4.5.1.1 Open system flush valves.
 - 3.4.5.1.2 Isolate system from connected products by opening manual bypass valves around connected products and closing their manual supply valves, by placing control valves in by-pass position, and by valving off pressure gauges/automatic fill valves/reliefs.
 - 3.4.5.1.3 Strainers/filters by-passes shall be in place.
 - 3.4.5.2 Stage I cleaning procedure:
 - 3.4.5.2.1 Fill system with cold water cleaning compound. Circulate in accordance with manufacturer's printed instructions (minimum 72 hours).
 - 3.4.5.2.2 Periodically purge system low points and clean strainer/filter bypass screens of accumulations.
 - 3.4.5.2.3 Drain system after this mixture has been circulated through system for prescribed time period.
 - 3.4.5.2.4 Purge system low points and clean strainer/filter bypass screens.
 - 3.4.5.2.5 Commence immediately with Stage II cleaning after Stage I cleaning procedure is complete.
 - 3.4.5.3 Before commencing with Stage II cleaning procedure:
 - 3.4.5.3.1 Close system flush valves.
 - 3.4.5.3.2 Open system to connected products except for pressure gauges/automatic air vents/automatic fill valves/reliefs.
 - 3.4.5.4 Stage II cleaning procedure:
 - 3.4.5.4.1 Fill system with hot water and hot water cleaning compound.
 - 3.4.5.4.2 Circulate continuously in accordance with manufacturer's printed instruction (minimum 72 hours).
 - 3.4.5.4.3 Periodically purge system low points and strainer/filter bypass screens of accumulations.
-

- 3.4.5.4.4 Open drains and flush out solution with raw water after this mixture has been circulated through system for prescribed period.
- 3.4.5.4.5 Clean strainer/filter screens, sediment pockets, pump casings after final flushing.
- 3.4.5.4.6 Discard the start-up strainers after final flushing and replace with permanent screens.
- 3.4.5.4.7 Remove several remote valves at random after system cleaning for checking system cleanliness.
- 3.4.5.4.8 Repeat Stage II cleaning procedure if system is still dirty.
- 3.4.5.4.9 Open up pressure gauge shut-off valves, automatic air vents, automatic fill valves, reliefs after system is accepted as clean.
- 3.4.5.5 No system shall be drained down and remain empty once filled with water. Refill systems immediately after systems are judged clean by chemical supplier and add corrosion inhibiting chemicals.

END OF SECTION

1 General

1.1 WORK INCLUDED

- 1.1.1 Conform to Section 21 05 00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

2 Products

2.1 MATERIALS

- 2.1.1 Provide pipe system filters equal to Ashland Drew Micron Medium Flow Filters Series 9240/ 9241 or GE W&P Technologies 3CMC/6CMC.
- 2.1.2 Shell and heads shall be suitable for 1035 kPa (150 psi) working pressure and filter media shall be suitable for 149 deg. C. (300 deg. F.) service temperature.
- 2.1.3 Filter media shall be bleached cotton for selective removal of particles from 1 to 100 microns. Media shall be non-rupturing and mounted so that no by-pass of media shall occur. Filters shall be equal to Ashland Drew PN 9236 or Viper VPYC.
- 2.1.4 Filters shall be sized for 3% of total system flow and shall be within the mid-capacity of the filter operating flow rate.
- 2.1.5 Pipe system filters shall be installed in the following systems:
- 2.1.5.1 Perimeter heating systems
 - 2.1.5.2 Constant temperature heating system
 - 2.1.5.3 Chilled water system
 - 2.1.5.4 Supplemental condenser water system

3 Execution

3.1 INSTALLATION

- 3.1.1 Install pipe system filters across the pumps with valved inlet and outlet. Outlet valve shall be a flow balancing valve. Refer to Section 23 11 23 – PIPES, VALVES AND FITTINGS (EXCEPT PLUMBING). Provide flanges or unions for servicing. Provide valved drain on unit casing.

END OF SECTION

1 General

1.1 WORK INCLUDED

1.1.1 Conform to Section 21 05 00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

1.2 SUBMITTALS

1.2.1 Shop Drawings: Submit Shop Drawings of all chemicals used in the system in accordance with SECTION 21 05 00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

2 Products

2.1 MATERIALS

2.1.1 Water piping cleaning solution for closed loop systems shall be equal to GE W&P Technologies FERROQUEST FQ7103 or Ashland Drew CSW 600. Refer to manufacturers instructions for chemical concentrations.

2.1.2 Boiler system cleaning formulation shall be equal to GE W&P Technologies OPTISPERSE ADJ0346 or Ashland Drew LAC PN 0057-40-7. Refer to manufacturers instructions for chemical concentrations.

2.1.3 Ethylene glycol system solution shall be 50% by volume of factory, pre-mixed solution of inhibited ethylene glycol. Ethylene glycol shall be Dow Chemical Co. "Dowtherm SR-1", Interstat Chemical Co. "Intercool NFE", or Recochem Inc. "Recotherm IG"..

2.1.4 Propylene glycol system solution shall be 50% by volume of factory, pre-mixed solution of inhibited propylene glycol. Propylene glycol shall be Dow Chemical Co "Dowfrost", Interstat Chemical Co. P-323" or Recochem Inc. "Recofreeze PG".

3 Execution

3.1 INSTALLATION

3.1.1 All systems shall have been hydrostatically tested prior to cleaning.

3.1.2 Thoroughly flush all systems with raw water to remove loose mill scale and debris. Remove and clean all strainers and flush low points before chemical cleaner is added.

3.1.3 All coils shall be disconnected and flow shall be by-passed.

3.1.4 A temporary pump shall be installed in the system and shall be capable of pumping adequate discharge at adequate head.

3.1.5 A temporary heater shall be installed in the system and shall be capable of maintaining the circulating water temperature as required for chemical treatment.

- 3.1.6 Systems shall be filled with city water and approved chemical cleaner introduced by a small temporary chemical injector pump at the temporary circulating pump section. Cleaner shall be introduced to maintain concentrations as per the manufacturer's recommendations.
- 3.1.7 All systems shall be cleaned in accordance with manufacturer's instructions and under the supervision of the chemical supplier's representative. Minimum cleaning procedures shall be to fill all water piping cleaning solution, circulate at 1.5 times specified system flow rate and maintain at highest possible temperature for 72 hours. During this period heavy blowdown of all low points shall be carried out every 6 hours. Strainers shall be cleaned as necessary to permit maximum flow possible and, in any event, at least every 6 hours. Drain the solution, all strainers, and flush entire system with clean water for a minimum of 24 hours. Repeat fill and flush procedure as often as required, adding inhibitor with each fill, to achieve acceptable contaminant levels. Systems shall then be refilled, ready for use. Temperature of system for cleaning shall be to suit chemical supplier's requirements.
- 3.1.8 Take samples of system from a series of representative drains as directed by the Consultant. If system is still dirty repeat cleaning procedure specified above until acceptable. Acceptable samples shall indicate that alkalinity and pH have returned to potable water levels. Copies of all test reports shall be submitted by the water treatment supplier to the Consultant for verification prior to final filling.
- 3.1.9 Add chemical treatment immediately after cleaning has been completed and accepted. Acceptable control parameters shall be as follows:
 - 3.1.9.1 Nitrite: 1000 – 1500 ppm
 - 3.1.9.2 pH: 8.5 – 10
 - 3.1.9.3 Iron: Less than 2.0 ppm
 - 3.1.9.4 Copper: Less than 0.3 ppm
 - 3.1.9.5 Molybdate: 100 – 150 ppm
- 3.1.10 The Mechanical Contractor shall supply the Consultant with certified documentation from the water treatment supplier that the systems have been properly equipped, chemically cleaned and that they are maintaining sufficient levels of scale/corrosion inhibitor. The contractor shall request such documentation from the water treatment supplier within one week of presentation to the Consultant.

END OF SECTION

1 General

1.1 WORK INCLUDED

1.1.1 Conform to Section 21 05 00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

1.1.2 Hangers, supports, anchors, guides and restraints shall be selected to withstand all static and dynamic loading conditions which act upon the piping system and associated equipment. The Mechanical Division shall prepare detailed shop drawings showing all anchors and guides for all systems with the potential for thermal expansion/contraction and/or loads due to weight or thrust. The drawings shall bear the signed seal of a Professional Engineer licensed to practice in the appropriate discipline and place of work. The drawings shall include all details of construction, static and dynamic forces at points of attachment, etc. necessary for review and acceptance by the project Structural Consultant. Make adjustments as necessary to satisfy the requirements of the Structural Division. No anchor points shall be permitted without reviewed shop drawings and, where installed prior to review, shall be removed and replaced to the satisfaction of the Consultant.

2 Products

2.1 MATERIALS

2.1.1 Guides and anchors: United Flexible, Flexonics or Hydroflex, specifically design for the system in which they are installed.

3 Execution

3.1 INSTALLATION

3.1.1 Provide for the expansion and Contraction of all pipes, and install with sufficient flexibility to prevent end thrust and movements caused by thermal expansion or Contraction causing detrimental distortion or damage of connected equipment. Provide offsets between mains and equipment of sufficient length to safely absorb the expansion of the main.

3.1.2 Guides shall be as shown and shall be located as follows:

3.1.2.1 distance from expansion loop to first guide shall be maximum 4 pipe diameters.

3.1.2.2 distance from first to second guide shall be maximum 14 pipe diameters

3.1.2.3 Maximum spacing between additional guides:

3.1.2.3.1 3.7 m for 65 mm (12 ft. for 2-1/2 in.) pipe

3.1.2.3.2 7.3 m for 75 mm and 100 mm (24 ft. for 3 in. and 4 in.) pipe 11 m for 125 mm and 150 mm (36 ft. for 5 in. and 6 in.) pipe

3.1.2.3.3 14.6 m for 200 mm (48 ft. for 8 in.) pipe

3.1.2.3.4 18.3 m for 250 mm (60 ft. for 10 in.) pipe

3.1.2.3.5 22 m for 300 mm and 350 mm (72 ft. for 12 in. and 14 in.) pipe

3.1.3 Anchors shall be as shown

END OF SECTION

1 General

1.1 WORK INCLUDED

- 1.1.1 Conform to Section 21 05 00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

2 Products

2.1 MATERIALS

- 2.1.1 Pipe connectors, where shown, for water, shall be Hydroflex Hose, Flexonics or Vibro-Flo or corrugated metal with braided sheath.
- 2.1.2 Corrugated metal and sheath shall be of bronze or stainless steel with threaded ends for 50 mm (2 in.) pipe size and smaller and flanged ends for larger sizes.
- 2.1.3 Total length of connector shall vary from a minimum of 300 mm (12 in.) for 25 mm (1 in.) deflection, and up to 350 mm (18 in.) for 50 mm (2 in.) or greater deflection.
- 2.1.4 Minimum working pressure at 21.1 deg. C. (70 deg. F.) shall be 1200 kPa (175 psi) based on maximum working pressure not exceeding burst pressure.

3 Execution

3.1 NOT USED

END OF SECTION

1. General

1.1 WORK INCLUDED

1.1.1 Conform to Section 21 05 00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

1.2 SUBMITTALS

1.2.1 Shop Drawings

1.2.1.1 Submit Shop Drawings of all catalogued components to be supplied. Include manufacturer's data sheets for certification, performance criteria, ratings, and physical dimensions and finishes.

1.2.1.2 Submit Shop Drawings of each supporting structural assembly required in the ductwork systems, designed by an engineer licensed to practice in the place of work in the appropriate discipline. Same design engineer stamps each and every Shop Drawing.

1.2.2 Samples: Submit samples as required.

1.2.2.1 Submit marked up prints showing detailed locations of all devices mounted in or on ductwork, dimensioning their locations.

2 Products

2.1 MATERIALS

2.1.1 Fabricate all ductwork unless specifically noted otherwise, of galvanized sheet steel with Z180 coating to A.S.T.M. A653/A653M-98.

2.1.2 Sealing compound: Minnesota Mining and Manufacturing or other approved manufacturer. Duct tape shall be Duro-Dyne or other approved manufacturer.

2.1.3 Flexible ducting:

2.1.3.1 .1 Flexible metal ducting shall be Flexmaster Triple-Lock Aluminum Flexible ducting T/L. ULC listing S110

2.1.4 Access Ports shall be Lawson-Taylor or other approved manufacture of 32 mm (1-1/4 in.) dia. ports.

2.1.4.1 Flexible Connections:

2.1.4.2 Ventfabrics, Duro Dyne or Dyne-Air.

2.1.4.3 For fans less than 0.5 kPa (2 in. wg.) connections shall be minimum 680 gm/sq.m. (20 oz./sq.yd.) fire retardant polyvinyl-chloride polyester fabric equal to Vinyl-Flex.

2.1.4.4 For fans in excess of 0.5 kPa (2 in. wg.) connections shall be minimum 1,080 gm/sq.m. (32 oz./sq.yd.) non-toxic neoprene coated fibreglass fabric equal to Neoprene N.T.

2.1.4.5 For all flexible connections located outside the building (e.g. roof top units) flexible connections shall be fire retardant Hypalon coated fibreglass fabric and shall be a minimum 9915 gm/sq.m. (27 oz./sq.yd.) equal to Hypalon.

2.1.4.6 For all systems where the temperature may exceed 112 deg. C. (235 deg. F.) silicone rubber coated fibreglass shall be used, and shall be equal to Silicone H1-T. Submit flexible connections for review before installation.

2.1.5 Dampers:

2.1.5.1 Dampers: For right angle branch duct take-off from vertical riser; Air vector Vectrol or other approved manufacturer.

2.1.5.2 Fire Dampers: Underwriters' Laboratories labeled. Fire dampers in supply air ducts shall be rated 'Dynamic' and shall have the blades clear of the air stream. Fire dampers shall be Ruskin, Nailor Industries or Controlled Air equal to Ruskin IBD2-Style 'B' or Style 'C'. Dampers in return and exhaust systems may have the blades in the air stream if permitted by the Consultant, and shall be equal to Ruskin IBD2-Style 'A'. Fire- stop flaps shall be as shown in the Underwriters' Laboratories list for the specific ceiling assembly used.

2.1.5.3 Combination balancing/fire damper: Price VCS4

2.1.5.4 Fabricate manual duct dampers as shown on Standard Details from galvanized steel

2.1.5.5 1.26 mm thick (0.048 in – 18 GSG gauge) or heavier. Dampers for ducts up to 300 mm (12 in.) deep shall be one blade carried on a 9 mm (3/8 in.) square steel rod mounted inside the duct. Dampers for ducts of greater depth than 300 mm (12 in.) shall be multi- blade, opposed-acting type, and shall have blades mounted in 38 mm (1-1/2 in.) steel channel frame, and interconnected for operation from one locking type hand quadrant. Dampers for right angle take-off of branch from vertical riser shall have operator extended to an accessible location. For externally insulated ducts, mount

- quadrant on a bracket, designed to clear the insulation. All dampers shall have indicator to show position of damper blade.
- 2.1.5.6 Fabricate splitter dampers as shown on Standard Details from at least the same thickness of galvanized steel as the duct in which it is installed, down to a minimum of
- 2.1.5.7 0.95 mm thick (0.0374 in – 20 GSG gauge). Fabricate of double thickness so that the entering edge presents a round nose to the air flow, and mount securely on hinges at the air leaving edge. Length of splitter shall be at least 1-1/2 times the width of the smaller branch duct, but in no case less than 300 mm (12 in.) long. Attach splitter hinge near the air entering edge with support passing through a clamp on the side of the duct, located where it is most accessible for external adjustment and locking of the damper.
- 2.1.5.8 Gravity backdraft dampers shall be multi-blade louver type, constructed of light grade aluminum. Blades shall be joined with a tie bar and have rust-proof shafts rotating in bronze bushings.
- 2.1.5.9 Motorized dampers for Control Operation: In accordance with applicable requirements control systems (pneumatic) or central energy management systems section.
- 2.1.6 Acoustic Insulation: 25 mm (1 in.) thick rigid coated glass fibre.
- 2.1.6.1 Hardware and Accessories:
- 2.1.6.1.1 Spin-in connections shall be specifically built for that purpose. Dampers shall be a minimum 1 gauge heavier than the ductwork in which it is installed and shall have a full length shaft pivoted at two diametrically opposed points. An indicator shall be attached to the shaft to indicate the damper position.
- 2.1.6.1.2 Hardware for balancing or splitter dampers shall be rattle-free and leak resistant.
- 2.1.6.1.3 Bearing rods shall be sized to suit the damper size. Neoprene seals shall be used to minimize leaks. Hardware shall be Dyn-Air or equal.
- 2.1.6.1.4 Turning vanes shall be either double thickness or single thickness with extended leading and trailing edges as specified in ASHRAE and SMACNA Standards. Rails shall be securely set in the elbow so that they cannot loosen. Turning vanes shall be Dyn-Air or equal.

2.2 FABRICATION

- 2.2.1 Fabricate ductwork in accordance with applicable duct construction requirements of SMACNA.

3 Execution

3.1 INSTALLATION

- 3.1.1 Make all laps in the direction of air flow. Use no sheet metal screws in the duct where it is possible to use rivets and bolts. Hammer down all edges and slips so as to leave smooth finished surface inside the ducts.
- 3.1.2 Brace and stiffen all ducts, and make tight so that they will not breathe, rattle, vibrate or sag. Cross-break all rectangular ducts with heights or widths of 300 mm (12 in.) or larger.
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3.1.3 Where rectangular ducts are shown, round ducts may be substituted at the Contractor's option, provided there is sufficient room. Conversion from rectangular to round duct, sizing shall be as shown on charts in ASHRAE.

3.1.4 Hang all ductwork securely and in a rigid manner. Provide hangers as follows:

TABLE 1: HANGERS

DUCT DIMENSION	HANGER CONSTRUCTION
Horizontal rectangular duct	
Up to 1500 mm (60 in.) for Low Pressure Ductwork Only	Two 25 mm (1 in.) x 16 US gauge straps with two screws on side of duct one screw on bottom. Hangers shall be at each joint but in no case more than a maximum 2400 mm (96 in.) on centres.
For all sizes of Medium and High Pressure Ductwork up to 3000 mm (120 in.) and Low Pressure Ductwork from 1525 mm to 3000 mm (61 in. x 120 in.)	50 mm x 50 mm x 6 mm (2 in. x 2 in. x 1/4 in.) trapeze hanger with two 9 mm (3/8 in.) dia. rods. Hangers shall be at each joint but in no case more than a maximum 2400 mm (96 in.) on centres.
3000 mm to 6000 mm (120 in. to 240 in.)	65 mm x 65 mm x 5 mm (2-1/2 in. x 2-1/2 in. x 3/16 in.) trapeze hanger with two 9 mm (3/8 in.) dia. rods. Hangers shall be at each joint but in no case more than a maximum 1200 mm (48 in.) on centres.
Horizontal round duct	
Up to 450 mm (18 in.)	One 25 mm (1 in.) x 16 US gauge hanger ring supported from one 25 mm (1 in.) x 16 US gauge hanger strap. Hanger shall be at each joint but in no case more than a maximum 2400 mm (96 in.) on centres.
475 mm to 900 mm (19 in. to 36 in.)	One 25 mm (1 in.) x 12 US gauge hanger ring supported from 25 mm (1 in.) x 12 US gauge hanger strap. Hanger shall be at each joint but in no case more than a maximum 2400 mm (96 in.) on centres.
925 mm to 1250 mm (37 in. to 50 in.)	One 25 mm (1 in.) x 12 US gauge hanger ring supported from 25 mm (1 in.) x 12 US gauge hanger strap. Hanger shall be at each joint but in no case more than a maximum 2400 mm (96 in.) on centres.

1275 mm to 2100 mm (51 in. to 84 in.)	Two 38 mm (1-1/2 in.) x 12 US gauge hanger connected to the 32 mm x 32 mm x 3 mm (1-1/4 in. x 1-1/4 in. x 1/8 in.) angle girth reinforcing of duct hanger. Hangers shall be at each joint but in no case more than a maximum 2400 mm (96 in.) on centres.
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- 3.1.5 Support all vertical ducts at each floor, on all sides, with angle riveted to the ducts.
- 3.1.6 The following low pressure, medium pressure and high pressure duct construction is based on an ASHRAE method of construction, and gives a minimum standard of construction.
- 3.1.7 Alternative ASHRAE or SMACNA duct construction is acceptable, provided it meets the minimum standards as outlined by these Specifications. Submit proposed alternatives for review prior to fabrication.
- 3.1.8 Construct low pressure rectangular ducts for systems less than 0.5 kPa (2 in.) static pressure and under 10.2 m/s (2000 fpm) velocity as follows:

TABLE 2: LOW PRESSURE DUCT CONSTRUCTION

MAX. DUCT DIMENSION	SHEET METAL US GAUGE	TRANSVERSE JOINT CONNECTION AND BRACING
Up to 300 mm (12 in.)	26	Flat drive or flat 'S' no bracing
325 mm to 425 mm (13 in. to 18 in.)	24	Flat drive or flat 'S' no bracing
475 mm to 750 mm (19 in. to 30 in.)	24	25 mm (1 in.) standing 'T' bracing 25 mm x 25 mm x 3 mm (1 in. x 1 in. x 1/8 in.) at maximum 1500 mm (60 in.) centres.
775 mm to 1050 mm (31 in. to 42 in.)	22	25 mm (1 in.) standing 'T' bracing 25 mm x 25 mm x 3 mm (1 in. x 1 in. x 1/8 in.) at maximum 1500 mm (60 in.) centres.
1075 mm to 1200 mm (43 in. to 48 in.)	22	38 mm (1-1/2 in.) standing 'T'; bracing 38 mm x 38 mm x 3 mm (1-1/2 in. x 1-1/2 in. x 1/8 in.) at maximum 1500 mm (60 in.) centres.
1225 mm to 1350 mm (49 in. to 54 in.)	22	38 mm (1-1/2 in.) standing 'T'; bracing 38 mm x 38 mm x 3 mm (1-1/2 in. x 1-1/2 in. x 1/8 in.) at maximum 1200 mm (48 in.) centres.
1375 mm to 1500 mm (55 in. to 60 in.)	20	38 mm (1-1/2 in.) standing 'T'; bracing 38 mm x 38 mm x 3 mm (1-1/2 in. x 1-1/2 in. x 1/8 in.) at maximum 1200 mm (48 in.) centres.

1525 mm to 2100 mm (61 in. to 84 in.)	20	38 mm (1-1/2 in.) standing 'T'; bracing 38 mm x 38 mm x 3 mm (1-1/2 in. x 1-1/2 in. x 1/8 in.) at maximum 1200 mm (48 in.) centres.
2125 mm to 2400 mm (85 in. to 96 in.)	18	50 mm (2 in.) standing 'T' bracing 38 mm x 38 mm x 5 mm (1-1/2 in. x 1-1/2 in. x 3/16 in.) at maximum 600 mm (24 in.) centres.
2425 mm to 3000 mm (97 in. to 120 in.)	18	50 mm (2 in.) standing 'T' bracing 50 mm x 50 mm x 6 mm (2 in. x 2 in. x 1/4 in.) at maximum 600 mm (24 in.) centres.
3025 mm and over (121 in. and over)	18	As above with addition of tie rods at 300 mm (120 in.) centres for joint bracing.

3.2.1 Bracing spacing shown is maximum spacing between two bracings or between bracing and joint.

3.2.2 Locate bracings mid-way between joints.

3.2.3 Make longitudinal joints Pittsburgh lock seam at edge of duct, and grooved seam on face of duct.

3.2.4 Medium pressure rectangular ducts are required for all smoke exhaust systems and in the following areas.

3.2.4.1 Variable Air Volume Systems from the air handling unit to the VAV terminal box

3.2.4.2 Outside air supply risers

3.2.4.3 General Exhaust risers

3.2.4.4 Sanitary Exhaust risers

3.2.5 Construct medium pressure rectangular ducts as follows:

TABLE 3: MEDIUM PRESSURE RECTANGULAR DUCT CONSTRUCTION

MAX. DUCT DIMENSION	SHEET METAL US GAUGE	TRANSVERSE JOINT CONNECTION & BRACING
Up to 300 mm (12 in.)	24	25 mm (1 in.) standing seam, 16 mm (5/8 in.) welded flange 25 mm (1 in.) pocket lock, no bracing.
325 mm to 425 mm (13 in. to 18 in.)	24	25 mm (1 in.) standing seam, 22 mm (7/8 in.) welded flange, 25 mm (1 in.) pocket lock, bracing 25 mm x 25 mm x 16 gauge (1 in. x 1 in. x 16 UG gauge) at 1200 mm (48 in.) centres.
475 mm to 600 mm (19 in. to 24 in.)	22	32 mm (1-1/4 in.) standing seam, 35 mm (1-3/8 in.) welded flange, 30 mm (1-1/8 in.) pocket lock, bracing 25 mm x 25 mm x 3 mm (1 in. x 1 in. x 1/8 in.) at maximum 120 mm (48 in.) centres.

625 mm to 900 mm (25 in. to 36 in.)	22	38 mm (1-1/2 in.) standing seam, 38 mm (1/2 in.) pocket lock, bracing 25 mm x 25 mm x 3 mm (1 in. x 1 in. x 1/8 in.) at maximum 120 mm (48 in.) centres.
925 mm to 1200 mm (37 in. to 48 in.)	22	50 mm (2 in.) standing seam or 50 mm (2 in.) flanged joint, bracing 38 mm x 38 mm x 3 mm (1-1/2 in. x 1-1/2 in. x 1/8 in.) at maximum 750 mm (30 in.) centres.
1125 mm to 1500 mm (49 in. to 60 in.)	20	38 mm (1-1/2 in.) standing seam or 38 mm (1-1/2 in.) flanged joint with tie rod in centre, bracing 50 mm x 50 mm x 3 mm (2 in. x 2 in. x 1/8 in.) at maximum 600 mm (24 in.) centres.
1525 mm to 1800 mm (61 in. to 72 in.)	20	38 mm (1-1/2 in.) standing seam or 38 mm (1-1/2 in.) flanged joint with tie rod in centre, bracing 50 mm x 50 mm x 3 mm (2 in. x 2 in. x 1/8 in.) at maximum 600 mm (24 in.) centres.
1825 mm to 2100 mm (73 in. to 84 in.)	18	50 mm (2 in.) standing seam or 38 mm (1-1/2 in.) flanged joint with tie rod in centre, bracing 65 mm x 65 mm x 5 mm (2-1/2 in. x 2-1/2 in. x 3/16 in.) at maximum 600 mm (24 in.) centres.
2425 mm and over (96 in. and over)	18	50 mm (2 in.) standing seam or 38 mm (1-1/2 in.) flanged joint with tie rod in centre, bracing 65 mm x 65 mm x 5 mm (2-1/2 in. x 2-1/2 in. x 3/16 in.) at maximum 600 mm (24 in.) centres.

- 3.3.1 Bracing spacing shown above is maximum spacing between two bracings or between bracing and joint. Locate bracing mid-way between joints.
- 3.3.2 Make longitudinal joints Pittsburgh lock seam at edge of duct, and grooved seam on face of duct.
- 3.3.3 Seal all joint of all ducts. Brush joints with the compound before and again after assembly.
- 3.3.4 Seal the bottom and side joints of outside air ducts or plenums water-tight.
- 3.3.5 Flexible hose shall be connected to sheet metal duct and diffusers using duct sealer, minimum of two screws separated by 180 degrees and metal draw bands. Duct tape is not acceptable.
- 3.3.6 Flexible ductwork may be used under the following conditions:
 - 3.3.6.1 Flexible ductwork shall be used where shown to allow easy location of diffusers.
 - 3.3.6.2 Minimum length of flexible duct used to connect diffusers and interior troffers shall be 2,400 mm (84 inches).
 - 3.3.6.3 Maximum length of flexible duct shall be 3,000 mm (120 inches).
 - 3.3.6.4 Flexible ductwork shall not pass through floors or fire walls,
 - 3.3.6.5 Flexible ductwork shall be a single section of duct (no joints). In the event that building construction requires connection between lengths of flexible duct use a rigid section of duct as the joint. Flexible duct shall be secure to the rigid section using ties and sealant.
 - 3.3.6.6 Flexible duct lengths greater than 2,400 mm (84 inches) shall be supported

at the midpoint with strap hangers.

- 3.3.7 Where ductwork passes through a wall or floor, other than when a fire damper is required, pack around the duct using a fire resistant material to ensure a sound and airtight joint.
 - 3.3.8 If changes of size of ducts are necessary because of building construction, maintain the same circular equivalent for the new size. Ratio of the longest side of the duct to the least shall not exceed 4 to 1 unless specifically authorized by the Consultant
 - 3.3.9 Select the gauge of metal and method of construction for the new size. Notify the Consultant of any change before such changes are incorporated into the work.
 - 3.3.10 If changes of location of duct, are required because of building construction, review with the Consultant before the locations indicated are changed in any way.
 - 3.3.11 Make changes of direction of horizontal ducts with elbows having an inside radius not less than 3/4 the width of the duct. Make change of direction from horizontal to vertical duct with elbows having an inside radius equal to the depth of the duct. Where this is not possible due to the building construction, use turning vanes.
 - 3.3.12 Provide access ports at convenient locations in all main ducts and main branch take-offs with airtight covers and extension sleeves through insulation to allow air meter readings. Access ports shall be approved by the Consultant and the testing company before installation.
 - 3.3.13 Provide flexible connections at each air handling unit and fan duct connection.
 - 3.3.14 Install manual duct dampers as shown on Standard Details. Ensure dampers for right angle take-off of branch from vertical riser have operator extended to an accessible location. Adjust quadrants to clear duct insulation.
 - 3.3.15 Provide splitter dampers as shown on Standard Details.
 - 3.3.16 Incorporate gravity backdraft dampers where shown.
 - 3.3.17 Install motorized dampers where directed.
 - 3.3.18 Install fire dampers where shown and at all penetrations through all fire rated assemblies. Where fire dampers are shown in grilles or diffusers at ceiling level they shall be firestop flap. Obtain local authorities approvals for all damper locations and keep one set of marked-up prints on site. Approvals shall be obtained before installation of fire dampers.
 - 3.3.19 Receive automatic dampers from separate Section on site, and set in place under the supervision of the control manufacturer.
 - 3.3.20 Provide access panels at all fire dampers, gravity dampers, motorized dampers, coils, heaters, humidifiers, fan bearings or similar equipment requiring occasional maintenance or inspection. Panels shall be 600 mm x 450 mm (24 in. x 18 in.) or full width of duct if less than 450 mm (18 in.) wide. Panels shall be of double wall construction and shall be internally insulated on insulated ducts. Frame shall be of structural angle with welded corners, gasketed to receive the panel. Panel shall be held in place with 4 window sash locks.
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- 3.3.21 Paint visible internal surface behind each grille or register flat black.
- 3.3.22 Where duct is acoustically lined, duct dimensions shown are net, inside of lining.
- 3.3.23 Intake and exhaust ductwork for indoor cooling towers shall be constructed the same as ductwork but the bottom section of the intake duct shall have extra reinforcing to support a mass of 100 kg (weight of 250 lbs) without deflecting. Provide a supporting steel angle frame to support the plenum from the floor.
- 3.3.24 Apply acoustic insulation internally to ductwork where shown. In addition, internally line all low or medium pressure supply air ductwork in mechanical rooms, fan rooms, or equipment rooms. Install using both pins and adhesive. Pins shall be maximum 450 mm (18 in.) centres and shall be tack welded to the duct or plenum. Seal all edges of acoustic insulation to prevent air erosion with sheet metal nosing that overlaps the insulation by 19 mm (3/4 in.) minimum.
- 3.3.25 Spin-in connections shall only be used downstream of variable volume boxes.
- 3.3.26 Ductwork shall be run parallel to the closest wall. Coordinate with piping and structural elements.
- 3.3.27 All open ends of ductwork that do not have a diffuser, grille or register shall have a protective screen mounted in a suitable frame to connect the screen securely to the duct, wall and floor as applicable. Where a duct terminates at a supply, return or exhaust air opening provided by other sections and located less than 2000mm (79 in.) Above the finished floor, the screen shall be installed and painted matte black and shall not be capable of passage of anything larger than a 15mm (1/2 in.) Sphere through the openings.
- 3.3.28 Supply air ductwork to variable volume boxes shall be rigid duct of size shown in schedules. If the length exceeds 3000 mm (10 ft.) or if there are 2-45 deg. elbows or 1-90 deg. elbow or more increase in supply air ductwork to the variable volume box one size. If the length exceeds 6000 mm (20 ft.) increase the duct by two sizes. Under no conditions shall be supply ductwork exceed 9000 mm (30 ft.) or have more than 3-90 deg. elbows or the equivalent.

END OF SECTION

1 General

1.1 WORK INCLUDED

1.1.1 Conform to Section 21 05 00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

1.1.2 Casings and plenums for built-up air handling units shall be either prefabricated high noise attenuation and high sound transmission loss panels as specified under Section 21 05 48 – VIBRATION AND NOISE CONTROLS, or field built-up panels as shown.

1.1.3 Field built-up panels shall be as specified below.

1.2 RELATED WORK SPECIFIED ELSEWHERE

1.2.1 120V/1/60 power wiring to the junction box – under Electrical Division.

1.3 SUBMITTALS

1.3.1 Shop Drawings – Submit Shop Drawings for casing, plenum, coil supports, and filter supports for review.

2 Products

2.1 MATERIALS

2.1.1 Field built-up panels shall be 1.56 mm thick (0.614 in – 16 GSG gauge) galvanized steel sheets with coating to A.S.T.M. A653/A653M-98, Designation Z275. Construction of plenums shall be as shown. Casings, plenums and connections between components of built-up apparatus shall be constructed from a completely self-supporting rigid structural steel frame bolted or welded. The entire casing shall be constructed to absolutely prevent deflection or drumming under vacuum or pressure conditions applicable to the particular system, with all joints caulked or gasketed to give an airtight applicable to the particular system, with all joint caulked or gasketed to give an airtight installation. Waterproof gaskets shall be provided at all wet sections. At the floor line and at other joints where casing joins masonry construction, panels shall be attached to a galvanized steel angle which has been secured to masonry with expansion shields and bolts on approximately 300 mm (12 in.) centres and caulked air and water tight to masonry. At floor, provide channel to which insulation can be finished off.

2.1.2 Provide air tight hinged access doors where shown and install to swing open against the plenum pressure. Doors shall be 38 mm (1-1/2 in.) minimum thickness, with each face formed of 20 US gauge galvanized steel. Latches shall be factory made specifically for this application and shall be operable from either side. Reinforce frame for door opening with 45 mm x 32 mm x 3 mm (1-3/4 in. x 1-1/4 in. x 1/8 in.) steel angle, welded at the corners.

- 2.1.3 Gasket against which door closes shall be foamed rubber or plastic. Doors shall be 500 mm wide x 1350 mm high (20 in. x 54 in.) located 450 mm (18 in.) clear of floor unless shown otherwise. Each door shall have a 300 mm x 300 mm (12 in. x 12 in.) inspection window with 6 mm (1/4 in.) thick safety glass.
- 2.1.4 Provide drain pans under each cooling coil.
- 2.1.5 Provide hot rolled steel or H.S.S. steel framework to support the coils and drain pans. In cooling coil sections the lowest portion of the support frame and any other section that may be in contact with water shall be Type 316 stainless steel.
- 2.1.6 Provide adjustable rigid sheet metal baffles, where shown or required in all supply air mixing plenums to prevent stratification of entering air.
- 2.1.7 Provide all catwalks in apparatus casings for servicing of filters.
- 2.1.8 Provide separately switched marine lights with protective metal cages and glass seals installed on the wall opposite access doors. Extend wiring to lights and switches from a junction box (one per unit).

3 Execution

3.1 INSTALLATION

- 3.1.1 Provide readily removable sections of plenums for removal of coils, fan wheels, and motors. These sections shall be flanged, gasketed and bolted such that the section may be removed after withdrawing the bolts.
- 3.1.2 Caulk all other joints in plenums. Fit pipe penetrating plenum with a 2.71 mm thick (0.1067 in – 12 GSG gauge) flange, welded to the pipe and bolted and caulked to the plenum.
- 3.1.3 Framework for support of coils shall be such that any coil may be removed without disturbing remaining coils.
- 3.1.4 Anti-stratification baffles in mixing plenums shall be adjusted after start-up of system and before balancing when outside conditions permit a representative test with thermocouple traverse and to give mixing conditions satisfactory to the Consultant. The baffles shall then be securely fixed in position.

END OF SECTION

1 General

1.1 WORK INCLUDED

1.1.1 Conform to Section 21 05 00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

1.1.2 This section is intended for all outside air intake and exhaust plenums.

1.1.3 Section 21 05 48 – VIBRATION AND NOISE CONTROL for acoustic plenums.

1.2 SUBMITTALS

1.2.1 Shop Drawings – Submit shop drawings of the plenums for review. Shop drawings shall include material type and construction details.

2 Products

2.1 MATERIALS – FIELD BUILT-UP PLENUMS

2.1.1 Field built-up panels shall be 1.56 mm thick (0.614 in – 16 GSG gauge) galvanized steel sheets with coating to A.S.T.M. A653/A653M-98, Designation Z275. Construction of plenums shall be as shown. Casings, plenums and connections between components of built-up apparatus shall be constructed from a completely self-supporting rigid structural steel frame bolted or welded. The entire casing shall be constructed to absolutely prevent deflection or drumming under vacuum or pressure conditions applicable to the particular system, with all joints caulked or gasketed to give an airtight applicable to the particular system, with all joint caulked or gasketed to give an airtight installation. Waterproof gaskets shall be provided at all wet sections. At the floor line and at other joints where casing joins masonry construction, panels shall be attached to a galvanized steel angle which has been secured to masonry with expansion shields and bolts on approximately 300 mm (12 in.) centres and caulked air and water tight to masonry. At floor, provide channel to which insulation can be finished off.

2.1.2 The inner wall of the floor shall be fabricated from minimum 0.9525 mm thick (0.0375 in – 20 USS gauge) or 1.27 mm thick (0.05 in – 18 USG gauge) galvanized steel sheet and formed stainless steel angles, and shall extend full length of plenum, double sloped to prevent standing water. The inner skin shall be welded construction. Provide 3 in. (75mm) of insulation between the floor panels.

2.1.3 Provide insulation on field built-up plenums in conformance with Section 21 07 00 – MECHANICAL INSULATION.

2.1.4 Construction of plenums shall be as shown and shall be constructed from a completely self-supporting rigid structural steel frame bolted or welded. The entire plenum shall be constructed to absolutely prevent deflection or drumming under vacuum or pressure conditions applicable to the particular system, with all joints caulked or gasketed to give an airtight installation.

- 2.1.5 Waterproof gaskets shall be provided at all wet sections. At the floor line, and at other joints where casing joins masonry construction, panels shall be attached to a galvanized steel angle that has been secured to masonry with expansion shields and bolts on approximately 12 in. (300 mm) centres and caulked air and water tight to masonry. At floor, provide channel to which insulation can be finished off.
- 2.1.6 Doors shall be flush mounted, minimum 1350 mm x 500 mm (54 in. x 20 in.) size and mounted 450 mm (18 in.) above the floor and shall be constructed of materials similar to the plenum panels. Doors shall have matching 2.7533 mm thick (12 G.S. gauge) frames, heavy duty hinges, pressure type latches operable from inside and outside and continuous rubber seal gaskets. Doors shall open against the plenum pressure.

3 Execution

3.1 INSTALLATION

- 3.1.1 Make all connections in a way to ensure the integrity of the plenum. Provide flanged or collar openings for ducts constructed of 1.6129 mm (1/16 in.) thick (16 G.S. gauge) galvanized steel. Fit pipes penetrating plenum with a 0.1067" - 12 GSG gauge (2.71 mm thick) flange, welded to the pipe and bolted and caulked to the plenum. Caulk all other joints in plenums
 - 3.1.2 Where panels are required inside plenums, they shall be similar to the wall panels to prevent air crossover. Internal panels are not required to be double wall.
 - 3.1.3 Provide a 200mm thick curb for all full height plenums. Install a plenum drain at the bottom of plenum where shown on the drawings with a minimum of one drain per plenum. Provide a cast iron dome if there is a chance of debris entering the plenum. Double slope the plenum floor to the drain.
 - 3.1.4 Coat all plenum seams and welds with 2 coats of rust resistant finish.
 - 3.1.5 Provide readily removable sections of plenums. These sections shall be flanged, gasketed and bolted such that the section may be removed after withdrawing the bolts.
 - 3.1.6 Each plenum shall be flood tested to ensure no leaks are present. Plug the drain in the plenum and fill the plenum with 3 inches of water using a garden hose and wait for 5 minutes. Visually inspect for leaks and perform remedial work as required. Notify Consultant, Testing and Balancing trades, and/or Departmental representative to witness the flood test.
 - 3.1.7 **END OF SECTION**
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1 GENERAL

1.1 RELATED REQUIREMENTS

1.1.1 Section 21 05 00 – General Instructions for Mechanical Sections.

1.1.2 Section 01 33 00 – Submittal Procedure.

1.2 REFERENCES

1.2.1 CSAB228.1- Pipes, Ducts and Fittings for Residential Type Air Conditioning.

1.3 PRODUCT DATA

1.3.1 Submit product data in accordance with Section 01 33 00 – Submittal Procedure.

1.3.2 Indicate the following:

1.3.2.1 Flexible connections.

1.3.2.2 Duct access doors.

1.3.2.3 Turning vanes.

1.3.2.4 Instrument test ports.

1.4 CERTIFICATION OF RATINGS

1.4.1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

2.1.1 Flexible Connections: To meet Specifications.

2.1.2 Instrument Test Ports: Duro Dyne.

2.1.3 Water Heating Coils: Heatcraft, Engineered Air, Trane, Aerofin.

2.2 GENERAL

2.2.1 Manufacture in accordance with CSA B228.1.

2.3 FLEXIBLE CONNECTIONS

2.3.1 Frame: galvanized sheet metal frame thick with fabric clenched by means of double locked seams.

2.3.2 Material:

2.3.2.1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at minus 40EC to plus 90EC, density of 1.3 kg/sq.m.

2.4 ACCESS DOORS IN DUCTS

- 2.4.1 Non-insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.
- 2.4.2 Insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.
- 2.4.3 Gaskets: neoprene or foam rubber.
- 2.4.4 Hardware:
 - 2.4.4.1 Up to 300 x 300 mm: 2 sash locks.
 - 2.4.4.2 301 to 450 mm: 4 sash locks.
 - 2.4.4.3 451 to 1000 mm: piano hinge and minimum 2 sash locks.
 - 2.4.4.4 Doors over 1000 mm: piano hinge and 2 handles operable from both sides.
 - 2.4.4.5 Hold open devices.

2.5 TURNING VANES

- 2.5.1 Factory or shop fabricated single thickness and double thickness with without trailing edge, to recommendations of SMACNA and as indicated.

2.6 INSTRUMENT TEST PORTS

- 2.6.1 1.6 mm thick steel zinc plated after manufacture.
- 2.6.2 Cam lock handles with neoprene expansion plug and handle chain.
- 2.6.3 28 mm minimum inside diameter. Length to suit insulation thickness.
- 2.6.4 Neoprene mounting gasket.
- 2.6.5 Acceptable material: Duro Dyne IP1 or IP2.

2.7 WATER HEATING COILS

- 2.7.1 Tubes: 5/8 inch (16mm) OD seamless copper arranged in parallel or staggered pattern, expanded into fins, brazed joints.
 - 2.7.2 Fins: Aluminum continuous plate type with full fin collars individual helical finned tube type wound under tension.
 - 2.7.3 Casing: Die formed channel frame of galvanized steel with mounting holes.
 - 2.7.4 Headers: Seamless copper tube with silver brazed joints .
 - 2.7.5 Testing: Air test under water to 1380 kPa 200 psig for working pressure of 1035 kPa 150 psig and 104 degrees C 220 degrees F .
 - 2.7.6 Configuration: Serpentine type with return bends on smaller sizes and return headers on larger sizes.
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3 EXECUTION

3.1 INSTALLATION

3.1.1 Flexible connections:

3.1.1.1 Install in following locations:

- 3.1.1.1.1 Inlets and outlets to supply air units and fans.
- 3.1.1.1.2 Inlets and outlets of exhaust and return air fans.
- 3.1.1.1.3 As indicated.

3.1.1.2 Length of connection: 100 mm.

3.1.1.3 Minimum distance between metal parts when system in operation: 75 mm.

3.1.1.4 Install in accordance with recommendations of SMACNA.

3.1.1.5 When fan is running:

- 3.1.1.5.1 Ducting on each side of flexible connection to be in alignment.
- 3.1.1.5.2 Ensure slack material in flexible connection.

3.1.2 Access doors:

3.1.2.1 Size:

- 3.1.2.1.1 1200 x 900 mm for person size entry.
- 3.1.2.1.2 300 x 300 mm for servicing entry.
- 3.1.2.1.3 150 x 150 mm for viewing.
- 3.1.2.1.4 As indicated.

3.1.2.2 Location:

- 3.1.2.2.1 At fire dampers.
- 3.1.2.2.2 At control dampers.
- 3.1.2.2.3 At devices requiring maintenance.
- 3.1.2.2.4 At locations required by code.
- 3.1.2.2.5 At reheat coils.
- 3.1.2.2.6 Elsewhere as indicated.

3.1.3 Instrument test ports.

3.1.3.1 General:

- 3.1.3.1.1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.

3.1.3.2 Locations.

3.1.3.2.1 For traverse readings:

- At ducted inlets to roof and wall exhausters.
- At inlets and outlets of other fan systems.
- At main and sub-main ducts.
- And as indicated.

3.1.3.2.2 For temperature readings:

- At outside air intakes.
 - In mixed air applications in locations as approved by Consultant.
 - At inlet and outlet of coils.
 - Downstream of junctions of two converging air streams of different temperatures.
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- And as indicated.

3.1.4 Turning vanes:

- 3.1.4.1 Install in accordance with recommendations of SMACNA and as indicated.

3.1.5 Water Heating Coils:

- 3.1.5.1 Install to manufacturers written instructions

- 3.1.5.2 Install in ducts and casings to SMACNA HVAC Duct Construction Standards, Metal and Flexible.

- 3.1.5.2.1 Support coil sections independent of piping on steel channel or double angle frames and secure to casings.

- 3.1.5.2.2 Provide frames for maximum three coil sections.

- 3.1.5.2.3 Arrange supports to avoid piercing drain pans.

- 3.1.5.2.4 Provide airtight seal between coil and duct or casing.

- 3.1.5.3 Protect coils to prevent damage to fins and flanges. Comb out bent fins.

- 3.1.5.4 Install coils level.

- 3.1.5.5 Make connections to coils with unions and flanges.

- 3.1.5.6 Hydronic Coils:

- 3.1.5.6.1 Hydronic Coils: Connect water supply to leaving air side of coil (counter flow arrangement).

- 3.1.5.6.2 Provide shut-off valve on supply line and on return line.

- 3.1.5.6.3 Locate water supply at bottom of supply header and return water connection at top.

- 3.1.5.6.4 Provide float operated automatic air vents at high points complete with stop valve.

END OF SECTION

1 GENERAL

1.1 RELATED REQUIREMENTS

1.1.1 Section 21 05 00 – General Instruction for Mechanical Sections.

1.1.2 Section 01 33 00 – Submittal Procedure.

1.2 REFERENCES

1.2.1 SMACNA HVAC D20 -Duct Construction Standards, Metal and Flexible-1985.

1.3 PRODUCT DATA

1.3.1 Submit product data in accordance with Section 01 33 00 – Submittal Procedure.

2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

2.1.1 Dampers: Honeywell, Johnsons, Landis & Gyr, Tamco Canada, Westvent.

2.2 GENERAL

2.2.1 Manufacture to SMACNA standards.

2.3 SINGLE BLADE DAMPERS

2.3.1 Of same material as duct, but one sheet metal thickness heavier. V-groove stiffened.

2.3.2 Size and configuration to recommendations of SMACNA, except maximum height 100 mm as indicated.

2.3.3 Locking quadrant with shaft extension to accommodate insulation thickness.

2.3.4 Inside and outside nylon end bearings.

2.3.5 Channel frame of same material as adjacent duct, complete with angle stop.

2.4 MULTI-BLADED DAMPERS

2.4.1 Factory manufactured of material compatible with duct.

2.4.2 Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA.

2.4.3 Maximum blade height: 100 mm as indicated.

2.4.4 Bearings: self-lubricating nylon.

2.4.5 Linkage: shaft extension with locking quadrant.

2.4.6 Channel frame of same material as adjacent duct, complete with angle stop.

3 EXECUTION

3.1 INSTALLATION

- 3.1.1 Install where indicated.
- 3.1.2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
- 3.1.3 For supply, return and exhaust systems, balancing dampers are to be located in each branch duct.
- 3.1.4 Each grille, register and diffuser connection to have balancing damper located as close as possible to main ducts.
- 3.1.5 Install splitter damper blade, pivot and control rod in rigid manner to prevent vibration.

END OF SECTION

1 GENERAL

1.1 RELATED REQUIREMENTS

1.1.1 Section 21 05 00 – General Instructions for Mechanical Sections.

1.1.2 Section 01 33 00 – Submittal Procedure.

1.1.3 Electrical.

1.2 REFERENCES

1.2.1 ASTM A525M-87, Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.

1.3 PRODUCT DATA

1.3.1 Submit product data in accordance with Section 01 33 00 – Submittal Procedure.

1.3.2 Indicate the following:

1.3.2.1 Performance data.

1.4 MAINTENANCE DATA

1.4.1 Provide maintenance data for incorporation into manual specified in Section 01 33 00 – Submittal Procedure.

1.5 CERTIFICATION OF RATINGS

1.5.1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency.

2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

2.1.1 Dampers: Honeywell, Johnson, Landis & Gyr, Moore, Tamco Canada, Westvent.

2.2 MULTI-LEAF

2.2.1 Opposed blade type as indicated.

2.2.2 Structurally formed steel or Extruded aluminum, interlocking blades, complete with extruded vinyl seals, spring stainless steel side seals, structurally formed and welded galvanized steel or extruded aluminum frame.

2.2.3 Pressure fit self-lubricated bronze bearings.

- 2.2.4 Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod.
- 2.2.5 Operator: to Division 25.
- 2.2.6 Performance: leakage in closed position to be less than 2% of rated air flow.
- 2.2.7 Acceptable material: Tamco.

3 EXECUTION

3.1 INSTALLATION

- 3.1.1 Install where indicated.
- 3.1.2 Install in accordance with recommendations of SMACNA and manufacturer's instructions.
- 3.1.3 Seal multiple damper modules with silicon sealant.
- 3.1.4 Upon system start-up, ensure that dampers operate properly.

END OF SECTION

1 GENERAL

1.1 RELATED REQUIREMENTS

- 1.1.1 Section 21 05 00 – General Instructions for Mechanical Sections.
- 1.1.2 Section 01 33 00 – Submittal Procedure.
- 1.1.3 Division 25 - Controls.
- 1.1.4 Electrical.

1.2 REFERENCES

- 1.2.1 ANSI/NFPA 90A-1985, Installation of Air Conditioning and Ventilating Systems.
- 1.2.2 CAN4-S112-M82(R1987), Fire Test of Fire Damper Assemblies.
- 1.2.3 CAN4-S112.2-M84, Fire Test of Ceiling Firestop Flap Assemblies.
- 1.2.4 ULC-S505-1974, Fusible Links for Fire Protection Service.

1.3 PRODUCT DATA

- 1.3.1 Submit product data in accordance with Section 01 33 00 – Submittal Procedure.
- 1.3.2 Indicate the following:
 - 1.3.2.1 Fire dampers.
 - 1.3.2.2 Fire stop flaps.

1.4 MAINTENANCE DATA

- 1.4.1 Provide maintenance data for incorporation into manual specified in Section 01 33 00 – Submittal Procedure.

1.5 MAINTENANCE MATERIALS

- 1.5.1 Provide maintenance materials in accordance with Section 21 08 03 – Operating and Maintenance Instructions.
- 1.5.2 Provide following:
 - 1.5.2.1 6 fusible links of each type.

1.6 CERTIFICATION OF RATINGS

- 1.6.1 Catalogue 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.
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2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- 2.1.1 Dampers: Canada Advanced Air Ltd., Controlled Air Manufacturing, Nailor Hart, Penn Ventilator Canada Ltd., Ruskin(Kerr- Hunt.

2.2 FIRE DAMPERS

- 2.2.1 Fire dampers: listed and bear label of ULC, meet requirements of provincial fire authority and NFPA 90A and authorities having jurisdiction.
- 2.2.2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.
- 2.2.3 Top hinged: offset single damper, round or square; multi-blade hinged or interlocking type; sized to maintain full duct cross section as indicated.
- 2.2.4 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow.
- 2.2.5 40 x 40 x 3 mm retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.
- 2.2.6 Acceptable material: Nailor Hart.

2.3 FIRE STOP FLAPS

- 2.3.1 To be ULC listed and labelled.
- 2.3.2 Construct of minimum 1.5 mm thick sheet steel with 1.6 mm thick non-asbestos ULC listed insulation and corrosion-resistant pins and hinges.
- 2.3.3 Flaps to be held open with fusible link conforming to ULC-S505 and close at 74 EC or as indicated.

3 EXECUTION

3.1 INSTALLATION

- 3.1.1 Install in accordance with NFPA 90A and in accordance with conditions of ULC listing.
 - 3.1.2 Fire damper assemblies to be fire tested in accordance with CAN4-S112.
 - 3.1.3 Fire stop flap assemblies to be fire tested in accordance with CAN4-S112.2.
 - 3.1.4 Maintain integrity of fire separation.
 - 3.1.5 After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.
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- 3.1.6 Install access door adjacent to each damper. See Section 23 33 00 - Duct Accessories.
- 3.1.7 Coordinate with installer of firestopping.

END OF SECTION

1 GENERAL

1.1 RELATED REQUIREMENTS

1.1.1 Section 21 05 00 – General Instructions for Mechanical Sections.

1.1.2 Section 01 33 00 – Submittal Procedure.

1.1.3 Section 23 31 13 – Ductwork Specialties.

1.2 REFERENCES

1.2.1 SMACNA HVAC Duct Construction Standards, Metal and Flexible-1985.

1.2.2 ASTM C177-85, Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.

1.2.3 CAN/ULC-S102-M88, Surface Burning Characteristics of Building Materials and Assemblies.

1.2.4 CGSB 51-GP-10M-76, Thermal Insulation, Mineral Fibre, Block or Board, for Ducting, Machinery and Boilers.

1.2.5 CGSB 51-GP-11M-76, Thermal Insulation, Mineral Fibre, Blanket, for Piping, Ducting, Machinery and Boilers.

1.2.6 ANSI/NFPA 90A-1985, Installation of Air Conditioning and Ventilating Systems.

1.2.7 ANSI/NFPA 90B-1984, Installation of Warm Air Heating and Air Conditioning Systems.

1.3 PRODUCT DATA

1.3.1 Submit product data in accordance with Section 01 33 00 – Submittal Procedure.

2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

2.1.1 Duct Liner: Fibreglas, Manson, Manville, Knauf. Sealants and Tape: Duro

2.1.2 Sealants and Tapes: Duro Dyne, Foster.

2.2 DUCT LINER

2.2.1 General:

2.2.1.1 Fibrous glass duct liner: air stream side faced with mat facing.

2.2.1.2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50 when tested in accordance with CAN/ULC-S102.

2.2.2 Rigid:

- 2.2.2.1 Use on flat surfaces where indicated.
- 2.2.2.2 25 mm thick, to CGSB 51-GP-10M, fibrous glass rigid board duct liner.
- 2.2.2.3 Density: 36 kg/m³; minimum.
- 2.2.2.4 Thermal resistance to be minimum 0.76 m². °C/W for 25 mm thickness.

2.2.3 Flexible:

- 2.2.3.1 Use on round or oval surfaces where indicated.
- 2.2.3.2 25 mm thick, to CGSB-51-GP-11M, fibrous glass blanket duct liner.
- 2.2.3.3 Density: 24 kg/m³ minimum.
- 2.2.3.4 Thermal resistance to be minimum 0.74 m². °C/W for 25 mm thickness when tested in accordance with ASTM C177, at 24 °C mean temperature.

2.2.4 Acceptable Material: Fibreglas.

2.3 ADHESIVE

- 2.3.1 Meet requirements of ANSI/NFPA 90A and ANSI/NFPA 90B.
- 2.3.2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 29 °C to plus 93 °C.
- 2.3.3 Acceptable material: Duro Dyne 1A-22.

2.4 FASTENERS

- 2.4.1 Weld pins 2.0 mm diameter, length to suit thickness of insulation. Metal retaining clips, 32 mm square.
- 2.4.2 Acceptable material: Duro Dyne PN series with Nc or Pc-1 series clips.

2.5 JOINT TAPE

- 2.5.1 Poly-Vinyl treated open weave fiberglass membrane 50 mm wide.
- 2.5.2 Acceptable material: Duro-Dyne FT2.

2.6 SEALER

- 2.6.1 Meet requirements of ANSI/NFPA 90A and ANSI/NFPA 90B.
 - 2.6.2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 68°C to plus 93°C.
 - 2.6.3 Acceptable material: Duro Dyne S-2.
-

3 EXECUTION

3.1 GENERAL

- 3.1.1 Do work in accordance with recommendations of SMACNA duct liner standards as indicated in SMACNA HVAC Duct Construction Standards, Metal and Flexible, except as specified otherwise.
- 3.1.2 Line inside of ducts where indicated.
- 3.1.3 Duct dimensions, as indicated, are clear inside duct lining.

3.2 DUCT LINER

- 3.2.1 Install in accordance with manufacturer's recommendations, and as follows:
 - 3.2.1.1 Fasten to interior sheet metal surface with 100% coverage of adhesive.
 - 3.2.1.2 In addition to adhesive, install weld pins not less than 2 rows per surface and not more than 425 mm on centres.

3.3 JOINTS FOR LOW PRESSURE DUCTS REFER TO SECTION 23 31 13

- 3.3.1 Protect leading and trailing edges of each Duct section with approved sealer to SMACNA standards.
- 3.3.2 Seal all joints with approved sealer to SMACNA standards.
- 3.3.3 Seal all exposed edges and all damaged areas of liner with Joint Tape and Sealer.
- 3.3.4 Replace badly damaged area of Liner at the discretion of the Consultant.

END OF SECTION

1 GENERAL

1.1 RELATED REQUIREMENTS

- 1.1.1 Section 21 05 00: General Instructions for Mechanical Sections.
- 1.1.2 Section 01 33 00: Submittal Procedure.
- 1.1.3 Section 21 05 48: Vibration and Noise Control.
- 1.1.4 Section 25 05 01: BAS General Requirements.
- 1.1.5 Division 26 electrical.

1.2 REFERENCES

- 1.2.1 AMCA 99-1986, Standards Handbook.
- 1.2.2 ANSI/AMCA 210-1985, Laboratory Methods of Testing Fans for Rating.
- 1.2.3 AMCA 300-1985 Revised 1987, Reverberant Room Method for Sound Testing of Fans.
- 1.2.4 AMCA 301-1976, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- 1.2.5 ANSI/ASHRAE 51-1985, Laboratory Methods of Testing Fans for Rating.
- 1.2.6 CGSB 1-GP-181M-77, Coating, Zinc Rich, Organic, ReadyMixed.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- 1.3.1 Submit shop drawings and product data in accordance with Section 01 33 00 – Submittal Procedure.
- 1.3.2 Product data to include fan curves and sound rating data, showing point of operation.
- 1.3.3 Indicate the following: motors, wheels, bearings, shafts.

1.4 OPERATION AND MAINTENANCE DATA

- 1.4.1 Provide operation and maintenance data for incorporation into manual specified in Section 01 33 00 – Submittal Procedure.

1.5 MAINTENANCE MATERIALS

- 1.5.1 Provide maintenance materials in accordance with Section 21 08 03 Operating and Maintenance Instructions.
 - 1.5.1.1 Spare parts to include:
 - 1.5.1.1.1 Matched sets of belts.

- 1.5.2 Furnish list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.

1.6 MANUFACTURED ITEMS

- 1.6.1 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 in force.

2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- 2.1.1 Centrifugal In-Line Fans: Greenheck, Penn, Lorne Cook, Delhi.

2.2 IN-LINE FANS

- 2.2.1 Duct mounted exhaust fans shall be of the centrifugal belt driven in-line type. The fan housing shall be of the square design constructed of heavy gauge galvanized steel and shall include square duct mounting collars.
 - 2.2.2 Fan construction shall include two removable access panels located perpendicular to the motor mounting panel. The access panels must be of sufficient size to permit easy access to all interior components.
 - 2.2.3 The fan wheel shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances. Wheels shall be statically and dynamically balanced.
 - 2.2.4 Motors shall be heavy duty ball bearing type, carefully matched to the fan load and furnished at the specified voltage, phase and enclosure. Motors and drives shall be mounted out of the airstream. Motors shall be readily accessible for maintenance.
 - 2.2.5 Precision ground and polished fan shafts shall be mounted in permanently sealed, lubricated pillow block ball bearings. Bearings shall be selected for a minimum (L50) life in excess of 200,000 hours at maximum cataloged operating speed.
 - 2.2.6 Drives shall be sized for a minimum of 150% of driven horsepower. Pulleys shall be of the fully machined cast iron type, keyed and securely attached to the wheel and motor shafts.
 - 2.2.7 Motor pulleys shall be adjustable for final system balancing. A NEMA 1 disconnected switch shall be provided as standard, except with explosion resistant motors, where disconnects are optional. Factory wiring shall be provided from motor to the handy box.
-

2.2.8 All fans shall bear the AMCA Certified Ratings Seal for both sound and air performance.

2.2.9 Each fan shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number for future identification.

2.2.10 Acceptable Material: Greenheck BSQ Series

3 EXECUTION

3.1 FAN INSTALLATION

3.1.1 Install fans as indicated, complete with resilient mountings specified in Section 21 05 48 - Vibration and Noise Control and flexible electrical leads.

3.1.2 Install fans with 100 mm flexible connection on inlet ductwork and on discharge ductwork. Ensure metal bands of connectors are parallel with minimum 75 mm flex between ductwork and fan during running.

3.1.3 Flexible connections shall not be in tension during running.

3.1.4 Provide sheaves and belts required for final air balance.

END OF SECTION

1 GENERAL

1.1 RELATED REQUIREMENTS

1.1.1 Section 21 05 00 - General Instructions for Mechanical Sections.

1.1.2 Section 01 33 00 – Submittal Procedure.

1.1.3 Section 23 05 93 – Testing Adjusting and Balancing (TAB).

1.2 PRODUCT DATA

1.2.1 Submit product data in accordance with Section 01 33 00 – Submittal Procedure.

1.2.2 Indicate the following:

1.2.2.1 Capacity.

1.2.2.2 Throw and terminal velocity.

1.2.2.3 Noise criteria.

1.2.2.4 Pressure drop.

1.2.2.5 Neck velocity.

1.3 MAINTENANCE MATERIALS

1.3.1 Provide maintenance materials in accordance with Section 21 08 03 – Operating and Maintenance Instructions.

1.3.2 Include:

1.3.2.1 Keys for volume control adjustment.

1.3.2.2 Keys for air flow pattern adjustment.

1.4 MANUFACTURED ITEMS

1.4.1 Grilles, registers and diffusers shall be product of one manufacturer for generic type.

1.5 CERTIFICATION OF RATINGS

1.5.1 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 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

2.1.1 Grilles, Registers and Diffusers: E.H. Price, Titus, Barber Coleman, Hart and Cooley, Kreuger, Nailor.

2.2 GENERAL

- 2.2.1 Standard product to meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as indicated.
- 2.2.2 Concealed operators.
- 2.2.3 Colour: As Indicated.
- 2.2.4 Acceptable material: As indicated.

2.3 SUPPLY GRILLES

- 2.3.1 General: with concealed manual operator and gaskets.
- 2.3.2 Steel, 25 mm border, double deflection with airfoil shape, horizontal face and vertical rear bars.

2.4 RETURN AND EXHAUST GRILLES

- 2.4.1 General: with opposed blade dampers on exhaust grilles, concealed manual operator and gaskets.
- 2.4.2 Steel or aluminium (as noted), 19 mm border, single 45E deflection, horizontal face bars.

2.5 DIFFUSERS

- 2.5.1 General: volume control dampers with flow straightening devices and blank-off quadrants and gaskets.
- 2.5.2 Steel, round type, having adjustable pattern, surface mounted.
- 2.5.3 Steel, square type, having fixed pattern, lay-in and or surface mounted.

2.6 NOISE CRITERIA

- 2.6.1 Grille, register and diffuser shall be sized to meet acceptable noise level indicated in the table below.
-

Space	Noise Level NC/RC
Residences (Apartment Houses)	25-35
Server Room	45
Storage Rooms	45
Washrooms	45

3 EXECUTION

3.1 INSTALLATION

- 3.1.1 Install in accordance with manufacturers instructions.
- 3.1.2 Install with oval head cadmium plated screws in countersunk holes where fastenings are visible.
- 3.1.3 Bolt grilles, registers and diffusers, in place, in gymnasium and similar game rooms.

END OF SECTION

1 GENERAL

1.1 RELATED REQUIREMENTS

1.1.1 Section 21 05 00 – General Instructions for Mechanical Sections.

1.1.2 Section 01 33 00 – Submittal Procedure.

1.2 REFERENCES

1.2.1 ANSI/NFPA 96-1987, Vapor Removal from Cooking Equipment.

1.2.2 ASTM E90-87, Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.

1.3 PRODUCT DATA

1.3.1 Submit product data in accordance with Section 01 33 00 – Submittal Procedure.

1.4 CERTIFICATION OF RATINGS

1.4.1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards.

1.5 TEST REPORTS

1.5.1 Submit certified data from independent laboratory substantiating acoustic and aerodynamic performance to ASTM E90.

2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

2.1.1 Louvers: Airolite, E.H.Price, Westvent, Ruskin.

2.2 STATIONARY LOUVRES

2.2.1 Construction: welded with exposed joints ground flush and smooth.

2.2.2 Material: extruded aluminum alloy 6063-T5.

2.2.3 Blade: stormproof pattern with centre watershed in blade, reinforcing bosses and maximum blade length of 1500 mm.

2.2.4 Frame, head, sill and jamb: 150 mm deep one piece extruded aluminum, minimum 3 mm thick with approved caulking slot, integral to unit.

2.2.5 Mullions: at 1500 mm maximum centres.

- 2.2.6 Fastenings: stainless steel (Society of Automotive Engineers) SAE-194-8F with SAE- 194- SFB nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, ss washer and aluminum body.
- 2.2.7 Screen: 12 mm exhaust 19 mm intake mesh, 2 mm diam wire aluminum birdscreen on inside face of louvres in formed U-frame.
- 2.2.8 Finish: factory applied enamel, Colour: to Architect's approval.
- 2.2.9 Acceptable material: Airolite CB6776.

3 EXECUTION

3.1 INSTALLATION

- 3.1.1 In accordance with manufacturers and SMACNA recommendations.
- 3.1.2 Reinforce and brace air vents, intakes and goosenecks to withstand local wind speeds as indicated.

END OF SECTION

1 GENERAL

1.1 RELATED WORK

1.1.1 Section 21 05 00 – General Instructions for Mechanical Sections.

1.1.2 Section 01 33 00 – Submittal Procedure.

1.2 REFERENCES

1.2.1 ASHRAE 52-76, "Method of Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter".

1.2.2 ULC C710-1980, "Grease Extractors for Exhaust Ducts".

1.2.3 CAN4-S111-M80, "Fire Tests for Air Filter Units".

1.2.4 CAN/CGSB-115.10-M80 Filters, Air, Disposable, for Removal of Particulate Matter from Ventilating Systems.

1.2.5 CAN/CGSB-115.11-M85 Filters, Air, High Efficiency, Disposable, Bag Type (Reaffirmed April 1985).

1.2.6 CAN/CGSB-115.12-M85 Filters, Air, Medium Efficiency, Disposable, Bag Type (Reaffirmed April 1985)

1.2.7 CAN/CGSB-115.13-85 Filter Media, Automatic Roll (Reaffirmed April 1985)

1.2.8 CAN/CGSB-115.14-M80 Filters, Air Cartridge Type, High Efficiency, Supported, for Removal of Particulate Matter from Ventilating Systems

1.2.9 CAN/CGSB-115.15-M80 Filter, Air, High Efficiency, Rigid Type, for Removal of Particulate Matter from Ventilating Systems

1.2.10 CAN/CGSB-115.16-M82 Activated Carbon for Odor Removal from Ventilating Systems

1.2.11 CAN/CGSB-115.18-M85 Filter, Air Extended Area Panel Type, Medium Efficiency

1.3 SHOP DRAWINGS AND PRODUCT DATA

1.3.1 Submit shop drawings and product data in accordance with Section 01 33 00 – Submittal Procedure.

1.3.2 Indicate the following: Filters, mounting frames and 1.

1.4 MAINTENANCE DATA

1.4.1 Provide maintenance data for incorporation into manual specified in Section 21 08 03 – Operating and Maintenance Instructions.

1.5 CERTIFICATION OF RATINGS

- 1.5.1 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 PRODUCTS

2.1 ACCEPTABLE MATERIAL

- 2.1.1 Filters: AAF, Cambridge, Farr.

2.2 GENERAL

- 2.2.1 Filters: suitable for air at 100% RH and air temperatures between minus 40 and 50 Deg.C.
- 2.2.2 Number of units, size and thickness of panels, overall dimensions of filter bank, configuration and capacities: as indicated.

2.3 ACCESSORIES

- 2.3.1 Holding frames: 1.6 mm thick channel section construction of galvanized steel or extruded aluminum.
- 2.3.2 Seals: to ensure leakproof operation.
- 2.3.3 Blank-off plates: as required, to fit all openings and of same material as holding frames.
- 2.3.4 Access and servicing: through doors/panels on each side and/or from upstream or downstream face of filter bank.

2.4 COTTON PANEL FILTERS

- 2.4.1 Disposable pleated reinforced 2 dry media: to CAN/CGSB 115.18.
- 2.4.2 Permanent galvanized steel holding frame or slide in channel for side access.
- 2.4.3 Efficiency: 30% to ASHRAE 52.
- 2.4.4 Fire rated: to CAN4-S111.
- 2.4.5 Nominal thickness: 50 mm.
- 2.4.6 Standard of Acceptance: Farr 30/30.

2.5 AIR FILTER GAUGES

- 2.5.1 Dial type: diaphragm actuated, direct reading.
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- 2.5.2 Range: 0 – 250 Pa.
- 2.5.3 One for each bank of filters.
- 2.5.4 Permanent markers for initial pressure drop and manufacturer's recommended final pressure drop.
- 2.5.5 Standard of Acceptance: Dwyer 2000 series gauge.

3 EXECUTION

3.1 INSTALLATION GENERAL

- 3.1.1 Install in accordance with manufacturers recommendations.

3.2 REPLACEMENT MEDIA

- 3.2.1 Replace all media with new upon acceptance.
- 3.2.2 Filter media to be new and clean, at time of acceptance.

3.3 SPARE FILTER MEDIA

- 3.3.1 Furnish in accordance with Section 21 05 00 – General Instructions for Mechanical Sections.

END OF SECTION

1 GENERAL

1.1 RELATED REQUIREMENTS

1.1.1 Section 21 05 00 - General Instructions for Mechanical Sections.

1.1.2 Section 01 33 00 – Submittal Procedure.

1.2 SHOP DRAWINGS AND PRODUCT DATA

1.2.1 Submit shop drawings and product data in accordance with Section 01 33 00 – Submittal Procedure.

1.2.2 Clearly indicate following:

1.2.2.1 Methods of sealing sections.

1.2.2.2 Methods of expansion.

1.2.2.3 Details of thimbles.

1.2.2.4 Supports.

1.2.2.5 Guy details.

1.2.2.6 Rain caps.

1.3 MAINTENANCE DATA

1.3.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.

1.4 CERTIFICATION OF RATINGS

1.4.1 Catalogued or published ratings shall be those obtained from tests carried out by independent testing agency or manufacturer signifying adherence to codes and standards.

2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

2.1.1 Chimneys: Selkirk Metalbestos, Van Packer, Ecco.

2.2 BREECHINGS

2.2.1 Shop fabricated 3.5 mm thick mild steel, with sweep bends from boiler outlet to thimble or chimney as indicated.

2.3 TYPE B GAS VENT

2.3.1 ULC labelled, 288 deg.C rating maximum, atmospheric gas vent only.

2.3.2 Sectional, prefabricated, double wall with 13 mm air space. Aluminum inner wall. Galvanized steel outer wall. Mated fittings and couplings.

2.3.3 Acceptable material: Selkirk Metalbestos.

2.4 ALL FUELS PRESSURE CHIMNEY AND BREECHING

2.4.1 ULC labelled, 760 deg.C rated, all fuels.

2.4.2 Sectional, prefabricated, double wall with airspace mineral wool insulation with mated fittings and couplings.

2.4.2.1 Liner: type 304 316 stainless steel.

2.4.2.2 Shell: type 304 316 stainless steel aluminized steel.

2.4.2.3 Outer seals between sections: to suit application.

2.4.2.4 Inner seals between sections: to suit application.

2.4.3 Acceptable material: Selkirk Metalbestos.

2.5 ACCESSORIES

2.5.1 Cleanouts: bolted, gasketed type, full size of breeching, as indicated.

2.5.2 Hangers and supports: in accordance with recommendations of SMACNA as indicated.

2.5.3 Rain cap.

3 EXECUTION

3.1 INSTALLATION - GENERAL

3.1.1 Follow manufacturer's and SMACNA installation recommendations for shop fabricated components.

3.1.2 Suspend breeching at 1.5 m centres and at each joint.

3.1.3 Support chimneys at bottom, roof and intermediate levels as indicated.

3.1.4 Install thimbles where penetrating roof, floor, ceiling and where breeching enters masonry chimney. Pack annular space with asbestos rope.

3.1.5 Install flashings on chimneys penetrating roofs, as indicated.

3.1.6 Install rain caps and cleanouts, as indicated.

END OF SECTION

1. General

1.1. WORK INCLUDED

- .1 Conform to Section 21 05 00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

2. Product

2.1. MATERIAL

- .1 The BOILER shall be a LOCHINVAR Model WHB399 having a modulating input rating of 400,000 Btu/Hr, an output of 367,000 Btu/Hr and shall be operated on Natural Gas. The BOILER shall be capable of following performance:

Model	Turndown	Minimum Input	Maximum Input
WHB399	10:1	80,000	400,000

- .2 Maximum unit dimensions shall be: 33 inches Length, 26-1/4 inches Width and 53-1/2 inches Height. Maximum operating (wet) unit weight shall be no more than 570 pounds.
- .3 The BOILER shall bear the ASME "H" stamp for 160 psi working pressure and shall be National Board listed. The BOILER shall have a fully welded, stainless steel, fire tube heat exchanger. Multiple pressure vessels in a single enclosure are not acceptable. There shall be no banding material, bolts, gaskets or "O" rings in the pressure vessel construction. The heat exchanger shall be designed for a single-pass water flow to limit the water side pressure drop. Pressure drop shall be no greater than 2.2 psi at 75 GPM. The condensate collection basin shall be constructed of welded stainless steel. The complete heat exchanger assembly shall carry a ten (10) year limited warranty.
- .4 The boiler shall be provided with condensate neutralization kit.
- .5 The heat exchanger shall have a volume of water no less than:

Model	Water Content
WHB399	6.5 gallons

- .6 The BOILER shall be certified and listed by C.S.A. International under the latest edition of the harmonized ANSI Z21.13 test standard for the U.S. and Canada. The BOILER shall comply with the energy efficiency requirements of the latest edition of ASHRAE 90.1 and the minimum efficiency requirements of the latest edition of the AHRI BTS-2000 Standard as defined by the Department of Energy in 10 CFR Part 431. The BOILER shall
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operate at a minimum of 97% Combustion and Thermal Efficiency at full fire as registered with AHRI. The BOILER shall be certified for indoor installation.

- .7 The BOILER shall be constructed with a heavy gauge steel jacket assembly, primed and pre-painted on both sides. The combustion chamber shall be sealed and completely enclosed, independent of the outer jacket assembly, so that integrity of the outer jacket does not affect a proper seal. A burner/flame observation port shall be provided for observing the burner flame and combustion chamber. The burner shall be a premix design constructed of high temperature stainless steel with a woven Fecralloy outer covering to provide smooth operation at all modulating firing rates. The BOILER shall be supplied with a negative pressure regulation gas valve and be equipped with a pulse width modulation blower system to precisely control the fuel/air mixture to the burner. The BOILER shall operate in a safe condition with gas supply pressures as low as 4 inches of water column. The burner flame shall be ignited by direct spark ignition with flame monitoring via a flame sensor.
 - .8 The BOILER shall utilize a 24 VAC control circuit and components. The control system shall have a factory installed display for boiler set-up, boiler status, and boiler diagnostics. All components shall be easily accessed and serviceable from the front and top of the jacket. The BOILER shall be equipped with a temperature/pressure gauge; high limit temperature control with manual reset; ASME certified pressure relief valve set for 50 psi (standard); outlet water temperature sensor with a dual thermistor to verify accuracy; system supply water temperature sensor; outdoor air sensor, flue temperature sensor with dual thermistor to verify accuracy; low water cut off with manual reset, blocked drain switch and a condensate trap for the heat exchanger condensate drain.
 - .9 The BOILER shall feature the "SMART SYSTEM™" control which is standard and factory installed with 128 x 128 resolution display, password security, outdoor air reset, pump delay with freeze protection, pump exercise, ramp delay featuring six steps, domestic hot water prioritization with limiting capabilities, USB drive for simple uploading of parameters and a PC port connection for connection to a local computer for programming and trending. A secondary operating control that is field mounted outside or inside the appliance is not acceptable. The BOILER shall have alarm contacts for any failure, runtime contacts and data logging of runtime at given modulation rates, ignition attempts and ignition failures. The BOILER shall have a built-in "Cascade" with leader redundancy to sequence and rotate while maintaining modulation of up to eight boilers of different Btu inputs without utilization of an external controller. The internal "Cascade" function shall be capable of lead-lag, efficiency optimization, front-end loading, and rotation of lead boiler every 24 hours. The BOILER shall be capable of remote communication via optional CON-X-US™ Remote Connectivity with the capability
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of historical trending and sending text message or email alerts to notify the caretaker of a boiler alarm and remote programming of onboard boiler control. The BOILER shall be capable of controlling an isolation valve (offered by manufacturer) during heating operation and rotation of open valves in standby operation for full flow applications. The control must have optional capability to communicate via Modbus protocol with a minimum of 46 readable points. The BOILER shall have a gateway device which will allow integration with BacNet protocols.

- .10 The "SMART SYSTEM™" control shall increase fan speed to boost flame signal when a weak flame signal is detected during normal operation. A 0-10 VDC output signal shall control a variable speed boiler pump (offered by manufacturer) to keep a fixed Delta T across the boiler regardless of the modulation rate. The BOILER shall have the capability to receive a 0-10 VDC input signal from a variable speed system pump to anticipate changes in system heat load in order to prevent flow related issues such as erratic temperature cycling.
- .11 The BOILER shall be equipped with two terminal strips for electrical connection. A low voltage connection board with 46 connection points for safety and operating controls, i.e., Alarm Contacts, Runtime Contacts, Louver Proving Switch, Tank Thermostat, Domestic Hot Water Building Recirculation Pump Contacts, Domestic Hot Water Building Recirculation Temperature Sensor Contacts, Remote Enable/Disable, System Supply Temperature Sensor, Outdoor Temperature Sensor, Tank Temperature Sensor, Modbus Building Management System Signal and Cascade Control Circuit. A high voltage terminal strip shall be provided for Supply voltage. Supply voltage shall be 120 volt / 60 hertz / single phase on all models. The high voltage terminal strip plus integral relays are provided for independent pump control of the System pump, the Boiler pump and the Domestic Hot Water pump.
- .12 The BOILER shall operate at altitudes up to 4,500 feet above sea level without additional parts or adjustments. The BOILER shall be certified for operation at elevations of 4,500 feet, and above, by a 3rd party organization.
- .13 The BOILER shall be suitable for use with polypropylene glycol up to a 50% concentration. The derate associated with the glycol will vary per glycol manufacturer.

3. Execution

3.1. INSTALLATION

- .1 Install in accordance with manufacturer's current installation instructions.
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- .2 The BOILER shall be installed and vented with a Direct Vent system with vertical termination of both the exhaust vent and combustion air. The flue shall be Category IV approved material constructed of AL29-4C Stainless Steel. A separate pipe shall supply combustion air directly to the boiler from the outside. The boiler's total combined air intake length shall not exceed 100 equivalent feet. The boiler's total combined exhaust venting length shall not exceed 100 equivalent feet.
- .3 Boiler control shall be installed and setup by manufacturer certified installer.

END OF SECTION

1. GENERAL

1.1. REFERENCES

- 1.1.1. American Bearing Manufacturer's Association (ABMA)
 - 1.1.2. ANSI/ABMA 9 Load Ratings and Fatigue Life for Ball Bearings.
 - 1.1.3. ANSI/ABMA 11 Load Ratings and Fatigue Life for Roller Bearings.
 - 1.1.4. Air Movement and Control Association (AMCA)
 - 1.1.5. AMCA 210, Laboratory Method of Testing Fans for Aerodynamic Performance Rating (ASHRAE).
 - 1.1.6. AMCA 300 Reverberant Room Method for Sound Testing of Fans.
 - 1.1.7. American National Standards Institute/Air-Conditioning and Refrigeration Institute (ANSI/ARI)
 - 1.1.8. ANSI/ARI 430, Central Station Air Handling Units.
 - 1.1.9. American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE)
 - 1.1.10. ASHRAE 68, Laboratory Method of Testing to Determine the Sound Power in a Duct.
 - 1.1.11. ASHRAE 84, Method of Testing Air-to-Air Exchangers.
 - 1.1.12. Canadian General Standards Board (CGSB)
 - 1.1.13. CAN/CGSB 1.181, Ready-Mixed Organic Zinc-Rich Coating.
 - 1.1.14. Canadian Standards Association (CSA)
 - 1.1.15. CSA B52 Mechanical Refrigeration Code.
 - 1.1.16. National Electrical Manufacturer's Association (NEMA)
 - 1.1.17. NEMA MG1 Motors and Generators
 - 1.1.18. NEMA ICS 7-1 Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems.
 - 1.1.19. Provincial Boiler, Pressure Vessel and Compressed Gas Regulations.
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1.1.20. Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA).

1.2. SHOP DRAWINGS AND PRODUCT DATA

1.2.1. Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

1.2.2. Indicate following: fan, fan curves showing point of operation, motor drive, bearings, filters, mixing box, dampers, VAV, coil, include performance data.

1.3. CLOSEOUT SUBMITTALS

1.3.1. Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.3.2. Include following: fan, bearings, motor, damper, VAV control, air volume, total cooling, sensible cooling, EDB,EWB, OAT.

1.4. WASTE MANAGEMENT AND DISPOSAL

1.4.1. Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal, and with the Waste Reduction Workplan.

1.4.2. Remove from site and dispose of packaging materials at appropriate recycling facilities. Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

1.4.3. Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental representative's Representative.

1.4.4. Divert unused paint material from landfill to official hazardous material collections site approved by Departmental representative's Representative.

1.4.5. Do not dispose of unused paint materials into sewer systems, into lakes, streams, onto ground or in other locations where it will pose health or environmental hazard.

1.5. EXTRA MATERIALS

1.5.1. Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

1.5.2. Provide one spare set of filters.

1.5.3. Provide list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with

list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.

- 1.5.4. Spare filters: in addition to filters installed for startup and commissioning. Immediately prior to acceptance by Departmental representative's Representative, supply 1 complete set of filters for each filter unit or filter bank.

2. PRODUCTS

2.1. GENERAL

- 2.1.1. Heat exchanger, cross-flow type made of aluminum.
- 2.1.2. Unit to be self contained with all necessary controls and wiring to facilitate a single point connect. Provide disconnect and vibration isolators.

2.2. CABINET, FANS AND FILTERS

- 2.2.1. Casing: galvanized, pre-painted steel with foil faced insulation. Double wall construction.
- 2.2.2. Provide full size access doors to allow for periodic maintenance and inspection. Door construction, same as unit with compression type handles and resilient gaskets.
- 2.2.3. Drain pans to be formed sections, recessed, fabricated from 1.2 mm stainless steel 304. Piped to nearest floor drain.
- 2.2.4. Fans: centrifugal type with double blowers and motors rated for single phase 208 V. Separate Motor for the supply and exhaust fan.
- 2.2.5. Filters: medium efficiency in the supply and exhaust air streams.
- 2.2.6. Defrost: exhaust.
- 2.2.7. Provide automatic recirc defrost cycle.
- 2.2.8. Capacity: 35.4 L/s @50 Pa, 1.5 kW electric slip in duct heater with duct mounted thermostat. Electrical requirements 120/1/60, 1.5A, 160W.

3. EXECUTION

3.1. INSTALLATION

- 3.1.1. Install units in accordance with manufacturer's instructions and as indicated.
 - 3.1.2. Ensure adequate clearance for servicing and maintenance.
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3.2. FANS

- 3.2.1. Install fan sheaves required for final air balance.
- 3.2.2. Install flexible connections at fan inlet and fan outlets.
- 3.2.3. Install vibration isolators.

3.3. DRIP PANS

- 3.3.1. Install deep seal P-traps and trap seal primer on drip lines.
- 3.3.2. Depth of water seal to be 1.5 times static pressure at this point.

END OF SECTION

1 General

1.1 WORK INCLUDED

- 1.1.1 Conform to Section 21 05 00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- 1.2.1 Electrical hard wire supply and primary connections to electrical components – under Electrical Division.

2 Products

2.1 MATERIALS

- 2.1.1 Direct gas fired air handling units shall be equal to Engineered Air, I.C.E, Thermotek.
 - 2.1.2 Unit casing will be of minimum 18 gauge (1.3mm) satin coat galvanized sheet metal. Surfaces will be cleaned with a degreasing solvent to remove oil and metal oxides and primed with a two-part acid based etching primer. Finish coat will be electrostatically applied enamel, to all exposed surfaces. All unprotected metal and welds will be factory coated.
 - 2.1.3 All walls, roofs and floors will be of formed construction, with at least two breaks at each joint. Joints will be secured by sheet metal screws or pop rivets. Wall and floor joints will be broken in and on all outdoor units roof joints broken out (exposed) for rigidity. All joints will be caulked with a water resistant sealant.
 - 2.1.4 Provide reinforcing structural C-channels under floor to minimize deflection. Formed metal channels are not acceptable.
 - 2.1.5 Units will be provided with access doors to the following components: fans and motors, filters, dampers and operators, electrical control panels and burner compartments. Access doors will be large enough for easy access. Removal of screwed wall panels will not be acceptable. Access doors will be hinged access doors, with extruded neoprene gasket, fully lined, and a minimum of two Leverlok handles, operable from both sides for all units. All access will be from one side of the unit.
 - 2.1.6 All units will be internally insulated with 1"(25mm) thick 1 1/2 lb./cu.ft. (24 kg./cu.m.) density, neoprene coated fibre glass thermal insulation. Insulation will be secured to metal panels with a fire retardant adhesive and welded steel pins at 16" (400mm) o/c. All longitudinal insulation joints and butt ends will be covered by a sheet metal break to prevent erosion of exposed edges. Units will have solid 22 gauge liner downstream of the profile plates.
 - 2.1.7 The units will be complete with an adjustable discharge air controller and a modulating burner of capacity required to yield 110 deg. F. temperature rise. An adjustable discharge air temperature selector will be mounted on the unit control panel and will include the following standard features:
 - 2.1.7.1 Self-checking of discharge air sensor to identify out of range or fault conditions
 - 2.1.7.2 Built in auto by-pass low limit with alarm contact
 - 2.1.7.3 Flame relay monitoring
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- 2.1.7.4 Air sensor self test
- 2.1.7.5 Air flow monitoring
- 2.1.7.6 Five LED indicator lights for status indication of 20 different status functions including: burner status, flame status, fan status, low limit and operation status

2.1.8 Unit shall be complete with the following:

- 2.1.8.1 Base frame to be integral steel channel construction.
- 2.1.8.2 Control cabinet to be a water and dustproof protective enclosure housing all control and gas manifold.
- 2.1.8.3 Blower to be forward curved centrifugal DWDI complete with polished ground shafting, ball bearings and V-belt drive.
- 2.1.8.4 Shall be suitable for 575 volts 3 phase 60 cycle complete with Contractor and 3 leg protection on all three phase units.
- 2.1.8.5 Prewired non-fused disconnect switch.
- 2.1.8.6 All controls to be prewired and factory tested.

2.1.9 Units shall be complete with the following accessories:

- 2.1.9.1 Motorized inlet damper
- 2.1.9.2 High pressure gas regulator 7 in.wg.
- 2.1.9.3 Control transformer

2.1.10 Unit shall carry CGA or other recognized testing authority approval. Test fire unit in the factory.

2.1.11 Fans shall be internally spring isolated with 25 mm (1 in.) static deflection.

3 Execution

3.1 INSTALLATION

- 3.1.1 Provide all control wiring in accordance with Electrical Division requirements.
- 3.1.2 Interlock make-up air units with associated parkade exhaust fans.

END OF SECTION

1 General

1.1 RELATED REQUIREMENTS

1.1.1 Electrical

1.2 CERTIFICATION AND STANDARDS

1.2.1 Products covered by this section to comply to the applicable standards of the following:

1.2.1.1 CSA C22.2 No.14-95 Industrial Control Equipment

C22.2 No.100-95 Motors and Generators

C22.2 No.0.16-M92 Measurement of Harmonic Currents

1.2.1.2 EEMAC Standards for Enclosures, Contact Ratings and Design B Motors

1.2.1.3 IEEE 519 M1992 Recommended Practices and Requirements for Harmonic Control in Electric Power Systems, Emerald Book for Transients

1.2.1.4 NEMA MG1 Part 31 1993 Rev 1 Motors and Generators

1.3 SHOP DRAWINGS

1.3.1 Provide [six] copies of shop drawings and operating literature.

1.3.2 Shop drawings shall include:

1.3.2.1 Catalogue information and technical data

1.3.2.2 Outline dimensions, shipping dimensions, weight, foundation requirements and mounting details.

1.3.2.3 Wiring, connection, and control diagrams and schematics

1.3.3 Product data for:

1.3.3.1 input current harmonics,

1.3.3.2 short circuit rating,

1.3.3.3 environmental limitations

1.3.3.4 control features.

1.4 OPERATING AND MAINTENANCE INFORMATION

1.4.1 Upon interim acceptance, provide three sets of operating and maintenance manuals including:

1.4.1.1 Operating instructions

1.4.1.2 As built shop drawings

1.4.1.3 Recommended spare parts list

1.4.1.4 Manufacturer and supplier data: including addresses and phone numbers for technical support and spare parts.

1.5 SUPPLIER QUALIFICATIONS

1.5.1 System supplier or manufacturer's authorized agent shall have technical service and maintenance capabilities, using experienced personnel, available on site within 24 hours of callout.

2 Products

2.1 PRODUCT MANUFACTURERS

2.1.1 Acceptable Manufacturers:

- 2.1.1.1 Siemens
- 2.1.1.2 Danfoss
- 2.1.1.3 Toshiba
- 2.1.1.4 Magnetek
- 2.1.1.5 Allen Bradley
- 2.1.1.6 Mitsubishi
- 2.1.1.7 Grundfos
- 2.1.1.8 Armstrong
- 2.1.1.9 Integral VFD for pumps

2.2 VARIABLE FREQUENCY DRIVES

2.2.1 General

- 2.2.1.1 Drive Type: Adjustable Frequency Drive, Pulse Width Modulated (PWM)
- 2.2.1.2 Output Devices: Insulated Gate Bipolar Transistors (IGBT) in the inverter section of the drive
- 2.2.1.3 All contactors, relays and switches EEMAC rated.
- 2.2.1.4 All drives of a single manufacture

2.2.2 Motor and Drive Compatibility:

- 2.2.2.1 Suitable for use with standard or high efficiency EEMAC Design B motors having a service factor of 1.15 or specific motors meeting NEMA MG1 Part 31, 1993 Rev.1.
- 2.2.2.2 Suitable for either constant or variable torque loads.
- 2.2.2.3 Operable without connected load for setup and testing.
- 2.2.2.4 Able to accept opening of a remote motor disconnect, while running, without damage to the drive.

2.2.3 Enclosure: EEMAC 1 [wall] [floor] mounted

2.2.4 Voltage:

- 2.2.4.1 Input: [208] [480] [600] volts nominal, $\pm 15\%$; 3 phase; 60 Hz ± 3 Hz. Refer to related equipment for required voltage.
- 2.2.4.2 Output: [208] [480] [600] volts, 3 to 66 Hz, 3 phase, with volts per hertz compensation. Refer to related equipment for required voltage.
- 2.2.4.3 Transformers: Do not use transformers on either the input or output for voltage compliance.

2.2.5 Rating:

- 2.2.5.1 Power: Horsepower or Kilowatt ratings as specified in the Equipment Schedule.
 - 2.2.5.2 Service Factor: 1.1 for rated output current, continuous duty
 - 2.2.5.3 Thermal: 130% of rated output current for one minute.
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- 2.2.5.4 Efficiency: 97% minimum at maximum load and speed.
 - 2.2.5.5 Power Factor: 0.95 minimum line side at all speeds.
 - 2.2.5.6 Harmonic Distortion: Total Harmonic Distortion (THD) for Input current generally not to exceed the requirements of IEEE 519 M1992 where the point of common coupling is considered to be where the drive connects to the system and specifically not to exceed:
 - 2.2.5.6.1 10% for drives 100 HP and larger
 - 2.2.5.6.2 12% for drives between 50 and 100 HP
 - 2.2.5.6.3 15% for drives under 50 HP.
 - 2.2.5.7 Short Circuit: Drive capable of withstanding short circuit of 50,000 amps, asymmetric at line side terminals.
 - 2.2.6 Drive Protection: Provide the following protection:
 - 2.2.6.1 Transients: Input transient protection for IEEE Class B ringwave.
 - 2.2.6.2 Voltage: Line over and under voltage, phase loss and phase unbalance.
 - 2.2.6.3 Short Circuit: Line to line and line to ground.
Drive to shut down without damaging any power circuit devices on either of these faults. Do not use fuses or isolation transformers to provide this protection.
 - 2.2.6.4 Overcurrent: electronic, instantaneous
 - 2.2.6.5 Current Limit: adjustable for 70 to 110% rated current.
 - 2.2.6.6 Internal controller over-temperature.
 - 2.2.7 Ambient Conditions: The drive shall operate satisfactorily under the following ambient conditions
 - 2.2.7.1 Temperature: 0 to 40°C.
 - 2.2.7.2 Humidity: 5 to 90% non-condensing.
 - 2.2.7.3 Altitude: up to 1000m without drive derating
 - 2.2.8 Controls: Provide the following controls and adjustments:
 - 2.2.8.1 Minimum speed: 0 - 70%, adjustable.
 - 2.2.8.2 Maximum speed: 50 - 150%, adjustable.
 - 2.2.8.3 Acceleration /deceleration ramp: 1 to 300 seconds (0 to 100% speed), adjustable, linear or S curve.
 - 2.2.8.4 Speed and load meter: 0 to 100% with selector switch, door mounted
 - 2.2.8.5 Run and Stop push buttons, door mounted
 - 2.2.8.6 Hand-off-auto selector switch, door mounted
 - 2.2.8.7 Keypad speed setting, door mounted.
 - 2.2.9 Motor Protection: Provide the following motor protection features:
 - 2.2.9.1 Overload: Provide thermal or solid state overload protection, adjustable from 80% to 115% of full load rating. For drives feeding multiple motors, provide individual motor overloads.
 - 2.2.9.2 Over temperature: Provide positive temperature coefficient (PTC) thermister protection for motors identified in the Equipment Schedule.
 - 2.2.9.3 Stall protection: electronic, to trip the drive off under motor stall conditions.
 - 2.2.9.4 Automatic restart: after an inverter fault trip the drive shall attempt to restart automatically three times and lock out after the third attempt if a restart has not occurred.
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- 2.2.9.5 Rotating motor restart: The drive shall restart a rotating motor without first stopping it for short duration power outages, shut downs or fault trips by resynchronizing with the motor at its rotating speed and re-accelerating it to setpoint speed.
 - 2.2.9.6 Output Filter: For drives of 100 HP and larger, provide an RLC output filter network to limit dv/dt or provide data showing that a filter is not required for the specific motor being driven.
 - 2.2.10 Control Interface: Provide the following control interfaces:
 - 2.2.10.1 4-20 mA or 0-10 VDC signal follower switchable to inverse characteristics
 - 2.2.10.2 Dry contact closure for run command
 - 2.2.10.3 Dry contact (N.O.) output to indicate:
 - 2.2.10.4 Inverter Fault
 - 2.2.10.5 Inverter Running (motor turning)
 - 2.2.10.6 4-20 mA isolated output, proportional to speed
 - 2.2.10.7 4-20 mA isolated output, proportional to load
 - 2.2.10.8 signal follower to interface with the Energy Management Control System (EMCS)
 - 2.2.11 Status: Provide on line status information. Display each of the following status points by a separate pilot light or LCD display on the controller door:
 - 2.2.11.1 Start Command Present
 - 2.2.11.2 External Trip (interlocks open)
 - 2.2.11.3 Lockout (fault shutdown after 3 restart attempts)
 - 2.2.11.4 Ready (power on - no faults present)
 - 2.2.11.5 Power On
 - 2.2.11.6 Low reference (missing or zero speed reference)
 - 2.2.11.7 Motor Running Direction
 - 2.2.11.8 Inverter in current limit
 - 2.2.12 Fault Diagnostics: Provide diagnostics which memorize and display the last ten fault occurrences even after the drive restarts. Indicate each of the following faults by a separate pilot light or LCD display on the controller door:
 - 2.2.12.1 Stop called for or start error
 - 2.2.12.2 External trip (interlock opened)
 - 2.2.12.3 Controller over temperature
 - 2.2.12.4 Emergency stop
 - 2.2.12.5 High DC Bus
 - 2.2.12.6 Output transistor fault
 - 2.2.12.7 Low DC Bus
 - 2.2.12.8 Current Overload
 - 2.2.13 Indicators: Provide additional LED's or other diagnostics to allow signal tracing of logic and base driver circuit boards.
 - 2.2.14 Interlocks: Provide external interlock for firestat, freezestat, smoke detector or other devices as indicated in the Equipment Schedule. Common interlock to cause motor to coast to stop.
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2.3 SYSTEM OPERATION:

- 2.3.1 Motor to start when the selector switch is in the "auto" position and the run command is received from the control system. Speed to be controlled by the control signal.
- 2.3.2 Motor to start when the door mounted run pushbutton is depressed when the selector switch is in the "manual" position. Speed to be controlled by the door mounted manual speed control.
- 2.3.3 Motor to automatically restart after a power outage when the power returns, if the run command is maintained. After short duration outages, motor to be restarted while rotating.
- 2.3.4 Motor to restart automatically, with up to 3 attempts, in the event of an inverter trip. Drive to lock out after 3 unsuccessful attempts.

2.4 OVERCURRENT PROTECTION

- 2.4.1 Provide incoming fused line disconnect switch or circuit breaker with the following:
 - 2.4.1.1 Door interlock
 - 2.4.1.2 Provisions for padlocking operating mechanism
 - 2.4.1.3 Overcurrent curves for fuses or circuit breakers coordinated with the drive's output protection. Fuses not to blow or breakers trip under output faults such as overcurrent, short circuit and ground fault

3 Execution

3.1 MOTORS

- 3.1.1 Ensure that the motors fed from the drives are compatible with the drives, including load rating, voltages and thermistor protection.

3.2 INSTALLATION

- 3.2.1 Set and secure the drives in place on channel bases, rigid, plumb and square to the building floors and walls.
- 3.2.2 For drives 100 HP and larger, locate drive so that conductors from drive to motor are less than 10m long.
- 3.2.3 Provide two hold down bolts for each 1m linear width.
- 3.2.4 Protect drives from dust and damage during construction.
- 3.2.5 After connections are made, vacuum clean interior, hand clean exterior and touch up any damaged paint.

3.3 START-UP AND TESTING

- 3.3.1 For drives 100 HP and larger, provide the services of a manufacturer trained technician, on the site, to review the installation and assist in the set up, starting and testing of the drives. Allow a minimum of four hours on site per drive.
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3.3.2 Set up the drive prior to energizing. Set up to include initial settings for all adjustable parameters.

3.3.3 Function test the drive prior to interim acceptance. Test shall include:

3.3.3.1 functional testing of all safety devices

3.3.3.2 start, run up, signal tracking, stop and hot restart

3.3.3.3 load test using the connected load, run through available load and speed range

3.3.3.4 test of control sequences

3.3.3.5 snapshot of harmonic content for input and output current at 100% and 50% load

3.4 DEMONSTRATION AND INSTRUCTION

3.4.1 For drives 100 HP and larger, provide operator training, on site, using manufacturer trained personnel.

3.4.2 Training to include the following topics:

3.4.2.1 Drive theory

3.4.2.2 Drive configuration and models installed

3.4.2.3 Set up for each drive type

3.4.2.4 Maintenance

3.4.2.5 Troubleshooting

End of Section

1 GENERAL

1.1 RELATED REQUIREMENTS

1.1.1 Section 21 05 00 – General Instructions for Mechanical Sections.

1.1.2 Section 01 33 00 – Submittal Procedure.

1.2 SHOP DRAWINGS

1.2.1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedure.

1.2.2 Indicate:

1.2.2.1 Equipment, capacity, piping, and connections.

1.2.2.2 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, sizes and location of mounting bolt holes.

1.3 MAINTENANCE

1.3.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.

2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

2.1.1 Unit heaters: Reznor, Eng. A, Trane, Rosemex, Sigma.

2.2 CABINET UNIT HEATERS

2.2.1 Cabinet: type recessed as indicated, 1.6 mm thick steel with rounded exposed corners and edges, removable panels, glass fiber insulation and integral air outlet and inlet.

2.2.2 Finish with factory applied primer coat.

2.2.3 Coils: aluminum fins mechanically bonded to copper tubes. Hydrostatically test to 1 MPa.

2.2.4 Fans: centrifugal double width wheels, statically and dynamically balanced, direct driven, sleeve bearings, resilient mounted.

2.2.5 Motor: multi-speed, tapped wound permanent split capacitor type with sleeve bearings, built-in thermal overload protection and resilient rubber isolation mounting.

2.2.6 Filters: removable 25 mm thick fibrous glass throwaway type.

2.2.7 Capacity: as indicated.

2.2.8 Control:

2.2.8.1 3 speed switch with integral overloads in cabinet.

2.2.8.2 Control sensor: tied into building management system.

2.2.9 Acceptable material: Engineered Air.

2.3 HORIZONTAL UNIT HEATERS

2.3.1 Casing: 1.6 mm thick cold rolled steel, gloss enamel finish, with threaded connections for hanger rods.

2.3.2 Coils: seamless copper tubing, silver brazed to steel headers with evenly spaced aluminum fins mechanically bonded to tubing. Hydrostatically test to 1 MPa.

2.3.3 Fan: direct drive propeller type, factory balanced, with anti-corrosive finish and fan guard.

2.3.4 Motor: speed as indicated continuous duty, built-in overload protection, and resilient motor supports.

2.3.5 Air outlet: two-way adjustable louvres.

2.3.6 Capacity: as indicated base hot water heating capacity on 57 deg.C E.W.T. and 10 deg.C temperature drop

2.3.7 Thermostat: electric, line voltage, set point locking device, concealed adjustment, plastic cover, thermometer in cover.

2.3.8 Acceptable material: Reznor, Eng. A, Trane, Rosemex, Sigma.EXECUTION

2.4 INSTALLATION

2.4.1 Install in accordance with manufacturer's instructions.

2.4.2 Install in accordance with piping layout and reviewed shop drawings.

2.4.3 Provide double swing pipe joints as indicated.

2.4.4 Check final location with Consultant if different from that indicated prior to installation. Should deviations beyond allowable clearances arise, request and follow Consultant's directive.

2.4.5 Hot water units: for each unit, install ball valve on inlet and outlet of each unit. Install drain valve at low point. Install manual air vent at high point.

2.4.6 Clean finned tubes and comb straight.

- 2.4.7 Provide supplementary suspension steel as required.
- 2.4.8 Thermostats on outside walls: mount on insulated backplates.
- 2.4.9 Before acceptance, set discharge patterns and fan speeds to suit requirements.

END OF SECTION

1. GENERAL

1.1. WORK INCLUDED

- .1 Provide all labour, materials, products, equipment and services to supply, install, test and commission Building Automation System (BAS) with Direct Digital Control (DDC) for building mechanical and electrical systems and interface with other microprocessor-based building subsystems as indicated on drawings and described herein.
- .2 Conform to Section 21 05 00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

1.2. RELATED SECTIONS

- .1 Section 01 45 00 – QUALITY CONTROL
- .2 Section 21 05 14 – WIRING AND STARTERS.
- .3 Section 21 08 00 – COMMISSIONING.
- .4 Section 26 05 00 – COMMON WORK RESULTS FOR ELECTRICAL.
- .5 Section 26 05 31 – CONDUITS, CONDUIT FASTENINGS AND CONDUIT FITTINGS

1.3. SYSTEM OUTLINE

- .1 General
 - .1 The documentation contained in this section and other contract documents pertaining to Building Automation System (BAS) is schematic in nature. The contractor shall provide all required hardware and software necessary to implement the functions shown or implied in the contract documents.
 - .2 Control system to consist of integral controller factory install on equipment. Equipment controller shall be electronic and provide minimum features of the specified equipment. Equipment controller shall have a web-based operator interface.
 - .3 Operators shall access the system through web browser and browser interface to perform normal operator functions.
 - .4 BAS to operate on building LAN communication infrastructure. Provide ethernet connection to equipment controller where required.
 - .2 Functional Principals
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- .1 BAS to control mechanical and electrical equipment as specified in CONTROL SEQUENCES, SCHEMATICS AND EQUIPMENT SCHEDULES.

1.4. CODES AND STANDARDS

- .1 Comply with rules and regulations of codes and ordinances of local, provincial, and federal authorities; such codes and ordinances, when more restrictive, take precedence over the Contract Documents.
- .2 Provide products listed and classified by the testing firm acceptable to the authority having jurisdiction as suitable for the purpose indicated and specified.

1.5. STANDARD OF EQUIPMENT

- .1 Use only new products and software that manufacturer is currently stocking and selling for use in new installations.
- .2 Do not use this installation as product test site unless explicitly approved in writing.
- .3 Spare parts, software and technical support to be available for at least ten years after acceptance is certified.

1.6. OPEN PROTOCOL STANDARD

- .1 Intention of this specification is to provide an integrated, open protocol BAS, BACnet as defined by ANSI/ASHRAE standard 135-2008.
- .2 BACnet devices on the lower tier network to support all BACnet functional groups, standard application services and standard object types necessary, but not limited to provide reading and writing functionality of all analog and binary inputs and outputs and change-of-value initiation and reporting between BACnet devices on the network.
- .3 All BACnet devices to be BTL tested. Provide Protocol Implementation Conformance Statement (PICS) for all BACnet devices.

1.7. SUBMITTALS

- .1 Product Data and Shop Drawings:
 - .1 Within 30 days of award of contract, before start of construction, submit completely engineered and coordinated shop drawing package.
 - .2 To Division 1 – Submittals in printed format and as amended below.
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- .3 Provide drawing files on CD.
 - .4 Riser Diagrams: Indicate: communication wire paths and connections to network devices; power wire and ground wire connections to Operator Interfaces and network devices; wire types and port types with manufacturer's model numbers; communication protocol and communication speed for network segments; power panel and breaker designations; wire terminal designations; addresses for network devices; room designations.
 - .5 Specifications and Instructions: Indicate: dimensions, capacities, electrical characteristics, mechanical characteristics, environmental characteristics, performance characteristics, finishes. Circle model number for products provided or furnished.
General catalogue sheets are not acceptable. Provide installation instructions.
 - .6 System Flow Diagrams: Indicate: control devices, control device designation, control device range, control device fail-safe position, point object type, point object name, point object address. Indicate flow directions for gases and liquids relevant to the controlled process. Indicate hardwired interlocks between control devices and equipment. Indicate the location of field control devices.
 - .7 Products Schedule: Indicate: product designation, product name, product manufacturer, product model number, product data sheet reference number, quantities. Provide quantities required under the Work.
 - .8 Valve Schedule: Indicate: system designation, control device designation, valve body size, pipe sizes, valve design flow, selected valve Cv, selected valve design flow pressure drop, valve body configuration, valve body model number, actuator fail-safe position, actuator model number, actuator quantity, actuator close-off pressure rating.
 - .9 Damper Schedule: Indicate: system designation, control device designation, duct dimensions, blade width, blade type, damper model number, calculated torque, actuator torque, actuator model number, actuator quantity, actuator fail-safe position, provisions for edge and blade seals, actuator mounting configuration.
 - .10 Room Schedule: Indicate: controller object name, controller address, controller model number, application designation, room designation, VAV air volume set points, sensor model numbers.
 - .11 Cabinet Layouts: Interior: Indicate: orientation of contents including controllers, transformers, cable trays, terminal strips, relays, control devices, labels. Exterior: Indicate: orientation of gauges, displays, switches, labels.
 - .12 Wire Details: Indicate: connections between control devices, controllers and equipment; connections to sources of power and grounds; control device designations, control device terminal designations, control device location; equipment terminal designations; cabinet terminal strip designations; wire designations. For control devices shown on multiple drawings, indicate the control device with the same designation on all drawings. Differentiate between manufacturer installed wire and field installed wire.
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- .13 Provide description of operation for interlocks that directly connect to the Work. Indicate references to the system flow diagram by control device designation or point object name.
 - .14 Custom Application Programs (Algorithms): Provide comments that describe the details of program functions.
 - .15 Flow Diagrams for Custom Application Programs (Algorithms): Provide in printed format.
 - .16 Points Schedule: Indicate: input points, output points and virtual points for each controller. Indicate: point object address, point object name, point object description, point object alarm limits. List points in ascending order based on point object address.
- .2 Project Record Documents:
- .1 Operation and Maintenance Manuals:
 - .1 Provide two copies in printed format for review by the Consultant at least ten weeks before the projected substantial completion date.
 - .2 Provide three copies of corrected manuals in printed format and three copies on CD within three weeks following completion of Acceptance Test under Part 3: Execution. Provide manuals in hard cover three-ring binders with index page and indexing tab per section.
 - .3 Sections:
 - .1 Contact Information: Provide names, addresses, 24-hour telephone numbers of service representatives and installing subcontractors.
 - .2 Operation: Provide departmental representative operating manuals for Operator Interfaces, Controller Resident Software, DDC Controllers, Advanced Application Controllers, Specific Application Controllers, control devices, compressed air system. For Custom Application Programs (Algorithms) Editor, provide a reference manual for the language syntax that describes each function.
 - .3 Engineering, Installation and Maintenance: Provide manuals for design and installation of point objects, controllers, control devices. Provide instructions for calibrating, troubleshooting and replacing controllers and control devices.
 - .4 Software: Provide complete original issue media and release notes for Operator Interfaces.
 - .5 Preventive Maintenance Procedures: Provide for Operator Interfaces, controllers, control devices. Provide a schedule of tasks; indicate dates for inspection, maintenance and calibration; indicate the pages in the engineering, installation and maintenance manuals that list the procedures.
 - .6 Replacement Parts List: Indicate: manufacturer name, manufacturer
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- model number, supplier name, supplier address, supplier telephone number.
- .7 Certificates: Provide original issue certificates for installation, maintenance and calibration.
- .8 Test Forms: Provide copies of test forms completed under Part 3: Execution, Testing and Commissioning.
- .9 Provide licenses, guarantees and warranty documents for products and systems.
- .2 As-built Product Data and Shop Drawings:
 - .1 Provide three copies in printed format and three copies on CD for approval by the Consultant within three weeks following the successful completion of Acceptance Test under Part 3: Execution.
 - .2 Provide drawing files on CD.
 - .3 Points Schedule: For points schedule generated under Part 1: Submittals, Product Data and Shop Drawings, indicate operating conditions for point object data; list point objects by system designation and alphabetically by point object name.
 - .4 Time-of-Day (TOD) Schedules: Indicate: objects assigned to the TOD Schedule, Occupied Mode times.
- .3 As-built Floor Plans:
 - .1 Maintain on the project site as-built conditions on one full-size set of Contract Drawings, referred to as Marked-up Drawings; indicate on these drawings as-built locations for: control devices, cabinets, network devices with network address, communication networks by type and address, connection points to communication networks for Operator Interfaces, power networks, conduit paths, junction boxes, Operator Interfaces.
 - .2 Submit three copies of Marked-up Drawings to Consultant for review within three weeks following successful completion of Acceptance Test under Part 3: Execution. Revise Contract Drawings to match the approved Marked-up Drawings; revise using AUTOCAD Release 12 or higher format and submit three copies as full-size in printed format and three copies of drawing files on CD.
- .3 Training Manuals:
 - .1 Provide a course outline, and one copy in printed format of training manuals provided under Part 3: Execution, Instruction and Training at least six weeks prior to the first class. Modify the course outline and training materials to suit Departmental representative's requirements and as requested by the Consultant.

1.8. WARRANTY

- .1 Warrant the Work in accordance with the General Conditions and as amended below.
- .2 Warranty start date will be the date the Work is accepted under Part 3: Execution, Acceptance Test.
- .3 Provide a single warranty start date even when the Departmental representative has received beneficial use prior to acceptance of the Work. For Work split into multiple contracts or for a multi-phase contract, provide a separate warranty start date and period for each contract or phase.
- .4 Adjust, repair or replace defects and failures in the Work at no additional cost during the warranty period and without reduction in service to the Departmental representative. Provide warranty service during normal business hours and within 24 hours of the Departmental representative's request for service.
- .5 Provide warranty service by factory trained service representatives of the Supplier.
- .6 Replace Operator Interface software, Controller Resident Software, controller firmware and database files with revisions that correct deficiencies or defects during the warranty period at no charge to the Departmental representative. Notify the Departmental representative of changes and schedule the installation. Update Operation and Maintenance Manuals with firmware release notes.
- .7 Prior to testing date under Part 3: Execution, Acceptance Test, update firmware in controllers to latest revisions at no additional cost to the Departmental representative; update Operation and Maintenance Manuals with firmware release notes.
- .8 During the Warranty period check the tuning of each control loop once during heating season and once during cooling season; notify the Departmental representative when this work is to occur. Forward to the Consultant documentation indicating observations and adjustments made.
- .9 Warrant products that are reconditioned under the Work to the same requirements as new products.

1.9. OWNERSHIP OF PROPRIETARY MATERIAL

- .1 Software and documentation supplied and generated under the Work or required for ongoing system operation, maintenance and modification becomes the property of the Departmental representative, including and not limited to graphic files, database files, Custom Application Programs, Project Record Documents, Training Manuals.
- .2 Licensing to permit an unlimited number of users to access the system without additional fees.
- .3 As of last day of the warranty period, all software to be upgraded to most current recommended version of manufacturer's release.

2. PRODUCTS

2.1. MATERIALS

- .1 Existing Products: To Part 3: Execution, Existing Products.
- .2 New Products: Non-beta versions currently under manufacture and have been applied in similar installations for a minimum period of one year.
- .3 Revisions: Latest available revision for Operator Software, Controller Resident Software and controller firmware at start of Warranty.
- .4 Replacement Parts: Readily available and not scheduled for discontinuation at time of Total Project Completion.
- .5 Expansion: Expandable through additional inputs and outputs and to card access, security, fire alarm, lighting control systems and other building systems.

2.2. 3RD PARTY MANUFACTURER INTERFACE:

- .1 3rd party manufacturer controllers included but not limited to chillers, boilers, variable frequency drives, power monitoring, medical gasses to be based on the open system communication (BACnet) for seamless integration with BAS. Include network connection from BAS to 3rd party manufacturer controllers.
- .2 If open system controllers are not available, include appropriate hardware equipment and software to allow bi-directional data communication between the BAS and 3rd party manufacturers' controlpanels.

2.3. POWER SUPPLIES AND LINE FILTERING

- .1 Provide a separate power supply for every Building Controller, Advanced Application Controller and Application Specific Controller for terminal units.
 - .2 Power Supplies:
 - .1 Type: Enclosed; Class 2 current-limiting, or over-current protection in primary and secondary circuits for Class 2 service to the National Electrical Code.
 - .2 Applied Loads: To 80% of rated capacity.
 - .3 DC Power Supplies: Regulated output.
 - .1 Built in over voltage and over current protection.
 - .2 Able to withstand 150% current overload for at least 3 seconds without trip or failure.
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- .4 Power Line Filtering: Provide internal or external transient voltage and surge suppression for workstations and controllers.

2.4. CABINETS

- .1 Type: NEMA rated and suitable for installed environment.
- .2 Door: Hinged with key-lock latch with common key for all cabinets; provide duplicate keys; for Application Specific Controllers provide screwed tight slide-off cover.
- .3 Controllers, transducers and relays mounted on backing board or DIN rails within inner section behind hinged doors.

2.5. CONTROL DEVICES

- .1 Motorized Control Dampers:
 - .1 Sizing:
 - .1 Dimensions: As indicated. Maximum damper section size: 1200 mm x 1500 mm (48 in. x 60 in.). For dampers larger than the section maximum, use an assembly of multiple, equally sized sections.
 - .2 Two-position: Parallel blade.
 - .3 Modulating: Opposed blade. Parallel blade dampers may be used for return air and bypass applications.
 - .2 Frame: 125 mm x 25 mm x 3 mm (5 in. x 1 in. x 0.125 in.) 6063T5 extruded aluminum with mounting flanges on both sides.
 - .3 Blades: Airfoil shape, 6063T5 extruded aluminum, maximum 150 mm (6 in.) depth.
 - .4 Seals:
 - .1 Blade Edge: Extruded thermoplastic rubber (TPR) suitable for -58 deg. C to 135 deg. C (-72 deg. F to 275 deg. F), mechanically locked in place and easily replaceable in the field.
 - .2 Blade Jamb: Spring-loaded stainless steel.
 - .5 Bearings: Molded synthetic.
 - .6 Linkage: Corrosion resistant steel and concealed in the frame.
 - .7 Drive Shaft: Corrosion resistant steel of square or hexagon shape.
 - .8 Axle: Corrosion resistant steel.
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- .9 Leakage: Maximum 0.35 L/s/sq m (8 CFM/sq ft) at 1.0 kPa (4 in. w.g.) of differential pressure across fully closed damper when tested to AMCA Standard 511.
 - .10 Make and Model: Ruskin CD-50 or equivalent.
 - .2 Actuators For Dampers, Electronic:
 - .1 Control Signal: Compatible with BC, AAC and ASC.
 - .2 Floating control signal is acceptable only for VAV damper application.
 - .3 Operating Time: Maximum 120 seconds throughout the full rotation.
 - .4 Angle of Rotation: Adjustable between 0° to 90°.
 - .5 Stall protection: Mechanical or electronic.
 - .6 Actuators shall have electronic overload protection or digital rotation sensing circuitry to prevent actuator damage throughout the entire rotation.
 - .7 Failsafe: Non-spring return for VAV terminals; spring return for other applications. Spring return to normal position within 15 seconds.
 - .8 Manual Override: Crank type. External gear release for non-spring return actuators.
 - .9 Position Indicator: Reversible for clockwise or counter-clockwise rotation; set the 0 degrees mark to the failsafe position.
 - .10 Torque: To damper manufacturer's requirements to provide complete compression of seals between frame and blades and for smooth control.
 - .3 Control Valves:
 - .1 Characteristics, materials and pressure ratings suitable for the application; refer to schedules.
 - .2 Flow Characteristic:
 - .1 Water:
 - .1 Two-way: Equal percentage.
 - .2 Three-way: A Port: Equal percentage. B Port: Linear or modified linear.
 - .2 Steam: Linear.
 - .3 Sizing Water Valves:
 - .1 Two-position: Line size with full ports.
 - .2 Two-way Modulating: Non Radiation: Pressure drop equal to the pressure drop through the coil or 27 kPa (4 psi), whichever is greater. Radiation: Pressure drop equal to 7 kPa (1 psi).
 - .3 Three-way Modulating: Non Radiation: Pressure drop equal to the pressure drop through the coil or 27 kPa (4 psi), whichever is greater. Radiation: Pressure drop equal to 7 kPa (1 psi).
 - .4 Butterfly Valves:
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- .1 Type: High-performance (HPBV).
 - .2 Make and Model: Dezurik BHP or equivalent.
 - .3 Tee-fitting: Provide for three-way application; with motor mounting bracket and linkage hardware.
 - .5 Valves 12 mm (1/2 in.) through 50 mm (2 in.):
 - .1 Screwed ANSI Class 250 bronze body.
 - .6 Valves 62 mm (2-1/2 in.) and Larger:
 - .1 Water temperature less than 121 deg. C (250 deg. F) at 1035 kPa (150 psi) or less than 93.2 deg. C (200 deg. F) at 1139 kPa (165 psi): Flanged ANSI Class 125 cast iron body.
 - .2 Water temperature greater than 121 deg. C (250 deg. F) at 1035 kPa (150 psi) or greater than 93.9 deg. C (200 deg. F) at 1138 kPa (165 psi): Flanged ANSI Class 250 cast iron body or ANSI Class 300 cast steel body.
 - .4 Leakage: ANSI Class IV.
 - .5 Materials:
 - .1 Stems: Stainless steel.
 - .2 Plugs and Seats: Brass or steel.
 - .3 Packing: PTFE for steam.
 - .6 Rangeability: 40:1 minimum.
 - .7 Heating valves shall be modulating unless noted otherwise.
 - .4 Actuators for Control Valves, Electronic:
 - .1 Control Signal: Compatible with BC, AAC and ASC.
 - .2 Floating control signal is not acceptable.
 - .3 Operating Time: Maximum 120 seconds throughout the full rotation.
 - .4 Mounting: Corrosion resistant hardware.
 - .5 Stall Protection: Electronic overload or digital rotation sensing.
 - .6 Failsafe: Non-spring return for radiation and terminal reheat coils; spring return for others. Spring returns to normal position within 15 seconds.
 - .7 Manual Override: Crank type. External gear release for non-spring return actuators.
 - .8 Position Indicator: Provide. Indicate valve open and closed positions.
 - .9 Close-off Pressure:
 - .1 Water:
 - .1 Two-way: 150% of total system head.
 - .2 Three-way: 300% of the pressure differential between ports A and B
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at design flow, or 100% of total system head.

.2 Steam: 150% of inlet pressure.

.5 Electric Relays:

- .1 Type: General purpose; enclosed coil; diodes provided for inductive switched loads; override button; LED "energized" indicator; plug-in type base.
- .2 Contact rating, configuration and coil voltage suitable for application.
- .3 Regulatory: UL listed.

.6 Damper End Switches:

- .1 Type: Lever operated activated by blade position.
- .2 Electrical Contacts: Rated for 10 A resistive, 6 FLA at 120 VAC.
- .3 Regulatory: UL listed.

.7 Level Switches:

- .1 Type: Float.
- .2 Electrical Contacts: Rated for 10 A resistive, 6 FLA at 120 VAC.
- .3 Mounting: Outside of fluid of measured fluid.
- .4 Enclosure: NEMA rated for the application.

.8 Low Limit Electromechanical Thermostat:

- .1 Type: Vapour Pressure; minimum 6000 mm (20 ft.) of capillary; actuated by any 300 mm (12 in.) of capillary element; manual reset upon activation.
- .2 Electrical Contacts: Double-pole double-throw (DPDT), snap-acting; rated for 10 A resistive, 6 FLA at 120 VAC.
- .3 Adjustable Set Point: Range: -1 deg. C to 13 deg. C (30 deg. F to 55 deg. F) and set to 1.67 deg. C (35 deg. F).
- .4 Regulatory: UL listed.

.9 High Limit Electromechanical Thermostat:

- .1 Type: Bimetallic sensing; manual reset upon activation.
- .2 Mounting: Airstream.
- .3 Electrical Contacts: Single-pole single-throw (SPST), normally closed, snap-acting; rated for 10 A resistive, 6 FLA at 120 VAC.
- .4 Adjustable Set Point: Range: 38 deg. C to 66 deg. C (100 deg. F to 150 deg. F) and set to 57 deg. C (135 deg. F).

.10 Electromechanical Thermostat:

- .1 Wall Mount:
 - .1 Provide samples of covers to Part 1: Submittals, Samples.
 - .2 Low Voltage:
 - .1 Type: 24 VAC, bimetal-operated, mercury-switch; adjustable or fixed anticipation heater; vented ABS plastic concealed cover.
 - .2 Set Point: Range: 13 deg. C to 30 deg. C (55 deg. F to 85 deg. F); 1 deg. C (2 deg. F) maximum differential.
 - .3 Line Voltage:
 - .1 Type: Bimetal-actuated open contact, or bellow-actuated enclosed snap- switch type, or equivalent solid state type; anticipation heater; vented metal concealed cover.
 - .2 Electrical Contacts: Rated for 10 A resistive, 6 A FLA at 120 VAC.
 - .3 Set Point: Range: 13 deg. C to 30 deg. C (55 deg. F to 85 deg. F); 1 deg. C (2 deg. F) maximum differential.
 - .4 Regulatory: UL listed.
 - .11 Digital Thermostat:
 - .1 Digital thermostats shall be 7-day programmable digital type suited for the application.
 - .2 Standalone terminal units shall utilize a digital thermostat where shown on drawings.
 - .3 Digital thermostat shall have user selectable engineering units (F or C) and set point adjustment.
 - .4 Digital thermostat shall support automatic daylight savings time switchover.
 - .5 Digital thermostat shall support automatic and manual heat/cool changeover when applicable.
 - .6 Digital thermostat shall support temporary set point adjustment with automatic return to normal operation.
 - .7 Fan Coil thermostat shall be TACO VT7300C502. Thermostat shall provide all-in-one control for fan coil and associated heating and cooling pumps. Thermostat shall operate stand alone. Control shall be low voltage. Thermostat shall have a display and override button
 - .12 Temperature Sensors:
 - .1 General Requirements:
 - .1 Temperature sensors shall be of the resistance type, two-wire 1000 ohm nickel RTD, two-wire 1000 ohm platinum RTD or two-wire 10,000 ohm thermistor.
 - .2 Space Temperature Sensors:
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- .1 For installation throughout the facility unless otherwise noted.
 - .3 Space Temperature Sensors With Adjustable Set-Point, Override and Display:
 - .1 Key pad or slider for temperature set-point adjustment.
 - .2 LED display.
 - .3 Timed override request push button with LED status for activation of after-hours operation.
 - .4 For installation only where indicated on drawings, controls diagrams or sequences of operations.
 - .4 Covers for Wall Mount Sensors:
 - .1 Overrides: Exposed set point adjustment and override button.
 - .2 Communication Port: For communication between Portable Operator Terminals and ASC controllers.
 - .5 Averaging Temperature Sensors:
 - .1 Minimum 1.5 m (5 ft) of capillary per 1 sq m (10 sq ft) of duct cross-section.
 - .2 Provide multiple sensors where single averaging element is unable to be positioned to provide complete duct or plenum traverse.
 - .6 Outside Air Temperature Sensors:
 - .1 Outside air temperature sensors shall be designed to withstand the environmental conditions to which they will be exposed.
 - .2 The sensors shall be provided with a solar shield.
 - .3 Temperature transmitters shall be of NEMA 3R construction and rated for ambient temperatures.
 - .7 Duct Temperature Sensors:
 - .1 Duct sensors shall be insertion type and constructed as a complete assembly, including lock nut and mounting plate.
 - .2 Probe length shall be no less than 1/3 of the duct width or diameter.
 - .3 For outdoor air duct applications, a weatherproof mounting box with weatherproof cover and gasket shall be used.
 - .8 Thermowells:
 - .1 Brass or Type 316 stainless steel suitable for the application.
 - .2 Heat transfer compound compatible with sensing element.
 - .13 Guards for Sensors and Thermostats:
 - .1 Materials: Heavy gauge steel.
 - .14 Relative Humidity Sensors:
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- .1 Sensors shall be calibrated to NIST standards.
 - .2 Sensing Element:
 - .1 Type: Thin film capacitance.
 - .3 Transmitter:
 - .1 Range: 0 to 100% RH.
 - .2 Signal: 4 to 20 mA or 0-10 VDC with span and zero adjustment.
 - .4 Accuracy Rating: +/- 2 % of output reading.
 - .5 Outside air relative humidity sensors shall be installed with a rain proof, perforated cover. The transmitter shall be installed in a NEMA 3R enclosure.
 - .6 Duct type sensing probes shall be constructed of 304 stainless steel, and shall be equipped with a neoprene grommet, bushings, and a mounting bracket.
- .15 Pressure Sensors:
- .1 General:
 - .1 Sensing Element:
 - .1 Type: Capacitance sensing.
 - .2 Materials: Suitable for continuous contact with measured medium.
 - .2 Transmitter:
 - .1 Range: Not to exceed two times the operating pressure.
 - .2 Signal: 4 to 20 mA or 0-10 VDC; with zero and span adjustment.
 - .3 Accuracy Rating: +/- 1.0 % of full scale.
 - .4 Response Time: Maximum 0.5 seconds.
 - .3 Isolation Valve: Between process connection and sensor.
 - .4 Capable of withstanding 100% overpressure without damage
 - .2 Air Static Pressure Sensors:
 - .1 Sensing Element:
 - .1 Type: Capacitance sensing with pitot tube sensing tips screwed securely to duct.
- .16 Submersible Pressure Sensor:
- .1 The sensor housing shall be made from high strength stainless steel or titanium for pressure ranges up to 100 PSI (689.5 kPa) and compatible with wide range of liquids.
 - .2 The sensor shall be vented through the cable to correct for barometric pressure changes.
 - .3 Sensor over range protection shall be two times rated pressure.
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- .4 Accuracy shall be +/- 0.25% of the full scale or better.
 - .5 Available control signals shall be 2-10 VDC or 4-20 mA.
 - .17 AC Current Sensing Switches:
 - .1 Type: Self-powered solid-state with split-core.
 - .2 Electrical Contacts: Rated for 1 A resistive at 30 VAC/DC.
 - .3 Insulation Rating: 600 VAC.
 - .4 Adjustable trip point with LED status indicator.
 - .18 AC Current Transducers:
 - .1 Type: Self-powered or loop-powered solid-state with split-core.
 - .2 Amperage Range: Motors: Factory calibrated to LRA; Switchgears: Factory calibrated to design load.
 - .3 Insulation Rating: 600 VAC.
 - .4 Signal: 4 to 20 mA or 0-10 VDC; internal zero and span adjustment.
 - .5 Accuracy Rating: +/- 2 % of full scale.
 - .6 Regulatory: UL listed or CSA approved.
 - .19 CO2 Sensors:
 - .1 Sensor shall employ non-dispersive infrared technology (NDIR).
 - .2 Accuracy shall be +/- 75 ppm over 0-1500 ppm range.
 - .3 Response time shall be less than 1 minute.
 - .4 Sensor shall have field selectable 0-10 VDC and 4-20 mA outputs.
 - .5 Power voltage shall be 20-30 VDC/AC.
 - .6 Operating temperature range shall be 0°C to 50°C.
 - .7 The sensor shall be duct mounted.
 - .20 Gas Detection System:
 - .1 Gas Detection Controller:
 - .1 Use: Centralized gas detection monitoring with real-time gas reading, selective alarm activation
 - .2 Enclosure: NEMA 4X Polycarbonate – ABS
 - .3 Power Requirement: 17-27 Vac, 24-38 Vdc, 500 mA
 - .4 Network: Three Modbus channels for up to 96 transmitters, one wireless channel for up to 50 301W wireless transmitters and an optional BACnet/LON/IP output; Communication Line Up to 609 m (2000 ft.) per channel
 - .5 Alarm Levels: 3 fully programmable alarm levels; Time Delays 0, 30 sec., 45
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- sec., 1-99 minutes before and after alarm
 - .6 Outputs: 4 DPDT relays (alarms and/or fault) at 5 A, 30 Vdc or 250 Vac (resistive load); 65dBA buzzer
 - .7 Display: 122 x 32 dot matrix LCD display
 - .8 Operating Humidity Range: 0-95% RH, non-condensing
 - .9 Operating Temperature Range: -20 to 50°C (-4 to 122°F)
 - .10 Certifications: CAN/CSA C22.2 No 61010-1
 - .11 Conforms to: ANSI/UL 61010-1; IEC 61010-1 Including Amendments A1:1992 + A2:1995 and National Deviations (Canada, US)
 - .12 Make and Model: Vulcain 301C or equivalent.
 - .2 Wireless Gas Transmitter:
 - .1 Use: Wall mounted, wireless gas detector transmitter used in conjunction with controller
 - .2 Enclosure NEMA 4X Polycarbonate – ABS
 - .3 Power Requirement: Battery operated with 2 years (minimum)
 - .4 Sensing Technology: Electrochemical
 - .5 Network: Wireless to the controller; Communication Protocol 2.4 Ghz - IEEE 802.15.4 - Secured 128-bit encryption
 - .6 Visual Indicators: Two LEDs
 - .7 Radius of Detection: 15.24 m (50ft.)
 - .8 Calibration: Not required for 2 years
 - .9 Alarms: Centralized alarm management via controller
 - .10 Conforms to: ANSI/UL 61010-1
 - .11 Certified to: CAN/CSA C22.2 No. 61010-1 FCC Part 15 Subpart C(15.247) RSS 210 Section 6.2.2(o)
 - .12 Make and Model: Vulcain 301W or equivalent.
 - .3 Wired or Stand-Alone Gas Transmitter:
 - .1 Use: Wall mounted, wired gas detector transmitter used in conjunction with controller
 - .2 Power Requirement: 17-27 Vac, 24-38 Vdc, 250 mA
 - .3 Network: Modbus RS-485
 - .4 Display: 10-step LED or LCD
 - .5 Visual Indicators: Failure Indication = Yellow LED (Available in network configuration only); Normal Operation = Green LED
 - .6 Audible Alarm: 65 dBA at 3 ft. / 1 m
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- .7 Alarm Relay: Rating: 5A, 30Vdc or 250 Vac (resistive load)
- .8 Optional Outputs: RS-485 Modbus, 4-20mA
- .9 Sensing Technology: Toxic = Electrochemical; Combustibles = Catalytic; Oxygen = Diffusion fuel cell; Refrigerants = Solid-state
- .10 Accuracy: Toxic, Combustibles, Oxygen = +/- 3%; Refrigerants = +/- 10%
- .11 Detection Range: Carbon Monoxide = 0 - 250 ppm; Nitrogen Dioxide (NO2) = 0-10 ppm; Oxygen = 0-1 ppm; Combustibles = 0-100% LEL; Refrigerants R11, R12, R22 and R134a = 0-2000 ppm
- .12 Certified to: CAN/CSA C22.2 No. 61010-1
- .13 Conforms to: ANSI/UL 61010-1
- .14 Make and Model: Vulcain 201T or equivalent.

2.6. WIRE AND CONDUIT

- .1 Conduit: Electrical metallic tubing EMT with compression type fittings in dry locations; cold rolled steel zinc coated or zinc coated rigid steel with threaded fittings in wet locations or where exposed to weather.
- .2 Outlet boxes: Dry locations: sheradized or galvanized drawn steel 100 mm (4 in.) square or octagon with suitable raised cover; Exposed to Weather: threaded hub cast aluminum boxes with gasket plate.
- .3 Junction boxes: Sized according to number, size and position of entering raceway; type: suitable for the environment.
- .4 Wire:
 - .1 Network: Per controls manufacturer recommendations.
 - .2 Analog Input, Output: Stranded 18 gauge copper twisted shielded.
 - .3 Binary Input, Output: 18 gauge, minimum insulation rating of 600 volts.
 - .4 Class 2: FT-6 without conduit in ceiling plenums; FT-4 in conduit for all other cases.

3. Execution

3.1. GENERALWORKMANSHIP

- .1 Install all controllers, cabinets, control devices and power supplies in readily accessible locations providing adequate ambient conditions for its specified application and to the Canadian Electrical Code.
 - .2 Install products to manufacturer's installation instructions.
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- .3 Install parallel to building walls and floors unless indicated or specified or required by manufacturer's installation instructions.
- .4 Mechanical contractor shall install all in-line devices such as temperature wells, pressure taps, airflow stations, etc.

3.2. CONTROL SEQUENCE AND OPERATION

- .1 Boiler Control:
 - 1. Boiler system (2 Boiler arrangement) provides heat to domestic system and building heating loop. This system shall operate year-round.
 - 2. The boiler controller shall provide lead/lag control of multiple boiler.
 - 3. Each boiler shall have dedicated controller. Boiler controller shall obtain a start/stop command and a supply temperature setpoint from supply temperature sensor. The controller shall start/stop the associated boiler pump, monitor water flow and Supply water temperature. Boiler shall shut down automatically if no flow condition is detected and on low water condition. Boiler controller shall provide status and alarm signal.
 - 4. The controller shall start/stop boilers as required to maintain the primary loop temperature at setpoint. The lead boiler shall start first, when it reaches 90% capacity, lag boiler shall be started. Boilers shall be stopped in reverse order when they drop below 40% capacity.
 - 5. The controller shall rotate lead/lag boiler every 500 hours. The controller shall monitor boiler status, boiler alarm, boiler circulation pump status.
 - 6. The controller shall reset the heating supply water temperature based on outdoor air temperature. Refer to heating schematic for scheduled temperature.
 - 7. The controller shall incorporate a domestic hot water priority. On call for heat from the domestic water system, the controller shall set the boiler supply temperature at 82.2°C. When the domestic hot water system is satisfied, the boiler supply temperature shall revert to previous setpoint.
 - 8. The controller shall monitor the status of pumps and water temperature. Alarms shall be generated when on pump failure and out-of-range temperature.
 - .2 Snowmelt Control:
 - 1. Ramp snowmelt system to be controlled by stand alone Tekmar 654 controller c/w snow sensor. Controller shall cycle the snow melt secondary pumps and modulate snow melt primary pumps to maintain supply water temperature at setpoint.
 - .3 Heating Manifold Control:
 - 1. The building heating pumps shall operate duty/standby. Pump speed shall modulate to maintain differential pressure as measured by integral pressure sensor. Pressure setpoint shall be determined during start-up and commissioning.
 - 2. Thermostat in the unit open/close manifold control valve on call for heat.
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3.3. COORDINATION

- .1 Submittals: To Part 1: General, Submittals.
- .2 Integrate and coordinate work under this section to controls and control devices provided or installed by others.
- .3 Each supplier of control product to configure, program, start-up and commission that product to satisfy requirements of Sequence of Operation regardless of where within contract documents product is described or specified.
- .4 Resolve compatibility issues between control product provided under this section and those provided under other sections or divisions of this specification.

3.4. WIRING AND CONDUIT

- .1 Wire shall be neatly tie wrapped to conduit mounted to the building structure but must be installed at right angles or parallel to the building. Loose wiring shall only be allowed over a distance of 1500 mm (5 ft.) but must not pass over lighting fixtures.
 - .2 Wiring in Equipment Room, between floors, or between concrete walls shall be installed in conduit. Exposed wiring will not be accepted. Conduit shall be installed at right angles or parallel to the building walls.
 - .3 Should it become necessary to splice field wiring it shall be soldered. If soldering is not possible, approved B type crimp connectors are an acceptable alternative. Wire nuts and Marr connections are not acceptable. Provide a 500 mm (20 in.) loop length at all splices.
 - .4 Conceal conduit within finished shafts, ceilings, and walls as required. Install exposed conduit parallel with or at right angles to the building walls.
 - .5 Plug or cap unused conduit openings and stubs with compatible fittings.
 - .6 Route all conduit to clear beams, plates, footings and structural members except through column footings and grade beams.
 - .7 Provide watertight seals at penetrations through outside foundation walls.
 - .8 Support conduit 25 mm (1 in.) and smaller to the building with one-hole non-perforated malleable iron or steel pipe straps. Suspend conduits larger than 1 in. on pipe racks with split- ring hangers and rods.
 - .9 Maintain caps on conduit openings throughout construction.
-

- .10 Where conduit is attached to vibrating or rotating equipment, install and anchor flexible metal conduit with a minimum length of 450 mm (18 in.) and a maximum length of 900 mm (36 in.) in such a manner that vibration and equipment noise will not be transmitted to the rigid conduit.
- .11 Where exposed to weather or in damp or wet locations, provide waterproof flexible conduit.
- .12 Fill conduit to maximum of 60% of its capacity. Provide a pull rope within the conduit when the installation is complete. Bend conduit to a radius of greater than 3 times the conduit diameter to a maximum of three 1/4 bends permitted between pull boxes.
- .13 Wire within cabinets shall be installed in a plastic tray with a cover. Terminate wires to field-removable, modular terminal strips.
- .14 All field sensors shall be provided with a flexible conduit connection minimum length of 450mm (18 in.) and an enclosure for the electrical connections.

3.5. POWER WIRING

- .1 Power for section 25 05 01 – BAS General Requirements shall be provided under Electrical Division 16 at 120 VAC 60 Hz single phase and shall terminate in junction boxes installed where shown on electrical and mechanical drawings. Wiring and conduit from these boxes to control devices being electrically powered to be provided by Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.
- .2 Where power for equipment is fed from MCC, 120 VAC power for Section 25 05 01 – BAS General Requirements shall also be fed from the MCC from the 120 VAC section. Wiring and conduit from the MCC to control devices being electrically powered to be provided by section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.

3.6. COMMUNICATION WIRING

- .1 Install communication wiring per controls manufacturer recommendations as to type of wire used and segment lengths.
- .2 Install communication wiring in conduit and raceways separated from other wiring.
- .3 Verify entire network's integrity following cable installation using appropriate tests for each cable.
- .4 Each run of communication wiring to be continuous length without splices.

3.7. OPERATOR INTERFACE

- .1 Operator Software:
 - .1 Security: Set up operators with independent user login name and password and assign access levels to Departmental representative's requirements.
 - .2 Reports: Configure the following reports:
 - .1 List of objects and point object data that are in alarm state sorted by priority in descending order then by point object name in ascending order.
 - .2 List of disabled point objects sorted by point object name in ascending order.
 - .3 List of TOD Schedules: Indicate: objects assigned to the TOD Schedule, Occupied Mode times.
- .2 Graphics: Generate graphic representations for systems as follows:
 - .1 Building elevation in three dimensions; indicate: floors and mechanical rooms.
 - .2 Floor plans: Indicate: Equipment rooms; point object data for temperature, humidity and pressure. Directly access graphic representation for terminal systems.
 - .3 Equipment Rooms: Indicate locations for systems.
 - .4 Systems: Indicate: Equipment, service connections, point object data, set points, reset schedules. Highlight point objects under operator command.
 - .5 Graphic representations link to and display graphic representations for associated systems.

3.8. CABINETS

- .1 Install rigidly to wall or to an independent frame installed to the floor slab. Installation to duct, equipment and locations subject to vibration is not accepted.
- .2 Cabinets for ASC controllers: Install to terminal equipment. Installation to duct, equipment and locations subject to vibration that could affect controller operation or calibration of control device is not accepted.
- .3 Coordinate cabinet locations with other trades and general contractor.

3.9. CONTROL DEVICES

- .1 Provide or furnish control devices as indicated on the drawings and to the requirements of this Section and to execute sequence of operation.
 - .2 Motor Operated Dampers:
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- .1 Furnish motor operated dampers for installation under Section 23 31 13 – DUCTWORK AND SPECIALTIES. Provide supervision on site during installation.
 - .2 Install in areas maintained above freezing.
 - .3 Actuators for Dampers, Electronic:
 - .1 Mounting: Direct coupled to drive shaft or jackshaft using a V bolt design.
 - .4 Control Valves:
 - .1 Furnish control valves for installation under Section 23 11 23 – PIPE, VALVES AND FITTINGS (EXCEPT PLUMBING). Provide supervision on site during installation.
 - .5 Actuators for Control Valves, Electronic:
 - .1 Factory install or field install actuator to valve body.
 - .6 Low Limit Electromechanical Thermostat:
 - .1 Install hardwire interlocked to supply fan starter for respective system.
 - .2 Shut down the fan when duct temperature is equal to or less than 1.67 deg. C (35 deg. F).
 - .3 Install to adequately cover potential areas of low level stratification. Provide one low- limit thermostat for each 2.8 sq M (25 sq ft) of duct cross section. Mount sensing element on plastic clips.
 - .7 High Limit Electromechanical Thermostat:
 - .1 Install hardwire interlocked to fan starters for respective system.
 - .2 Shut down the fans when duct temperature is equal to or greater than 51.7 deg. C (125 deg. F).
 - .3 Provide one high-limit thermostat for each 3.7 sq M (40 sq ft) of duct cross section.
 - .8 Electromechanical Thermostats and Temperature Sensors:
 - .1 Furnish sensing wells for installation under Section 23 11 23 – PIPE, VALVES AND FITTINGS (EXCEPT PLUMBING). Provide supervision on site during installation.
 - .2 Samples: Provide for wall mount type to Part 1: Submittals, Samples.
 - .3 Wall Mount Type:
 - .1 Cover Colour: White.
 - .2 Install to furred-in columns and permanent walls on concealed junction boxes supported by wall framing or surface mount 1.2 m (4 ft) above
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- finished floor. Installation to mobile and temporary partitions is not acceptable.
- .3 Installation to exposed architectural concrete columns and walls is not acceptable, unless otherwise indicated or specified. For installation to concrete, set conduit in place before pouring of concrete.
 - .4 Single Point Type, Duct:
 - .1 Provide sufficient contact with process fluid to measure average conditions.
 - .2 Apply pipe sealing compound to plug thread.
 - .5 Single Point Type, Pipe:
 - .1 Provide sufficient contact with process fluid to measure average conditions.
 - .2 Install with heat conducting fluid in wells.
 - .6 Outdoor Type:
 - .1 Install to north side of building away from sources of heat such as lamps and exhaust vents; to greater than 1500 mm (5 ft) above horizontal surfaces.
 - .2 Where indicated or specified for installation in outside air intake, locate so as not to be affected by exhaust air flow or reverse flow.
 - .3 Provide solar shield. Install shield to open downward.
 - .4 Seal interior of conduit at penetration through exterior wall.
 - .7 Guards for Thermostats and Temperature Sensors:
 - .1 Provide for wall mount sensors and thermostats where indicated on the drawings.
 - .2 Samples: Provide to Part 1: Submittals, Samples.
 - .8 Air Static Pressure Sensors:
 - .1 Duct Mount: Pipe the high-pressure tap to the duct using a pitot tube.
 - .2 Building Static: Pipe the low-pressure port of the pressure sensor to the static pressure port located on the outside of the building and install with a shielded static air probe to reduce pressure fluctuations caused by wind.
 - .3 The piping to the pressure ports on all pressure transducers shall contain a capped test port located adjacent to the transducer.
 - .9 Wet/Wet Differential Pressure Sensors:
 - .1 Differential pressure sensors shall be supplied with tee fittings and shut-off valves in the high and low sensing pick-up lines.
 - .10 Relative Humidity Sensors:
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- .1 Install to requirements for Electric Thermostats and Temperature Sensors.
- .11 AC Current Sensors and Transducers:
 - .1 Install in motor starter cabinet.
- .12 CO Sensors:
 - .1 Mount the sensor 4-6 feet from the floor.
- .13 Air Flow Sensors, Fan Bell Mouth:
 - .1 Coordinate installation of air flow sensors to inlet of fans with fan manufacturer.
- .14 Air Flow Sensors, Duct Mount:
 - .1 Furnish duct mount air flow sensors for installation under Section 23 31 13 – DUCTWORK AND SPECIALTIES. Provide supervision on site during installation.

3.10. IDENTIFICATION

- .1 All wires shall be tagged at both ends. The tagging shall identify the device it is connected to. Use of the point object name is acceptable.
- .2 All wires passing through a junction box shall be tagged with the device identity or its termination point.
- .3 The junction boxes shall be tagged "BAS" with a sequential number suffix.
- .4 Label wires, control devices, controllers.

3.11. TESTING AND COMMISSIONING

- .1 Test and commission the BAS prior to the Demonstration and Acceptance Test.
 - .2 Prepare test forms which shall identify each test. The forms shall be sub-divided into points, controllers, programs, loops, networks and graphics.
 - .3 Device tests shall identify and confirm successful completion of the following:
 - .1 Device installation.
 - .2 Device identification.
 - .3 Device calibration.
 - .4 Device operation.
 - .5 Wiring to device, connection details and wire type.
 - .6 Validation of the device signal at the controller.
 - .4 Controller tests shall identify and confirm successful completion of the following:
 - .1 Controller installation.
 - .2 Power source and grounding.
 - .3 Make, model and serial number, software revisions.
 - .5 Software tests shall identify and confirm successful completion of the following:
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- .1 Custom application programs.
 - .2 Alarm reporting.
 - .3 Trending and reports.
 - .4 Energy management programs.
 - .6 Loop tuning tests shall identify and confirm successful completion of the following:
 - .1 Loop input signal.
 - .2 Loop output signal.
 - .3 Set point adjustment.
 - .4 Device response.
 - .5 Control response.
 - .7 Network communication tests shall identify and confirm successful completion of the following:
 - .1 Primary network communication function.
 - .2 Secondary network communication function.
 - .3 Alarm reporting function.
 - .4 Operator communication.
 - .8 Dynamic graphics tests shall identify and confirm successful completion of the following:
 - .1 All graphics.
 - .2 All point objects per graphic.
 - .3 All set-points per graphic.
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3.12. DEMONSTRATION

- .1 When all tests have been completed and the documentation completed, request a meeting with the Consultant and Departmental representative. Provide at this meeting a demonstration that all systems on the BAS are operating. At the successful conclusion of this demonstration the Consultant will allow the Acceptance Test to begin.
- .2 At the discretion of the Consultant and Departmental representative, demonstrate up to 10% of the tests described in Part 3: Execution, Testing and Commissioning and witnessed by the Consultant and Departmental representative. Should any test fail then the BAS Contractor shall retest the failed components or functionality.

3.13. ACCEPTANCE TEST

- .1 When Testing and Commissioning and the Demonstration have been completed satisfactorily the Consultant will give approval for commencement of the Acceptance Test.
- .2 Notify the Departmental representative in writing 2 weeks prior to the testing date.
- .3 Furnish a new operator's log book to building operators.
- .4 The Acceptance Test period shall be 21 days. Visit the site each morning, Monday to Friday, to review the BAS operation and the building operators log book which contains records of all problems experienced by the building operators, the point object name and value and time and date of failure, and time of return to service. During the first 14 days of the acceptance test, any operational failures due to malfunction of wiring, controllers or Operator Interfaces, shall designate a restart to testing for 21 days. Any failure of control devices shall be corrected and the acceptance test shall continue from the date the failure has been corrected. During the last 7 days of testing, no failures of any kind will be accepted, or the last 7 days shall be repeated.
- .5 The BAS shall not be accepted or considered substantially complete until the Acceptance Test is successfully completed.
- .6 At the successful completion of the Acceptance Test, provide a certificate of completion.

3.14. INSTRUCTION AND TRAINING

- .1 Provide three days of instruction during the BAS installation. This instruction shall include:
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identification of devices, power sources, conduit and wire installation, the operation of controlled devices and how they interface with the mechanical systems.

- .2 Provide an additional five days of instruction that shall cover the operation and maintenance of the BAS systems. The instruction shall be conducted in the building and videotaped by the Departmental representative. Submit training course outline for review by the Consultant before completion of the BAS and before instruction period commences. Instruction shall include:
 - .1 Operation and maintenance of Operator Interfaces.
 - .2 Operation and maintenance of controllers.
 - .3 Custom Application Programming software.
 - .4 Point objects addressing and commanding.
 - .5 Custom reporting.
 - .6 Creating and modifying graphics.
 - .7 Data base modification, deletion and back-up and restore operations.
 - .8 System malfunction diagnostics and maintenance.
 - .9 Control devices, operation and maintenance.
- .3 Provide an additional three days of training that may be scheduled up to six months after BAS Acceptance. The Departmental representative will advise the BAS Contractor of the training content required.
- .4 One day shall be 7.5 working hours excluding one hour lunch break.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Drawings and Specifications of the Contract, including General and Supplementary Conditions and Division 01 requirements apply to this Section.

1.2 REFERENCES

- .1 Definitions:
 - .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.
- .2 Reference Standards:
 - .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1 23rd Edition 2015 Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.
 - .2 CSA C22.2, Canadian Electrical Code, Part 2, Manufacturer's General Requirements
 - .2 Alberta Building Code 2014.
 - .3 Alberta Fire Code 2014.
 - .4 Alberta Safety Codes Council.
 - .5 Worker's Compensation Board requirements.
 - .6 Underwriters' Laboratories of Canada (ULC)..
 - .7 National Fire Protection Association (NFPA)
 - .8 Electrical and Electronic Manufacturer's Association of Canada (EEMAC).
 - .9 Institute of Electrical and Electronics Consultants (IEEE).

1.3 DEFINITIONS

- .1 Definitions include:
 - .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.
 - .2 The terms "Consultant" and "Consultant" shall be used interchangeably throughout this specification.
 - .3 "Provide" means to manufacture supply, test and commission all the Products and services specified.
 - .4 The "Work" means the total construction and supply of Products required by these specifications and includes all Products, Services, plant and site labour for testing and commissioning of the Products.
 - .5 "Products" means all material, machinery, equipment systems and fixtures as required by these specifications to provide complete assemblies.

- .6 “Specifications” means these Specifications for electrical Work and embodying all referenced documents and drawings. To provide complete electrical installation; all fully approved by authorities having jurisdiction, and all fully operational.
- .7 “Drawings” means drawings forming part of these Specifications, which are to be read in conjunction therewith as an integral part.
- .8 “Departmental Representative Acceptance”, which will only be given in writing, means the date when the completed Work is accepted by the Departmental Representative and on which the equipment is put into complete approved operation. This shall not occur before the final inspection by the Consultant, the correction of all deficiencies, completion of all testing, final approved commissioning, delivery of all required documentation and sign off all in compliance with the Specifications.

1.4 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 List of required submittals:
 - .1 Electrical Permit.
 - .2 Contract Price Breakdown.
 - .3 Shop Drawings.
 - .4 Samples (where requested).
 - .5 Record Drawings.
 - .6 Operation and Maintenance Manuals.
 - .7 Written Guarantee.
 - .8 Warranty Certificate.
 - .9 Training Materials.
- .3 Shop drawings:
 - .1 Submit shop drawings for all materials and equipment. Provide full details on all major and key components Provide vectorized electronic PDF copies (not scanned copies).
 - .2 Present shop drawings no later than scheduled after the award of the Contract. Assume full responsibility for timely submission of shop drawings. Allow sufficient time for the General Contractor’s, Electrical Contractor’s and Consultant’s review.
 - .3 The Consultant will only consider shop drawings bearing the stamp of approval of the General Contractor and the Electrical Contractor, who shall check for all pertinent information such as physical dimensions, make, performance, electrical characteristics, and indicate the intended use and location before stamping these drawings approved.
 - .4 The General Contractor and the Electrical Contractor shall be responsible for checking supplied equipment dimensions related to available space and accessibility for installation, maintenance and service, and compliance with codes and inspection authorities. Ensure that shop

drawings indicate the shipping and working weights and sizes of the equipment.

- .5 The Consultant will mark the shop drawings “Reviewed”, “Reviewed as Noted”, “Revise and Resubmit”, or “Rejected”.
 - .1 When drawings are marked “Reviewed” this acknowledges the Consultant’s review with no comment provided.
 - .2 When drawings are marked “Reviewed as Noted” make the revisions shown as soon as practical and forward copies to the Consultant through the Electrical Contractor and Contractor for their records.
 - .3 When drawings are marked “Revise and Resubmit”, make the required corrections or adjustments to ensure compliance with the specifications and resubmit.
 - .4 When drawings are marked “Rejected”, resubmit shop drawings of the product having specified performance and satisfactory physical arrangements.
- .6 The Consultant’s review shall not relieve the General Contractor or Electrical Contractor from responsibility for deviations from the Specifications and Drawings.
- .7 The Consultant’s review shall be constructed to apply to, and only to, general compliance and shall not relieve the Electrical Contractor from the responsibility for the correctness of performance, details, and dimensions. Any on-site fabrication, erection, setting out or other work carried out in advance of the receipt of approved drawings shall be done at the Electrical Contractor’s risk. Any in-plant fabrication, setting out, or other work done in advance of the receipt of stamped shop drawings shall be entirely at the Electrical Contractor’s risk.
- .8 Shop drawings shall provide the following information:
 - .1 General arrangement, configurations, outlines, physical layout and weights;
 - .2 Shipping splits, including component sizing and weights and functional relationships.
 - .3 Single line diagrams;
 - .4 Schematic diagrams of overall systems and all system components and parts;
 - .5 Separate wiring diagrams showing all internal and external components and modules and their interrelationship, and indicate on the wiring diagrams, terminal blocks for all interconnecting wiring between equipment and main components. All such interconnecting and external wiring shall be consolidated at readily accessible terminal blocks in all major equipment, and such wires and terminals shall be clearly identified, for simple interconnection.
 - .6 Controls drawings, all fully designated, showing all wiring and terminal tag & identifications.
 - .7 Confirmation of all ‘Performance Criteria’ and Technical Characteristics.

- .8 Confirmation and certification of in-plant testing as specified herein.
 - .9 Installation and commissioning instructional data.
 - .10 Indication of provisions for future components.
 - .11 Clear identification of all points of interfacing and tie-ins for all mechanical, electrical and physical points clearly shown; all site power and control wiring.
- .4 Certificates:
- .1 Provide CSA certified equipment and material.
 - .2 Where CSA certified equipment and material is not available, submit such equipment and material to Consultant for special approval before delivery to site.
 - .3 Submit test results of installed electrical systems and instrumentation.
 - .4 Permits and fees: in accordance with General Conditions of contract.
 - .5 Submit, upon completion of Work, load balance report as described in PART 3 - LOAD BALANCE.
 - .6 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to the Consultant.
- .5 Manufacturer's Field Reports: submit to Consultant manufacturer's written report, within 3 days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in PART 3 - FIELD QUALITY CONTROL.

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 electrical systems for incorporation into manual.
 - .1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
 - .2 Operating instructions to include following:
 - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
 - .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
 - .3 Safety precautions.
 - .4 Procedures to be followed in event of equipment failure.
 - .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.
 - .3 Post instructions where directed.
 - .4 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.
 - .5 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

1.6 DELIVERY, STORAGE AND HANDLING

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

1.7 Permits, Certificates and Fees

- .1 Give all necessary notices, obtain all permits and pay all fees in order that the work herein specified may be carried out.
- .2 Submit to Utility and Electrical Inspection Department necessary number of drawings and specifications for examination and approval prior to commencement of work.
- .3 At completion of work, provide a final certificate of inspection as evidence that all work installed conforms to the laws and regulations of all authorities having jurisdiction.
- .4 Pay all associated fees.

1.8 DRAWINGS AND SPECIFICATIONS

- .1 Consider the Drawings and these Specifications as complimentary. Any item, system, etc. which is mentioned, shown or reasonably specified in either the Drawings or Specifications shall be considered as properly and sufficiently specified and shall be provided as part of this Contract.
- .2 The Drawings and Specifications are not a detailed set of installation instructions but a guide establishing quality of equipment, materials, workmanship and performance.
- .3 The drawings shall be considered as diagrammatic and are intended to serve as a guide indicating the general layout of the complete electrical systems; number, location and arrangement of equipment, outlets, fixtures, etc. The drawings are not intended to show every fitting, junction and accessory nor every difficulty that will be encountered during installation of the work.
- .4 The drawings are not necessarily working drawings from which measurements may be taken except where dimension figures are specifically shown, since final locations, distances and levels will be governed by actual field conditions. Information involving accurate measurements shall be taken from figured dimensions on Architectural or Structural drawings or at site.
- .5 Check Architectural, Structural and Mechanical drawings to avert possible conflicts in work. Discrepancies shown on different drawings or between

drawings and specifications shall be clarified before proceeding. Decisions or additional instructions will be issued as required.

- .6 The Electrical Contractor shall seek clarification in writing from the Consultant of any discrepancy between drawings and/or specifications prior to the submission of the Contract Price. If this is not done then the electrical contractor will include the most expensive alternative in the Contract Price. No extras will be considered based on differences in interpretation of drawings and specifications or failure to obtain clarifications. Final decisions as to intent remain with the Prime Consultant and the Consultant.
- .7 The intention of the Drawings and Specifications is to call for finished work, tested and ready for operation that complies with all relevant codes and regulations and a system that complies with industry practices for a commercial installation. Include obvious items such as conduit supports, anchors, etc. whose detail is not usually shown or specified but which are necessary for proper installation and operation as if herein specified or shown. No extras will be considered for items that are obviously required for the installation to comply with standard industry practices for commercial installations. Seek clarification from the Consultant in writing prior to submission of bid, otherwise include all costs in the Contract Price for the supply and installation of a complete electrical system.
- .8 The Electrical Contractor takes responsibility that all Division 26, 27 and 28 vendors and suppliers fully adhere to the requirements of the Drawings and Specifications, including all Electrical Specification documents.

1.9 DISCREPANCIES, OMISSIONS, ERRORS

- .1 Report to the Consultant all discrepancies, omissions, errors, departures from Building By-Laws or good practice and points considered to be of dubious intent, so that the Consultant may, if he considers it desirable, issue instructions by addenda preferably a minimum of five working days before Tender Closing Date. Neither the Consultant nor the Departmental Representative shall be responsible for oral instructions.
- .2 Check all pages of Specifications and Drawings against number of pages listed in the index to ensure that the set is complete.

1.10 CONTRACT PRICE

- .1 The Electrical Contractor's Contract Price shall provide for all labour, material, equipment, software, licenses, services, necessary approvals and certifications to complete all Work as called for in the Drawings and Specifications and to make all necessary arrangements to deliver the equipment to the jobsite on the scheduled date.
- .2 Provide a Contract Price breakdown for equipment, labour and materials on a system-by-system basis in a format acceptable to the Consultant.

Part 2 Products

2.1 DESIGN REQUIREMENTS

- .1 Operating voltages: to CAN3-C235.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.
 - .1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .3 Language used for operating and labelling: English.

2.2 MATERIALS AND EQUIPMENT

- .1 Provide material and equipment in accordance with Section 01 61 00 - Common Product Requirements.
- .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 as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- .3 Factory assemble control panels and component assemblies.
- .4 Where materials or equipment are specified by the technical description only without reference to manufacturer or trade name, these shall be of the best commercial quality obtainable for the purpose.
- .5 Where two or more items of equipment or material of the same type are required, they shall be products of a single manufacturer.
- .6 Any material or equipment installed, without prior approval, shall, if so directed, be removed and replaced at this Contractor's expense with the approved material selected by the Consultant.
- .7 Material and equipment for a particular system shall be by one manufacturer only. Do not indiscriminately mix materials or equipment of different manufacturers.
- .8 Materials installed in hazardous locations, shall be suitable for the area classification as defined in the current edition of the Canadian Electrical Code.
- .9 Where equipment or materials are specified by manufacturer or trade name, this is for the purpose of establishing a standard of quality. Contractors quoting on materials other than those specified or approved for substitution, will be rejected.
- .10 All manufacturers named as base bid or as acceptable manufacturers are required to comply completely with the intent of the specifications, even if this implies custom made products or standard products modified to comply. Naming of an acceptable manufacturer does not imply that a standard product of the manufacturer will be accepted. If it deviates from the specifications in any way whatsoever, the standard product will not be approved for use on the project.

2.3 SPECIFIED AND EQUIVALENT PRODUCTS

- .1 It is the intent of these Specifications to establish standards of quality and performance of the material and equipment installed. Where an item or class of material is specified exclusively by manufacturer, brand name, type or catalogue number, only such items shall be used to form the basis of the Contract Price.
- .2 Drawings and specifications are based generally on one manufacturer's product, hereinafter called "base product" (the first manufacturer listed in the specifications). Other manufacturers listed shall be considered as having "reviewed product" status.
- .3 Other manufacturers not listed in the specifications may request approval from the Consultant to submit their products as equivalents to the "base product" during bidding period. Manufacturer's products reviewed at this time shall be considered as "reviewed products". Do not submit products as equivalents unless prior approval for submission has been obtained.
- .4 Use of "reviewed products" in no way lessens the Electrical Contractor's obligation in fulfilling the requirements of the specifications. Space requirements for mechanical and electrical equipment are established on "base product" requirements. Changes to these requirements by the use of revised or "reviewed products" shall be at the Subcontractor's expense and shall be included in his Contract Price. Coordinate with other trades to ensure that there are no conflicts.
- .5 Request for "reviewed product" status must be made at least one week prior to date of Tender closing or at a time as noted in "Instructions to Bidders", whichever date is earliest. Requests shall be accompanied by all descriptive and technical data (electrical photometric, etc.) so that an accurate assessment can be made. Where this is not done, requests will be returned as not reviewed.
- .6 Review of submittals by the Consultant is to check on conformance in principle with the general design concept. Review by the Consultant shall not relieve the Electrical Contractor of the responsibility of meeting the requirements and detailed design of the specified base product.

2.4 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- .1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.
- .2 Conduit, wiring and connections below 50 V which are related to control systems as shown on mechanical drawings.

2.5 WIRING TERMINATIONS

- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

2.6 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates as follows:

- .1 Nameplates: plastic laminate 3 mm thick plastic engraving sheet, black face, white core, lettering accurately aligned and engraved into core, adhesive backed.

- .2 Sizes as follows:

NAMEPLATE SIZES			
Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

- .2 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.
- .3 Wording on nameplates to be approved by Consultant prior to manufacture.
- .4 Allow for minimum of twenty-five (25) letters per nameplate.
- .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .6 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .7 Terminal cabinets and pull boxes: indicate system and voltage.
- .8 Transformers: indicate capacity, primary and secondary voltages.

2.7 WIRING IDENTIFICATION

- .1 Maintain phase sequence and colour coding throughout.
- .2 Colour coding: to CSA C22.1.
- .3 Use colour coded wires in communication cables, matched throughout system.

2.8 CONDUIT AND CABLE IDENTIFICATION

- .1 Not applicable.

2.9 FINISHES

- .1 All electrical fittings, supports, hanger rods, pull boxes, channel frames, conduit racks, outlet boxes, brackets, clamps, etc. shall have a protective finish e.g. galvanized finish. In exposed areas, where required by the Consultant, they shall be given two coats of paint to match other equipment.
- .2 All switchboards, panelboards, distribution and motor control centers, motor starters, etc. shall be factory finished with rust resistant primer inside and outside, and at least two coats of finish enamel. All panels, distribution centers or similar factory finished units that are scratched or marked during installation, shall be touched up with matching lacquer or, if required by the Consultant, shall be completely repainted at the expense of the Electrical Contractor.
- .3 Paint indoor distribution equipment enclosures light grey (ANSI 49 or 61).

Part 3 Execution

3.1 INSTALLATION

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.
- .2 Provide complete, fully tested, commissioned and operational electrical systems to meet the requirements described herein, in complete accordance with applicable codes and ordinances.
- .3 Follow manufacturer's recommended installation details and procedures for equipment, supplemented by requirements of the drawings and specifications. Provide adequate access space for maintenance and service.
- .4 Install equipment generally in locations and routes shown, close to building structure with minimum interference with other services or free space. Remove and replace improperly installed equipment to satisfaction of the Consultant at no cost to the Departmental Representative.
- .5 Workmanship shall be of a high standard throughout and shall be a minimum of the current trade practices for electrical installations in similar facilities.
- .6 All electrical material and equipment shall be new, the best of their respective kinds, fully approved and listed by the Canadian Standards Association for the particular use intended or proposed; shall conform to CEMA Standards and shall be installed in strict accordance with the best practices of the industry and the electrical trade.
- .7 Install and test all equipment and material in accordance with the detailed recommendations of the manufacturer.
- .8 Perform all work in a neat and workmanlike manner. Any materials or equipment condemned as not approved or work installed which is not to the satisfaction of the Consultant, shall be removed, replaced and reinstalled by the Contractor at no additional cost.
- .9 Exposed conduit runs including runs in ceiling spaces shall be perpendicular or parallel to the building lines as necessary. Panels, boxes, covers, etc. shall be mounted in a similar manner. Use spirit levels to ensure proper alignment.
- .10 Bolts or nuts in a "stripped" or "cross threaded" condition shall be replaced immediately.
- .11 Avoid connection between dissimilar metals and the use of corrosive material in wet or damp locations.
- .12 Keep all conduit openings closed by means of plugs or caps to prevent the entrance of foreign matter. Protect all conduit, fixtures, equipment, etc. against dirty water, chemical or mechanical damage both before and after installation. Any such fixture, equipment, etc. damaged prior to final acceptance of the work shall be restored to its original condition or replaced at the expense of the Contractor.
- .13 Equipment standing on the job site shall be covered or otherwise suitably protected at the direction of, and to the satisfaction of, the Consultant. If

coverings become torn, etc., they shall be replaced until the equipment is connected and operating.

- .14 The Electrical Contractor shall be responsible for daily cleaning of all debris accumulated during the course of the work, upon completion of the Contract and whenever directed by the Departmental Representative. The complete installation shall be maintained in a neat and tidy manner during its entire course.
- .15 Conceal all electrical rough-ins in public areas. Where this becomes impossible, obtain ruling from the Consultant as to what adjustments are to be made before proceeding with work.

3.2 NAMEPLATES AND LABELS

- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.3 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit and sleeves prior to pouring of concrete.
 - .1 Sleeves through concrete: schedule 40 PVC, sized for free passage of conduit, and protruding 50 mm.
- .2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .3 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

3.4 LOCATION OF OUTLETS

- .1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- .2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes. Adhere to minimum distances in party walls per Canadian Electrical Code.
- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.
- .4 Locate light switches on latch side of doors.
 - .1 Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

3.5 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 specified or indicated, verify before proceeding with installation.
- .3 Install electrical equipment at following heights unless indicated otherwise.
 - .1 Local switches: 1150 mm.

- .2 Wall receptacles:
 - .1 General: 300 mm.
 - .2 Above top of continuous baseboard heater: 200 mm.
 - .3 Above top of counters or counter splash backs: 175 mm.
 - .4 In mechanical rooms: 1400 mm.
- .3 Panelboards: as required by Code or as indicated.
- .4 Door bell pushbuttons: 1500 mm.

3.6 CO-ORDINATION OF PROTECTIVE DEVICES

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

3.7 FIELD QUALITY CONTROL

- .1 Load Balance:
 - .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
 - .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
 - .3 Provide upon completion of work, load balance report as directed in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS, phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .2 Conduct following tests in accordance with Section 01 45 00 - Quality Control.
 - .1 Power distribution system including phasing, voltage, grounding and load balancing.
 - .2 Circuits originating from branch distribution panels.
 - .3 Lighting and its control.
 - .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
 - .5 Systems: communications.
 - .6 Insulation resistance testing:
 - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
 - .2 Check resistance to ground before energizing.
- .3 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .4 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and

submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.

- .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.8 INSPECTION OF WORK

- .1 The Departmental Representative and Consultant will make periodic visits to the site during construction to ascertain that the Work is being executed in reasonable conformity with all Specifications and Drawings, but will not execute quality control. The General Contractor and Electrical Contractor must each maintain his own quality control.
- .2 Correct all deficiencies immediately as noted during field inspections.
- .3 Request in writing for inspections on the following milestones:
 - .1 Underground trenches and ductbanks before concrete encasement and/or backfill.
 - .2 Rough-in.
 - .3 Prior to energization.
- .4 Request in writing that a final inspection of electrical systems be made. Do not issue this written request until:
 - .1 All deficiencies noted during job inspections have been corrected;
 - .2 All systems have been tested and are ready for operation;
 - .3 All inspections and test reports have been submitted and reviewed;
 - .4 All letters of certification have been submitted;
 - .5 All instruction manuals have been submitted and reviewed; and the Departmental Representative's instructions have been carried out;
 - .6 All identification is in place;
 - .7 The cleanup is finished in all respects;
 - .8 All spare parts and replacement parts specified have been provided and receipt of same acknowledged
 - .9 All asbuilt drawings are completed and checked.

3.9 SYSTEM STARTUP

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

3.10 CLEANING

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

3.11 GUARANTEE AND WARRANTY

- .1 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 Departmental Representative's Acceptance.
- .2 The Electrical Contractor further agrees that they will, at their own expense, promptly investigate any electrical system malfunction, and repair or replace all such defective work and all other damages thereby which becomes defective during the time of the guarantee-warranty.
- .3 The period of the guarantee specified shall not, in any way, supplant any other guarantees of a longer period provided by Manufacturers or specified.

3.12 SUBSTANTIAL PERFORMANCE INSPECTION

- .1 Refer to Division 1.
- .2 A complete list of items which the Electrical Contractor has not finished, or are deficient shall be provided by the Consultant. If, in the opinion of the Consultant, this list indicates the project is excessively incomplete, a substantial completion inspection will not be performed.
- .3 Prior to the Electrical Contractor requesting an inspection for substantial performance, all the following items must be provided:
 - .1 Comply with requirements in Division 1.
 - .2 Approved Operation and Maintenance Manuals.
 - .3 Asbuilt drawings.
 - .4 Testing and Commissioning Reports
 - .5 The Electrical Contractor shall certify in writing that all systems are complete and fully operational.
 - .6 Instructions to the Departmental Representative's operating personnel shall be provided in accordance with the specifications. A signed statement to this effect, countersigned by the Departmental Representative, shall be submitted to the Consultant.

3.13 RELEASE OF ELECTRICAL SCHEDULE C2

- .1 To the release of the Electrical Schedule C2, certain requirements must be met, including, but not limited to:
 - .1 Utility power supply systems are complete and operational.
 - .2 All life safety electrical systems such as lighting systems and exit signs must be complete and operational.

- .3 Junction box covers are installed; electrical installation is commissioned and operational.
- .4 Firestopping and sealing is complete.
- .5 Life safety emergency generator and associated distribution (transfer switches, etc.) are tested, commissioned and operational.
- .6 Departmental Representative has beneficial usage of space.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

1.2 REFERENCES

- .1 CSA (Canadian Standards Association).
 - .1 CSA-C22.1-15 - Canadian Electrical Code, Part I (23rd Edition), Safety Standard for Electrical Installations.
 - .2 CSA-C22.2 No. 0.3-09 - Test Methods for Electrical Wires and Cables.
 - .3 CSA-C22.2 No. 48-15 - Nonmetallic Sheathed Cable.
 - .4 CSA-C22.2 No. 51-09 - Armoured Cables.
 - .5 CSA-C22.2 No. 52-15 - Underground secondary and service-entrance cables.
 - .6 CSA-C22.2 No. 65-13 - Wire Connectors.
 - .7 CSA-C22.2 No. 75-08 (R2013) - Thermoplastic-Insulated Wires and Cables.
 - .8 CSA-C22.2 No. 123-08 (R2012) - Metal Sheathed Cables.

1.3 PRODUCT DATA

- .1 Provide product data in accordance with Section 01 33 00 - Submittal Procedures.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Refer to Section 26 05 00 Common Work Results For Electrical.

Part 2 Products

2.1 BUILDING WIRES

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2 Copper or Aluminum conductors: size as indicated, with 600 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE.

2.2 ARMOURED CABLES

- .1 Conductors: insulated, copper, size as indicated.
- .2 Type: AC90 with interlocking type armour fabricated from aluminum strip.
- .3 Type: ACWU90 PVC flame retardant jacket over thermoplastic armour and compliant to applicable Building Code classification for this project.
- .4 Connectors: anti short connectors.

2.3 NON-METALLIC SHEATHED CABLE

- .1 Non-metallic sheathed copper cable type: NMD90 300V XLPE insulation PVC jacket, size as indicated, 14 AWG permitted within residential units.

Part 3 Execution

3.1 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform tests before energizing electrical system.

3.2 GENERAL CABLE INSTALLATION

- .1 Completely and thoroughly swab raceway before installing wire.
- .2 Install wire and cable to manufacturer's written instructions.
- .3 Route wire and cable as required to meet project conditions.
- .4 Use suitable wire pulling lubricant for building wire 4 AWG and larger.
- .5 Protect exposed cable from damage.
- .6 Cable Colour Coding: to Section 26 05 00 - Common Work Results for Electrical.
- .7 Conductor length for parallel feeders to be identical.
- .8 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.
- .9 Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.
- .10 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.
- .11 Use suitable cable fittings and connectors.
- .12 Neatly train and lace wiring inside boxes, equipment, and panelboards.
- .13 Clean conductor surfaces before installing lugs and connectors.
- .14 Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
- .15 Terminate aluminum conductors with tin-plated aluminum- bodied compression connectors only. Fill with anti- oxidant compound before installing conductor.
- .16 Use suitable reducing connectors or mechanical connector adaptors for connecting aluminum conductors to copper conductors.
- .17 Use split bolt connectors for copper conductor splices and taps, 6 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor.

- .18 Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
- .19 Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

3.3 INSTALLATION OF BUILDING WIRES

- .1 Install wiring as follows:
 - .1 In conduit systems in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
 - .2 In underground ducts as required.
 - .3 In wireways and auxiliary gutters.
 - .4 Overhead service conductors.

3.4 INSTALLATION OF ARMOURED CABLES

- .1 Group cables wherever possible on channels.

3.5 INSTALLATION OF NON-METALLIC SHEATHED CABLE

- .1 Install cables.
- .2 Install straps and box connectors to cables as required.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Not applicable.

1.2 REFERENCES

- .1 CSA-C22.1-15 - Canadian Electrical Code, Part I (23rd Edition), Safety Standard for Electrical Installations.
- .2 CSA (Canadian Standards Association).
- .3 UL (Underwriters Laboratories Inc.).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for grounding equipment for incorporation into manual.

1.5 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.

Part 2 Products

2.1 EQUIPMENT

- .1 Clamps for grounding of conductor: size as required to electrically conductive underground water pipe.
- .2 Plate electrodes: manufactured galvanized steel ground plate with ground conductor connector, 250mm x 400mm x 6mm.
- .3 Grounding conductors: bare stranded copper, soft annealed, size as indicated.
- .4 Insulated grounding conductors: green RW90 insulation, copper conductors, size as indicated.
- .5 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.
- .6 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
 - .1 Grounding and bonding bushings.
 - .2 Protective type clamps.

- .3 Bolted type conductor connectors.
- .4 Bonding jumpers, straps.
- .5 Pressure wire connectors.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for grounding equipment installation in accordance with manufacturer's written instructions.

3.2 INSTALLATION GENERAL

- .1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect exposed grounding conductors from mechanical damage.
- .4 Make buried connections, and connections to conductive water main, electrodes, using permanent mechanical connectors or inspectable wrought copper compression connectors to ANSI/IEEE 837.
- .5 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .6 Soldered joints not permitted.
- .7 Install bonding wire for flexible conduit, connected at one end to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .8 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.
- .9 Install separate ground conductor to outdoor lighting standards.
- .10 Connect building structural steel and metal siding to ground.
- .11 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- .12 Ground utility electrical service neutral at main switch.

3.3 ELECTRODES

- .1 Install plate electrodes and make grounding connections.
- .2 Bond separate, multiple electrodes together.
- .3 Use size 6 AWG copper conductors for connections to electrodes.
- .4 Make special provision for installing electrodes that will give required resistance to ground value where rock or sand terrain prevails. Ground as indicated.

3.4 SYSTEM AND CIRCUIT GROUNDING

- .1 Install system and circuit grounding connections to neutral secondary 120/240 V system.

3.5 EQUIPMENT GROUNDING

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, frames of motors, motor starters, control panels, building steel work, distribution panels, outdoor lighting, etc.

3.6 GROUNDING BUS

- .1 Install copper grounding bus mounted on insulated supports on wall of electrical room and communication equipment room.

3.7 COMMUNICATION SYSTEMS

- .1 Install grounding connections for telephone, sound, security systems, intercommunication systems as follows:
 - .1 Telephones: make telephone grounding system in accordance with telephone company's requirements.
 - .2 Sound, security systems, intercommunication systems as indicated.

3.8 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Consultant and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

Part 2 Products

2.1 SUPPORT CHANNELS

- .1 C-Channel: U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted or suspended.

Part 3 Execution

3.1 INSTALLATION

- .1 Secure equipment to masonry, tile and plaster surfaces using manufacturer approved methods.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .4 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.
- .5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .6 Fasten exposed conduit or cables to building construction or support system using straps.
 - .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
 - .2 Two-hole steel straps for conduits and cables larger than 50 mm.
 - .3 Beam clamps to secure conduit to exposed steel work.
- .7 Suspended support systems.
 - .1 Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.
 - .2 Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.
- .8 For surface mounting of two or more conduits use channels at required spacing intervals for the conduit size per CEC.

- .9 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .10 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .11 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .12 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Consultant.
- .13 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Not applicable.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-15, Canadian Electrical Code, Part 1, 23rd Edition.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide shop drawings: in accordance with Section 26 05 00 Common Work Results for Electrical.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal:
 - .1 Separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 SPLITTERS

- .1 Construction: sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.
- .2 Terminations: main and branch lugs or connection lugs to match required size and number of incoming and outgoing conductors as indicated.
- .3 Spare Terminals: minimum three spare terminals on each connection or lug block sized less than 400 A.

2.2 JUNCTION AND PULL BOXES

- .1 Construction: welded steel enclosure.
- .2 Covers Flush Mounted: 25 mm minimum extension all around.
- .3 Covers Surface Mounted: screw-on covers.

2.3 CABINETS

- .1 Construction: welded sheet steel hinged door.

Part 3 Execution

3.1 SPLITTER INSTALLATION

- .1 Mount plumb, true and square to building lines.
- .2 Extend splitters full length of equipment arrangement except where indicated otherwise.

3.2 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Mount cabinets with top not higher than 2 m above finished floor except where indicated otherwise.
- .3 Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1.

3.3 IDENTIFICATION

- .1 Equipment Identification: to Section 26 05 00 - Common Work Results for Electrical]
- .2 Identification Labels: size 2 indicating equipment name, voltage and phase or as indicated.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Not Applicable.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-15 Canadian Electrical Code, Part 1, 23rd Edition.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Not Applicable.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

Part 2 Products

2.1 OUTLET AND CONDUIT BOXES GENERAL

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm square or octagonal outlet boxes as required.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.
- .5 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 GALVANIZED STEEL OUTLET BOXES

- .1 One-piece electro-galvanized construction.
- .2 Single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .3 Utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.
- .4 102 mm square or octagonal outlet boxes for lighting fixture outlets.
- .5 Extension and plaster rings for flush mounting devices in finished walls.

2.3 MASONRY BOXES

- .1 Electro-galvanized steel masonry single and multi gang boxes for devices flush mounted in exposed block walls.

2.4 CONCRETE BOXES

- .1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.5 FLOOR BOXES

- .1 Not Applicable.

2.6 CONDUIT BOXES

- .1 Cast FS boxes with factory-threaded hubs and mounting feet for surface wiring of devices.

2.7 OUTLET BOXES FOR NON-METALLIC SHEATHED CABLE

- .1 Electro-galvanized, sectional, screw ganging steel boxes, minimum size 76 x 50 x 63 mm with two double clamps to take non-metallic sheathed cables.

2.8 FITTINGS - GENERAL

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 35 mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

Part 3 Execution

3.1 INSTALLATION

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Do not install reducing washers.
- .5 Vacuum clean interior of outlet boxes before installation of wiring devices.
- .6 Identify systems for outlet boxes as required.
- .7 Maintain headroom and present neat mechanical appearance.
- .8 Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- .9 Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.
- .10 Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.

- .11 Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.
- .12 Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.
- .13 Use flush mounting outlet box in finished areas.
- .14 Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- .15 Do not install flush mounting box back-to-back in walls; provide minimum 150 mm separation. Provide minimum 600 mm separation in acoustic rated or party walls.
- .16 Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- .17 Use stamped steel bridges to fasten flush mounting outlet box between studs.
- .18 Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- .19 Use adjustable steel channel fasteners for hung ceiling outlet box.
- .20 Do not fasten boxes to ceiling support wires.
- .21 Support boxes independently of conduit.
- .22 Use gang box where more than one device is mounted together. Do not use sectional box.
- .23 Use gang box with plaster ring for single device outlets.
- .24 Use cast outlet box in exterior locations exposed to the weather and wet locations.
- .25 Large Pull Boxes: Use hinged enclosure in interior dry locations, surface-mounted cast metal box in other locations.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 21 - Wires and Cables.
- .2 Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA-C22.1-15 - Canadian Electrical Code, Part I (23rd Edition), Safety Standard for Electrical Installations.
 - .2 CSA-C22.2 No. 56-13 - Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .3 CSA-C22.2 No. 83.1-07 (R2012) - Electrical Metallic Tubing - Steel.
 - .4 CSA-C22.2 No. 211.1-06 (R2011) - Rigid Types EB1 and DB2/ES2 PVC Conduit.
 - .5 CSA-C22.2 No. 211.2-06 (R2011) - Rigid PVC (Unplasticized) Conduit.
 - .6 CSA-C22.2 No. 227.1-06 (R2011) - Electrical Nonmetallic Tubing.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.5 DELIVERY, STORAGE, AND PROTECTION

- .1 Accept conduit on site. Inspect for damage.
- .2 Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- .3 Protect PVC conduit from sunlight.

Part 2 Products

2.1 CONDUIT REQUIREMENTS

- .1 Minimum Size: 16 mm unless otherwise specified.
- .2 Underground Installations:
 - .1 In or Under Slab on Grade: Non-metallic conduit.
 - .2 Minimum Size: 21 mm
- .3 Outdoor Locations, Above Grade: Electrical metallic tubing.

- .4 In Slab Above Grade:
 - .1 Electrical non-metallic tubing.
 - .2 Maximum Size Conduit in Slab: 27 mm or per Structural Engineer's direction.
- .5 Dry Locations:
 - .1 Concealed: Electrical metallic tubing.
 - .2 Exposed: Electrical metallic tubing.
- 2.2 FLEXIBLE METAL CONDUIT**
 - .1 Description: Interlocked steel construction.
 - .2 Fittings: CSA-C22.2 No. 56.
- 2.3 LIQUID TIGHT FLEXIBLE METAL CONDUIT**
 - .1 Description: Interlocked steel construction with PVC jacket.
 - .2 Fittings: CSA-C22.2 No. 56.
- 2.4 ELECTRICAL METALLIC TUBING (EMT)**
 - .1 Description: CSA-C22.2 No. 83.1; hot-dip galvanized steel tubing with topcoat for corrosion and abrasion protection and interior coating for efficient wire-pulling.
 - .2 Sizes: 16mm through 103mm.
 - .3 Fittings and Conduit Bodies: steel set-screw.
- 2.5 RIGID NON-METALLIC PVC CONDUIT**
 - .1 Description: Schedule 40 PVC.
 - .2 Sizes: 16mm through 155mm.
 - .3 Utilize only solvent cements and adhesive primers which are acceptable for LEED projects.
 - .4 Fittings and Conduit Bodies: CSA-C22.2 No. 211.2.
- 2.6 ELECTRICAL NON-METALLIC TUBING**
 - .1 Description: CSA-C22.2 No. 227.1. Non-corroding and non-conducting for use in concrete.
 - .2 Sizes: 16mm through 103mm.
 - .3 Forms a concrete-tight system.
 - .4 Approved for use.
 - .5 Fittings and Conduit Bodies: CSA-C22.2 No. 227.1; high-impact PVC, concrete-tight without tape.
- 2.7 CONDUIT FASTENINGS**
 - .1 One hole steel straps to secure surface conduits 53 mm and smaller.

- .1 Two hole steel straps for conduits larger than 53 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits.
- .4 Threaded rods, 6 mm diameter, to support suspended channels.

2.8 CONDUIT FITTINGS

- .1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified. Coating: same as conduit.
- .2 Ensure factory "ells" where 90 degrees bends for 41 mm and larger conduits.
- .3 Set-screw connectors and couplings for EMT.

2.9 FISH CORD

- .1 Polypropylene.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install conduit to CSA-C22.1.
- .2 Install non-metallic conduit to manufacturer's written instructions.
- .3 Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with raceways as required for complete system.
- .4 Arrange supports to prevent misalignment during wiring installation.
- .5 Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
- .6 Group related conduits; support using conduit rack.
- .7 Construct rack using steel channel. Provide space on each for 25% additional conduits.
- .8 Fasten conduit supports to building structure and surfaces to Section 26 05 29.
- .9 Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.
- .10 Do not attach conduit to ceiling support wires.
- .11 Arrange conduit to maintain headroom and present neat appearance.
- .12 Route conduit parallel and perpendicular to walls.

- .13 Route conduit installed above accessible ceilings parallel and perpendicular to walls.
- .14 Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket.
- .15 Route conduit in and under slab from point-to-point.
- .16 Do not cross conduits in slab.
- .17 Maintain adequate clearance between conduit and piping.
- .18 Cut conduit square using saw or pipe cutter; de-burr cut ends.
- .19 Bring conduit to shoulder of fittings; fasten securely.
- .20 Join electrical non-metallic conduit using cement as recommended by manufacturer.
 - .1 Wipe electrical non-metallic conduit dry and clean before joining.
 - .2 Apply full even coat of cement to entire area inserted in fitting.
 - .3 Allow joint to cure for 20 minutes, minimum.
 - .4 Install to form a water-tight system.
- .21 Use conduit hubs to fasten conduit to cast boxes in damp and wet locations.
- .22 Install no more than equivalent of three (3) 90-degree bends between boxes.
 - .1 Use conduit bodies to make sharp changes in direction, as around beams.
 - .2 Use hydraulic one-shot bender to fabricate or utilize factory elbows for bends in metal conduit larger than 41mm trade size.
 - .3 Fittings shall only be installed in straight sections of conduit.
- .23 Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.
- .24 Provide suitable fittings to accommodate expansion and deflection where conduit crosses building expansion joints.
- .25 Provide suitable pull string in each empty conduit except sleeves and nipples.
- .26 Use suitable caps to protect installed conduit against entrance of dirt and moisture.
- .27 Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."
- .28 Ground and bond conduit to Section 26 05 28.
- .29 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .30 Conceal conduits except in mechanical and electrical service rooms.
- .31 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.
- .32 Minimum conduit size for lighting and power circuits: 21 mm.

- .33 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .34 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .35 Install fish cord in empty conduits.
- .36 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.
- .37 Dry conduits out before installing wire.

3.3 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on suspended or surface channels.
- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.4 CONCEALED CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Do not install horizontal runs in masonry walls.
- .3 Do not install conduits in terrazzo or concrete toppings.

3.5 CONDUITS IN CAST-IN-PLACE CONCRETE

- .1 Locate to suit reinforcing steel.
 - .1 Install in centre one third of slab.
- .2 Protect conduits from damage where they stub out of concrete.
- .3 Install sleeves where conduits pass through slab or wall.
- .4 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed.
 - .1 Use cold mastic between sleeve and conduit.
- .5 Conduits in slabs: minimum slab thickness 4 times conduit diameter.
- .6 Encase conduits completely in concrete with minimum 25 mm concrete cover.
- .7 Organize conduits in slab to minimize cross-overs.

3.6 CONDUITS IN CAST-IN-PLACE SLABS ON GRADE

- .1 Where identified, run conduits 27 mm and larger below slab and encase in 75 mm concrete envelope.

- .1 Provide 50 mm of sand over concrete envelope below floor slab.

3.7 CONDUITS UNDERGROUND

- .1 Slope conduits to provide drainage.
- .2 Waterproof joints (pvc excepted) with heavy coat of bituminous paint.

3.8 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 50 00 – Lighting.

1.2 REFERENCES

- .1 CSA C22.1-15, Canadian Electrical Code, Part 1 (23rd Edition), Safety Standard for Electrical Installations.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for photoelectric devices and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

Part 2 Products

2.1 PHOTOELECTRIC LIGHTING CONTROL

- .1 Photoelectric Lighting Controls: to CSA C22.1.
 - .1 Wall mounting.
 - .2 Capable of switching minimum 1000 W of lighting at 120 V.
 - .3 Voltage variation: plus or minus 10%.
 - .4 Temperature range: minus 40 degrees C to plus 40 degrees C.
 - .5 Options:
 - .1 Sensitivity adjustment.
 - .6 Switching time delay relay.
 - .7 Wall mounting bracket.
 - .8 Colour coded leads: size 10 AWG, 460 mm long.

2.2 CONTACTOR

- .1 Contactor: to CSA C22.1.
 - .1 Cabinet mounting.
 - .2 Multi-pole contactor capable of switching multiple lamp circuits.

- .3 120V rated coil.
- .4 120V 20 Amp rated contacts.
- .5 Manual override (Hand-Off-Auto).

Part 3 Execution

3.1 INSTALLATION

- .1 Install photoelectric controls in accordance with manufacturer's written instructions and to CSA C22.1.
- .2 Adjust sensitivity and mounting angle.

3.2 PROTECTION

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Not Applicable.

1.2 REFERENCES

- .1 CSA International
 - .1 CSA-C22.1-15 - Canadian Electrical Code, Part I (23rd Edition), Safety Standard for Electrical Installations.
 - .2 CSA-C22.2 No. 5-13 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures.
 - .3 CSA C22.2 No.29-15, Panelboards and Enclosed Panelboards.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for panelboards and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Include on drawings:
 - .1 Voltage rating.
 - .2 Continuous current rating for each bus, including phase, neutral, and ground buses.
 - .3 Short-circuit current rating (RMS Symmetrical).
 - .4 Bus material.
 - .5 Lug type, size and configuration.
 - .6 NEMA enclosure rating.
 - .7 Branch circuit breakers types and ratings.
 - .8 Enclosure dimensions.
 - .9 Assembled weight.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for panelboards for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with with manufacturer's written instructions.

- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect panelboards from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for recycling packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 PANELBOARDS

- .1 Panelboards: to CSA C22.2 No.29 and product of one manufacturer.
 - .1 Install circuit breakers in panelboards before shipment.
 - .2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.
- .2 250 V panelboards: bus and breakers rated for short circuit current as noted on Drawings RMS (symmetrical) interrupting capacity.
- .3 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.
- .4 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
- .5 Minimum of 2 flush locks for each panel board.
- .6 Two keys for each panelboard and key panelboards alike.
- .7 Aluminum bus with neutral of same ampere rating of mains.
- .8 Moulded Case Circuit Breakers: CSA-C22.2 No. 5, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Type HACR for air conditioning equipment circuits, Class A ground fault interrupter circuit breakers where scheduled. Do not use tandem circuit breakers.
- .9 Enclosure:
 - .1 NEMA 1.
 - .2 Surface mount.
 - .3 Code-gauge galvanized steel construction.
 - .4 Hinged front cover.
 - .5 Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

- .6 Single tub arrangement for up to 84 branch breaker poles.
- .7 Metal circuit directory frame.
- .8 Finish: Manufacturer's standard ANSI 61 grey finish over rust-inhibiting primer on phosphatizing-treated metal surfaces.
- .10 Include grounding busbar with 3 of terminals for bonding conductor equal to breaker capacity of the panel board.
- .11 Circuit breaker trip unit size and settings shall be visible and accessible without removing any covers or filler plates.

2.2 LOAD CENTRES

- .1 Description: Circuit breaker load centre, with bus ratings as indicated.
- .2 Minimum Short Circuit Current Rating (RMS Symmetrical): 10,000 amperes.
- .3 Moulded Case Circuit Breakers: CSA-C22.2 No. 5, plug-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Class A ground fault interrupter circuit breakers where indicated. Tandem circuit breakers permitted.
- .4 Enclosure: General Purpose suitable for recessed mounting in dwelling unit interior partitions.
- .5 Box: Flush with door, and lock on door. Finish in manufacturer's standard white enamel paint finish.

2.3 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Nameplate for each panelboard size 4 engraved as indicated.
- .3 Complete circuit directory with typewritten legend showing location and load of each circuit, mounted in plastic envelope at inside of panel door.

Part 3 Execution

3.1 INSTALLATION

- .1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2 Install surface mounted panelboards on plywood backboards. Where practical, group panelboards on common backboard.
- .3 Mount panelboards to height specified in Section 26 05 00 - Common Work Results for Electrical or as indicated.
- .4 Connect loads to circuits.
- .5 Connect neutral conductors to common neutral bus.
- .6 Tighten bus joints, electrical connectors, and terminals according to manufacturer's published torque-tightening values.

- .7 Ground and bond panelboard enclosure according to Section 26 05 28.
- .8 Provide filler plates for unused spaces in panelboards.

3.2 FIELD QUALITY CONTROL

- .1 Complete the following Pre-Checks:
 - .1 Visually inspect equipment, wiring, components, connections, and installation provisions.
 - .2 Visual inspection of field electrical equipment for conformity to specified labeling.
 - .3 Visually inspects field electrical equipment and feeder installations for conformity to specified methods.
 - .4 Visually inspect all power cabling and terminations.
- .2 Verify voltage and phase rotation.

3.3 ADJUSTING

- .1 Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 20% of each other.
- .2 Maintain proper phasing for multi-wire branch circuits.

3.4 CLEANING

- .1 On completion of installation, inspect interior and exterior of equipment. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair damaged finishes.
- .2 Touch up scratched or marred surfaces to match original finish.

3.5 PROTECTION

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.

1.2 REFERENCES

- .1 CSA International
 - .1 CSA-C22.1-15 - Canadian Electrical Code, Part I (23rd Edition), Safety Standard for Electrical Installations.
 - .2 CSA-C22.2 No. 42-10 (R2015) - General Use Receptacles, Attachment Plugs, and Similar Wiring Devices.
 - .3 CSA-C22.2 No. 42.1-13 - Cover Plates for Flush-Mounted Wiring Devices.
 - .4 CSA-C22.2 No. 55-15 - Special Use Switches.
 - .5 CSA-C22.2 No. 111-10 (R2015) - General-Use Snap Switches.
 - .6 CSA-C22.2 No. 184.1-15 - Solid-State Dimming Controls.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings to be submitted for wiring devices.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for wiring devices for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Packaging Waste Management: remove for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 SWITCHES

- .1 Description: CSA-C22.2 No. 111, Commercial Specification Grade Decora, AC only general-use snap switch.
- .2 Type: quiet operation, slow make, slow break design.

- .3 Body and Handle: white thermoplastic with rocker handle.
- .4 Ratings:
 - .1 Voltage: 120-277 volts, 347 volts AC.
 - .2 Current: 20 amperes.
- .5 Configuration: Single pole, 3-way or 4-way as noted on Drawings.
- .6 Manually-operated general purpose AC switches with following features:
 - .1 Terminal holes approved for No. 10 AWG wire.
 - .2 Silver alloy contacts.
 - .3 Urea or melamine moulding for parts subject to carbon tracking.
 - .4 Suitable for back and side wiring.
- .7 Switches of one manufacturer throughout project.

2.2 WALL DIMMERS

- .1 Description: CSA-C22.2 No. 184.1; Commercial Specification Grade Decora, semiconductor dimmer suitable for LED lamps.
- .2 Type: RFI filter with voltage compensating capabilities. Compatible with 0-10V LED drivers where specified.
- .3 Body and Handle: white thermoplastic with linear slide.
- .4 Voltage: 120-277 volts.
- .5 Power Rating: Match load shown on Drawings; 600 watts minimum.

2.3 RECEPTACLES

- .1 Description: CSA-C22.2 No. 42, Commercial Specification Grade Decora style.
- .2 Device Body:
 - .1 General use receptacles shall be white decora.
 - .2 Computer receptacles shall be grey decora.
 - .3 Special receptacles as shown on Drawings.
- .3 Convenience Receptacle: Type 5-15R.
- .4 GFCI Receptacle: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.
- .5 20 Amp T-slot Receptacle: Type 5-20R.

2.4 WALL PLATES

- .1 Decorative Cover Plate: smooth plastic, color to match receptacle.
- .2 Weatherproof Cover Plate: While-in-use cover with gasketed device cover.

2.5 SOURCE QUALITY CONTROL

- .1 Cover plates from one manufacturer throughout project.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify existing conditions before starting work.
- .2 Verify that outlet boxes are installed at proper height.
- .3 Verify that wall openings are neatly cut and will be completely covered by wall plates.
- .4 Verify that floor boxes are adjusted properly.
- .5 Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
- .6 Verify that openings in access floor are in proper locations.

3.2 PREPARATION

- .1 Provide extension rings to bring outlet boxes flush with finished surface.
- .2 Clean debris from outlet boxes.

3.3 INSTALLATION

- .1 Install to CSA-C22.1 and manufacturer's written instructions.
- .2 Install devices plumb and level.
- .3 Install switches with OFF position down.
- .4 Install wall dimmers to achieve full rating specified and indicated after de-rating for ganging as instructed by manufacturer.
- .5 Install switches in gang type outlet box when more than one switch is required in one location.
- .6 Do not share neutral conductor on load side of dimmers.
- .7 Install receptacles with grounding pole on bottom.
- .8 Where split receptacle has one portion switched, mount vertically and switch upper portion.
- .9 Connect wiring device grounding terminal to outlet box with bonding jumper.
- .10 Install decorative plates on switch, receptacle, and blank outlets in finished areas.
- .11 Connect wiring devices by wrapping conductor around screw terminal.
- .12 Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.
- .13 Install suitable common cover plates where wiring devices are grouped.

3.4 INTERFACE WITH OTHER PRODUCTS

- .1 Coordinate locations of outlet boxes provided under Section 26 05 34 to obtain mounting heights indicated on Drawings.

- .2 Install wiring devices to specified mounting heights.

3.5 FIELD QUALITY CONTROL

- .1 Inspect each wiring device for defects.
- .2 Operate each wall switch with circuit energized and verify proper operation.
- .3 Verify that each receptacle device is energized.
- .4 Test each receptacle device for proper polarity.
- .5 Test each GFCI receptacle device for proper operation.

3.6 ADJUSTING

- .1 Adjust devices and wall plates to be flush and level.

3.7 CLEANING

- .1 Clean installed work.
- .2 Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 18 13.01 – Fuses – Low Voltage.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CAN/CSA C22.2 No.4-04 (R2009), Enclosed Switches.
 - .2 CSA C22.2 No.39-M89 (R2003), Fuseholder Assemblies.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 WASTE MANAGEMENT AND DISPOSAL

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

Part 2 Products

2.1 FUSIBLE DISCONNECT SWITCHES

- .1 Fusible, horsepower rated disconnect switch in CSA Enclosure Type 1 or 3R for exterior locations to CAN/CSA C22.2 No.4, size as indicated.
- .2 Provision for padlocking in off switch position by up to three locks.
- .3 Mechanically interlocked door to prevent opening when handle in ON position.
- .4 Fuses: size as indicated, in accordance with Section 26 28 13.01 - Fuses - Low Voltage.
- .5 Fuseholders: to CSA C22.2 No.39 suitable without adaptors, for type and size of fuse indicated.
- .6 Quick-make, quick-break action.
- .7 ON-OFF switch position indication on switch enclosure cover.
- .8 Neutral grounding block for service entrance applications.

2.2 NON-FUSIBLE DISCONNECT SWITCHES

- .1 Non-fusible, horsepower rated disconnect switch in CSA Enclosure Type 1 or 3R to CAN/CSA C22.2 No.4 size as indicated.
- .2 Provision for padlocking in off switch position by up to three locks.

- .3 Mechanically interlocked door to prevent opening when handle in ON position.
- .4 Quick-make, quick-break action.
- .5 ON-OFF switch position indication on switch enclosure cover.

2.3 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Indicate name of load controlled on size 4 nameplate.

Part 3 Execution

3.1 INSTALLATION

- .1 Install disconnect switches complete with fuses if applicable.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 28 23 Disconnect Switches - Fused and Non-Fused.

1.2 REFERENCES

- .1 CSA (Canadian Standards Association).
 - .1 CSA-C22.1-15 - Canadian Electrical Code, Part I (23rd Edition), Safety Standard for Electrical Installations.
 - .2 CSA-C22.2 No. 248.1-11 - Low-voltage fuses - Part 1: General requirements.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Shop Drawings:
 - .1 Provide fuse performance data characteristics for each fuse type and size above 15 A. Performance data to include: average melting time-current characteristics.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Ship fuses in original containers.

1.5 EXTRA MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Three (3) spare fuses of each type and size installed.

Part 2 Products

2.1 FUSES - GENERAL

- .1 Fuse type references L, J, RK1, etc. have been adopted for use in this specification.
- .2 Fuses: product of one manufacturer.

2.2 FUSE TYPES

- .1 Dimensions and Performance: CSA-C22.2 No. 248.1, Class as specified or indicated.
- .2 Voltage: Provide fuses with voltage rating suitable for circuit phase-to-phase voltage.
- .3 Main Service Switches Less than 600 amperes:
 - .1 Class J (time delay).

- .2 Visual blown fuse indication.
- .3 Fuses shall be time-delay and shall hold 500% of rated current for a minimum of 10 seconds and be CSA certified with an interrupting rating of 200,000 RMS symmetrical amperes.
- .4 Power Branch Circuits: Class J (time delay).
 - .1 Class J (time delay).
 - .2 Visual blown fuse indication.
 - .3 Fuses shall be time-delay and shall hold 500% of rated current for a minimum of 10 seconds and be CSA certified with an interrupting rating of 200,000 RMS symmetrical amperes.
- .5 Motor Branch Circuits:
 - .1 Class J (time delay).
 - .2 Visual blown fuse indication.
 - .3 Fuse sizes for motor protection shall be chosen from tables published by the fuse manufacturer.

2.3 FUSE STORAGE CABINET

- .1 Description: Wall-mounted sheet metal cabinet, suitably sized to store spare fuses and fuse pullers specified.
- .2 Doors: Hinged, with hasp for Departmental Representative's padlock.
- .3 Finish: ANSI 61 or 49 grey.

Part 3 Execution

3.1 INSTALLATION

- .1 Install fuses in mounting devices immediately before energizing circuit.
- .2 Ensure correct fuses fitted to physically matched mounting devices.
 - .1 Install rejection clips for Class R fuses.
- .3 Ensure correct fuses fitted to assigned electrical circuit.
- .4 Where UL Class RK1 fuses are specified, install warning label "Use only UL Class RK1 fuses for replacement" on equipment.
- .5 Install spare fuses in fuse storage cabinet.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Not Applicable.

1.2 REFERENCES

- .1 CSA-C22.1-15 - Canadian Electrical Code, Part I (23rd Edition), Safety Standard for Electrical Installations.
- .2 CSA-C22.2 No. 9.0-96 (R2011) - General Requirements for Luminaires.
- .3 CSA-C22.2 No. 141-15 - Emergency lighting equipment.
- .4 CSA-C22.2 No. 250.0-08 (R2013) - Luminaires.
- .5 NEMA WD 6-12 - Wiring Devices - Dimensional Requirements.
- .6 CSA (Canadian Standards Association).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings:
 - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Clearly indicate selections where options are available from the manufacturer.

1.4 QUALITY ASSURANCE

- .1 Provide mock-ups as requested.
- .2 Conform to requirements of CSA-C22.1.
- .3 Products: Listed and classified by CSA or UL as suitable for the purpose specified and indicated.
- .4 Testing Certifications: LED luminaires shall be manufactured in compliance with LM-79 standard and tested for a lumen maintenance rating of 50,000 hours in accordance with LM-80 standards.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for recycling packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

- .4 Divert unused metal materials from landfill to metal recycling facility.

Part 2 Products

2.1 LUMINAIRES

- .1 Manufacturers:
 - .1 Refer to Luminaire Schedule on Drawings.
 - .2 Substitutions: Alternate manufacturers may be considered for approval. Request for approval must be accompanied with the following requirements:
 - .1 Lighting fixture catalogue cutsheets c/w IES files.
 - .2 Manufacturer-produced point-by-point lighting calculations are to be provided for all rooms and areas.
 - .3 Watts/sq.m calculation for all sections.
 - .4 Requests for approval must be received by the Engineer complete with above items a minimum of 7 days prior to tender close.
- .2 Description: Luminaires with lamps and drivers installed by luminaire manufacturer.
- .3 Mounting: As indicated.
- .4 Lamps to be included.
- .5 Accessories: As indicated.

2.2 SOLID STATE (LED) DRIVERS

- .1 Voltage: Match luminaire voltage.
- .2 Integral to luminaire complete with surge protection.
- .3 High efficiency.
- .4 Minimum Power Factor of 0.9.
- .5 THD less than 20%.
- .6 0-10V dimming.
- .7 CSA certified to Canadian safety standards.

2.3 FINISHES

- .1 Light fixture finish and construction to meet ULC listings and CSA certifications related to intended installation.

2.4 OPTICAL CONTROL DEVICES

- .1 As indicated in luminaire schedule.

Part 3 Execution

3.1 INSTALLATION

- .1 Locate and install luminaires as indicated.
- .2 Locate recessed ceiling luminaires as indicated on lighting layout plans.
- .3 Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.
- .4 Install recessed luminaires in finished ceilings to permit removal from below.
- .5 Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- .6 Install clips to secure recessed grid-supported luminaires in place.
- .7 Install wall mounted luminaires at height as indicated on Drawings.
- .8 Install accessories provided with each luminaire.
- .9 Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- .10 Bond products and metal accessories to branch circuit equipment grounding conductor.
- .11 Install specified lamps in each luminaire (where required).

3.2 WIRING

- .1 Connect luminaires to lighting circuits.

3.3 LUMINAIRE ALIGNMENT

- .1 Align luminaires mounted in continuous rows to form straight uninterrupted line.
- .2 Align luminaires mounted individually parallel or perpendicular to building grid lines.

3.4 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Not Applicable.

1.2 REFERENCES

- .1 CSA International
 - .1 CSA C22.2 No.141-15, Emergency Lighting Equipment.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for emergency lighting and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for emergency lighting for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

Part 2 Products

2.1 BATTERY UNIT EQUIPMENT

- .1 Emergency lighting equipment: to CSA C22.2 No.141.
- .2 Supply voltage: 120 Volts, AC.
- .3 Output voltage: 12 Volts DC.
- .4 Operating time: 60 minutes.
- .5 Battery: sealed, maintenance free.
- .6 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output of plus or minus 0.01 V for plus or minus 10% input variations.
- .7 Solid state transfer circuit.

- .8 Low voltage disconnect: solid state, modular, operates at 80% battery output voltage.
- .9 Signal lights: solid state, for 'AC Power ON' and Diagnostic Lights to indicate Battery Failure, Battery Disconnected, Charger Failure, Lamp Failure, Service Alarm, Charger Rate High.
- .10 Integral lamp heads: 345 degrees horizontal and 180 degrees vertical adjustment. Lamp type: LED, as noted on Drawings.
- .11 Cabinet: suitable for direct or shelf mounting to wall and c/w knockouts for conduit. Removable or hinged front panel for easy access to batteries.
- .12 Finish: White.
- .13 Auxiliary equipment:
 - .1 Test switch.
 - .2 Mounting shelf.

2.2 REMOTE HEADS

- .1 Dual head, LED lamps as noted on Drawings.
- .2 Mounting: suitable for ceiling or wall mounting.
- .3 Finish: White.

Part 3 Execution

3.1 INSTALLATION

- .1 Install unit equipment and remote mounted fixtures.
- .2 Direct heads.
- .3 Connect exit lights to unit equipment.

3.2 PROTECTION

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Not Applicable.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.141-15, Unit Equipment for Emergency Lighting.
 - .2 CSA C860-11 (R2016), Performance of Internally-Lighted Exit Signs.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 STANDARD UNITS

- .1 Exit lights: to CSA C22.2 No.141 and CSA C860.
- .2 Housing: one-piece aluminum housing and faceplates.
- .3 Universal mounting – end, wall or ceiling.
- .4 Lamps: LED long life.
- .5 Operation: designed for over 80,000 hours of continuous operation.
- .6 Pictogram with direction selection: Left From Here, Straight From Here and Right From Here.
- .7 Universal Input Voltage: 120 to 347 Volts AC and 6 to 24 Volts DC.

2.2 SELF-POWERED UNITS

- .1 Exit lights: to CSA C22.2 No.141 and CSA C860.
- .2 Match Standard Units.
- .3 Operating time: 60 minutes minimum.
- .4 Battery: sealed, maintenance free.

- .5 Charger: solid state, voltage/current regulated, inverse temperature compensated, short circuit protected, with regulated output of plus or minus 0.01 V for plus or minus 10% V input variation.
- .6 Solid state transfer circuit.
- .7 Signal lights: solid state, for 'AC Power ON' and Diagnostic Alarm condition.
- .8 Lamp heads: integral on unit, 345 degrees horizontal and 180 degrees vertical adjustment.
 - .1 Lamp type: LED, size per Drawings.
- .9 Mounting: suitable for universal mounting directly on junction box and c/w knockouts for conduit.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install exit lights to manufacturer's recommendations, listing requirements, and local regulatory requirements.
- .2 Connect fixtures to exit light circuits.
- .3 Connect emergency lamp sockets to emergency circuits.
- .4 Ensure that exit light circuit breaker is locked in on position.

3.3 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Telephone service.
- .2 Television service.

1.2 RELATED SECTIONS

- .1 N/A.

1.3 REFERENCES

- .1 ANSI/TIA-568.0.D Generic Telecommunications Cabling for Customer Premises.
- .2 ANSI/TIA-568.1.D Commercial Building Telecommunications Cabling Standard.
- .3 ANSI/TIA-568.3-D, Optical Fiber Cabling and Components Standard

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Coordinate work with utility providers Telus and Shaw Communications.

1.5 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Shop Drawings: Submit manufacturer's instructions, printed product literature and data sheets for communications equipment and include product characteristics, performance criteria, physical size, finish and limitations.

1.6 CLOSEOUT SUBMITTALS

- .1 Section 01 78 10: Submission procedures.

1.7 QUALITY ASSURANCE

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

1.8 DELIVERY, STORAGE, AND PROTECTION

- .1 Section 01 61 00: Transport, handle, store, and protect products.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect communications equipment from nicks, scratches, and blemishes.

- .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 OFF-PREMISES COMMUNICATIONS CABLE

- .1 Supply of off-premises (service) communication cable by Telus.
- .2 Supply of off-premises (service) communication cable by Shaw.

Part 3 Execution

3.1 COORDINATION

- .1 Engage and coordinate communication utility providers in sufficient time to maintain construction schedule.

3.2 INSTALLATION

- .1 Installation of off-premises communication cabling by Telus personnel through trenched conduit raceway supplied and installed by this Electrical Contractor.
- .2 Installation of off-premises communication cabling by Shaw personnel through trenched conduit raceway supplied and installed by this Electrical Contractor.
- .3 Terminate service entry conduits at Telephone Television backboards per the Drawings.
- .4 Bond communication service equipment and panels.

3.3 FIELD QUALITY CONTROL

- .1 Section 01 45 00: Field inspection.
- .2 Testing of off-premises cabling by Telus / Shaw personnel.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Horizontal Telecommunication Cabling.

1.2 RELATED SECTIONS

- .1 27 05 13 Communication Services.

1.3 REFERENCES

- .1 ANSI/TIA-568.0.D Generic Telecommunications Cabling for Customer Premises.
- .2 ANSI/TIA-568.1.D Commercial Building Telecommunications Cabling Standard.
- .3 ANSI/TIA-568-C.2, Balanced Twisted-Pair Telecommunication Cabling and Components Standard.
- .4 ANSI/TIA-568.3-D, Optical Fiber Cabling and Components Standard.

1.4 SYSTEM DESCRIPTION

- .1 Structured telecommunications wiring system consists of unshielded-twisted-pair cables, terminations, connectors, cross-connection hardware and related equipment installed inside building for dwelling unit telecommunications systems, including cabling for voice, data, and auxiliary systems.
- .2 Installed in physical star configuration with separate horizontal and backbone sub-systems.
- .3 Horizontal cables link dwelling units to Telecommunications Demarcation in Main Electrical Room.

1.5 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Shop Drawings: Submit manufacturer's instructions, printed product literature and data sheets for communications equipment and include product characteristics, performance criteria, physical size, finish and limitations.

1.6 CLOSEOUT SUBMITTALS

- .1 Section 01 78 10: Submission procedures.

1.7 QUALITY ASSURANCE

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum Ten (10) years documented experience.

1.8 REGULATORY REQUIREMENTS

- .1 Products: Listed and classified by CSA or UL as suitable for the purpose specified and indicated.

1.9 DELIVERY, STORAGE, AND PROTECTION

- .1 Section 01 61 00: Transport, handle, store, and protect products.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect communications equipment from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

1.10 WARRANTY

- .1 Electrical Contractor shall provide a 1 year parts and labor warranty against defective workmanship and/or system component failure.
- .2 Electrical Contractor shall execute a Lifetime (which is defined as the usable life of the building and is referred to as the "Warranty Period") Applications Assurance Warranty for parts and labor to support stated applications from the connectivity Manufacturer.
- .3 This warranty covers the copper permanent links of the network as defined by TIA-568-C.0 which includes the cable and connecting hardware. This warranty will be extended to include the entire channel provided that the applicable Manufacturer patch cords and Manufacturer equipment cords are utilized, and all products are installed within areas protected from outside elements.

1.11 SOURCE QUALITY CONTROL

- .1 All materials shall be purchased from Distributors authorized by system Manufacturers to sell new and unused components.

Part 2 Products

2.1 GENERAL

- .1 All work, equipment, and systems will be manufactured, provided, repaired, installed, and tested in accordance with the latest edition and all current amendments of the applicable publications and standards of the Canadian Electrical Code and the Latest version of the ANSI/EIA/TIA 568 Series as of the date of the Contract Documents. When the Specification requirements exceed the requirements of these publications and standards, the Specifications will govern.

- .2 Active components such as ethernet network switches, fibre-to-copper switches, wireless access points, etc. are supplied by others.

2.2 HORIZONTAL STRUCTURED CABLE

- .1 Horizontal four pair unshielded twisted pair Category 6 copper cabling system using 23 AWG conductors shall be capable of supporting 1000 Base-T applications for a total distance of 100 meters with equipment cords. System shall provide “future proof” channel performance and guaranteed margins as noted in this document and is guaranteed to meet ANSI/TIA/EIA-568-C.2 Category 6 specifications for Insertion Loss, NEXT, PSNEXT, ACR, PSACR, ELFEXT, PSELFEXT and Return Loss to 250 MHz. The system is also guaranteed 9 dB PSACR headroom at 250 MHz and meets IEEE 802.3af and IEEE 802.3at for PoE applications.
- .2 Combustible construction rated FT4 cables may be routed exposed. Rated cables shall be labelled FT4 along the length of the cable jacket per building code requirements. Cables not carrying one of these designations must be routed in enclosed raceways.
- .3 The UTP cabling systems will have TIA/EIA T568A pin/pair termination assignment.
- .4 Jacket colour:
 - .1 Blue.
- .5 Manufacturers:
 - .1 Belden
 - .2 Commscope
 - .3 Nexans
 - .4 Panduit
 - .5 Superior Essex

2.3 DWELLING UNIT COMMUNICATIONS PANEL

- .1 Indoor structured wiring enclosure with white hinged door suitable for housing both cable and telecom service equipment.
- .2 Provide termination punch downs and coax splitter for communication outlets within the dwelling unit.
- .3 Interior dimensions: 30”H x 14”W x 3.5”D suitable for recessed installation in a 16”oc stud space.
- .4 Material: Flame retardant ABS Polymer Material.
- .5 Manufacturer:
 - .1 Primex Telecommunications, Model P3000.
 - .2 Approved Equal.

2.4 HORIZONTAL CABLING ACCESSORIES

- .1 Wallplates: single gang, 2-port wallplates with ID Windows, white colour.

- .2 Jacks: Category 6 connector with retention force, 8-position RJ45, 110 punchdown terminations, white.
- .3 Patch Cords: None.

Part 3 Execution

3.1 INSTALLATION

- .1 Install horizontal cables as indicated free-air or in conduits. Identify and label as indicated to: TIA/EIA-606-A.
- .2 Bend radius of cables shall be maintained as recommended by the manufacturer and per TIA and BICSI standards.
- .3 Support cables to manufacturer's recommendations. Provide supplementary "J" hooks to support cables at intervals not exceeding 1 metre.
- .4 Terminate horizontal cables in telecommunications room, at dwelling unit panels and at individual jacks.
- .5 Coil spare cables and store in ceiling space in zone.
- .6 Leave 1 metres slack cable at each end.

3.2 FIELD QUALITY CONTROL

- .1 Cabling systems shall meet or exceed the electrical and transmission characteristics of the systems specified.
- .2 Cable segments and links shall be tested from both ends of the cable for each of the construction phases. (Verify that cable labeling matches at both ends).
- .3 The system shall not be considered certified until the tester has acknowledged that the performance of the physical layer of the system has been fully tested and is operational at the completion of the installation phase.
- .4 Field Testing Equipment: Submit during shop drawing review on the testing equipment to be utilized on this project. The installer shall test all cables installed under this Section.
 - .1 Unshielded Twisted Pair Testing Equipment:
 - .1 The cable tester shall have a wide variety of preprogrammed cable types as an integral part of its testing system and have the ability to test cables less than 6 feet (1,824mm) from the test point.
 - .2 Testing shall be accomplished using level III or higher field tester that is loaded with the most current version of test software by the manufacturer of the test equipment.

END OF SECTION

Part 1 GENERAL

1.1 SECTION INCLUDES

- .1 Excavation, filling, compacting and grading operations for below-grade improvements and to achieve grades and elevations indicated. Provide trenching and backfill for water, sanitary and storm pipes.
- .2 Subbase materials, pipe bedding, common fill and fill material for slabs, pavements to a complete finish.
- .3 Suitable fill from off-site if on-site quantities are insufficient or unacceptable, and legal disposal of excess fill off-site.
- .4 Rock excavation without blasting unless blasting is specifically authorized.

1.2 RELATED SECTIONS

- .1 Appendix B – Summary of Environmental Work

1.3 SUBMITTALS

- .1 Submit under provision of Section 01 33 00 – Submittal Procedures.
- .2 Test Reports: Submit for approval of test reports, list of materials and the proposed use.

1.4 QUALITY ASSURANCE

- .1 Operator Qualifications: Minimum 2 years experience working under similar conditions.

1.5 PRE-SITE MEETINGS

- .1 Convene minimum two weeks prior to starting work of this section.

1.6 PROJECT CONDITIONS

- .1 Visit and examine the site and become familiar with all features and characteristics affecting the work. No allowances will be made by department representative for any difficulties due to any features or peculiarities of the site or existing conditions which exist.
- .2 Inspect the project site to determine the conditions under which the work is to be done and the amount of materials and debris to be handled and removed.

Part 2 PRODUCTS

2.1 SUBSTITUTIONS:

- .1 Any product required under this section shall be considered for substitutions in accordance with provisions of Section 01 61 00 – Product Requirements.

2.2 MATERIALS

- .1 Earthwork:
1. Subbase Material: Graded gravel or crushed stone.
 2. Bedding Course: Graded crushed gravel and sand.
 3. Borrow Soil: Off-site soil for fill or backfill.
 4. Drainage Fill: Ashed gravel or crushed stone.
 5. Subsoil Grading/Backfill: Mineral soil free from unsuitable material.
 6. Structural Fill: Graded gravel.

Part 3 EXECUTION

3.1 PREPARATION

- .1 Prepare surfaces using the methods recommended by department representative for achieving the best result for the substrate under project conditions.

3.2 INSTALLATION

- .1 Excavation is unclassified and includes excavation to pipe depth and grading elevations regardless of materials encountered. Repair excavations beyond elevations and dimensions indicated as follows:
1. At trenches: With Concrete or compacted fill or structural fill.
 2. Elsewhere: Backfill and compact as directed.
- .2 Maintain stability of excavations; coordinate shoring and bracing as required by authorities having jurisdiction. Prevent surface and subsurface water from accumulation in excavations. Stockpile satisfactory materials for reuse, allow for proper drainage and do not stockpile material within drip line to trees to remain.
- .3 Compact materials at the optimum moisture content as determined by the ASTM D 1557 by aeration or wetting to the following percentages of maximum dry density:

1. Pipe trenches, pavement, walkways: Subgrade each fill layer to 95 percent of maximum dry density to suitable depth.
 2. Unpaved Areas: Top 6 inches of subgrade and each fill layer to 90 percent maximum dry density.
- .4 Place acceptable materials in layers not more than 8 inches loose depth for materials compacted by heavy equipment and not more than 4 inches loose depth for materials compacted by hand equipment to subgrades indicated as follows.
 1. Structural Fill: Use under foundations, slabs on grade in layers indicated.
 2. Drainage Fill: Use under designated building slabs, at foundation drainage and elsewhere indicated.
 3. Common Fill: Use under unpaved area and for backfill of pipe trenches.
 4. Subbase Material: Use under pavement, walks and steps.
- .5 Grading Tolerances Outside Building Lines:
 1. Landscaped areas, unpaved areas and walks, plus or minus 1 inch.
 2. Pavement, plus or minus ½ inch.
- .6 Grading Tolerances for Fill under Building Slabs: Plus, or minus ½ inch measured with 10-foot straightedge.
- .7 Protect newly graded areas from traffic and erosion. Recompact and regrade settled, disturbed and damaged areas as necessary to restore quality, appearance and condition of work.
- .8 Control erosion to prevent runoff into sewers or damage to sloped or surfaced areas.
- .9 Control dust to prevent hazards to adjacent properties and vehicles. Clean soiled surfaces.
- .10 Dispose of waste and unsuitable materials off-site in a legal manner.

END OF SECTION

Part 1 General

1.1 INTENT

- .1 This section describes the minimum requirements for the supply and installation of a radon mitigation rough-in system.
- .2 The radon rough-in system is to be designed, inspected, photographed and tested by the Departmental Representative.
- .3 If, after the building is completed and occupied, long term radon testing results indicate the rough-in system needs to be activated, the installed components provide radon gas extraction points from within the building. Follow Health Canada guidelines for long term radon testing. The Departmental Representative would then need to extend the extraction points to the outside of the building and mechanically vent the radon to the outside, so that radon levels are controlled within the building.
- .4 If the system is activated, it must be capable of reducing and maintaining the radon concentration to as low as practicable below 200 Becquerels per cubic metre (Bq/m³) within the building, as per Health Canada guidelines.

1.2 REFERENCES

- .1 National Building Code 2015.
- .2 EPA/625/R-92/016 - 1994 Radon Prevention in the Design and Construction of Schools and Other Large Buildings.
- .3 ASTM applicable standards.
- .4 Health Canada – Guide for Radon Measurements in Public Buildings – 2016.

1.3 DELIVERY, STORAGE, AND HANDLING

- .1 Ensure all products delivered to the site meet manufacturer's quality requirements. Remove and do not use any defective products. Store and handle materials as per manufacturer's requirements, recommendations and safety data sheets. Protect materials from construction and weather related damage using appropriate coverings and adequate ventilation.

1.4 PROJECT/SITE ENVIRONMENTAL REQUIREMENTS

- .1 All products and materials are to be stored at temperatures and environmental conditions that conform to manufacturer guidelines.
- .2 Perform installation work only when the weather conditions are within installation guidelines established by manufacturer.

1.5 WARRANTY

- .1 Provide a two (2) year warranty against slab perimeter and penetration sealing defects and/or deficiencies, and confirm that the materials meet performance specifications and installation requirements.
- .2 Review all manufacturer's requirements for warranty period before the commencement of work. Ensure that all materials and installations are in conformance with manufacturer and warranty requirements, system design, and requirements of this specification.

- .3 All slab perimeter and penetration sealing defects and/or deficiencies that occur within the warranty period are to be corrected promptly by the Contractor at no expense to the Departmental Representative.

1.6 PERFORMANCE REQUIREMENTS

- .1 Installation of the geotextile fabric, gas permeable layer, suction pits and cages, collection/extension/riser pipes, membrane barrier system, and sealing methods for the slab perimeters and penetrations for the building concrete in contact with the soil, is to comply with manufacturers requirements, system design, and the requirements of this specification.
- .2 All system components are to be chemically compatible with the soil environment (ASTM E154-08).
- .3 The radon rock (gas permeable venting layer) is to be a minimum 100 mm layer of clean, coarse, aggregate meeting Size #5 specifications as defined in ASTM C33/C33M - 18 Standard Specification for Concrete Aggregates, and as stated in the EPA/625/R-92/016 - 1994 Radon Prevention in the Design and Construction of Schools and Other Large Buildings document.
- .4 The radon membrane barrier system (also is the vapour barrier) is to be a minimum, 10 mil polyolefin based resin sheet membrane, meeting the requirements of ASTM E1745-17.
- .5 Radon membrane barrier system is to be overlapped and sealed at all perimeters and floor slab penetrations to provide a continuous seal of the building area in contact with the soil, as per manufacturer requirements, system design, and the requirements of this specification.
- .6 Install and seal floor drains, suction pits/cages and collection/extension/riser pipes in accordance with EPA/625/R-92/016 - 1994 Radon Prevention in the Design and Construction of Schools and Other Large Buildings.

Part 2 Products

2.1 MANUFACTURER

- .1 No specific product manufacturers for the radon mitigation rough-in system are identified. All products shall conform to the applicable ASTM standards and the EPA/625/R-92/016 - 1994 technical design document, and as indicated in the design drawings and specifications.

2.2 GEOTEXTILE FABRIC

- .1 The geotextile fabric is to be installed on the subsoil below the radon rock gas permeable venting layer. The geotextile fabric protects the gas venting layer from being contaminated with fines from the subsoil.
- .2 The geotextile fabric is to have the following physical characteristics:
 - .1 Non-woven fiber construction with an apparent opening size of 0.15mm.
 - .2 Unit weight of 340g/m² (ASTM D5261).
 - .3 Grab tensile strength of 1100 N (ASTM D4632).
 - .4 Elongation of from 45 to 105% (ASTM D4632).
 - .5 Trapezoid tear resistance of 450N (ASTM D4533).

- .6 Puncture resistance of 700N (ASTM D4833).
- .7 Mullen Burst of 3600Pa (ASTM D3786).

2.3 GAS PERMEABLE VENTING LAYER

- .1 The gas permeable venting layer (radon rock) is to be a minimum 100 mm layer of clean, coarse, aggregate meeting Size #5 specifications as defined in ASTM C33 / C33M - 18 Standard Specification for Concrete Aggregates, and as stated in the EPA/625/R-92/016 - 1994 Radon Prevention in the Design and Construction of Schools and Other Large Buildings document.

2.4 MEMBRANE BARRIER SYSTEM

- .1 The radon membrane barrier system (also the vapour barrier) is to be a minimum, 10 mil polyolefin based resin sheet membrane, meeting the requirements of ASTM E1745-17.
- .2 All membrane seams are to be prepared, overlapped and sealed as per the manufacturer's recommendations.
- .3 Supply and install air/vapour barrier, as a transition between the radon membrane and upturn onto grade beams, foundation walls, footings or any item that penetrates the finished floor slab. Joints are to be designed to accommodate anticipated movement.
- .4 The membrane is to be terminated with an upturn at the perimeter grade beams, foundation walls, footings and strip footings, and terminate between the beam, wall or footing and finished floor slab. Membrane is to terminate midway through the floor slab and be sealed and secured using Termination Bar, mechanically fastened to the beam or footing on 300mm centers. Sealant to be applied to junction between membrane to footing, wall or beam, above Termination Bar.
- .5 Gas tight seals are to be provided around the surfaces of all vertical penetrations. Such surfaces are to be prepared as per manufacturer's requirements to facilitate membrane adherence. Use air/vapour barrier, sealants and construction tape as required to provide a continuous seal between radon membrane and any pipe, conduit or other item that penetrates the floor slab.
- .6 Once concrete floor slab has cured sufficiently to allow work to proceed on it, apply sealant to all penetration junctions on the top side of the finished floor slab.

2.5 SUCTION PIT AND CAGE

- .1 The suction pits and cages are to be designed by the structural engineer. This method exposes void areas in the gas permeable venting layer to facilitate depressurization, if required.
- .2 The suction pit area is to be sized to fit a galvanized metal suction pit cage. The cages are used to prevent the gas permeable venting layer from entering the suction pits.
- .3 Ensure that a vertical collection riser pipe extends from the suction pit and cage to 300 mm above the finished floor slab. Horizontal collection/extension pipes may be required in the system design.

2.6 COLLECTION, EXTENSION AND RISER PIPES

- .1 The collection, extension and riser pipe locations are shown on the design drawings. Collection pipes are to be placed into the clear granular material / gas permeable venting layer having a minimum, thickness of 100mm.
- .2 The collection, extension and riser pipes are to consist of a minimum Schedule 40 non-perforated smooth walled 100mm (inside) diameter rigid pipe of PVC, High Density PE or ABS construction.
- .3 The collection, extension and riser pipes are to be installed in accordance with the EPA/625/R-92/016 - 1994 Radon Prevention in the Design and Construction of Schools and Other Large Buildings document.
- .4 A single vertical riser pipe is to be installed at each suction pit and cage location and extend from the suction pit and cage to 300mm above the finished floor slab.

Part 3 Execution

3.1 INSTALLATION

- .1 Prepare sub-grade surface prior to installation of the geotextile fabric, suction pits and cages, and collection, extension and riser piping, as per the elevations specified in the building construction drawings and radon mitigation rough – in system design drawings and specifications.
- .2 Place geotextile fabric layer over the entire sub-grade surface, with sufficient overlaps as per the manufacturer's requirements.
- .3 Construct and install the suction pits and cages as close to the center of the sub-slab area as practicable, as per the radon mitigation rough – in system design drawings and specifications and manufacturer's requirements.
- .4 Install collection/extension/riser pipes in locations as per the design drawings.
- .5 The collection pipes are to be placed within the gas permeable venting layer.
- .6 All pipe joints are to be solvent welded and fully inserted into coupling or fitting to ensure joint integrity as per manufacturer's instructions.
- .7 If the riser pipe penetrations through the floor slab cannot be installed in the center of the sub-slab area, an extension pipe must be installed so that it extends from the center of the suction pit and cage to the preferred pipe slab penetration location.
- .8 Riser pipe floor slab penetrations are not to interfere with planned future use of the interior space. Confirm riser pipe penetration locations with the Departmental Representative on site prior to installation.
- .9 The space around the riser pipe installations must be considered for possible future pipe extensions. Future exterior exhaust locations are to be located a minimum of 2.0 meters from any opening in the building or adjacent building.
- .10 Riser pipe installations are to ensure the same sized exhaust pipe extensions can be made to the exterior of the building through the wall or roof system, if required in the future.
- .11 The gas permeable venting layer (radon rock) is to be a minimum 100 mm layer of clean, coarse, aggregate meeting Size #5 specifications as defined in ASTM

C33 / C33M - 18 Standard Specification for Concrete Aggregates, and as stated in the EPA/625/R-92/016 - 1994 Radon Prevention in the Design and Construction of Schools and Other Large Buildings document.

- .12 The gas permeable venting layer (radon rock) is to be constructed by placing, grading and compacting (if required structurally) it over the entire sub-grade surface, geotextile layer and collection/extension/riser piping. Ensure the suction pit and cage area remains clear of the gas permeable venting layer (radon rock).
- .13 At completion of the substrate, component and gas permeable venting layer, the Contractor is to contact the Departmental Representative to inspect the installation of this portion of the system.
- .14 Membrane barrier system is to be placed over the gas permeable venting layer (radon rock). All membrane overlaps and sealing is to be done as per the manufacturer's requirements and specifications.
- .15 Membrane barrier system installation is to be performed by trained qualified installers using manufacturer's recommended techniques and equipment.
- .16 Membrane barrier system is to be a minimum, 10 mil polyolefin based resin sheet membrane, meeting the requirements of ASTM E1745-17.
- .17 Membrane barrier system is to be installed and sealed around all vertical penetrations with sufficient overlap and using air/vapour barrier, sealant and construction tape or chemical welded seams as per manufacturer's requirements and specifications.
- .18 At completion of the membrane barrier system, Departmental Representative to review the integrity of the membrane barrier system and conduct depressurization testing of the system.
- .19 Care must be taken not to puncture the membrane excessively during floor slab construction. To limit membrane puncture during floor slab construction, items such as rebar chair supports designed with a wide base (instead of legs) are to be used to better spread the rebar load.
- .20 Once concrete floor slab has cured sufficiently to allow work to proceed on it, clean joint surfaces in accordance with manufacturer's instructions and seal all finished floor slab perimeter cold joints and any other floor slab penetration junctions between dissimilar materials using high quality sealants suitable for use on each subject material surface. Test sealant to confirm adhesion with all surfaces prior to use. Joints are to be pre-designed to accommodate anticipated movement.
- .21 The above slab exposed open top of the riser pipes must be capped and 100% solvent welded to provide a complete seal.
- .22 The above slab exposed riser pipe and cap are both to be labeled to identify them as part of the "Radon Mitigation Rough-in System".
- .23 At completion of the slab perimeter and penetration sealing and capping and labeling of the exposed riser pipes, Contractor is to contact the (C-NRPP) Certified Mitigation Professional for a final inspection of the installation. Results are to be documented by a (C-NRPP) Certified Mitigation Professional.
- .24 Contractor shall proceed with related work, when acceptance of the installation of the slab perimeter and penetration sealing and capping and labeling of the exposed riser pipes has been provided by the Departmental Representative.

- .25 Deficiencies in the radon mitigation rough – in system are to be corrected in accordance with this specification and as per instructions from the Departmental Representative.

END OF SECTION

Part 1 GENERAL

1.1 SECTION INCLUDES

- .1 Dewatering system.

1.2 RELATED SECTIONS

- .1 Section 31 20 00 – Earthwork

1.3 SUBMITTALS

- .1 Submit under provision of Section 01 30 00 – Administrative Requirements.
- .2 Shop Drawings: Submit shop drawings indicating layout of dewatering system, detail of construction, connections and relationship with adjacent construction and adjacent dwellings and properties.
- .3 Dewatering plan to be submitted to and reviewed by ESO. Dewatering Plan should include anticipated volume, duration and timing, locations of discharge, and the process for characterizing water quality for discharge.

1.4 QUALITY ASSURANCE

- .1 Installer Qualifications: Minimum 2 years experience for similar work.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Dewatering:
 - 1. Obtain permission and dewatering permits from the Town of Banff and pay related costs for permits. Follow all dewatering requirements of the Town of Banff as per their bylaw(s) and guidelines.
 - 2. Provide a system to lower and control groundwater in order to permit construction activities. Install sufficient dewatering equipment to drain water-bearing strata above and below bottom of pipes in trenches, foundations, drains and other excavation.
 - 3. Operate dewatering system continuously until dewatering is no longer required. Dispose of water removed from excavations in a manner to avoid endangering public health, property and portions of work under construction or completed. Provide flow control devices as required by governing authorities.

4. Provide all services to liaise and coordinate with assigned geotechnical consultants for the ground water conditions and follow the instructions and requirements of the Geotechnical consultants for dewatering.
 5. Sample water discharge quality and install filters
- .2 Observation Wells:
 1. Provide, take measurements and maintain observation wells as directed by geotechnical consultants and additional observation wells as may be required by governing authorities.
 2. Remove observation wells when dewatering is completed.

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Do not begin installation until substrates have been properly prepared.
- .2 If substrate preparation is the responsibility of another installer, notify department representative of any unsatisfactory preparation and site conditions before proceeding.
- .3 Notify the ESO 24 hrs before beginning to dewater
- .4 Dewatering should occur according to the guidelines in the Dewatering Plan

3.2 INSTALLATION

- .1 Install in accordance with dewatering equipment instructions and operation and in proper relationship with any adjacent construction and existing properties and roads, walkways and utilities. Test for proper operation and adjust until satisfactory results are obtained. Install system to provide the following:
 1. Lowering and controlling groundwater levels during excavation and construction.
 2. Control of hydrostatic pressure during excavation and construction.
 3. Control of surface and subsurface water, ice and snow related to dewatering.
 4. Standby equipment for system back-up.
 5. Establishment and monitoring of observation wells.
 6. Legal disposal of water removed from excavation.
- .2 Maintain stability of excavations; coordinate shoring and bracing as required by authorities having jurisdiction. Prevent surface and subsurface water from accumulation in excavations. Stockpile satisfactory materials for reuse, allow for proper drainage and do not stockpile material within drip line to trees to remain.

- .3 Compact materials at the optimum moisture content as determined by the ASTM D 1557 by aeration or wetting to the following percentages of maximum dry density:
 - 1. Pipe trenches, pavement, walkways: Subgrade each fill layer to 95 percent of maximum dry density to suitable depth.
 - 2. Unpaved Areas: Top 6 inches of subgrade and each fill layer to 90 percent maximum dry density.
- .4 Place acceptable materials in layers not more than 8 inches loose depth for materials compacted by heavy equipment and not more than 4 inches loose depth for materials compacted by hand equipment to grades indicated as follows.
 - 1. Structural Fill: Use under foundations, slabs on grade in layers indicated.
 - 2. Drainage Fill: Use under designated building slabs, at foundation drainage and elsewhere indicated.
 - 3. Common Fill: Use under unpaved area and for backfill of pipe trenches.
 - 4. Subbase Material: Use under pavement, walks and steps.
- .5 Grading Tolerances Outside Building Lines:
 - 1. Landscaped areas, unpaved areas and walks, plus or minus 1 inch.
 - 2. Pavement, plus or minus ½ inch.
 - 3. Pipe laying- grading for pipe slopes and pipe invert elevations, plus or minus 1/4 inch
- .6 Grading Tolerances for Fill under Building Slabs: Plus, or minus ½ inch measured with 10-foot straightedge.
- .7 Protect newly graded areas from traffic and erosion. Recompact and regrade settled, disturbed and damaged areas as necessary to restore quality, appearance and condition of work.
- .8 Control erosion to prevent runoff into sewers or damage to sloped or surfaced areas.
- .9 Control dust to prevent hazards to adjacent properties and vehicles. Clean soiled surfaces.
- .10 Dispose of waste and unsuitable materials off-site in a legal manner.

END OF SECTION

Part 1 GENERAL

1.1 SECTION INCLUDES

- .1 Erosion and sedimentation control.

1.2 RELATED SECTIONS

- .1 Section 31 20 00 – Earthwork

1.3 SUBMITTALS

- .1 Submit under provision of Section 01 33 00 – Submittal Procedures.
- .2 Product Data: Manufacturers data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- .3 Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections and relationship with adjacent construction.
- .4 Submit an Erosion and Sediment Control Plan as part of the EPP

1.4 QUALITY ASSURANCE

- .1 Manufacturer Qualifications: Minimum 5 years experience manufacturing similar products.
- .2 Installer Qualifications: Minimum 2 years experience installing similar products.

1.5 PRE-INSTALLATION MEETINGS

- .1 Convene minimum one week prior to starting Construction work of this section.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver and store products in manufacturers' unopened packaging bearing the brand name and manufacturer's identification until ready for installation.
- .2 Handling: Handle materials to avoid damage.

1.7 PROJECT CONDITIONS

- .1 Maintain existing conditions within limits recommended by manufacturer for optimum results. Do not install under conditions outside manufacturers recommended limits.

1.8 SEQUENCING

- .1 Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

Part 2 PRODUCTS

2.1 MANUFACTURERS:

- .1 Request for substitutions will be considered in accordance with provisions of Section 01 61 00 – Product Requirements.

2.2 MATERIALS

- .1 EROSION AND SEDIMENTATION CONTROL:
 - 1. Type: Silt fences and storm inlet protectors.
 - 2. Type: Turf mat or erosion control blankets.
 - 3. Type: Geotextiles
 - 4. Crushed stone with filters fabric and stone riprap.

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Do not begin installation until substrates have been properly prepared.
- .2 If substrate preparation is the responsibility of another installer, notify Consultant of any unsatisfactory preparation and site conditions before proceeding.

3.2 PREPARATION

- .1 Prepare site using the methods recommended by the manufacturer for achieving the best results for the Erosion and Sediment Control and for the substrates under the project conditions.

3.3 INSTALLATION

- .1 Install in accordance with manufacturer's instruction and in proper relationship with adjacent properties and existing infrastructure and any adjacent construction.

3.4 PROTECTION

- .1 Protect and maintain installed products until completion of project.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 ASTM International
 - .1 ASTM D4491, Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
 - .2 ASTM D4595, Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method.
 - .3 ASTM D4632, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
 - .4 ASTM D4716, Test Method for Determining the (In-plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head.
 - .5 ASTM D4751, Standard Test Method for Determining Apparent Opening Size of a Geotextile.
 - .6 ASTM D5261, Standard Test Method for Measuring Mass per Unit Area of Geotextiles
- .2 Canadian General Standards Board (CGSB)
 - .1 .1 CAN/CGSB-4.2 No. 11.2-M89, Textile Test Methods - Bursting Strength - Ball Burst Test.
 - .2 .2 CAN/CGSB-148.1, Method of Testing Geosynthetics
 - .1 No.2, Methods of Testing Geosynthetics - Mass per Unit Area.
 - .2 No.3, Methods of Testing Geosynthetics - Thickness of Geotextiles.
 - .3 No.6.1, Methods of Testing Geotextiles and Geomembranes - Bursting Strength of Geotextiles Under No Compressive Load.
 - .4 No.7.3, Methods of Testing Geotextiles and Geomembranes - Grab Tensile Test for Geotextiles.
 - .5 No. 10, Methods of Testing Geosynthetics - Geotextiles - Filtration Opening Size.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit manufacturer's instructions, printed product literature and data sheets for geotextiles and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Samples:
 - .1 .1 Submit following samples 2 weeks prior to beginning Work.
 - .1 Minimum length of 1 m of roll width of geotextile.
 - .2 Methods of joining.
- .3 Test and Evaluation Reports:
 - .1 Submit copies of mill test data and certificate at least 2 weeks prior to start of Work.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 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 geotextiles from direct sunlight and UV rays.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIAL

- .1 As specified on landscape drawings.

Part 3 EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION

- .1 Place geotextile material by unrolling onto graded surface in orientation, manner and locations indicated and retain in position with sandbags.
- .2 The areas to be covered with geotextile shall be prepared by shaping the ground to present a uniform and regular surface free from bumps and depressions.
 - .1 Geotextile shall not be placed on stumps, brush, limbs, ice or other material that may tear or puncture the fabric.
 - .2 The geotextile shall be placed so as to create a surface that is smooth and free of tension stress, folds, wrinkles and creases.

- .3 Place geotextile material on sloping surfaces in one continuous length from toe of slope to upper extent of geotextile.
- .4 The manufacturer's installation procedures shall be the standard of installation that shall be applied except as follows:
 - .1 Where more than one width of fabric is used, the fabric shall be joined by sewing or by an overlap of at least 600 mm and all overlap joints shall be securely held in place.
- .5 Protect installed geotextile material from displacement, damage or deterioration before, during and after placement of material layers.
- .6 After installation, cover with overlying layer within 4 hours of placement.
- .7 The Contractor shall immediately repair damaged geotextile to approval of Departmental Representative.
 - .1 The damaged area shall be covered with a patch of the same fabric type extending a minimum of one metre beyond the perimeter of the damaged area.

3.3 CLEANING

- .1 Progress Cleaning: Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

3.4 PROTECTION

- .1 Vehicular traffic not permitted directly on geotextile.

END OF SECTION

Part 1 GENERAL

1.1 SECTION INCLUDES

- .1 Section includes the design and installation of temporary excavation shoring or underpinning required for construction of the structure. Shoring system may be temporary or permanent depending on the system provided by the contractor.

1.2 RELATED SECTIONS

- .1 Section 01 11 00 – Summary of Work
- .2 Section 01 14 00 – Work Restrictions
- .3 Section 01 56 00 - Temporary Barriers & Enclosures
- .4 Section 03 30 00 - Cast In Place Concrete.
- .5 Section 31 20 00 - Earthwork
- .6 Section 31 25 00 - Erosion & Sedimentation Control
- .7 Appendix B – Summary of Environmental Work
- .8 Appendix D – Geotechnical Report

1.3 DESIGN REQUIREMENTS

- .1 Design of temporary excavation shoring or underpinning shall be by a qualified licensed Engineer.
- .2 The bracing and shoring systems required to provide temporary support of existing conditions, a structure or portions of a structure during construction shall be designed to support the dead, live, soil, earthquake and wind loads that may be imposed on the structure during construction in accordance with industry standards and generally accepted engineering principles.
- .3 Excavation shoring or underpinning shall be designed to resist the influence of any surcharge loads from adjacent existing properties, structures, roadways, etc. shown on the Contract Drawings, and shall be designed to prevent damage to the adjacent existing properties, structures, roadways, etc.

1.4 QUALITY ASSURANCE

- .1 Execute work in accordance with local and state regulations and codes and in accordance with the regulations of regulatory agencies having jurisdiction over the work.

1.5 EXISTING CONDITIONS, STRUCTURES OR ROADWAYS

- .1 Make complete examination and survey of any existing adjacent structures or roadways to determine all facts necessary to design, install and monitor the temporary excavation shoring.
- .2 Contractor shall be responsible for and shall repair any damage to the existing structures or roadways that is related to excavation and shoring.
- .3 Work is not permitted beyond the property line of the project. Any disturbance to existing adjacent properties should be returned to existing conditions

Part 2 PRODUCTS

2.1 MATERIALS FOR SHORING AND BRACING

- .1 Materials for shoring and bracing shall be undamaged, high quality materials.

Part 3 EXECUTION

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Structural Drawings – Cast-In-Place Concrete
- .2 Structural Drawings – Concrete Reinforcing
- .3 Structural Drawings – Excavating, Trenching, and Backfill

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM A185/A185M-07, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
 - .2 ASTM A496/A496M-07, Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
 - .3 ASTM A497/A497M-07, Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete.
 - .4 ASTM C42/C42M-18, Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
 - .5 ASTM C295/C295M-18, Standard Guide for Petrographic Examination of Aggregates for Concrete
 - .6 ASTM C309-11, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - .7 ASTM D1751-04(2013)e1, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
 - .8 ASTM D4797-17, Standard Test Methods for Gravimetric Analysis of White and Yellow Thermoplastic Pavement Marking
 - .9 ASTM E1360-05(2015), Standard Practice for Specifying Color by Using the Optical Society of America Uniform Color Scales System
- .2 Canadian Standards Association (CSA)
 - .1 CAN/CSA-A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete, Includes Update No. 1 (2015).
 - .2 CAN/CSA-A3000-13, Cementitious Materials Compendium.
 - .3 CAN/CSA G30.18-09(R2014), Carbon Steel Bars for Concrete Reinforcement. Includes Update No. 1 (2012)
- .3 The Master Painters Institute (MPI):
 - .1 New Surfaces: Architectural Painting Specification Manual.

1.3 ADMINSTRATIVE REQUIREMENTS

- .1 Pre-Installation Meeting: Convene pre-installation meeting one week prior to beginning work of this Section and on-site installation, with Contractor, Departmental Representative, installer, manufacturer's representative to:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.

- .3 Co-ordination with other building subtrades.
- .4 Review manufacturer's installation instructions and warranty requirements.
- .2 Coordination: Coordinate with local Authorities Having Jurisdiction requirements for standard sidewalks, curbs, and gutters.

1.4 ACTION SUBMITTALS/INFORMATIONAL SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 – Submittals:
 - .1 Submit design mixes for each concrete pavement mixture including alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances require adjustments.
 - .2 Provide two copies of WHMIS MSDS - Material Safety Data Sheets in accordance with WHMIS acceptable to Labour Canada, and Health and Welfare Canada.
- .2 Submit samples in accordance with Section 01 33 00 – Submittals:
 - .1 Submit samples of exposed aggregate in 4.5 kg bags for review and acceptance by Departmental Representative.
- .3 Certificates: Submit to Departmental Representative, manufacturer's test data and certification that the following material meets requirements of this section prior to starting concrete work:
 - .1 Cementitious materials.
 - .2 Steel reinforcement and reinforcement accessories.
 - .3 Admixtures.
 - .4 Joint Sealants.
 - .5 Curing Materials.
 - .6 Joint Filler.

1.5 QUALITY ASSURANCE

- .1 Use ready mixed concrete producers in accordance with CSA A23.1, CSA A23.2 and CSA A3000 requirements for production facilities and equipment, and which is a member of the Alberta Ready Mix Concrete Association.
- .2 Installer Qualifications: Company or person specializing in Portland cement concrete paving with 5 years documented experience who has completed systems similar in materials, design and extent to that indicated for Project and with a record of successful performance.
- .3 Testing
 - .1 Compaction testing of base, and testing of concrete, will be performed in accordance with structural drawings.
- .4 Mock-Ups
 - .1 Provide field mock-up for architectural finished concrete indicating forming methods and materials, and procedures proposed to achieve architectural finish in accordance with Section 01 45 00 – Quality Control, and to comply with the following requirements, using materials indicated for completed work.

- .2 Cast mock-ups of full size sections of concrete pavement to demonstrate typical joints, surface finish, texture, colour, and standard of workmanship, and as follows:
 - .1 Build mock-ups in location and size indicated or; if not indicated, as directed by Departmental Representative.
 - .2 Notify Departmental Representative seven (7) days in advance of dates and times when mock-ups will be constructed.
 - .3 Obtain Departmental Representative's review of mock-ups before starting construction.
 - .4 Maintain acceptable mock-ups during construction in an undisturbed condition as a standard for judging the completed pavement.
 - .5 Acceptable mock-ups may become part of the completed Work if undisturbed at time of Substantial Performance.

1.6 WASTE MANAGEMENT AND DISPOSAL

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

1.7 JOB CONDITIONS

- .1 Prevent damage to buildings and adjacent property.
- .2 Protect surfaces of fresh concrete against damage by rain, dirt and dust, debris and traffic until sufficient strength attained to resist damage.
- .3 Use winter concreting methods in accordance with CSA A23.1 section 7.4.2.5 when the mean daily temperature falls below 5°C. Concrete shall not be considered a seasonal deficiency and shall be installed with heating and hoarding as part of the Contract.

Part 2 Products

2.1 FORMS

- .1 Form Materials: Plywood, metal, metal framed plywood, or other acceptable panel type materials to provide full depth, continuous, straight, smooth exposed surfaces.
- .2 Use flexible or curved forms for curves with a radius of 30 m or less.
- .3 Form Release Agent: Commercially formulated form release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.2 STEEL REINFORCEMENT

- .1 Deformed Steel Welded Wire Reinforcement: Meeting the requirements of ASTM A497, flat sheet.
- .2 Welded Wire Fabric: to ASTM A185.
- .3 Tie Bar for Construction Joints: plain steel bars to CSA G30.18.
- .4 Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and

dowels in place, fabricated from steel wire, plastic, or precast concrete of greater compressive strength than concrete; equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

2.3 CONCRETE MATERIALS

- .1 Cement Type: Normal Portland Cement in accordance with CSA A3000, Type GU.
- .2 Water: Meeting requirements of CSA A23.1/A23.2.
- .3 Aggregates For Concrete: to CSA A23.1 and as follows:
 - .1 Normal Density Fine Aggregate: Nominal maximum aggregate size in accordance with CSA A23.2-1A, uniformly graded to maintain Workability and control water bleed out, as indicated on Drawings.
 - .2 Normal Density Coarse Aggregate: Aggregate selected from Group I or Group II Grading Classifications, to suit design mix, in accordance with CSA A23.2-13A, nominal maximum aggregate sizes and applications as indicated on Drawings.
 - .3 Ironstone content of aggregates in exposed interior or exterior concrete subject to intermittent or continuous wetting shall not exceed the following, when tested Meeting requirements of ASTM C295:
 - .1 Coarse Aggregate: maximum 1%.
 - .2 Fine Aggregate, Retained on 2.5 mm Sieve: maximum 1.5%.
- .4 Air Entraining Admixture: to CAN3-A266.1.

2.4 CONCRETE MIXES

- .1 Design ready-mix concrete conforming to CSA A23.1/A23.2, and as indicated in Structural Specifications.
 - .1 Compressive Strength: Minimum 32 MPa after 28 days.
 - .2 Class of Exposure: C-2
 - .3 Slump: 30 mm maximum.
 - .4 Air Content Category: 1
 - .5 Maximum Water to Cement Ratio: 0.45
 - .6 Aggregate Size: 20 mm Maximum
 - .7 Concrete Admixtures:
 - .1 Air Entrained.
 - .2 Fly Ash or Pozzolan, limited to 25% maximum
- .2 Temperature of concrete mix at placing shall be no less than 10°C and no greater than 27°C. Provide mix toward lower end of temperature range during hot weather and toward higher end of temperature range during cold weather, in accordance with CSA A23.1.
- .3 Use of admixtures, other than air-entraining admixtures, are not permitted without prior written approval of Departmental Representative.
- .4 Site mix concrete is permitted for placements not exceeding 1 m³ and for core filling of non-load bearing masonry and bond beams.

- .5 Add an air entraining admixture to all concrete exposed to the weather or in contact with the ground, producing entrained air in accordance with CSA A23.1, Table 10; air entraining admixture is not required for interior slabs on grade.

2.5 PAVEMENT MARKINGS

- .1 Paint: Latex traffic paint meeting requirements of ASTM D4797. Refer to Section 09 91 00, Exterior System EXT 2.1A.

2.6 ACCESSORIES

- .1 Poured Joint Filler: Asphalt elastic compound.
- .2 Preformed Joint Filler: asphalt impregnated type to ASTM D1751.
- .3 Curing Compound: to ASTM C309, Type 2 white pigmented, Class B resin-based, liquid membrane-forming type.

Part 3 Execution

3.1 SUBGRADE PREPARATION

- .1 Construct subgrade to elevation and grade indicated.
- .2 Compact subgrade to 95% Standard Proctor Maximum Dry Density.
- .3 Excavate soft spots and fill with 50 mm crushed gravel compacted to 95% Standard Proctor Maximum Dry Density.

3.2 SAND AND GRANULAR CUSHION

- .1 Place 50 mm thick sand layer and crushed gravel layer on prepared subgrade, and compact to 95% Standard Proctor Dry Density.
- .2 Place 50 mm thick sand cushion layer for precast sidewalk blocks and compact to 95% Standard Proctor Dry Density.

3.3 REINFORCEMENT

- .1 Install steel reinforcement in accordance with CSA A23.1 for fabricating, placing, and supporting reinforcement.
- .2 Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- .3 Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement; maintain minimum cover to reinforcement.
- .4 Install welded wire reinforcement in longest practical lengths; lap adjoining pieces at least one full mesh and lace splices with wire; offset laps of adjoining widths to prevent continuous laps in either direction.

3.4 CONCRETE PLACEMENT

- .1 Inspect and complete formwork installation, steel reinforcement, and items being embedded or cast in concrete before placing concrete; notify other trades to permit installation of their work.
- .2 Remove snow, ice, or frost from sub-base surface and reinforcement before placing concrete; do not place concrete on frozen surfaces.

- .3 Moisten sub-base to provide a uniform dampened condition at time concrete is placed; do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- .4 Place concrete in accordance with recommendations in CSA A23.1 for measuring, mixing, transporting, and placing concrete.
- .5 Do not add water to concrete during delivery, at project site, or during placement.
- .6 Consolidate concrete with mechanical vibrating equipment.
- .7 Do not add water to fresh concrete after testing.
- .8 Deposit and spread concrete in a continuous operation between transverse joints; do not push or drag concrete into place or use vibrators to move concrete into place.
- .9 Place concrete in two operations as follows, hooking and raising reinforcing mats will not be considered as an acceptable method for setting reinforcing:
 - .1 Strike off initial pour for entire width of placement and to the required depth below finish surface.
 - .2 Lay welded wire fabric or fabricated bar mats immediately in final position.
 - .3 Place top layer of concrete, strike off, and screed.
 - .4 Remove and replace concrete that has been placed for a maximum of 15 minutes without being covered by top layer, or use bonding agent if acceptable by Departmental Representative.
- .10 Screed pavement surfaces with a straightedge and strike off.
- .11 Commence initial floating using bull floats or darbies to impart an open textured and uniform surface plane before excess moisture or bleed water appears on the surface; do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
- .12 Submit revised mix design and laboratory test results that meet or exceed requirements when automatic machine placement is used for curb and gutter placement; produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified for formed concrete; remove and replace with formed concrete where results are not acceptable to the Departmental Representative.
- .13 Submit revised mix design and laboratory test results that meet or exceed requirements when automatic machine placement is used for pavement; produce pavement to required thickness, lines, grades, finish, and jointing as required for formed pavement; compact sub-base and prepare sub-grade of sufficient width to prevent displacement of paver machine during operations.

3.5 JOINTS

- .1 Construct joints true to line with faces perpendicular to surface of paving. Construct transverse joints at right angles to paving centreline and longitudinal joints, unless otherwise indicated.
- .2 Expansion Joints at Building Face or Other Vertical Abutments: place 15 mm wide preformed joint filler 5 mm below finished surface for full width and depth of concrete.

- .3 Contraction Joints for Concrete Paving, Curbs and Gutters: construct 35 mm deep by 5 mm wide joints 3 m on centre and where shown on drawings by means of marking tool or other approved method.
- .4 Align curb, gutter, and sidewalk joints.

3.6 FINISHING

- .1 Do not add water to concrete surfaces during finishing operations.
- .2 Begin second floating operation when bleed water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations, and as follows:
 - .1 Float surface with power driven floats, or by hand floating if area is small or inaccessible to power units
 - .2 Finish surfaces to true planes.
 - .3 Cut down high spots and fill low spots.
 - .4 Re-float surface immediately to uniform granular texture.
- .3 Apply following finishes as indicated on Drawings:
 - .1 Medium-to-Coarse Textured Broom Finish: Provide a coarse finish by striating float finished concrete surface 1.5 to 3 mm deep with a stiff bristled broom, perpendicular to line of traffic.
 - .2 Provide broom finish to sidewalks.

3.7 CURING AND PROTECTION

- .1 Cure freshly deposited concrete in accordance with CSA A23.1.
- .2 Apply curing compound immediately after finishing, in accordance with manufacturer's instructions. Promptly re-coat areas subjected to heavy rainfall within 3 hours after initial application.
- .3 When ambient air temperature is at or below 5°C, or when there is a probability of it falling to 5°C within 24 hours of placing, provide cold weather protection until a period of 7 days of concrete temperature at or above 10°C has been attained. Protection shall meet requirements of CSA A23.1.
- .4 Estimate rate of surface moisture evaporation in accordance with CSA A23.1 and provide protection from drying as required.
- .5 Keep vehicular traffic off paved areas until paving has cured sufficiently to support such loads.

3.8 TOLERANCES

- .1 Place concrete in accordance with tolerances listed in CAN/CSA A23.1 and as follows:
 - .1 Elevation: 6 mm.
 - .2 Thickness: +10 mm, -6 mm.
 - .3 Surface: Gap below 3 m long, unlevelled straightedge not to exceed 6 mm.
 - .4 Lateral Alignment and Spacing of Tie Bars and Dowels: 25 mm.
 - .5 Vertical Alignment of Tie Bars and Dowels: 6 mm.

- .6 Alignment of Tie-Bar End Relative to Line Perpendicular to Pavement Edge: 13 mm.
- .7 Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge: Length of dowel 6 mm per 300 mm.
- .8 Joint Spacing: 75 mm.
- .9 Contraction Joint Depth: +6 mm, no minus.
- .10 Joint Width: +3 mm, no minus.

3.9 PAVEMENT MARKINGS

- .1 Do not apply pavement marking paint until layout, colours, and placement have been verified with Departmental Representative.
- .2 Allow concrete pavement to cure for a minimum of 28 days and be dry before starting pavement marking; delay application of pavement markings where slow curing conditions exist
- .3 Sweep and clean surface to remove loose material and dust.
- .4 Apply paint with mechanical equipment to produce pavement markings of dimensions indicated with uniform, straight edges to paint manufacturer's recommended wet film thickness.

3.10 FIELD QUALITY CONTROL

- .1 Testing Agency: Engage qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement according to requirements specified in this Article in accordance with CSA A23.2.
- .2 Non-Destructive Testing: Impact hammer, sonoscope, or other non-destructive device may be permitted by Departmental Representative, but will not be used as sole basis for acceptance or rejection of concrete.
- .3 Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Departmental Representative with costs being paid for by the Contractor.
- .4 Remove and replace concrete pavement where test results indicate that it does not meet specified requirements.
- .5 Additional testing and inspecting, at Contractor's expense, will be performed to determine acceptance of replaced or additional work with specified requirements.

3.11 REPAIRS

- .1 Remove and replace concrete pavement that is broken, damaged, or defective or that does not comply with requirements in this Section.

3.12 PROTECTION

- .1 Protect concrete from damage:
 - .1 Exclude traffic from pavement for at least 14 days after placement.
 - .2 Maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur when construction traffic is permitted.
- .2 Maintain concrete pavement free of stains, discolouration, dirt, and other foreign material.
- .3 Sweep concrete pavement a maximum of two days before date scheduled for Substantial Performance.

END OF SECTION

Part 1 General

1.1 PRICE AND PAYMENT PROCEDURES

- .1 Measurement procedures:
 - .1 Measure precast concrete paving for payment in square metres.

1.2 REFERENCES

- .1 ASTM International
 - .1 ASTM C136-[13], Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .2 ASTM C979/C979M-[10], Standard Specification for Pigments for Integrally Colored Concrete.
- .2 Canada Green Building Council (CaGBC)
 - .1 LEED Canada-NC Version 1.0-[2004], LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package For New Construction and Major Renovations (including Addendum [2007]).
 - .2 LEED Canada-CI Version 1.0-[2007], LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Guide For Commercial Interiors.
 - .3 LEED Canada 2009 for Design and Construction-[2010], LEED Canada 2009 for Design and Construction Leadership in Energy and Environmental Design Green Building Rating System Reference Guide.
 - .4 LEED Canada for Existing Buildings, Operations and Maintenance-[2009], LEED Canada 2009 Leadership In Energy and Environmental Design Green Building Rating System Reference Guide.
- .3 CSA Group
 - .1 CSA A23.1/A23.2-[09], Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
 - .2 CAN/CSA-A179-[04(R2009)], Mortar and Grout for Unit Masonry.
 - .3 CSA A231.1/A231.2-[06(R2010)], Precast Concrete Paving Slabs/Precast Concrete Pavers.
 - .4 CSA A283-[06(R2011)], Qualification Code for Concrete Testing Laboratories.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for precast concrete unit paving and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Samples:
 - .1 Submit full size sample of each type, standard, end, half, size pavers.
- .3 Test and Evaluation Reports:
 - .1 Submit following sampling and testing data:

- .1 Unit paver sampling and testing.
- .2 Evaluation of cleaning and sealing compound.
- .2 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .3 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.

1.4 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installer: company or person specializing in precast concrete paver installations with 5 years of documented experience.
- .2 Mock-ups:
 - .1 Construct mock-up for area identified on drawing for departmental representative's review.
 - .2 Mock-up will be used:
 - .1 To judge quality of work, substrate preparation, operation of equipment and material application.
 - .2 To determine surcharge of bedding layer, joint sizes, lines, laying patterns, colours and texture.
 - .3 Allow 24 hours for inspection of mock-up before proceeding with work.
 - .4 When accepted, mock-up will demonstrate minimum standard of quality required for this work. Approved mock-up may remain as part of finished work. Remove mock-up and dispose of materials when no longer required and when directed by Departmental Representative.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect precast concrete units from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 CONCRETE PAVERS

- .1 Concrete pavers: As indicated on landscape drawings
 - .1 Colour: As indicated on landscape drawings.
 - .2 Standard end, corner, border units as required.

- .2 Manufactured in moulds, with spacers, suitable for installation and delivered on site in cubes of laying panels , in protective wrapping.
- .3 Pigment in concrete pavers: to ASTM C979/C979M.

2.2 EDGE RESTRAINTS

- .1 Edge restraints shall be poured in place concrete upstand walls..

2.3 PEDESTALS

- .1 Pedestals shall be BLACK JACK 'SCREW JACK PEDESTALS' OR APPROVED EQUIVALENT and installed as per manufacturer's specifications.

2.4 CLEANING COMPOUND

- .1 Clear, organic solvent, designed and recommended by manufacturer for cleaning concrete pavers of contamination encountered.
- .2 Acid based chemical detergent, designed and recommended by manufacturer for removal of contamination encountered on pavers.

2.5 SEALING COMPOUND

- .1 Clear, exterior type, water based, specially formulated for application on precast concrete pavers.

Part 3 Execution

3.1 EXAMINATION

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

3.2 STRUCTURAL SURFACE

- .1 Verify that structural surfaces conform to levels [required for installation of unit pavers. If discrepancies occur, notify Departmental Representative and do not commence work until instructed by Departmental Representative.
- .2 Verify that top of structural surface (top of base) does not exceed plus or minus 10 mm of grade over 3 m straightedge.
- .3 Ensure that structural surface is not frozen or standing water is present during installation.

3.3 STRUCTURAL CURBS

- .1 Verify that structural curbs conform to elevations and alignments required for installation of unit pavers. If discrepancies occur, notify Departmental Representative and do not commence work until instructed by Departmental Representative.

3.4 INSTALLATION OF EDGE RESTRAINTS

- .1 Install restraints true to grade, in accordance with manufacturer's recommendations.

3.5 INSTALLATION OF PEDESTALS

- .1 Install pedestals as per manufacturer's specifications.

3.6 INSTALLATION OF CONCRETE PAVERS

- .1 Lay pavers to pattern] indicated. Joints between pavers: as recommended by manufacturer to a max. of 2 mm wide.
- .2 Use appropriate end, edge and corner stones. Saw cut pavers to fit around obstructions and at abutting structures.
- .3 Installation by mechanical equipment:
 - .1 Prepare installation sequence and obtain approval of sequence by Departmental Representative.
 - .2 Place paver pallets and other materials without exceeding load bearing capacity, or otherwise detrimentally affecting installations.
 - .3 Run equipment approved for installation only on paving surfaces vibrated in place.
 - .4 Complete installation after placing each 100 square metres.
 - .5 Inspect pavers and remove chipped, broken or otherwise damaged pavers as directed by Departmental Representative.
 - .6 Replace pavers removed without altering layout and structural quality.
- .4 Inspect, remove, and replace chipped, broken and damaged pavers.
- .5 Continue application of joint material and vibrating of pavers until joints are full. Do not vibrate within 1 m of unrestrained edges of pavers.
- .6 Final surface elevations not to exceed plus or minus 10 mm under 3 m long straightedge.
- .7 Surface elevation of pavers: as indicated on drawings.
- .8 Ensure conformance of final elevations.

3.7 PRECAST CONCRETE UNIT CLEANING

- .1 Carry out cleaning at times and conditions recommended by manufacturer of cleaning compound and as directed by Departmental Representative.
- .2 Remove and dispose of loose, extraneous materials from surfaces to be cleaned.
- .3 Apply cleaning compounds appropriate for removal of various contaminants encountered in accordance with manufacturer's recommendations.
- .4 Final surface to be free of contamination.

3.8 SEALING

- .1 Ensure paver surfaces to be sealed are clean, free of extraneous materials and efflorescence, dry and appropriately cured.
- .2 Apply 1 coat sealer in accordance with manufacturer's recommendations.
- .3 Protect sealed surfaces from trespass until sealer has dried and hardened.

3.9 CLEANING

- .1 Progress Cleaning:
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 MEASUREMENT AND PAYMENT

- .1 Measure granular sub-base in cubic metres of material incorporated into Work and accepted by Departmental Representative.
- .2 Measure granular base in cubic metres of material incorporated into Work and accepted by Departmental Representative.
- .3 Measure granular topping in cubic metres of material incorporated into Work and accepted by Departmental Representative.

1.2 REFERENCES

- .1 ASTM International
 - .1 ASTM C136-06, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .2 ASTM C117-04, Standard Test Method for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.
 - .3 ASTM D4318-05, Standard Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
 - .4 ASTM D698-07e1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort 12,400 ft-lbf/ft³ (600 kN-m/m³).
- .2 Canada Green Building Council (CaGBC)
 - .1 LEED Canada-NC Version 1.0-2004, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package For New Construction and Major Renovations including Addendum 2007.
 - .2 LEED Canada-CI Version 1.0-2007, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Guide For Commercial Interiors.
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.1-[88], Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2-[M88], Sieves, Testing, Woven Wire, Metric.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Access: allow access to building at all times.
- .2 Scheduling: co-ordinate paving schedule to minimize interference with normal use of premises.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Store crushed stone as and where directed by Departmental Representative.

Part 2 Products

2.1 MATERIALS

- .1 Granular sub-base:
 - .1 Crushed, pit run or screened stone, gravel or sand consisting of hard durable particles free from clay lumps, cementation, organic material, frozen material and other deleterious materials.
 - .2 Gradations: within limits specified when tested to ASTM C136, ASTM C117. Sieve sizes to CAN/CGSB-8.1, CAN/CGSB-8.2.

- .2 Table:

Sieve Designation	% Passing
75 mm	100
4.75 mm	25-85
0.425 mm	5-30
0.075 mm	0-10

- .3 Granular base:
 - .1 Crushed stone or gravel: hard, durable, angular particles, free from clay lumps, cementation, organic material, frozen material and other deleterious materials.
 - .2 Gradations: within limits specified when tested to ASTM C136, ASTM C117. Sieve sizes to CAN/CGSB-8.1, CAN/CGSB-8.2.

- .3 Table:

Sieve Designation	% Passing
19 mm	100
12.5 mm	70-100
4.75 mm	40-70
2.00 mm	23-50
0.425 mm	7-25
0.075 mm	3-8

- .4 Liquid limit: ASTM D4318 maximum 25.
- .5 Plasticity index: ASTM D4318 maximum 6.

- .4 Granular topping:

- .1 Screenings: hard, durable, crushed stone particles as indicated on landscape drawings, free from clay lumps, cementation, organic material, frozen material and other deleterious materials.
- .2 Gradations: within limits specified when tested to ASTM C136, ASTM C117

- .5 Edging: as indicated on landscape drawings.
- .6 Geotextile filter: as indicated on landscape drawings.

Part 3 Execution

3.1 SUBGRADE

- .1 Ensure subgrade preparation conforms to levels and compaction required, to allow for installation of granular base.

3.2 GEOTEXTILE FILTER

- .1 Install geotextile filter as indicated.

3.3 GRANULAR SUB-BASE

- .1 Granular sub-base material minimum thickness: 150 mm.
- .2 Place material in uniform layers not to exceed 150 mm compacted thickness.
 - .1 Compact layer to 100 % Standard Density in accordance with ASTM D698.

3.4 GRANULAR BASE

- .1 Granular base material thickness: 150 mm minimum.
- .2 Spread and compact granular base material in uniform layers not exceeding 100 mm compacted thickness.
- .3 Compact to a density of not less than 100 % Standard Density in accordance with ASTM D698.

3.5 EDGING

- .1 Install edging true to grade, in location and layout as indicated.

3.6 GRANULAR TOPPING

- .1 Place granular topping to compacted thickness 100 mm minimum.
- .2 Place material in uniform layers not to exceed 50 mm compacted thickness.
 - .1 Compact layer to 100 % Standard Density in accordance with ASTM D698.

3.7 FIELD QUALITY CONTROL

- .1 Inspection and testing of crushed stone paving: carried out by designated testing laboratory.
- .2 Costs of tests: paid as per contract agreement between the contractor and PARKS CANADA.

3.8 CLEANING

- .1 Progress Cleaning:
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.
- .3 Waste Management: separate waste materials for reuse, recycling in accordance with PARKS CANADA requirements.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.9 PROTECTION

- .1 Prevent damage to buildings, landscaping, curbs, sidewalks, trees, roads and adjacent property.
 - .1 Repair damages incurred.
- .2 Provide access to building at all times. Co-ordinate paving schedule to minimize interference with normal use of premises.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Exterior Site Furnishings

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit detailed shop drawings for Departmental Representative's review prior to manufacturing. Submit manufacturer's instructions, printed product literature and data sheets for furniture and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit maintenance data for care and cleaning of site furnishings.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect furnishings from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

- .1 As listed on landscape drawings.

Part 3 Execution

3.1 EXAMINATION

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

3.2 PREPARATION

- .1 Locate and protect utility lines.
- .2 Notify and acquire written acknowledgment from utility authorities before beginning installation Work

3.3 INSTALLATION

- .1 Assemble furnishings in accordance with manufacturer's written recommendations.
- .2 Install furnishing as directed by Departmental Representative.
- .3 Touch-up damaged finishes to approval of Departmental Representative.

3.4 CLEANING

- .1 Progress Cleaning:
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

3.5 PROTECTION

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

END OF SECTION

- .1 Separate waste materials for reuse or recycling in accordance with the SECTION 01 74 21.
- .2 Unused soil amendments are to be removed from the National Park and disposed of as per regulations.

Part 2 Products

2.1 TOPSOIL

- .1 Topsoil for planting beds: Fertile, agricultural soil, typical for locality i.e. PARKS CANADA APPROVED SUITABLE FOR NATIONAL PARK APPLICATION, capable of sustaining vigorous plant growth, taken from drained site; free of subsoil, impurities, plants, weeds and roots.
 - .1 Soil texture based on The Canadian System of Soil Classification, to consist of 20 to 70 % sand, minimum 7 % clay, and contain 2 to 10 % organic matter by weight.
 - .2 Contain no toxic elements or growth inhibiting materials.
 - .3 Finished surface free from:
 - .1 Debris and stones over 50 mm diameter.
 - .2 Course vegetative material, 10 mm diameter and 100 mm length, occupying more than 2% of soil volume.
 - .4 Consistence: friable when moist.

2.2 SOIL AMENDMENTS

- .1 Fertilizer:
 - .1 Fertility: major soil nutrients present in following amounts:
 - .2 Nitrogen (N): 20 to 40 micrograms of available N per gram of topsoil.
 - .3 Phosphorus (P): 40 to 50 micrograms of phosphate per gram of topsoil.
 - .4 Potassium (K): 75 to 110 micrograms of potassium per gram of topsoil.
 - .5 Calcium, magnesium, sulfur and micro-nutrients present in balanced ratios to support germination and/or establishment of intended vegetation.
 - .6 Ph value: 6.5 to 8.0.
- .2 Peatmoss:
 - .1 Derived from partially decomposed species of Sphagnum Mosses.
 - .2 Elastic and homogeneous, brown in colour.
 - .3 Free of wood and deleterious material which could prohibit growth.
 - .4 Shredded particle minimum size: 5 mm.
- .3 Sand: washed coarse silica sand, medium to course textured.
- .4 Organic matter: compost Category A, B in accordance with CCME PN1340, unprocessed organic matter, such as rotted manure, hay, straw, bark residue or sawdust, meeting the organic matter, stability and contaminant requirements.
- .5 Use composts meeting Category B requirements for land fill reclamation and large scale industrial applications.

2.3 SOURCE QUALITY CONTROL

- .1 Advise Departmental Representative of sources of topsoil to be utilized with sufficient lead time for testing.
- .2 Contractor is responsible for arranging certified test reports at its own expense and amendments to supply topsoil as specified.
- .3 Soil testing by recognized testing facility for PH, P and K, and organic matter.

- .4 Testing of topsoil will be carried out by testing laboratory approved by Departmental Representative. Contractor to provide a list of recognized testing facilities.
- .1 Soil sampling, testing and analysis to be in accordance with Provincial standards.

Part 3 Execution

3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.
- .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.2 STRIPPING OF TOPSOIL

- .1 Strip and remove topsoil from site as per Appendix B – Summary of Environmental Work.

3.3 STOCKPILE CLEANUP

- .1 Remove stockpile, leave area in a clean and neat condition. Grade site surface to prevent free standing surface water.
- .2 Leave unused materials in a neat, compact stockpile.
- .3 If a borrow area is indicated, leave area in a clean and neat condition. Grade site surface to prevent free standing surface water.

3.4 PREPARATION OF EXISTING GRADE

- .1 Verify that grades are correct.
 - .1 If discrepancies occur, notify Departmental Representative and do not commence work until instructed by Departmental Representative.
- .2 Grade soil, eliminating uneven areas and low spots, ensuring positive drainage.
- .3 Remove debris, roots, branches, stones in excess of 50 mm diameter and other deleterious materials.
 - .1 Remove soil contaminated with calcium chloride, toxic materials and petroleum products.
 - .2 Remove debris which protrudes more than 75 mm above surface.
 - .3 Dispose of removed material off site.
- .4 Cultivate entire area which is to receive topsoil to minimum depth of 100 mm.
 - .1 Cross cultivate those areas where equipment used for hauling and spreading has compacted soil.

3.5 PLACING AND SPREADING OF TOPSOIL/PLANTING SOIL

- .1 Place topsoil after Departmental Representative has accepted subgrade.
- .2 Spread topsoil in uniform layers not exceeding 150 mm.

- .3 For shrub, trees, perennial planting areas keep topsoil 100 mm below finished grade.
- .4 Spread topsoil to minimum depths after settlement as indicated on landscape drawings.
- .5 Manually spread topsoil/planting soil around trees, shrubs and obstacles.

3.6 FINISH GRADING

- .1 Grade to eliminate rough spots and low areas and ensure positive drainage.
 - .1 Prepare loose friable bed by means of cultivation and subsequent raking.
- .2 Consolidate topsoil to required bulk density using equipment approved by Departmental Representative.
 - .1 Leave surfaces smooth, uniform and firm against deep foot printing.

3.7 ACCEPTANCE

- .1 Departmental Representative will inspect soil testing reports submitted, as well as will review the material, depth of topsoil and finish grading on site.

3.8 SURPLUS MATERIAL

- .1 Dispose of materials except topsoil not required off site.

3.9 CLEANING

- .1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 31 11 00 – Clearing and Grubbing.
- .2 Section 32 91 19.13 - Topsoil Placement and Grading.
- .3 Appendix B – Summary of Environmental Work

1.2 DESCRIPTION

- .1 This Section specifies requirements for planting trees, shrubs and groundcover following vegetation disturbance resulting from project construction activities.
- .2 Landscape Drawing (L3 – PLANTING PLAN) should be referred to for a description of the designated area(s) to be planted.

1.3 REFERENCES

- .1 Agriculture and Agri-Food Canada:
 - .1 Plant Hardiness Zones in Canada, 2000.
- .2 Alberta Conservation Information Management System List of Elements in Alberta - Vascular Plants.
 - .1 Found online at www.albertaparks.ca/albertaparksca/management-land-use/alberta-conservation-information-management-system-acims/download-data
- .3 Canadian Nursery Landscape Association (CNLA):
 - .1 Canadian Standards for Nursery Stock, 2006.
- .4 Vegetation Removal and Restoration/Reclamation Guidelines. Banff National Park. Parks Canada.
- .5 Woody/Vegetative Debris Management Guidelines. 2017. Parks Canada.

1.4 DEFINITIONS

- .1 Topsoil: The top layer of soil containing organic material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.
- .2 Mycorrhiza: association between fungus and roots of plants. This symbiosis, enhances plant establishment in newly landscaped and imported soils.

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Scheduling: obtain approval from Departmental Representative of schedule 7 days in advance of shipment of plant material. Schedule to include:
 - .1 Quantity and type of plant material.
 - .2 Shipping dates.
 - .3 Arrival dates on site.

- .4 Planting dates.

1.6 SUBMITTALS

- .1 Submit accordance with as Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for trees, shrubs, ground cover, mycorrhiza, anti-desiccant, anchoring equipment, and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit 2 copies of WHMIS Safety Data Sheets.
- .3 Samples:
 - .1 Submit samples of mycorrhiza.

1.7 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Landscape Contractor: to be a Member in Good Standing of Landscape Alberta Nursery Trades Association (LANTA).
 - .2 Landscape Planting Supervisors: "Landscape Industry Certified" Technician with Softscape Installation Specialization as regulated by Canadian Nursery Landscape Association (CNLA).

1.8 PRODUCT DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
 - .1 Protect plant material from frost, excessive heat, wind and sun during delivery.
 - .2 Protect plant material from damage during transportation:
 - .1 Delivery distance is less than 30 km and vehicle travels at speeds under 80 km/h, tie tarpaulins around plants or over vehicle box.
 - .2 Delivery distance exceeds 30 km or vehicle travels at speeds over 80 km/h, use enclosed vehicle where practical.
 - .3 Protect foliage and root balls using anti desiccants and tarpaulins, where use of enclosed vehicle is impractical due to size and weight of plant material.
 - .4 Pad all points of contact between plant material and equipment.
- .3 Unload and inspect all plants immediately upon arrival to site and water as required. Trees with cracked or broken root balls or leaders will not be accepted.
- .4 Storage and Handling Requirements:
 - .1 Immediately store and protect plant material which will not be installed within 24 hours in accordance with supplier's written recommendations and after arrival at site in storage location approved by Engineer.
 - .2 Protect stored plant material from frost, wind and sun and as follows:

- .1 For bare root plant material, preserve moisture around roots by burying roots in topsoil and watering to full depth of root zone.
- .2 For pots and containers, maintain moisture level in containers.
- .3 For balled and burlapped and/or wire basket root balls, place to protect branches from damage. Maintain moisture level in root zones.
- .4 For live cuttings, obtain necessary permit from Parks Canada prior to harvest, collect in dormant season only, soak and install immediately after harvest; ensure cuttings are not left in direct sun between soaking and installation. If immediate installation is not possible, cuttings shall be sent to nursery to be rooted.
- .3 Store and manage manufactured materials in a weatherproof location in accordance with manufacturer's written instructions.
- .4 Packaging Waste Management:
 - .1 Collect and separate for disposal and recycling all palettes, crates, padding and packaging materials.
 - .2 Dispose / recycle materials at appropriate facilities.

1.9 SUBSTITUTION

- .1 All substitutions shall be made through a change order to the Contract.

1.10 WARRANTY

- .1 Contractor hereby warrants that plant materials as itemized on the plant list will remain free of defects, but for one (1) full growing season following the year of installation.
- .2 End of warranty inspection will be conducted by Parks Canada Vegetation Specialist.
- .3 Departmental Representative reserves the right to extend the Contractor's warranty responsibilities for an additional one year if, at the end of the initial warranty period, leaf development and growth is not sufficient to ensure future survival.
- .4 Non-native vegetation will be removed by the Contractor during the warranty period. Weeds will be hand-pulled twice in July and twice in August. Weeds shall include any species listed as exotic on the Alberta Conservation Information Management System (ACIMS). When removing weeds, care will be taken to ensure all parts of the plant including roots are removed. Responsible personnel will have knowledge and expertise to identify plant species.

Part 2 Products

- .1 Tree Planting
 - .1 Plant in rough and loose soil with woody debris at 100 m³/ha. Woody debris to be sourced from material on site and should comprise a wide range of sizes, with an average diameter of at least 10 cm and average length of at least 2 m.
Plant in locations specified on attached Drawing where disturbance occurs within existing conifer stand due to removal of overhead

powerlines, and removal of water and sanitary lines, and road relocations.

.2 Shrub Planting

- .1 Plant shrubs at locations shown on Drawing.

2.1 PLANT MATERIAL

.1 Type of root preparation, sizing, grading and quality: comply to Canadian Standards for Nursery Stock.

- .1 Only native species of wild provenance shall be installed. No cultivars are permitted.
- .2 Trees and shrubs shall have genetic origin from locations within 400 km of the project site and from Plant Hardiness Zone 2, 3, or 4. To the extent possible, the origin of plant material shall be of similar or lower elevation and latitude.

.2 Plant material: plants shall be generally true to type and structurally sound, well branched, healthy and vigorous and free of disease, insect infestations, insect eggs, rodent damage, sunscald, frost cracks and mechanical wounds. They shall be densely foliated when in leaf and have a healthy, well-developed root system. Pruning cuts shall show vigorous bark on all edges and all parts shall be moist and show live, green cambium tissue when cut.

.3 Root balls:

- .1 Shall be of a diameter as specified in the CNLA Canadian Standards for Nursery Stock. Root ball sizes are a minimum and shall be adjusted according to the growth habit of plants.
- .2 Root ball sizes shall be sufficiently large to contain at least 75% of the fibrous root depth.
- .3 The root ball shall contain all the original soil in which the tree has grown and shall be free of all weeds and vegetation. It shall be firmly secured to prevent any soil from spilling or drying out.
- .4 Any increase or decrease in tree size shall require a corresponding adjustment to the root ball size to conform to CNLA Canadian Standards for Nursery Stock.

.4 Deciduous trees

- .1 Deciduous trees shall have straight stems unless that would be uncharacteristic to the tree species.
- .2 Minor adjustments of structural integrity may be attempted by structural pruning carried out by a Certified Arborist and will be subject to re-inspection.
- .3 Clump or multi-stem trees shall have three or more stems originating from a common base.
- .4 Deciduous trees to show signs of good trunk taper and free of branches to a point not less than 60% or 1.5 m.
- .5 All trunks shall be straight, clean and free from stubs and portions of decay, splits or other damage.

.5 Coniferous trees:

- .1 Coniferous trees shall be of normal shape and quality for the species. Trees with broken or missing leaders will not be accepted.
- .2 Pine varieties shall have uniform branching which starts no higher than 600 mm from the root collar.
- .3 Root balls for coniferous trees to be:

<u>Tree Height Range</u>	<u>Ball Diameter</u>
1.8 – 2.4 m	86 cm
2.5 – 3.0 m	100 cm
3.1 – 3.5 m	122 cm

- .6 Collected stock: Any plants dug from native stands, woodlots, orchards or neglected nurseries and have not received proper cultural maintenance as advocated by the Canadian Nursery Landscape Association.
 - .1 The use of collected stock will not be permitted unless previously inspected and approved in writing by Engineer.
 - .2 Trees collected from native stands or established plantings must be so designated and approved by the Departmental Representative prior to planting. Root balls shall be at least ten percent larger in diameter than nursery grown stock.
- .7 Shrubs shall have natural form typical of the species with a minimum of four canes.
- .8 Vines shall have at least four runners, each of a minimum length of 300 mm.
- .9 Ground covers shall have well developed tops, size proportionate to the developed roots typical of the species.
- .10 Plants that have been top-worked, sheared or colour treated are not acceptable.

2.2 TOPSOIL

- .1 Topsoil shall be replaced where stripping occurred immediately following final grading of subsoil.
- .2 In locations of topsoil replacement, depth of topsoil shall be a minimum of 300 mm.
- .3 Soils shall be left rough and loose to provide an irregular and undulating surface.
- .4 Following topsoil replacement, vehicle and equipment traffic shall be prohibited to prevent soil compaction.

2.3 WATER

- .1 Free of impurities that would inhibit germination and growth.
- .2 Contractor to supply all related hoses, trucks, sprinklers as required at no cost to Departmental Representative.

2.4 STAKES

- .1 T bar, steel, 40 x 40 x 5 mm thick, 2100 mm in length (not including 1-year or 2-year old seedlings).

2.5 WIRE TIGHTENER

- .1 Type 1: galvanized steel, stamped plate type rod, triangular shape (not including 1- or 2-year old seedlings).

2.6 GUYING WIRE

- .1 Galvanized #12 guy wire or approved equal (not including 1-year or 2-year old seedlings).

2.7 GUYING COLLAR

- .1 2 ply, reinforced, 12 mm black rubber hose, or approved equal (not including 1-year or 2-year old seedlings).

2.8 TRUNK PROTECTION

- .1 As directed by Departmental Representative:
 - .1 Wire mesh: galvanized, electrically welded 1.4 mm wire mesh with 25 x 25 mm mesh and fastener.
 - .2 Plastic: perforated spiralled strip.
 - .3 Burlap: clean 2.5 kg/m² minimum mass and 150 mm wide, and twine fastener.
 - .4 Tar impregnated crepe paper and twine fastener.

2.9 FERTILIZER

- .1 Fertilizer shall not be used; it is not recommended for native species planting.

2.10 AMENDMENT

- .1 Synthetic commercial type as recommended by soil test report.
 - .1 Ensure new root growth is in contact with mycorrhiza.
 - .2 Use mycorrhiza as recommended by manufacturer's written recommendations.

2.11 ANTI DESICCANT

- .1 Wax like emulsion.

2.12 FLAGGING TAPE

- .1 Fluorescent orange colour.

2.13 SOURCE QUALITY CONTROL

- .1 Obtain approval from Departmental Representative of plant material prior to planting. Previous approval of plant material shall not impair the right of Departmental Representative during construction to reject plants which have been damaged or which, in any way, do not conform to the Specifications.
- .2 Imported plant material must be accompanied with necessary permits and import licences. Conform to Federal, Provincial or Territorial regulations.

Part 3 Execution

3.1 PLANTING SEASON

- .1 Plant trees, shrubs and ground covers only during periods that is normal for such work. It is recommended that all coniferous material should be planted by mid August to allow for root establishment and energy storage prior to winter.

3.2 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrate previously installed under other Sections are acceptable for planting installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Engineer.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.
 - .4 Commencement of planting operations implies acceptance of subgrade.

3.3 PRE-PLANTING PREPARATION

- .1 Proceed only after receipt of written acceptability of plant material from Departmental Representative.
- .2 Remove damaged roots and branches from plant material.
- .3 Apply anti desiccant to conifers and deciduous trees in leaf in accordance with manufacturer's instructions.
- .4 Locate and protect utility lines.
- .5 Notify and acquire written acknowledgment from utility authorities before beginning excavation of planting pits for trees and shrubs.
- .6 Planting areas shall be free of weeds prior to excavation and preparation for planting.

3.4 EXCAVATION AND PREPARATION OF PLANTING BEDS AND PITS

- .1 Prepare subsoil to eliminate uneven areas. Maintain profiles and contours. Make changes in grade gradual. Blend slopes into level areas.
- .2 Remove foreign materials, weeds and undesirable plants and their roots. Remove contaminated subsoil.
- .3 Preparation of planting beds in accordance with Section 32 91 19.13 Topsoil Placement and Grading.
- .4 Stake out location and obtain approval from Departmental Representative prior to excavating.
- .5 Tree pits:
 - .1 Depth of planting hole to be 40 mm less than height of the root ball, such that following planting, the top of the rootball is 40mm above grade.

- .2 Remove rocks, roots, debris and toxic material from excavated material that will be used as planting soil for trees and individual shrubs. Dispose of excess material off site as directed by Engineer.
- .3 Scarify sides of planting hole.
- .4 Remove water which enters excavations prior to planting. Notify Engineer if water source is ground water.

3.5 PLANTING

- .1 For jute burlapped root balls, cut away top one third of wrapping and wire basket without damaging root ball.
 - .1 Do not pull burlap or rope from under root ball.
 - .2 If circling roots are found in the root ball, cut the root at the beginning of the circling.
- .2 For container stock or root balls in non-degradable wrapping, remove entire container or wrapping without damaging root ball.
 - .1 If circling roots are found in the root ball, gently loosen roots and cut container vertically with a sharp knife to allow root ball to become free.
- .3 Plant vertically in locations as indicated.
- .4 Orient plant material to give best appearance in relation to structure, roads and walks.
- .5 For trees and shrubs:
 - .1 Backfill soil in 150 mm lifts.
 - .1 Do not place soil while frozen or muddy.
 - .2 Tamp each lift to eliminate air pockets.
 - .3 When two thirds of depth of planting pit has been backfilled, fill remaining space with water.
 - .4 After water has penetrated into soil, backfill to finish grade.
- .6 For ground covers, backfill soil evenly to finish grade and tamp to eliminate air pockets.
- .7 Water plant material thoroughly.
- .8 After soil settlement has occurred, fill with soil to finish grade.
- .9 Install and maintain fence around tree and shrub planting areas during the 1year establishment period to prevent damage by herbivory.

3.6 TRUNK PROTECTION

- .1 Install trunk protection on deciduous trees as directed by Departmental Representative.
- .2 Install trunk protection before installation of tree supports.

3.7 TREE SUPPORTS

- .1 Install tree supports for large trees, not including 1-year or 2-year old seedlings.
- .2 Support plants with stakes and guy wires immediately after installation.

- .3 Install guying collars above branch to prevent slipping at approximately 2/3 height for evergreens and 1/2 height for deciduous trees. Collar mounting height not to exceed 2.5 m above grade.
 - .1 Guying collars to be of sufficient length to encircle tree plus 50 mm space for trunk clearance.
- .4 Thread guy wire through collar encircling tree trunk and secure to lead wire by clamp or multi wraps; cut wire ends close to wrap. Spread lead wires equally proportioned about trunk.
- .5 Attach guy wire to stakes. Tension wire and secure by installing clamps.
- .6 Install wire tightener ensuring that guys are secure and leave room for slight movement of tree. All guy wires to be folded or bent in such a fashion so as to not be exposed outwardly.
- .7 After tree supports have been installed, remove broken branches with clean, sharp tools.

3.8 MAINTENANCE

- .1 Conduct maintenance of trees, shrubs and groundcovers as required. Maintenance activities include watering, hand pulling weeds, and replacement of any staking or fencing installed to protect plants.
- .2 Contractor shall control weeds during the warranty period as described in Section 1.11.

3.9 REPLACEMENTS

- .1 All required replacements shall be of plants of the same size and species as specified on the Drawing and shall be supplied and planted in accordance with the Drawing and Specifications.

3.10 ACCEPTANCE

- .1 Trees, shrubs and groundcovers will be accepted by Departmental Representative provided plant materials are in a vigorous, healthy condition, meet or exceed the sizes indicated on the Drawing, are structurally sound and of a shape and form typical of the species.

END OF SECTION

Part 1 GENERAL

1.1 SECTION INCLUDES

- .1 Underground Water Tanks:
 - 1. Tank installation in the following locations:
 - a. Marten Street, Banff, Canada
 - 2. For the following application:
 - a. Rainwater harvesting / Stormwater Detention.
 - 3. Type of Tanks:
 - a. Cast in situ concrete tank as per details and specifications on drawings.

1.2 RELATED SECTIONS

- .1 Section 31 20 00 – Earthworks
- .2 Section 03 30 00 – Cast In Place Concrete.

1.3 REFERENCES

- .1 Underground Water Tanks
 - 1. American Concrete Institute (AC) standard ACI 318, Building Code Requirements for Structural Concrete.

1.4 SUBMITTALS

- .1 Submit under provisions of Section 01 33 00 – Submittal Procedures.
- .2 Construction Data: Submit any data sheets and shop drawings on tank as required for a complete construction.
- .3 Contractor shall submit the following for review and approval prior to installation of the tank.
 - 1. Detailed methods of tank construction as per drawings of tank, with all accessories necessary for complete construction.
 - 2. Detailed handling and installation instructions as per site conditions.

1.5 QUALITY ASSURANCE

- .1 Tank installation in Canada:
 - 1. Regulatory Requirements: Comply with applicable requirements of the laws, codes, ordinances and regulations of Federal, provincial and

municipal Construction, health and safety and environmental codes and local authorities having jurisdiction.

1.6 UNDERGROUND WATER TANKS:

.1 Rainwater Harvesting / Stormwater Detention Applications

1. Governing Standards, as applicable.
American Concrete Institute (AC) standard ACI 318, Building Code Requirements for Structural Concrete

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 This section includes requirements for supply and installation of perimeter foundation and under-slab drainage system with granular filter and/or geotextile filter material.

1.2 RELATED REQUIREMENTS

- .1 Section 07 11 10 – Bituminous Dampproofing
- .2 Section 07 13 52 – Modified Bituminous Sheet Waterproofing

1.3 REFERENCES

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM C4-04(2018), Standard Specification for Clay Drain Tile and Perforated Clay Drain Tile.
 - .2 ASTM C136/C136M-14, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .3 ASTM C444/C444M-17 Standard Specification for Perforated Concrete Pipe (Metric).
 - .4 ASTM C654/C654M-15, Standard Specification for Porous Concrete Pipe (Metric).
 - .5 ASTM D698-12e2, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
- .2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
- .3 Canadian Standards Association (CSA):
 - .1 CSA A23.1-14/A23.2-14, Concrete materials and methods of concrete construction / Test methods and standard practices for concrete, Includes Update No. 1 (2015)
 - .2 CSA B1800-18, Thermoplastic Non-pressure Piping Compendium (Consists of B181.1, B181.2, B181.3, B181.5, B182.1, B182.2, B182.4, B182.6, B182.7, B182.8 and B182.11).
 - .3 CSA-G401-14, Corrugated Steel Pipe Products

1.4 ACTION SUBMITTALS / INFORMATIONAL SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 – Submittals Procedures.
 - .1 Submit manufacturer's product literature for each product listed including manufacturer's recommended installation procedures and any modifications required to suit installation conditions.
- .2 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Drainage Pipe: Provide a 300 mm length of perforated and non-perforated pipe and end connection.

- .2 Filter Fabric: Provide 600 mm x 600 mm filter cloth sample for review and acceptance.
- .3 Certificates:
 - .1 Submit manufacturer's test data and certification that drain pipe materials meet requirements of this Section at least 2 weeks prior to beginning Work.
 - .2 Submit proposed source of granular bedding and filter materials a minimum of two (2) weeks before beginning work of this Section, indicate gradation and certification of expected flow rate of granular materials.
 - .3 Certification to be marked on pipe.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, handle, store and protect materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Store materials in accordance with manufacturer's written instructions.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 MATERIALS

- .1 Corrugated Plastic Drainage Tubing: PVC DR 35 to CAN/CSA B182.1, perforated, tapered ends, sizes as indicated on drawings. Unperforated matching pipe leads.
- .2 Other pipe as indicated on the drawings or as directed by the Departmental Representative.
- .3 Filter Gravel: Coarse aggregates to CSA A23.1-94, Table 3, Group 1, 20 mm to 5 mm nominal size of aggregate.
- .4 Filter Cloth and Sock: Tensile strength minimum 400 N, equivalent opening size 70 microns or less.
- .5 Accessories: Drainage pipe couplings (where pipe does not have bell connectors), end caps, clean-outs, and access covers, all as required for complete system.
- .6 Geotextile filter: Geotextile to be non-woven plastic, non-biodegradable type designed for separation of fill materials while permitting movement of ground water.
 - .1 Acceptable Material: Nilex NudrainPD20

Part 3 Execution

3.1 PREPARATION

- .1 Trenching

- .1 Do excavating, trenching and backfilling in accordance with Section 31 20 00 – Earth Works.
- .2 Trim and compact trench bottom to provide firm uniform support throughout length of pipe.
- .3 Allow 100 mm clearance on both sides of pipe for filter aggregate.
- .2 Bedding
 - .1 Place 100 to 150 mm layer of bedding filter material as indicated and compact to minimum 95% of maximum density to ASTM D698.

3.2 INSTALLATION OF PIPE SUB-DRAINS

- .1 Lay pipe drains on prepared bed, true to line and grade with inverts smooth and free of sags or high points.
- .2 Place at trench bottom the geotextile fabric of sufficient width to completely wrap around filter aggregate and pipe with minimum 300 mm overlap. Alternatively a sock of approved geotextile fabric may be slipped over the pipe.
- .3 Ensure barrel of each pipe is in contact with bed throughout full length.
- .4 Begin laying at outlet and proceed in upstream direction.
- .5 Lay perforated pipes on fabric with perforations 2/3 down.
- .6 Lay bell and spigot pipe with bell ends facing upstream.
 - .1 Do not mortar joints.
- .7 Make joints tight in accordance with manufacturer's instructions.
- .8 Make watertight connections to existing drains, new or existing manholes and catch basins where indicated or as directed by Departmental Representative. Seal joints with approved sealant.
- .9 Plug open upstream ends of pipes with watertight concrete, steel or wood bulkheads.
- .10 Surround and cover drain with filter material in uniform 150 mm layers to an elevation of at least 150 mm above top of drain and compact to at least 95% maximum density to ASTM D698. Level aggregate surface and overlap the fabric
- .11 Backfill remainder of trench to structural drawings - Excavating Trenching and Backfilling and as directed by Departmental Representative.
- .12 Do not place bedding surround and backfill materials in frozen condition.
- .13 Protect sub-drains against flotation during installation.
- .14 Install "Y" connections to surface as indicated, for flushing.

END OF SECTION