

# PROJECT MANUAL

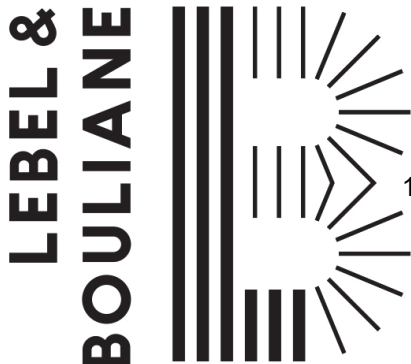
## TPL Pleasant View

Branch Expansion  
575 Van Horne Avenue  
Toronto, Ontario

**PROJECT NO. 22-008**

## ISSUED FOR TENDER

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**LEBEL & BOULIANE**

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**END OF SECTION**

## **1.1 WORK COVERED BY CONTRACT DOCUMENTS**

- .1 The Work includes renovation and construction of an addition to an existing branch library in accordance with the requirements of the Contract Documents. Refer to Toronto Public Library (TPL) procurement documents for bidding instructions and options, forms and contract terms and conditions.
- .2 The specifications have been prepared to include instructions that apply to the building being renovated, with the building-specific scope of work illustrated by the Contract Drawings; the Drawings and Specifications shall be read together as a whole to determine requirements.
- .3 General Contractor is responsible for obtaining and payment of any and all permits applicable to the project work.
- .4 Branch Library Address:  
Pleasant View Library  
575 Van Horne Street, Toronto, ON M2J 4S8

## **1.2 PHASING**

- .1 The Work shall be executed in Phases as indicated on Drawings. Coordinate and cooperate with the TPL Project Manager as required.

## **1.3 DEFINITIONS**

- .1 Notwithstanding definitions specified elsewhere, the following definitions take precedence and govern specification divisions 01 through 33 inclusive of the Contract Documents. In the event of conflict, the following shall govern.
  - .1 And/or: 'and/or' means that the sentence in which it appears should be read twice to extract the complete meaning, once with the conjunction 'and' used, and once with the conjunction 'or' used.
  - .2 Equivalent: means a material or product that has the same or better performance characteristics, physical properties, warranty provisions, and technical support as the specified material or product, and has been approved in accordance with the requirements of Section 01 62 00.
  - .3 May: 'may' is used to express an option or that which is permissible within the limits of the Contract.
  - .4 Place of the Work: means the location of the Work identified in the Contract Documents.
  - .5 Product: means material, machinery, equipment, and fixtures forming the Work.
  - .6 Project: means the total construction contemplated of which the Work may be the whole or a part.
  - .7 Project Team: all the parties involved in the Project, including Owner, Consultant, Contractor, Subcontractors and Suppliers.
  - .8 Must: 'must' is used in the specifications to indicate a requirement that is contractually binding, meaning it is required to be implemented, and its implementation verified; it has the same contractual purpose as 'shall' in the specifications.
  - .9 Provide: means that the Work concerned shall include any delegated design necessary for, and the supply and installation of, the products required for completion of that part of the Work.
  - .10 Shall: 'shall' is used in the specifications to indicate a requirement that is contractually binding, meaning it is required to be implemented, and its implementation verified.

- .11 Should: 'should' is used in the specifications to indicate a goal that must be addressed by the Contractor but is not formally verified. The Contractor is required to communicate to the Consultant at progress meetings how they are intending to achieve the goal and what progress they have made.
- .12 Supplier: means person or entity having direct contract with Contractor, trade contractor or subcontractor, or to supply Products.
- .13 Trade Contractor, Subcontractor: means person or entity having direct contract with Contractor to perform a part or parts of the Work at the Place of the Work.
- .14 Will: 'will' is used in the specifications to indicate a statement of fact.
- .15 Work: means the total construction or a part or parts thereof and related services required by the Contract Documents.

#### 1.4 DEFINED TERMS

- .1 The parties to the *Contract* agree that a term found defined in DEFINITIONS of the *Contract Documents* and used in the *Specifications*, whether appearing in regular font or in italics or capitalized or not, shall have the meaning of that defined term.

#### 1.5 COMPLEMENTARY DOCUMENTS

- .1 Drawings, specifications, and schedules are complementary each to the other and what is called for by one to be binding as if called for by all. Should any discrepancy appear between documents which leaves doubt as to the intent or meaning, abide by Precedence of Documents article below or obtain direction from the Consultant.
- .2 Examine all discipline drawings, specifications, and schedules and related documents to ensure that Work can be satisfactorily executed. Conflicts or additional work beyond work described to be brought to attention of Consultant.

#### 1.6 COORDINATION

- .1 *Subcontractors* and *Suppliers* shall cooperate with each other in carrying out their respective works as required to maintain Construction Schedule and eliminate inefficiencies and carry out instructions of *Contractor* and *Consultant*.
- .2 *Subcontractors* and *Suppliers* shall coordinate work with that of other *Subcontractors* and *Suppliers* as required to maintain Construction Schedule and eliminate inefficiencies. If any part of the *Work* subcontracted depends for its proper execution or result upon *Work* of another subcontract, report promptly in writing any constraints that may interfere with proper and timely execution of the *Work* contracted to *Contractor* and *Consultant*.
- .3 Coordination and cooperation between *Subcontractors* and *Suppliers* is required.
- .4 Coordinate use of worksite and property under direction of *Contractor* and *Consultant*.
- .5 Obtain and pay for use of additional storage or work areas needed for operations under this Contract.

#### 1.7 SITE EXAMINATION

- .1 Site Examination: all bidders are advised to visit the branch library location and examine existing conditions prior to submitting bids. Failure to review the site before submitting a bid will not be accepted as justification for additional costs to Contract. It is the responsibility of all bidders to understand the site and existing conditions before submitting their bid.

**1.8 MINIMUM PROJECT WARRANTY REQUIREMENTS**

- .1 Notwithstanding General Conditions of Contract, Contractor shall correct any deficiencies found in the Work performed for a minimum period of 24-months from date of Substantial Performance; where extended warranties are specified beyond the 24-month period, then the longer warranty period applies.
- .2 No warranty shall be construed as limiting or shall limit in any way Owner's recourse under civil law to recover damages.

**1.9 DOCUMENTS REQUIRED**

- .1 Keep the following documents at Place of the Work, stored securely and in good order and available to Owner and Consultant in hard copy or electronic form:
  - .1 Current Contract Documents, including Drawings, Specifications and addenda.
  - .2 Change Orders, Change Directives, and Supplementary Instructions.
  - .3 Reviewed Shop Drawings, Product data and samples.
  - .4 List of Outstanding Shop Drawings.
  - .5 Field test reports and records.
  - .6 Construction progress schedule.
  - .7 Meeting minutes.
  - .8 Manufacturer's certifications.
  - .9 Permits, inspection certificates, and other documents required by authorities having jurisdiction.
  - .10 Current as-built drawings.
  - .11 Safety Data Sheets (SDS).
  - .12 Copy of approved Project Schedule.
  - .13 6-week look-ahead schedule.
  - .14 Health and Safety Plan and Other Safety Related Documents.
  - .15 Other documents as required by authorities having jurisdiction.

**END OF SECTION**

**Part 1 General**

**1.1 USE OF SITE AND FACILITIES**

- .1 General: Confine Construction Equipment, Temporary Work, storage of Products, waste products and debris, and all other construction operations to limits required by laws, ordinances, permits, and Contract Documents, whichever is most restrictive. Do not unreasonably encumber Place of the Work.
- .2 Library will remain in operation during construction. Phase the Work accordingly, and arrange schedule with Owner. Work after regular business hours for all Work that may be disruptive of or interfere with normal operations. Develop a phasing plan and submit with construction schedule and update as required.
- .3 Maintain existing services to building and provide for personnel and vehicle access.
- .4 Maintain all services (mechanical and electrical connections and operations) throughout the project. Any proposed disruption to be coordinated with the Owner, and scheduled during non-operational hours.
- .5 Provide coordination with Owner to minimize impact of disruptions.
- .6 Maintain all fire-fighting and emergency access lanes to the existing area.
- .7 Do not damage and/or interrupt the operation of fire detection, alarm, or suppression systems.
- .8 Where security is reduced by work provide temporary means to maintain security.

**1.2 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING**

- .1 Execute work with least possible interference or disturbance to building operations, adjacent tenants, and public access and use of building. Arrange with Owner to facilitate execution of work.
- .2 Do not load or permit to be loaded any part of the Work with a weight or force that will endanger the safety or integrity of the Work.

**1.3 SPECIAL REQUIREMENTS**

- .1 Work or activities that generate excessive noise to be performed outside of library's business hours.
  - .1 Comply with local noise restrictions and requirements.
- .2 Submit schedule in accordance with Section 01 32 16 – Construction Schedule.
- .3 Ensure that Contractor personnel employed on site become familiar with and obey regulations including safety, fire, traffic, and security regulations.
- .4 Keep within limits of work and avenues of ingress and egress.

**1.4 BUILDING SMOKING ENVIRONMENT**

- .1 Comply with smoking restrictions. Smoking is not allowed near or within building.

**END OF SECTION**

**1.1 RELATED REQUIREMENTS SPECIFIED ELSEWHERE**

- .1 Particular requirements for inspection and testing to be carried out by testing laboratory designated by Consultant are specified under the various technical specification sections.

**1.2 APPOINTMENT AND PAYMENT**

- .1 Owner will appoint and pay for services of testing laboratory except as follows:
  - .1 Inspection and testing required by laws, ordinances, rules, regulations, and orders of public authorities.
  - .2 Inspection and testing performed exclusively for Contractor's convenience.
  - .3 Testing, adjustment and balancing of conveying systems, mechanical and electrical equipment and systems.
  - .4 Mill tests and certificates of compliance.
  - .5 Tests specified to be carried out by Contractor under the supervision of Consultant.
- .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 Consultant to verify acceptability of corrected work.
- .3 Consultant will coordinate and oversee inspection and testing.

**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 Consultant 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 Consultant.

**END OF SECTION**

## **1.1 ADMINISTRATIVE**

- .1 Schedule and administer project meetings throughout the progress of the work and at the call of Consultant.
- .2 Prepare agenda for meetings.
- .3 Distribute written notice of each meeting four days in advance of meeting date to Consultant.
- .4 Provide physical space and make arrangements for meetings.
- .5 Preside at meetings.
- .6 Record meeting minutes. Include significant proceedings and decisions. Identify actions by parties.
- .7 Reproduce and distribute copies of minutes within three days after meetings and transmit to meeting participants and affected parties not in attendance.
- .8 Representatives of Contractor, major Subcontractors and Suppliers attending meetings will be qualified and authorized to act on behalf of party each represents.

## **1.2 CONSTRUCTION PARTNERING WORKSHOP**

- .1 Within 30 days after award of Contract, a meeting of parties in Contract shall be called to discuss and resolve administrative procedures and responsibilities.
- .2 Representatives of Owner, Consultant, Contractor, major Subcontractors, Suppliers, field inspectors and supervisors shall be in attendance.
- .3 Contractor will coordinate time and location of meeting and notify parties concerned minimum 5 days before meeting.
- .4 Agenda to include:
  - .1 Appointment of official representative of participants in the Work.
  - .2 Schedule of Work: in accordance with Construction Progress Schedules.
  - .3 Schedule of submission of shop drawings, samples, colour chips. Submit submittals as specified.
  - .4 Development and implementation strategies of Project six-week look-ahead schedules, trade cross-referenced and coordinated weekly work plans, trade toolbox meetings, and project flow visualizations to maximize production in realizing design objectives.
  - .5 Requirements for temporary facilities, site sign, offices, storage sheds, utilities, fences.
  - .6 Delivery schedule of specified equipment.
  - .7 Site security and fencing.
  - .8 Proposed changes, change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, administrative requirements.
  - .9 As-built drawings and record documents.
  - .10 Maintenance manuals.
  - .11 Take-over procedures, acceptance, and warranties.
  - .12 Monthly progress claims, administrative procedures, photographs, hold backs.
  - .13 Appointment of inspection and testing agencies or firms.
  - .14 Insurances, transcript of policies.



### **1.3 PROGRESS MEETINGS**

- .1 During course of Work schedule progress meetings every 2-weeks.
- .2 Contractor, major Subcontractors involved in Work, and Consultant shall be in attendance.
- .3 Notify parties minimum 5-days prior to meetings.
- .4 Record minutes of meetings and circulate to attending parties and affected parties not in attendance within 7-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 Six week look-ahead schedule.
  - .4 Project Coordination.
  - .5 Review opportunities to maximize production through coordinated weekly work plans, trades cross-referencing to enable visualization of potential bottlenecks, and respective solution-finding.
  - .6 Field observations, problems, conflicts.
  - .7 Problems which impede construction schedule.
  - .8 Review of off-site fabrication delivery schedules.
  - .9 Corrective measures and procedures to regain projected schedule.
  - .10 Revision to construction schedule.
  - .11 Progress schedule, during succeeding work period.
  - .12 Review submittal schedules: expedite as required.
  - .13 Maintenance of quality standards.
  - .14 Review proposed changes for affect on construction schedule and on completion date.
  - .15 Other business.

**END OF SECTION**

## 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 Schedule: shall mean Project Schedule.
- .5 Construction Work Week: Monday to Friday, inclusive, will provide 5-day work week and define schedule calendar working days as part of Bar (GANTT) Chart submission.
- .6 Duration: number of work periods (not including holidays or other nonworking periods) required to complete activity or other project element. Usually expressed as workdays or workweeks.
- .7 Master Plan: summary-level schedule that identifies major activities and key milestones.
- .8 Milestone: significant event in project, usually completion of major deliverable.
- .9 Project Schedule: planned dates for performing activities and the planned dates for meeting milestones. Dynamic, detailed record of tasks or activities that must be accomplished to satisfy Project objectives. Monitoring and control process involves using Project Schedule in executing and controlling activities and is used as basis for decision making throughout project life cycle.
- .10 Project Planning, Monitoring and Control System: overall system operated by Consultant 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.
- .5 Submit Detail Schedules to Contractor and Consultant within 15 working days of Award of Contract in the form of a Bar (GANTT) Chart for purposes of creation of a Master Plan, and Project planning, coordinating, monitoring and reporting Work progress.

## 1.3 PROJECT SCHEDULE

- .1 Develop detailed Project Schedule derived from Master Plan.
- .2 Ensure detailed Project Schedule includes as minimum milestone and activity types the following items, selected as applicable to Contractor's scope of Work:
  - .1 Award.
  - .2 Shop Drawings, Samples.
  - .3 Permits.

- .4 Phasing.
- .5 Mobilization.
- .6 Inspections by authorities having jurisdiction.
- .7 Excavation.
- .8 Backfill.
- .9 Building footings.
- .10 Slab on grade.
- .11 Structural Steel.
- .12 Siding and Roofing.
- .13 Interior Construction:
  - .1 Partitions.
  - .2 Fittings.
- .14 Interior Finishes:
  - .1 Wall Finishes.
  - .2 Floor Finishes.
  - .3 Ceiling Finishes.
- .15 Equipment and Furnishings:
  - .1 Equipment.
  - .2 Fixed Furnishings.
- .16 Specialties.
- .17 Plumbing.
- .18 Lighting.
- .19 Electrical.
- .20 Piping.
- .21 Controls.
- .22 Heating, Ventilating, and Air Conditioning.
- .23 Fire Systems.
- .24 Commissioning.
- .25 Demobilization.
- .26 Closeout submissions.
- .27 Supplied equipment long delivery items.
- .28 Required dates for supplied equipment.

#### **1.4 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.

#### **1.5 SUBMITTALS SCHEDULE**

- .1 Format and Content:
  - .1 Prepare schedule identifying all required Shop Drawing, Product data, and sample submissions including those for Owner supplied Products.
  - .2 Prepare schedule in electronic format.

- .3 Provide a separate line for each required submittal, organized by Specifications section names and numbers, and further broken down by individual Products and systems as required.
- .4 For each required submittal, show planned earliest date for initial submittal and latest date for return of reviewed submittal by Consultant without causing delay.
- .2 Submission:
  - .1 Submit initial schedule to Consultant within 15 Working Days after Contract award.
  - .2 Submit schedule via e-mail as a PDF or Microsoft Excel file.
  - .3 Consultant will review format and content of initial schedule and request necessary changes, if any, within 5 Working Days after receipt.
  - .4 If changes are required, resubmit finalized schedule within 5 Working Days after return of review copy.
  - .5 Submit updated submittals schedule monthly to Owner and Consultant.

## **1.6 PROJECT MEETINGS**

- .1 Discuss Project and Submittals Schedules 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 and negotiated.

**END OF SECTION**

## **1.1 ELECTRONIC SUBMITTAL PROCEDURES**

- .1 Summary:
  - .1 Submit all documents required by the Contract and Specification Sections to the Owner's Representative, in PDF format unless noted otherwise, using email or internet-based electronic document management (IEDM) software as determined by the Owner at Owner's sole discretion.
  - .2 Documents include but not limited to the following:
    - .1 Shop drawings.
    - .2 Product data.
    - .3 As-built documents.
    - .4 Schedules.
    - .5 Requests for information (RFIs).
    - .6 Proposed changes to Contract (PCs).
    - .7 Requests for payment.
    - .8 Contractor's photographs.
    - .9 Test reports.
    - .10 Logs.
    - .11 Contractor's Shop Drawing Review Form, attached following this Section.
  - .3 Owner reserves the right not to process any documents sent by other means; and reserves the right to withhold payments to the contractor of any kind should the Contractor fail to provide and use electronic delivery means.
  - .4 Owner reserves the right to issue documents, including such items as Supplementary Information (SIs), drawings, and specifications, and respond to all documents submitted by the Contractor, using email or the aforementioned web-based electronic document management software.
  - .5 Provide 3 USB flash drives containing all documents saved in Owner's designated on-line system or otherwise delivered electronically as part of the close-out submission.
- .2 Contracting, Costs, and Administrative Rights:
  - .1 Contract and pay costs of IEDM software for use by the Owner, the Contractor, the Consultant Team, and other project team members for the duration of the Work, plus 3 months beyond final completion.
  - .2 The Owner and the Owner's project team members will have no contractual relationship with the IEDM supplier.
  - .3 Pay for one-time only training by IEDM supplier for Owner, Consultant, and Owner's other project team members.
  - .4 Pay for training by IEDM supplier for Contractor and Contractor's project team members as required.
  - .5 Pay for use of IEDM software and initial training in full no later than 10 days after Notice of Award is given and provide payment receipt to Owner's Representative immediately thereafter.

## **1.2 ADMINISTRATIVE**

- .1 Submit to Consultant submittals listed for review using online document management system.
- .2 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.

- .3 Do not proceed with Work affected by submittal until review is complete.
- .4 Present shop drawings, product data, samples, and mock-ups in SI Metric units.
- .5 Where items or information is not produced in SI Metric units converted values are acceptable.
- .6 Review submittals prior to submission to Consultant. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and coordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated, and identified as to specific project will be returned without being examined and considered rejected.
- .7 Notify Consultant in writing at time of submission, identifying deviations from requirements of Contract Documents, stating reasons for deviations.
- .8 Verify field measurements and affected adjacent Work are co-ordinated.
- .9 Contractor's responsibility for errors and omissions in submission is not relieved by Consultant's review of submittals.
- .10 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Consultant review.
- .11 Keep one reviewed copy of each submission on site.

### **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 Shop Drawing submittals shall include:
  - .1 Contractor's stamp, date, and signature of Contractor's authorized representative responsible for Shop Drawing review, indicating that each Shop Drawing has been reviewed for compliance with Contract Documents and, where applicable, that field measurements have been verified.
  - .2 Submit shop drawings bearing stamp and signature of qualified professional engineer registered or licensed in Province of Ontario.
  - .3 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes, and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
  - .4 Where required by authorities having jurisdiction, provide submittals to such authorities for review and approval.
- .5 Allow 5 working days for Consultant's review of each submission.
- .6 Adjustments made on shop drawings by Consultant are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Consultant prior to proceeding with Work.
- .7 Make changes in shop drawings as Consultant may require, consistent with Contract Documents. When resubmitting, notify Consultant in writing of revisions other than those requested.
- .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.
  - .5 Details of appropriate portions of Work as applicable:
    - .1 Fabrication.
    - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
    - .3 Setting or erection details.
    - .4 Capacities.
    - .5 Performance characteristics.
    - .6 Standards.
    - .7 Operating weight.
    - .8 Wiring diagrams.
    - .9 Single line and schematic diagrams.
    - .10 Relationship to adjacent work.
  - .6 Contractor's Shop Drawing Review Form (properly filled out and signed) for each Section requiring shop drawings, attached following this Section.
- .10 After Consultant's review, distribute copies.
- .11 Submit electronic copy of shop drawings for each requirement requested in specification Sections and as Consultant may reasonably request.
- .12 Submit electronic copies of product data sheets or brochures for requirements requested in specification Sections and as requested by Consultant 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 Consultant.
  - .1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.
  - .2 Testing must have been within 3 years of date of contract award for project.
- .14 Submit electronic copies of certificates for requirements requested in specification Sections and as requested by Consultant.
  - .1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.
  - .2 Certificates must be dated after award of project contract complete with project name.

- .15 Submit electronic copies of manufacturers instructions for requirements requested in specification Sections and as requested by Consultant.
  - .1 Pre-printed material describing installation of product, system or material, including special notices and 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 Consultant.
  - .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 Consultant.
- .18 Delete information not applicable to project.
- .19 Supplement standard information to provide details applicable to project.
- .20 If upon review by Consultant, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.
- .21 Resubmit corrected submittals through same procedure indicated above before any fabrication or installation of the Work proceeds. When resubmitting, notify Consultant in writing of any revisions other than those requested by Consultant.
- .22 The review of shop drawings by the Consultant is for sole purpose of ascertaining conformance with general design concept.
  - .1 Consultant's notations on submittals are intended to ensure compliance with Contract Documents and are not intended to constitute a change in the Work requiring change to the Contract Price or Contract Time. If Contractor considers any Consultant's notation to be a change in the Work, promptly notify the Consultant in writing before proceeding with the Work.
  - .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 coordination of Work of sub-trades.

#### **1.4 SAMPLES**

- .1 Submit for review samples in duplicate as requested in respective specification Sections. Label samples with origin and intended use.
- .2 Deliver samples prepaid to Consultant's business address.
- .3 Notify Consultant 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 Consultant are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Consultant prior to proceeding with Work.
- .6 Make changes in samples which Consultant 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            MOCK-UPS**

- .1       Erect mock ups in accordance with 01 45 00 - Quality Control.

**1.6            PHOTOGRAPHS: DIGITAL FORMAT**

- .1       Progress Photographs
  - .1       Sizes: minimum 2 mega pixel image file size, jpeg image file.
  - .2       Number of photo sets: one (1) set per month.
  - .3       Identification: referenced to photo file with name, location, purpose, and number of project and date of exposure.
  - .4       Viewpoints: interior and exterior locations: viewpoints determined by Consultant.
  - .5       Frequency: at completion of excavation, foundation, framing, and services before concealment and at completion of each discrete phase of construction.
  - .6       Distribution: post photographs to on-line folder established by Consultant Contractor.

**1.7            CERTIFICATES AND TRANSCRIPTS**

- .1       Prior to Contract start-up and commencement of work onsite, submit Workers' Compensation Board status.
- .2       Prior to Contract start-up and commencement of work onsite, submit transcription of insurance.

**END OF SECTION**

## CONTRACTOR'S SHOP DRAWING REVIEW

SPECIFICATION SECTION NO.: \_\_\_\_\_

SECTION TITLE: \_\_\_\_\_

PROJECT LOCATION: \_\_\_\_\_

PROJECT NUMBER: \_\_\_\_\_

The affected trade contractor (fabricator/installer) and supplier(s) shall perform no portion of the Work requiring submittal and review of Shop Drawings and other submittals until the respective submittal has been reviewed by the Consultant and approved by the General Contractor.

By signing below as approved, the Contractor hereby certifies that he has reviewed the submittal in accordance with the Contract, Supplementary Conditions, and Section 01 33 00 of the Project Manual and has checked and coordinated the information contained therein with related work and has reported any errors, inconsistencies, or omissions to the Owner and the Consultant.

The Consultant's review of these submittals shall neither relieve the Contractor or affected trade contractor and supplier(s) from the responsibility to comply with the requirements of the Contract Documents nor approve any Work not complying therewith. Shop drawings and submittals are not Contract Documents and do not modify Contract Documents. The Contractor and the affected trade contractor and suppliers shall be responsible for the accuracy of measurements, elevations, line and grades of the Work.

### SUBMITTAL:

Shop drawings from fabricator/installer dated:

\_\_\_\_\_.

(check the appropriate submittal and fill in date on shop drawings)

- |   |  |
|---|--|
| <input type="checkbox"/> Reviewed             | <input type="checkbox"/> Revise and resubmit |
| <input type="checkbox"/> Reviewed as modified | <input type="checkbox"/> Rejected            |

If comments are required, attach a separate sheet.

Approved by Contractor:

Firm Name: \_\_\_\_\_

Signed by: \_\_\_\_\_ Date: \_\_\_\_\_

Return one copy to the Owner, one copy to the Owner Construction Manager, and one copy each to the affected trade contractor and supplier(s).

**END OF FORM**

## **1.1 SUMMARY**

- .1 Delegated Design Submittals shall account for professional engineering responsibility for design, review, and acceptance of components of Work forming a part of permanent Work in accordance with Ontario Building Code (OBC) and that has been assigned to a design entity other than Consultant including, but not limited to, the following:
  - .1 Design requiring structural analysis of load bearing components and connections.
  - .2 Design requiring compliance with fire safety regulations.
  - .3 Design requiring compliance with life or health safety regulations.
- .2 Delegated Design Submittals are not required for components of Work requiring engineering for temporary Work (e.g., crane hoisting, engineered lifts, falsework, shoring, concrete formwork, etc.) that would normally form a part of Contractor's scope of Work.
- .3 The requirements of this section do not change or diminish responsibilities of Consultant of Record. Submittals will be used by the Consultant of Record to establish that Work meets or exceeds the requirements of OBC.

## **1.2 DELEGATED DESIGN**

- .1 Performance and Design Criteria: Provide products and systems complying with specific performance and design criteria indicated where professional design services or certifications by a design professional are specifically required of Contractor by Contract Documents.
- .2 If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Consultant.
- .3 Delegated design will be required for elements designed by a specialty professional, all loads as determined in accordance with OBC requirements, which may include but are not necessarily limited to the following:
  - .1 Elements normally fabricated off-site.
  - .2 Elements that require specialized fabrication equipment or a proprietary fabrication process not usually available at job site.
  - .3 Elements requiring engineering not normally a part of scope of services performed by architectural, structural, mechanical, or electrical disciplines of Consultant.
  - .4 Specification Sections requiring engineered shop drawings, which include but are not necessarily limited to the following:
    - .1 Structural engineering where engineered shop drawings are specified;
    - .2 Electrical and mechanical engineering where engineered shop drawings are specified;
    - .3 Other specification Sections requiring submission of engineered shop drawings.

## **1.3 IMPLEMENTATION**

- .1 Include summary of Work described in relevant 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.

**END OF SECTION**

## **1.1 DEFINITIONS**

- .1 Incident: Property damage, spills, noise infraction, unauthorized parking, or unauthorized parking or roadway obstruction, or other non-compliant disturbance affecting existing occupants of facilities to remains and operations, the community, including, but not limited to, complaints from third parties (e.g., the general public, facility operator, occupants, adjacent business owners, adjacent home owners, the media, and other third-parties) received by a Supplier or the Contractor or any individual or entity subordinate to the Contractor.

## **1.2 GENERAL**

- .1 The Project Team is committed to maintaining positive relationships with facility occupants, and local communities throughout the Work of this Contract. Positive community relationships are everyone's responsibility, and the Contractor, Suppliers and Subcontractors shall work together to maintain positive relationships with third parties.
- .2 The Contractor is the point of contact and community liaison for the public and the media concerning the Work. However, a Supplier or Subcontractor may receive questions, complaints, and other inquiries directly from the public or the media. The Supplier or the Subcontractor involved shall refer parties to the Contractor for response, and report all contacts and Incidents immediately to the Contractor.
  - .1 Questions, comments and complaints from third-parties (e.g., the general public, business owners, homeowners, the media, and other third-parties) received by a Supplier, the Subcontractor or any individual or entity subordinate to the Contractor, shall be documented and directed to the Contractor immediately who will determine the response.
  - .2 Suppliers and the Subcontractor, or any individual or entity subordinate to the Contractor, shall not respond unless requested to do so by Contractor and shall provide details of the response to Contractor within 24-hours.
- .3 Suppliers and the Subcontractor shall cooperate with Contractor in addressing questions, comments and complaints in a timely manner.
- .4 Report all Incidents to the Contractor.
- .5 All Project documents are confidential and protected under law.
- .6 Notify Contractor of any planned activity that may trigger an Incident; for example, hot work, expected heavy delivery volume, noise, odours, or temporary interruption of services.

**END OF SECTION**

## **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 Safety Data Sheets (SDS).
- .3 Province of Ontario
  - .1 Occupational Health and Safety Act, Regulations, and amendments.
  - .2 O. Reg. 213/91: CONSTRUCTION PROJECTS.
  - .3 Other applicable Acts and Regulations, as amended, of the Province of Ontario.
- .4 General Contractor's health and safety plan and site-specific procedures.
- .5 Requirements of authorities having jurisdiction.

## **1.2 OWNER'S HEALTH AND SAFETY POLICY AND PROCEDURES**

- .1 The building will be occupied during the Work and the Contractor shall obtain a copy of and review the Owner's health and safety policy and procedures, and special COVID-19 procedures in place.
- .2 Coordinate with the Owner's supervisory staff as required to mitigate and reduce any interferences to the normal enjoyment of the facility by users, and ensure a safe site for all concerned during the Work.

## **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit 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 copies of Contractor's authorized representative's work site health and safety inspection reports to Consultant 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 SDS - Safety Data Sheets.
- .7 Consultant 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 Consultant within 7 days after receipt of comments from Consultant.
- .8 Consultant'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 Consultant.
- .10 On-site Contingency and Emergency Response Plan: address standard operating procedures to be implemented during emergency situations.

#### **1.4 FILING OF NOTICE**

- .1 General Contractor shall file "Notice of Project". Each Subcontractor is required to file any required notices required by authorities having jurisdiction.
- .2 File Notification of Project with Provincial authorities prior to beginning of Work.
  - .1 According to Section 6 of the Regulation for Construction Projects (O. Reg. 213/91) constructors are required to notify the Ministry of Labour before construction begins of any project meeting any of the requirements applicable to this section.
- .3 Registration of Constructors and Employers Engaged in Construction:
  - .1 According to Section 5 of the Regulation for Construction Projects (O. Reg. 213/91), before beginning work at a project every constructor and employer engaged in construction has to complete an approved registration form.
  - .2 This form does not have to be submitted to the Ministry of Labour, but it must be at the project while the employer is working there.
- .4 Notice of Trench Work:
  - .1 Notify the Ministry of Labour, before work is begun at a construction project, if the project includes work on a trench more than 1.2 metres deep into which a worker may enter.

#### **1.5 SUBCONTRACTORS**

- .1 Subcontractors shall refer to and comply with General Contractor's health and safety plan and site-specific procedures, the requirements of the Ontario Employment Standards Act and Occupational Health and Safety Regulations, and the requirements of the General Contractor -Subcontractor contract.
  - .1 All operations shall comply with the codes concerning safety applicable to the project and safety standards and rules established during the progress of the Work.
  - .2 Provide a written Fall Protection plan on site worker training ensuring 100% tie-off when working at heights greater than 6 feet or at risk of injury. Also include in this procedure for guard rail removal and prevention of workers from other trade contractors from entering the work area.
  - .3 General Contractor or the Owner shall have the authority in an emergency to stop the progress of work whenever in their opinion, such stoppage may be necessary to ensure the safety of life, or of the work, or property.
  - .4 General Contractor and Subcontractors shall comply fully with all legislated requirements and submit a comprehensive safety plan prior to mobilization. Adhere to the practices and procedures outlined in site-specific company health and safety plan.
  - .5 Only certified Electricians are to perform temporary and permanent electrical connections of this trade contractor's equipment (e.g. tower crane, swing stages, welders etc.).
  - .6 Ensure that each worker operating equipment has received and can provide proof of training on specific equipment.

#### **1.6 SAFETY ASSESSMENT**

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

## **1.7 MEETINGS**

- .1 Schedule and administer Health and Safety meeting attended by General Contractor and all Subcontractors and Suppliers prior to commencement of Work.

## **1.8 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 Consultant may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns.

## **1.9 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, and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

## **1.10 COMPLIANCE REQUIREMENTS**

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

## **1.11 UNFORESEEN 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 General Contractor verbally and in writing.

## **1.12 CONSTRUCTOR**

- .1 Responsibility for Work Site Safety – The Contractor Is "Constructor":
  - .1 The Contractor shall, for the purposes of the Occupational Health and Safety Act (Ontario), and for the duration of the Work of this Contract:
    - .1 Be the "Constructor" for the "Work Site", and
    - .2 Meet requirements of the Occupational Health and Safety Act and regulations made under the Act, Workplace Safety and Insurance Board requirements, Fire Code legislation, Workplace Safety and Insurance Act, and all other applicable laws, ordinances and by laws that govern workplace safety.
  - .2 The Contractor shall direct all 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 "Constructor" 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 The Contractor shall employ or engage the services of a safety officer who has one of the recognized safety certifications or designations listed in the “*Guide to OH&S Certifications & Designations*”. The safety officer shall oversee site safety on behalf of the Contractor, and shall have the authority to stop dangerous work, direct the correction of safety deficiencies, offer site-specific safety training, and manage the Contractor's safety procedures for the duration of the Contract.

#### **1.13 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 Consultant.

#### **1.14 CORRECTION OF NON-COMPLIANCE**

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

#### **1.15 BLASTING**

- .1 Blasting or other use of explosives is not permitted without prior receipt of written instruction by authorities having jurisdiction.

#### **1.16 POWDER ACTUATED DEVICES**

- .1 Use powder actuated devices only after receipt of written permission from General Contractor.

#### **1.17 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.

#### **1.18 FIREWATCH**

- .1 Subcontractor is responsible for on-site fire safety during the Work for scope of Work included in construction package and shall establish policies and procedures sufficient to manage risk and safeguard the Work as required to prevent fires. Overall site fire safety is managed and directed by the General Contractor.
- .2 A Firewatch is a person assigned to observe ongoing hot work (welding, use of torches, etc.) to identify and react to hazards. A Firewatch is necessary at any time where hot work (e.g., welding) is performed in locations where a fire greater than a minor one might develop.
- .3 Before hot work begins, written permission, like a hot work permit, must be issued by the General Contractor.
- .4 Inspect the work area for any sources of fuel, such as trash, rags and flammable materials and liquids. This applies to lower decks or levels where sparks or slag could fall.
- .5 Some of the responsibilities of a Firewatch include:
  - .1 Having fire extinguishing equipment readily available;
  - .2 Know how to sound an alarm in the event of a fire;



- .3 Monitor for fires in all exposed areas, including lower decks or levels;
- .4 Attempt to extinguish the fire only within the capacity of available equipment, if not sound the alarm;
- .5 Monitor hot work area for at least half an hour after hot work operations stop.
- .6 The Firewatch cannot have any other duties while monitoring the hot work.
- .7 Continuous surveillance must be maintained throughout the course of the hot work, including a minimum 1-hour cool down period after hot work concludes, or longer if determined by the General Contractor's or Subcontractor's health and safety risk assessment.

#### **1.19 RESPONSIBILITIES OF SUBCONTRACTORS AND SUPPLIERS**

- .1 All Subcontractors and Suppliers are responsible for health and safety of their workers as regulated by Federal, Provincial, and Municipal Acts and Regulations.
- .2 Each Subcontractor's and Supplier's operations shall comply with the codes concerning safety applicable to the Project and safety standards and rules established during the progress of the work.
- .3 Comply with General Contractor's health and safety requirements in accordance with the safety requirements of the General Contractor-Subcontractor contract.

**END OF SECTION**

**1.1 FIRES**

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

**1.2 DISPOSAL OF WASTES**

- .1 Strictly adhere to requirements of Section 01 74 19 – Waste Management and Disposal. Do not bury rubbish and waste materials on site unless approved by Consultant.
- .2 Do not dispose of waste or volatile materials, such as mineral spirits, oil or paint thinner into waterways, storm or sanitary sewers.

**1.3 DRAINAGE**

- .1 Do not pump water containing suspended materials into waterways or drainage systems.
- .2 Control disposal of water containing suspended materials or other harmful substances in accordance with local authority requirements.

**1.4 POLLUTION CONTROL**

- .1 Maintain pollution control features installed under this contract.
- .2 Control emissions from equipment and plant to local authorities' emission requirements.
- .3 Prevent sandblasting and other extraneous materials from contaminating air beyond application area by providing temporary enclosures.
- .4 Cover or wet down dry materials and rubbish to prevent blowing dust and debris.

**END OF SECTION**

## 1.1 REFERENCES AND CODES

- .1 The following establishes the minimum requirements of the Contract:
  - .1 Ontario Building Code, errata and amendments – most recent published edition.
  - .2 Contract Documents.
  - .3 Specified standards, Codes, and referenced documents found in Contract Documents.
  - .4 Orders and directions from authorities having jurisdiction.
- .2 Province of Ontario - Work shall comply with the following, including errata and amendments:
  - .1 Perform Work in accordance with the laws and regulations of the Province of Ontario applicable to the Work, and to the direction of the authorities having jurisdiction.
  - .2 Bill 142, Construction Lien Amendment Act, 2017.
  - .3 Construction Act, R.S.O. 1990, c. C.30.
    - .1 Last amendment: 2018, c. 17, Sched. 8, s. 1-20.
  - .4 Ontarians with Disabilities Act, 2001, S.O. 2001, c. 32.
  - .5 Occupational Health and Safety Act.
  - .6 Occupational Health and Safety Act, Ontario Regulation 213/91 Construction Project.
  - .7 Environmental Protection Act, R.S.O. 1990, c. E.19.
  - .8 Ontario Employment Standards Act, 2000, S.O. 2000, c. 41 and Regulations under this Act.
  - .9 Other laws and regulations applicable to the Work.
- .3 Regions and Municipalities:
  - .1 Perform Work in accordance with local by-laws, regulations, and ordinances, and to the direction of authorities having jurisdiction.

## 1.2 FLAME-SPREAD RATINGS

- .1 The interior wall and ceiling finishes throughout the building shall conform to the flame spread ratings of OBC Subsection 3.1.13.
- .2 Flame-spread rating and smoke developed classification for all finishes shall be determined under CAN/ULC S102 or CAN/ULC S102.2 as appropriate and OBC.
- .3 The flame-spread ratings for interior finishes are summarized as follows:

Occupancy, Location or Element	Maximum Permitted Flame-Spread Rating for Wall Surfaces	Maximum Permitted Flame-Spread Rating for Ceiling Surfaces
Exit stairways and exit corridors <sup>1</sup>	25	25
Public corridors and corridors not within suites	150	150
Elevator cars	75	75
Elevator vestibules	25	25

Occupancy, Location or Element	Maximum Permitted Flame-Spread Rating for Wall Surfaces	Maximum Permitted Flame-Spread Rating for Ceiling Surfaces
Services spaces, service shafts, service rooms	25	25
Doors (including overhead garage doors)	200	NA
Plumbing fixtures	200	200
Other locations and other elements	150	150

<sup>1</sup> The flame spread rating for exits applies to any surface in the exit that would be exposed by cutting through the material in any direction, excluding doors.

- .4 Combustible plumbing fixtures, including shower and tub caps and surrounds shall be fabricated of material having a flame-spread rating not exceeding 200.
- .5 If combustible interior wall and ceiling finishes are used in the building, they shall not be more than 25 mm thick, and flame-spread restrictions apply to any surface that would be exposed by cutting.
- .6 The maximum allowable flame-spread rating of walls and up to 10% of a ceiling area within a sprinklered floor area, excluding exits and vertical service spaces, is 150; the remainder of the ceiling area shall have a flame spread rating not exceeding 25.

### 1.3 EXTERIOR WALL ASSEMBLIES

- .1 Exterior wall assemblies shall pass the tests mandated by CAN/ULC S134, Fire Test of Exterior Wall Assemblies.

### 1.4 ASBESTOS MATERIAL DISCOVERY

- .1 Asbestos: Work involving contact with asbestos containing materials is hazardous to health. Review SDS for each material and product to be used, and should material or product resembling or containing asbestos be encountered in course of Work, do not use product, immediately stop work at location, and notify Consultant.

### 1.5 BUILDING SMOKING ENVIRONMENT

- .1 No smoking of any kind is permitted on or immediately adjacent to the Place of the Work, including electronic cigarettes or devices.
- .2 Smoking restrictions apply to all persons at all times without exception.

### 1.6 WORKPLACE SAFETY AND INSURANCE

- .1 Comply with the Ontario Workplace Safety and Insurance Act, 1997, S.O. 1997, c. 16, Schedule A and Regulations under this Act, including errata and amendments.

### 1.7 LABOUR STANDARDS

- .1 Comply with the Ontario Employment Standards Act, 2000, S.O. 2000, c. 41 and Regulations under this Act, including errata and amendments.

**1.8 HARASSMENT POLICY**

- .1 Develop workplace harassment and offensive language policy and procedures. Submit to Consultant within 15 days of award of Contract.

**1.9 BUILDING CODE**

- .1 Comply with the provisions of Ontario Building Code, and errata and amendments, and applicable Regulations made under the Act.

**1.10 EMPLOYMENT INSURANCE**

- .1 Comply with the provisions of the Employment Insurance Act (S.C. 1996, c. 23) and Regulations (SOR /96-332) of Canada, including errata and amendments.

**END OF SECTION**

## **1.1 REVIEW AND INSPECTION**

- .1 Allow Consultant access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.
- .2 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by Consultant 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 Consultant will order part of Work to be examined if Work is suspected to be not in accordance with Contract Documents. If, upon examination such work is found not in accordance with Contract Documents, correct such Work and pay cost of examination and correction. If such Work is found in accordance with Contract Documents, Owner shall pay cost of examination and replacement.

## **1.2 INDEPENDENT INSPECTION AGENCIES**

- .1 Independent Inspection/Testing Agencies: refer to Section 01 29 83 - Payment Procedures Testing Laboratory Services.
- .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 or testing, appointed agency will request additional inspection or testing to ascertain full degree of defect. Correct defect and irregularities as advised by Consultant at no cost to Owner. Pay costs for retesting and reinspection.

## **1.3 ACCESS TO WORK**

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

## **1.4 PROCEDURES**

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

## **1.5 REJECTED WORK**

- .1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by Consultant and/or Owner as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.
- .2 Make good other Contractor's work damaged by such removals or replacements promptly.

- .3 If in opinion of Owner it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, Owner may deduct from Contract Price difference in value between Work performed and that called for by Contract Documents, amount of which shall be determined by Owner.

## **1.6 REPORTS**

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

## **1.7 TESTS AND MIX DESIGNS**

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

## **1.8 MOCK-UPS**

- .1 Prepare mock-ups for Work specifically requested in specifications. Include for Work of all Sections required to provide mock-ups.
- .2 Construct in all locations acceptable to Consultant and as specified in specific Section.
- .3 Prepare mock-ups for Consultant's review with reasonable promptness and in an orderly sequence, so as not to cause any delay in Work.
  - .1 Allow 5 working days in construction schedule for the review of mock-ups after they have been prepared.
  - .2 Provide 2 weeks' notice for mock-up review to Consultant in advance of preferred review date(s).
- .4 Failure to prepare mock-ups in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .5 Mock-Ups Required by Specific Technical Specification Sections:
  - .1 If noted in the technical section, remove mock-up at conclusion of Work, or when acceptable to Consultant.
  - .2 Mock-up(s) may remain as part of Work if so stated in the technical specification section.
  - .3 Specification sections identify whether mock-up may remain as part of Work or if it is to be removed and when.

## **1.9 MILL TESTS**

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

## **1.10 EQUIPMENT AND SYSTEMS**

- .1 Submit adjustment and balancing reports for mechanical, electrical, and building equipment systems.
- .2 Refer to technical Sections for requirements.

**END OF SECTION**

## **1 REFERENCE STANDARDS**

- .1 ANSI/ASHRAE 52.2-2017: Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
- .2 ANSI/ASHRAE 62.1-2016: Ventilation for Acceptable Indoor Air Quality.
- .3 EPA: EPA Protocol for Environmental Requirements, Testing for Indoor Air Quality Baseline IAQ.
- .4 Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
  - .1 SMACNA 008-2008 (Chapter 3), IAQ Guidelines for Occupied Buildings Under Construction, 2nd Edition.

## **2 CONSTRUCTION INDOOR AIR QUALITY MANAGEMENT PLAN**

- .1 The intent of this plan is to prevent construction and future indoor air quality problems that may result from construction affecting the comfort and well being of construction workers and building occupants.
- .2 The provision of the Construction Indoor Air Quality Management Plan or IAQ Management Plan is the responsibility of the Contractor.
- .3 Provide a fully developed IAQ Management Plan implemented through construction and pre-occupancy of the building including the following activities:
  - .1 Meet or exceed the recommended Design Approaches in SMACNA 008 (Chapter 3) and other requirements as detailed in this specification during all construction activities. These design approaches shall be applicable for all buildings regardless of whether it is a new construction or renovation.
  - .2 Protect all stored and installed absorptive materials from moisture or dust, chemical and gas damage as specified in Section 01 61 00 - Common Product Requirements.
  - .3 Construction use of air handling units, heat recovery ventilators, fans or any associated equipment and systems for ventilation, heating, dehumidification, humidification, dust control or any other use is strictly prohibited.
  - .4 Replace all filtration equipment for air handling units, heat recovery ventilators and fans with new filter media as specified within the technical specification sections in Division 23 at the end of construction.
- .4 Provide the following submittals to the requirements of Section 01 33 00 - Submittal Procedures:
  - .1 IAQ Management Plan:
    - .1 Provide a draft documented IAQ Management plan in writing for review by the Consultant within 21 days of award of contract.
    - .2 The IAQ Management Plan submission is to include:
      - .1 Details of each management plan strategy including:
        - .1 The Design Approaches in SMACNA 008 (Chapter 3) including:
          - .1 HVAC Protection
          - .2 Source Control procedures.
          - .3 Pathway Interruption.
          - .4 Housekeeping.
          - .5 Scheduling.
          - .6 Reporting.
        - .2 Samples of reporting documents based SMACNA 008 (Chapter 3).



- .3 Methods for protecting all stored and installed absorptive materials from moisture or dust, chemical and gas damage.
    - .4 Declaration that air handling units, heat recovery ventilators, fans or any associated equipment and systems will not be used during construction for ventilation, heating, de-humidification, humidification and dust control.
    - .5 Schedule for filter replacement as a component of the building start-up and Commissioning.
  - .3 Format: submit 5 copies of reports, each in "D" ring binders, complete with index tabs for verification and review by Consultant.
  - .4 Make changes or additions to the draft IAQ Management Plan within the specified plan requirements to the satisfaction of the Consultant and reissue as final draft.
  - .5 Distribute the final IAQ Management Plan to all trades working on the site.
- .2 Construction Reporting
  - .1 During the course of construction provide the following reporting to the Consultant for review:
    - .1 Photographs indicating the general conformance to the IAQ Management Plan.
    - .2 Completed Planning Checklist for all trades on the project indicating scheduling and the requirements of IAQ procedures with respect to scheduled construction activities for that week.
    - .3 Inspection sheets completed by the Site Superintendent reviewing that all trades completed the scheduled requirements of the IAQ procedures for that week including any deficiencies and corrective actions taken.
  - .2 Provide reporting on weekly basis unless otherwise approved by the Consultant during periods of low IAQ risk construction or low construction activity.
- .5 Provide the following close out submittals to the requirements of Section 01 78 00 - Closeout Submittals:
  - .1 Provide all IAQ Management Plan submittals including the following:
    - .1 The final version of the Construction IAQ Management Plan.
    - .2 Digital copies of all weekly photographs.
    - .3 All weekly planning checklists.
    - .4 All weekly inspection sheets.
    - .5 Format: submit 5 copies of closeout report, each in "D" ring binders, complete with index tabs for verification and review by Consultant.
- .6 Provide the following activities specified to meet or exceed the recommended Design Approaches in SMACNA 008 (Chapter 3) during all construction activities. These design approaches shall be applicable for all buildings regardless of whether it is a new construction or renovation:
  - .1 HVAC Protection:
    - .1 Use of air handling units, heat recovery ventilators, fans or any associated equipment and systems for ventilation, heating, de-humidification, humidification, dust control or any other use during Construction is strictly prohibited.

- .2 Seal off supply, return and exhaust air system openings to prevent the accumulation of dust and debris in the systems at all times unless work is being completed on the immediate area of the system using plastic seals to the approval of the Consultant. This is to include overnight and longer work stoppages. All diffusers, grilles, and displacement ventilators are also to be sealed in plastic.
- .3 Protect stored and installed absorptive materials from moisture and dust, chemical and gas damage as specified in Section 01 61 00 – Basic Product Requirements.
- .4 Keep operable doors on air handling units closed at all times unless work is being completed on the immediate area of the system.
- .5 Do not store construction or waste materials in Fan and Mechanical Rooms.
- .6 Keep all construction areas clean and neat as specified elsewhere in this specification.
- .7 Replace all filtration equipment for air handling units, heat recovery ventilators and fans with new filter media as specified with the technical specification sections in Division 22 at the end of construction.
- .8 Where ducts become contaminated due to inadequate protection these ducts will be cleaned professionally as specified in Division 23.
- .2 Source Control:
  - .1 Use of low VOC products as specified elsewhere are to be utilized at all times.
  - .2 Restrict traffic volume and idling of motor vehicles where emissions could be drawn into the building.
  - .3 Direct fired construction heaters are not acceptable. Vent all construction heater products of combustion to the outdoors.
  - .4 Cycle heating equipment off when not being used or needed.
  - .5 Exhaust all pollution sources to the outside with portable fan systems ensuring exhaust does not re-circulate back into the building.
  - .6 Keep containers of wet products closed as much as possible. Cover and seal waste materials, which can release odour or dust.
- .3 Pathway Interruption:
  - .1 Prevent dust from migrating to other areas with the use of dust curtains or temporary enclosures where applicable.
  - .2 Relocate pollutant sources as far away as possible from construction ventilation equipment, stored materials and areas occupied by workers when feasible. Any construction supply and exhaust systems that ventilate both areas where pollutant sources are being used and areas where they are not been used should be shut down or isolated during such activity with supplemental construction ventilation provided as required.
  - .3 Isolate during construction, areas of work to prevent contamination of clean or occupied areas. Utilize pressure differentials generated by mechanical means to prevent contaminated air from entering clean areas.
  - .4 Ventilate contaminated air from construction areas directly to the outside during installation of VOC emitting materials.
- .4 Housekeeping:

- .1 Cleaning activities are specified in Section 01 74 11 however provide special emphasis on HVAC equipment and building spaces to remove contaminants from the building prior to operation of any permanent ventilation equipment.
- .2 Keep coils, filters, fans, and ductwork clean during installation as specified and clean prior to performing Testing, Adjusting and Balancing of the systems.
- .3 During construction suppress dust with wetting agents or sweeping compounds. Use efficient and effective dust collecting methods such as a damp cloth, wet mop, and vacuums with particulate filters, or wet scrubbers.
- .4 Remove accumulations of water inside the building during construction. Protect porous materials such as insulation and ceiling tile from exposure to moisture.
- .5 Scheduling:
  - .1 Schedule work to ensure dust emitting work does not coincide with installation of absorbent materials (ceiling tiles, gypsum wall board, fabric furnishings, carpet and insulation, for example) that may act as 'sinks' for dust.
  - .2 Do not schedule any construction activities that would require the use of VOC or dust emitting activities during occupancy without the approval of the Consultant.
  - .3 Schedule use of VOC emitting and high odorous materials BEFORE installing absorbent materials (ceiling tiles, gypsum wall board, fabric furnishings, carpet and insulation, for example) that may act as 'sinks' for VOCs, odours and other contaminants.

**END OF SECTION**

**1.1 INSTALLATION AND REMOVAL**

- .1 Provide temporary utilities controls in order to expedite Work.
- .2 Remove from site all such Work after use.

**1.2 WATER SUPPLY**

- .1 Contractor may use water available at site, and make own connections and remove connections at closeout. Owner will pay for water use for the project.

**1.3 TEMPORARY HEATING AND VENTILATION**

- .1 Contractor shall provide adequate temporary heating and ventilation as required for their own use, and use of Owner's staff and users.
- .2 Construction heaters used inside building shall be vented to outside.
- .3 Temporary heat and ventilation required in enclosed areas 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.
  - .6 Provide suitable interior temperature and ventilation for use of facility by Owner's staff and customers.
- .4 Maintain temperatures of minimum 10°C in 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 HVAC systems of building: Be responsible for damage to HVAC systems if use is permitted.
- .7 On completion of Work for which HVAC systems have been used, replace filters and thoroughly clean permanent equipment used during construction.
- .8 Ensure Date of Substantial Performance and Warranties for HVAC systems do not commence until entire system is in as near original condition as possible and is certified by Consultant.
- .9 Owner will pay utility charges when the temporary heat source is the building equipment. In all other circumstances, Contractor shall provide adequate heating and ventilation for Work.

- .10 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.
- .11 Be responsible for damage to Work due to failure in providing adequate heat and protection during construction.

#### **1.4 TEMPORARY POWER AND LIGHT**

- .1 Contractor is responsible for hook-ups to power supply. Owner will pay utility charges.
- .2 Arrange for connection with appropriate utility company. Pay costs for installation, maintenance and removal.
- .3 Provide and maintain temporary lighting throughout project. Ensure level of illumination on all floors and stairs is not less than 162 lx.
- .4 Connect to power supply in accordance with Canadian Electrical Code and provide meters and switching as required.
- .5 Provided that warranties and guarantees are not affected, electrical power and lighting systems installed under this Contract may be used for construction requirements only with prior approval of Owner and Consultant. Make good damage to electrical system caused by use under this Contract. Replace lamps which have been used for more than 3 months.

#### **1.5 TEMPORARY COMMUNICATION FACILITIES**

- .1 Contractor shall provide and pay for temporary telephone, fax, computer, Wi-Fi system (password secured), data lines and equipment necessary for their own use.

**END OF SECTION**

**1.1 SCAFFOLDING**

- .1 Provide scaffolding and protective or insulating tarps as needed in accordance with CAN/CSA S269.2, Access Scaffolding for Construction Purposes.
- .2 Provide and maintain safe access to Work as required.

**1.2 SITE STORAGE/LOADING**

- .1 Do not unreasonably encumber premises with Products and materials.
- .2 Do not load or permit to load any part of Work with weight or force that will endanger Work.

**1.3 CONSTRUCTION PARKING**

- .1 Make own arrangements for parking.
- .2 Some limited temporary parking may be available; coordinate with Owner's Representative.

**1.4 SECURITY**

- .1 Contractor is responsible for the security and protection of its Products, materials, tools, equipment, and other items brought to the Site for performance of the Work.
- .2 If exterior doors or windows are compromised due to renovations, ensure that compromised openings are temporarily in-filled with an insulated assembly (e.g., plywood, painted, and rigid insulation) designed to keep intruders out of facility and maintain interior working conditions at suitable temperatures for use by Owner's staff and users.
- .3 Provide perimeter fencing as required for protection of general public and Owner's staff.

**1.5 OFFICES**

- .1 Provide office heated to 22°C, lighted 750 lx and ventilated, of sufficient size to accommodate site meetings and furnished with drawing laydown table.
- .2 Provide marked and fully stocked first-aid case in a readily available location.

**1.6 EQUIPMENT, TOOL AND MATERIALS STORAGE**

- .1 Provide and maintain, in clean and orderly condition, lockable weatherproof enclosures as required for storage of tools, equipment and materials.
- .2 Locate materials not required to be stored in weatherproof enclosures on site in manner to cause least interference with work activities, and at direction of Contractor.

**1.7 SANITARY FACILITIES**

- .1 Contractor shall make own arrangements for sanitary facilities, and shall maintain in a clean and sanitary condition throughout duration of Project.
- .2 Permanent facilities shall not be used.

**1.8 CONSTRUCTION SIGNAGE**

- .1 Provide general safety signs. Each subcontractor shall provide and maintain their own safety signs as required for their work. No advertising, company identification, or promotional signs permitted.
- .2 Maintain approved signs and notices in good condition for duration of work, and dispose of off site on completion, or earlier if directed by Consultant.

**1.9 DAILY CLEAN-UP**

- .1 Remove construction debris, waste materials, packaging material from work site daily.
- .2 Clean dirt and mud tracked onto paved or surfaced roadways.

**END OF SECTION**

**1.1 INSTALLATION AND REMOVAL**

- .1 Provide temporary controls as required in order to expedite Work.
- .2 Remove from site all such Work after use.

**1.2 HOARDING**

- .1 Erect and maintain pedestrian walkways including roof and side covers, complete with signs and electrical lighting as required by authorities having jurisdiction.
- .2 Erect temporary exterior work area enclosures using purpose-made, prefabricated interlocking metal fence panels 2.1 m high; provide as required to keep public, Owner's staff, customers, and unauthorized persons away from exterior work areas while work is in progress.

**1.3 GUARD RAILS AND BARRICADES**

- .1 Provide secure, rigid guard rails and barricades around deep excavations, open shafts, open stair wells, 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. Provide tamperproof, vandal-resistant screws to secure in place.
- .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 DUST TIGHT SCREENS**

- .1 Provide dust tight screens or insulated partitions to localize dust generating activities, and for protection of workers, finished areas of Work, and public.
- .2 Maintain and relocate protection until such work is complete.

**1.6 FIRE ROUTES**

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

**1.7 PROTECTION FOR ADJACENT, OFF-SITE AND PUBLIC PROPERTY**

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

**1.8 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 Consultant locations and installation schedule 3 days prior to installation.
- .4 Be responsible for damage incurred due to lack of or improper protection.

**END OF SECTION**



## **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, Consultant reserves right to have such products or systems tested to prove or disprove conformance.
- .4 Cost for such testing will be borne by Owner in event of conformance with Contract Documents or by Contractor in event of non-conformance.

## **1.2 QUALITY**

- .1 Products, materials, equipment, and 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 Defective products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.
- .3 Should disputes arise as to quality or fitness of products, decision rests strictly with Consultant based upon requirements of Contract Documents.
- .4 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.
- .5 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

## **1.3 AVAILABILITY**

- .1 Immediately upon signing Contract, review product delivery requirements and anticipate foreseeable supply delays for items. If delays in supply of products are foreseeable, notify Consultant of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of Work.
- .2 In event of failure to notify Consultant at commencement of Work and should it subsequently appear that Work may be delayed for such reason, Consultant reserves right to substitute more readily available 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, adulteration, deterioration, and soiling and in accordance with manufacturer's instructions when applicable.
- .2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.
- .3 Store products subject to damage from weather in weatherproof enclosures.
- .4 Store cementitious products clear of earth or concrete floors, and away from walls.
- .5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.

- .6 Store sheet materials, lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.
- .7 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.
- .8 Remove and replace damaged products at own expense and to satisfaction of Consultant.
- .9 Touch-up damaged factory finished surfaces to Consultant's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

#### **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 Consultant 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 Consultant to require removal and re-installation at no increase in Contract Price or Contract Time.

#### **1.7 QUALITY OF WORK**

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

#### **1.8 COORDINATION**

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

#### **1.9 CONCEALMENT**

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

#### **1.10 REMEDIAL WORK**

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

**1.11 LOCATION OF FIXTURES**

- .1 Consider location of fixtures, outlets, and mechanical and electrical items indicated as approximate.
- .2 Locate for ease and efficiency of post-occupancy maintenance, exact locations determined by Consultant.
- .3 Inform Consultant of installation interferences and/or conflict. 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 that 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.
- .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 Consultant.

**1.15 EXISTING UTILITIES**

- .1 When breaking into or connecting to existing services or utilities, execute Work at times directed by authorities having jurisdiction, with minimum of disturbance to Work, and pedestrian and vehicular traffic.
- .2 Protect, relocate, or maintain existing active services. When services are encountered that are not to be incorporated into the Project as active services or service neighboring properties, cap off in manner approved by authority having jurisdiction. Stake and record location of capped service.

**END OF SECTION**

## 1.1 DEFINITIONS

- .1 Acceptable Materials: The term 'Acceptable Materials' (or 'Acceptable materials') is used to specify products by trade name, manufacturer, catalogue number, model number, or similar reference, and is used within the Project Manual as follows:
  - .1 Acceptable Materials listings are based on Consultant's determination that materials meet specified requirements and opinion of applicability to the project requirements.
  - .2 Acceptable Materials listings are deemed to establish the standard of acceptance that Consultant will consider appropriate for the Work.
  - .3 Any product listed in the Acceptable Materials listing may be used to establish the Bid Price.
- .2 Basis-of-Design: The term 'Basis-of-Design' is used to specify a specific material name, manufacturer, catalogue number, model number or similar reference and is used as follows:
  - .1 Basis-of-Design are used to establish Consultant's preference for a single source product listing based on performance, physical properties, appearance or configuration.
  - .2 Use the Basis-of-Design to establish the Bid Price unless an Addendum is issued adding additional Acceptable Materials.
  - .3 Schedules or labels on the Drawings that indicate materials or products by proprietary name or manufacturer, and possibly also listing a specific colour or finish, are Basis-of-Design, and subject to the requirements of this specification Section 01 62 00.
- .3 Non-proprietary specification means a specification that includes descriptive, reference standard or performance requirements, or any combination thereof, but does not include proprietary names of products or manufacturers.
- .4 Substitution means a proposal from Contractor to provide a product, material, or item of equipment not specified in the Contract documents but functionally equivalent and readily exchangeable to a specified item; for consideration by Contractor and Consultant.

## 1.2 SUBMITTALS

- .1 When requested by Contractor and/or Consultant, submit complete data substantiating compliance of a product with requirements of Contract Documents. Include the following:
  - .1 Product identification, including manufacturer's name and address.
  - .2 Written verification that the substitute products can be obtained, meet the performance required for the project, and meet requirements of the Building Code.
  - .3 Manufacturer's literature providing product description, applicable reference standards, and performance and test data.
  - .4 Samples, as applicable.
  - .5 Name and address of projects on which product has been used and date of each installation.
  - .6 For substitutions and requests for changes to accepted products, include in addition to the above, the following:
    - .1 Itemized comparison of substitution with named product(s). List significant variations.
    - .2 Designation of availability of maintenance services and sources of replacement materials.

### **1.3 PRODUCT OPTIONS**

- .1 For products specified by non-proprietary specification:
  - .1 Select any product, assembly, or material that meets or exceeds the specified standards for products specified only by referenced standards and performance criteria.
- .2 Acceptable Materials: Select any named product, assembly, or material contained in the listing of Acceptable Materials.
- .3 Basis-of-Design: Use the named product contained in the Basis-of-Design listing, unless an addendum is issued indicating acceptance of additional Acceptable Materials.

### **1.4 SUBSTITUTIONS**

- .1 Contractor will assemble requests for substitutions requested by subcontractors and submit to Consultant and Contractor for review.
- .2 Consultant and Contractor will review proposed substitute products for acceptability only when submitted by Contractor; Consultant or Contractor will not review requests submitted independently by subcontractors.
- .3 No substitutions will be permitted without Consultant's Consultant and Contractor's written acceptance; Contractor will be required to remove products and replace with specified materials or provide a credit to the value of the contract at Consultant's Consultant and Contractor's joint discretion where substitutions are found in the Work that have not been formally accepted by Consultant and Contractor.
- .4 Consultant and Contractor are not obliged to accept any Proposed Substitution offered by Contractor, and reserves the right to dismiss any item with no further explanation.
- .5 Substitute Products: Where substitute products are permitted, unnamed products may be accepted by Consultant, subject to the following:
  - .1 Substitute products shall be the same type as, be capable of performing the same functions as, and meet or exceed the standards of quality and performance of the named product(s). Substitutions shall not require revisions to Contract Documents nor to work of Other Contractors.
- .6 Substitute Manufacturers: Where substitute manufacturers are permitted, unnamed manufacturers may be accepted by Consultant, subject to the following:
  - .1 Substitute manufacturers shall have capabilities comparable to those of the named manufacturer(s). Substitutions shall not require revisions to Contract Documents nor to work of Other Contractors.
- .7 In making a proposal for substitution the Contractor represents:
  - .1 That they have investigated the proposal and (unless the proposal explicitly states otherwise) determined that it performs in a similar way or is superior to the product or method specified, and does not have a negative impact on other trades.
  - .2 That the same guaranty / warranty will be furnished as for the originally specified product or construction method.
  - .3 That they will coordinate installation of the accepted substitute into the Work, making such changes in the Work as may be required to accommodate the change.
  - .4 That they will bear costs and waives claims for additional compensation for costs and time that subsequently become apparent arising out of the substitution.

**END OF SECTION**

PROJECT NAME AND LOCATION:		REQUEST DATE:
		CONSULTANT:
REQUEST BY (NAME OF FIRM):		
Address		
Contact Name:	Telephone:	Fax:
SUBSTITUTION IS REQUESTED FOR:	REASON FOR SUBSTITUTION:	
<input type="checkbox"/> Specified Product		
<input type="checkbox"/> Product type, material or finish		
<input type="checkbox"/> Installation Method		
SPECIFICATIONS AFFECTED BY SUBSTITUTION: Specification Section: _____ Clause Number(s): _____ Page Number(s): _____	DRAWINGS AFFECTED BY SUBSTITUTION:	
Describe in detail any modifications or changes to any other part of the Work that will be necessitated by the requested substitution: _____ _____ _____ _____ _____		
Describe why the substitution should be considered in terms of benefit to the Project and the Owner: _____ _____ _____ _____ _____		

COMPARISON	
Fill in the following information as applicable. It is the Contractor's responsibility to verify that the proposed substitution either meets or exceeds the properties and performance requirements of the specified product. Information provided below is required by the Consultant to evaluate the proposed substitution. Failure to provide the required information or provision of inadequate information will result in the request being returned without review.	
SPECIFIED PRODUCT OR INSTALLATION METHOD	PROPOSED SUBSTITUTION
Product Name:	Product Name:
Product Type:	Product Type:
Manufacturer:	Manufacturer:
Model No.:	Model No.:
Thickness:	Thickness:
Composition:	Composition:
Availability (time):	Availability (time):
Country of manufacture:	Country of manufacture:
Substrate preparation required:	Substrate preparation required:
Length of Warranty:	Length of Warranty:
Sound Transfer Co-efficient (STC), if applicable:	Sound Transfer Co-efficient (STC), if applicable:
Fire-resistance Rating (in hours, if applicable):	Fire-resistance Rating (in hours, if applicable):
Resistance to Chemicals (list):	Resistance to Chemicals (list):
Compliance with Standards:	Compliance with Standards:
Test Reports:	Test Reports:
Specified Performance Criteria:	Specified Performance Criteria:
Projects completed in the vicinity of Project locality:	Projects completed in the vicinity of Project locality:
Cost of Material: \$ _____	Cost of Material: \$ _____
Cost of Labour: \$ _____	Cost of Labour: \$ _____
Overhead and Profit: \$ _____	Overhead and Profit: \$ _____
Total Cost: \$ _____	Total Cost: \$ _____

Additional Information Provided:

- ☐ Shop Drawings  
☐ Manufacturer's Literature / Website  
☐ Samples  
☐ Other

**CONTRACTORS REVIEW:**

I certify that I have reviewed the above-referenced documentation for the proposed Request for Substitution and warrant it to be substantially complete and accurate.

\_\_\_\_\_  
Signed by (Name): \_\_\_\_\_

Date: \_\_\_\_\_

**CONSULTANT'S REVIEW:**

- ☐ Request Approved  
☐ Request Approved with Comments as Noted Below  
☐ Request Denied

Comments:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

\_\_\_\_\_  
Signed by (Name): \_\_\_\_\_

Date: \_\_\_\_\_



**1.1 SURVEY REQUIREMENTS**

- .1 Establish two temporary bench marks for layout and finishing purposes. Record locations, with horizontal and vertical data, in Project record / as-built documents.
- .2 Establish lines and levels, locate and lay out by instrumentation.
- .3 Establish lines and levels for mechanical and electrical work, floor finishes, and erection of partitions.

**1.2 EXISTING SERVICES**

- .1 Before commencing work, establish location and extent of service lines to which connection is required.

**1.3 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 Consultant 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 Consultant.

**1.4 RECORDS**

- .1 Maintain a complete, accurate log of control and survey work as it progresses.
- .2 On completion of Work, prepare a survey showing dimensions, locations, angles and elevations of Work.
- .3 Record locations of services.

**1.5 SUBMITTALS**

- .1 Submit name and address of Surveyor to Consultant.
- .2 On request of Consultant, submit documentation to verify accuracy of field engineering work.
- .3 Submit certificate signed by surveyor certifying and noting those elevations and locations of completed Work that conform and do not conform with Contract Documents.

**END OF SECTION**

## **1.1 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit written request in advance of cutting or alteration that 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 Contractor or separate Contractor.
- .2 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 Contractor or separate Contractor.
  - .7 Written permission of Contractor.
  - .8 Date and time work will be executed.

## **1.2 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.

## **1.3 EXECUTION**

- .1 Execute cutting, fitting, and patching, including excavation and fill, to complete Work as required during the progress of the 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.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 07 84 00 – Firestopping and Smoke Seals.
- .2 Divisions 21, 22 and 23 Mechanical.
- .3 Divisions 26, 27 and 28 Electrical.

**1.2 DEFINITIONS**

- .1 Cutting: Removal of existing construction necessary to permit installation or performance of other Work.
- .2 Patching: Fitting and repair work required to restore surfaces and substrates to original conditions after installation of other Work.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- 1. Submit in accordance with Section 01 33 00 - Submittal Procedures requirements.
- 2. Submit written request in advance of cutting, coring, and alteration which affects:
  - 1. Structural integrity of any element of Work.
  - 2. Integrity of weather-exposed or moisture-resistant elements.
  - 3. Efficiency, maintenance, or safety of any operational element.
  - 4. Visual qualities of sight-exposed elements.
  - 5. Owner or work of other contractors.
- 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 Owner or work of other contractors.
  - 7. Written permission of affected separate contractor.
  - 8. Date and time work will be performed.
  - 9. X-ray photographic images or ultrasound images of work to be cut or cored.
- 4. Do not commence cutting, patching, or remedial work until request has been reviewed by Consultant.
- 5. Submit for Consultant's review engineered shop drawings prepared by a structural professional engineer (P.Eng.) licensed to practice in the Place of the Work, in accordance with the requirements of Section 01 35 01 - Delegated Design. Shop drawings shall identify precise locations and size of openings to be cored, and design and configuration of temporary supports for structural elements. Include engineering calculations.

**1.4 QUALITY ASSURANCE**

- .1 Structural Elements: Do not cut and patch structural elements without the delegated design inputs and supervision of a qualified Professional Engineer (P.Eng.) licenced to practice in Ontario.

- .2 Operational Elements: Do not cut and patch operating elements and related components in a manner that results in impairing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety, including the following:
  - .1 Primary operational systems and equipment.
  - .2 Air or smoke barriers.
  - .3 Fire protection systems.
  - .4 Control systems.
  - .5 Communication systems.
  - .6 Conveying systems.
  - .7 Electrical wiring systems.
- .3 Miscellaneous Elements: Do not cut and patch the following elements or related components in a manner that could change their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety, including the following:
  - .1 Water, moisture, and vapour barriers.
  - .2 Membranes and flashings.
  - .3 Exterior wall construction.
  - .4 Equipment supports.
  - .5 Piping, ductwork, vessels, and equipment.
  - .6 Noise and vibration control elements and systems.
- .4 Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that reduces the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner. If possible, retain original Installer or fabricator to cut and patch exposed Work listed below. If it is impossible to engage original Installer or fabricator, engage another recognized, experienced, and specialized firm.
- .5 Cutting and Patching Conference: Before proceeding, meet at project site with parties involved in cutting and patching, including firestopping, mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.
- .6 Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 General: Comply with requirements specified in other Sections of the Contract Specifications.
- .2 Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible:
  - .1 If identical materials are unavailable or cannot be used, use materials that, when installed, will match the appearance and performance of existing materials.

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed:
  - .1 Inspect existing conditions, including elements subject to damage or movement during cutting and patching.
  - .2 After uncovering, inspect conditions affecting performance of the Work.
  - .3 Provide ultrasound or other approved methods to determine locations of existing services and reinforcing in existing floors and walls before cutting and renovations. Advise Consultant of findings before proceeding with the Work and revise cutting or coring locations as required and directed by Consultant.
  - .4 Compatibility: Before patching, verify compatibility with substrates, including compatibility with existing finishes or primers.
  - .5 Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.
  - .6 Beginning of cutting or patching means acceptance of existing conditions.

**3.2 PREPARATION**

- .1 Temporary Support: Provide supports to assure structural integrity of surroundings; devices and methods to protect other portions of the Work from damage.
  - .1 Temporary construction supporting structural elements shall be designed and reviewed by a professional structural engineer (P.Eng.) licensed to practice in the Place of the Work, in accordance with the requirements of Section 01 35 01 - Delegated Design.
- .2 Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- .3 Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- .4 Existing Services: Where existing services are required to be removed, relocated, or abandoned, bypass such services before cutting to minimize interruption of services to occupied areas.
- .5 Indoor Air Quality: take measures as required to prevent migration of dust and debris to areas outside the immediate work area.
- .6 Provide protection from elements for areas which may be exposed by uncovering work; maintain excavations free of water.
- .7 Where uncovering of area exposes local deterioration, cracking, evidence of water infiltration, structural settlement, previous modifications, or other unexpected conditions, advise Consultant immediately in writing and leave conditions exposed until receipt of Consultant's written instructions. If area is exposed to the exterior, Provide temporary protection from inclement weather.

### 3.3 EXECUTION AND PERFORMANCE

- .1 General: employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay:
  - .1 Cut existing construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition. Ensure corners of openings to be cut are predrilled or sawed. Under no circumstances will overcutting of corners of opening be accepted.
  - .2 Provide openings in non-structural elements of the Work for penetrations of mechanical and electrical work
  - .3 Remove and replace defective and non-conforming work.
  - .4 Remove samples of installed work for testing if directed by Consultant.
  - .5 Provide X-ray or ultrasound images of structural concrete to be cored or cut for Consultant review. Coring and cutting work locations shall be reviewed by Consultant for acceptance before proceeding.
- .2 Cutting: cut existing construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations:
  - .1 Perform work by methods to avoid damage to other work, and which will provide proper surfaces to receive patching and finishing.
  - .2 Employ qualified and experienced installers to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.
  - .3 In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use. Pneumatic or impact tools not allowed to be used anywhere within building unless approved by Consultant.
  - .4 Existing Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
  - .5 Concrete or Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond core drill.
  - .6 Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
  - .7 Proceed with patching after construction operations requiring cutting are complete.
- .3 Patching: patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications:
  - .1 Inspection: where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
  - .2 Fit work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces and with suitable allowance for deflections and expansions and contractions.
  - .3 Enclose pipes, ducts, conduit and wires passing through floors at areas where faucets occur (for example, washrooms, kitchens, mechanical rooms on suspended floors, janitor rooms) in 100 mm (4 inch) high metal sleeves and make air and watertight with water resistant firestopping and sealants.

- .4 Completely seal voids at penetrations of non-rated fire separations and fire rated wall, ceiling, and floor constructions with fire-stopping and smoke seals.
- .5 Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
- .6 Where patching occurs in a finished surface other than paint, match existing finish and blend in as required; ensure patch is not visible in public areas.
- .7 Refinish surfaces to match adjacent finishes. Refinish continuous surfaces to nearest intersection. Refinish entire assembly units.

### **3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Progress and Final Cleaning requirements. 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 - Progress and Final Cleaning requirements. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3 Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 - Waste Management and Disposal requirements.

### **3.5 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**END OF SECTION**



## **1.1 PROJECT CLEANLINESS**

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

## **1.2 PREREQUISITES TO FINAL PAYMENT**

- .1 Remove from the Place of the Work all remaining surplus Products, Construction Equipment, and Temporary Work.
- .2 Perform final cleaning and waste removal necessitated by the Contractor's work performed after Ready-For-Takeover, as specified in this Section 01 74 11.
- .3 Notify the Consultant of the need for cleaning caused by Owner or other contactors.

## **1.3 FINAL CLEANING**

- .1 Clean work prior to final review by Consultant.
- .2 When Work is Substantially Performed remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.
- .3 Remove waste as specified.
- .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 Subcontractors shall remove waste products and debris created by their own Work.
- .7 Remove waste materials from site at regularly scheduled times or dispose of as directed by Consultant. Do not burn waste materials on site, unless approved by Consultant.
- .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.

**END OF SECTION**

## **1 WASTE MANAGEMENT REQUIREMENTS**

- .1 Construction Waste Management Requirements: comply with Province of Ontario and City of Toronto requirements for construction waste diversion, transportation and management.
- .2 Reduce solid waste produced by Work in accordance with CCA 81-2001: A Best Practices Guide to Solid Waste Reduction.
- .3 The Contractor shall be responsible for the Material Recovery Plan, Waste Reduction Plan and Construction Management Plan.

## **2 DEFINITIONS**

- .1 Class III: non-hazardous waste - construction renovation and demolition waste.
- .2 Demolition Waste Audit (DWA): relates to actual waste generated from project.
- .3 Inert Fill: inert waste - exclusively asphalt and concrete.
- .4 Materials Source Separation Program (MSSP): consists of series of ongoing activities to separate reusable and recyclable waste material into material categories from other types of waste at point of generation.
- .5 Recyclable: ability of product or material to be recovered at end of its life cycle and re-manufactured into new product for reuse.
- .6 Recycle: process by which waste and recyclable materials are transformed or collected for purpose of being transferred into new products.
- .7 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.
- .8 Reuse: repeated use of product in same form but not necessarily for same purpose. Reuse includes:
  - .1 Salvaging reusable materials from re-modelling projects, before demolition stage, for resale, reuse on current project or for storage for use on future projects.
  - .2 Returning reusable items including pallets or unused products to vendors.
- .9 Salvage: removal of structural and non-structural materials from deconstruction/disassembly projects for purpose of reuse or recycling.
- .10 Separate Condition: refers to waste sorted into individual types.
- .11 Source Separation: acts of keeping different types of waste materials separate beginning from first time they became waste.
- .12 Waste Audit (WA): detailed inventory of materials in building. Involves quantifying by volume/weight amounts of materials and wastes generated during construction, demolition, deconstruction, or renovation project. Indicates quantities of reuse, recycling and landfill. Refer to Schedule A.
- .13 Waste Management Coordinator (WMC): contractor representative responsible for supervising waste management activities as well as coordinating related, required submittal and reporting requirements.
- .14 Waste Reduction Workplan (WRW): written report which addresses opportunities for reduction, reuse, or recycling of materials. Refer to Schedule B. WRW is based on information acquired from WA (Schedule A).

**3 DOCUMENTS**

- .1 Maintain at job site, one copy of following documents:
  - .1 Waste Audit.
  - .2 Waste Reduction Workplan.
  - .3 Material Source Separation Plan.
  - .4 Schedules A, B, and C completed for project.

**4 SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Prepare and submit following prior to project start-up:
  - .1 Submit 2 copies of completed Waste Audit (WA): Schedule A.
  - .2 Submit 2 copies of completed Waste Reduction Workplan (WRW): Schedule B.
  - .3 Submit 2 copies of completed Demolition Waste Audit (DWA): Schedule C.
  - .4 Submit 2 copies of Materials Source Separation Program (MSSP) description.

**5 WASTE AUDIT (WA)**

- .1 Conduct WA prior to project start-up.
- .2 Prepare WA: Schedule A.
- .3 Record, on WA - Schedule A, extent to which materials or products used consist of recycled or reused materials or products.

**6 WASTE REDUCTION WORKPLAN (WRW)**

- .1 Prepare WRW prior to project start-up.
- .2 WRW should include:
  - .1 Destination of materials listed.
  - .2 Deconstruction/disassembly techniques and sequencing.
  - .3 Schedule for deconstruction/disassembly.
  - .4 Location.
  - .5 Security.
  - .6 Protection.
  - .7 Clear labelling of storage areas.
  - .8 Details on materials handling and removal procedures.
  - .9 Quantities for materials to be salvaged for reuse or recycled and materials sent to landfill.
- .3 Describe management of waste.
- .4 Identify opportunities for reduction, reuse, and recycling of materials. Based on information acquired from WA.
- .5 Post WRW or summary where workers at site are able to review content.
- .6 Set realistic goals for waste reduction, recognize existing barriers and develop strategies to overcome these barriers.
- .7 Monitor and report on waste reduction by documenting total volume and cost of actual waste removed from project.

**7 DEMOLITION WASTE AUDIT (DWA)**

- .1 Prepare DWA prior to project start-up.
- .2 Complete DWA: Schedule C.
- .3 Provide inventory of quantities of materials to be salvaged for reuse, recycling, or disposal.

**8 MATERIALS SOURCE SEPARATION PROGRAM (MSSP)**

- .1 Prepare MSSP and have ready for use prior to project start-up.
- .2 Implement MSSP for waste generated on project in compliance with approved methods and as reviewed by Consultant.
- .3 Provide on-site facilities for collection, handling, and storage of anticipated quantities of reusable and recyclable materials.
- .4 Provide containers to deposit reusable and recyclable materials.
- .5 Locate containers in locations, to facilitate deposit of materials without hindering daily operations.
- .6 Locate separated materials in areas which minimize material damage.
- .7 Collect, handle, store on-site, and transport off-site, salvaged materials in separate condition.
- .8 Collect, handle, store on-site, and transport off-site, salvaged materials in combined condition.

**9 STORAGE, HANDLING AND PROTECTION**

- .1 Store, materials to be reused, recycled and salvaged in locations as directed by Consultant.
- .2 Unless specified or indicated on Drawings otherwise, materials for removal become Contractor's property.
- .3 Protect, stockpile, store and catalogue salvaged items.
- .4 Separate non-salvageable materials from salvaged items. Transport and deliver non-salvageable items to licensed disposal facility.
- .5 Protect structural components not removed for demolition from movement or damage.
- .6 Support affected structures. If safety of building is endangered, cease operations and immediately notify Consultant.
- .7 Protect surface drainage, mechanical and electrical from damage and blockage.
- .8 Separate and store materials produced during dismantling of structures in designated areas.
- .9 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 comingled materials to off-site processing facility for separation.
  - .3 Provide waybills for separated materials.

**10 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 Keep records of construction waste including:
  - .1 Number and size of bins.
  - .2 Waste type of each bin.
  - .3 Total tonnage generated.

- .4 Tonnage reused or recycled.
- .5 Reused or recycled waste destination.
- .4 Remove materials from deconstruction as deconstruction/disassembly Work progresses.
- .5 Prepare project summary to verify destination and quantities on a material-by-material basis as identified in pre-demolition material audit.
- 11 USE OF SITE AND FACILITIES**
  - .1 Execute work with least possible interference or disturbance to normal use of premises.
  - .2 Maintain security measures established by existing facility, and also provide temporary security measures approved by Consultant when required to assure continuity of security.
- 12 SCHEDULING**
  - .1 Coordinate Work with other activities at site to ensure timely and orderly progress of Work.
- 13 APPLICATION**
  - .1 Do Work in compliance with WRW.
  - .2 Handle waste materials not reused, salvaged, or recycled in accordance with appropriate regulations and codes.
- 14 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.

*[Remainder of Page Left Intentionally Blank]*

**15 WASTE AUDIT (WA)**

**.1 Schedule A - Waste Audit (WA):**

<b>Material Category</b>	<b>Material Quantity Unit</b>	<b>Estimated Waste %</b>	<b>Total Quantity of Waste (unit)</b>	<b>Generation Point</b>	<b>% Recycled</b>	<b>% Reused</b>
Wood and Plastics Material Description						
Off-cuts						
Warped Pallet Forms						
Plastic Packaging						
Cardboard Packaging						
Other						
Doors and Windows Material Description						
Painted Frames						
Glass						
Wood						
Metal						
Other						

**16 WASTE REDUCTION WORKPLAN (WRW)**

**.1 Schedule B:**

<b>Material Category</b>	<b>Person(s) Responsible</b>	<b>Total Quantity of Waste (unit)</b>	<b>Reused Amount (units) Projected</b>	<b>Actual</b>	<b>Recycled Amount (unit) Projected</b>	<b>Actual</b>	<b>Material Destination</b>
Wood and Plastics Material Description							
Chutes							
Warped Pallet Forms							
Plastic Packaging							
Cardboard Packaging							
Other							
Doors and Windows Material Description							
Painted Frames							
Glass							
Wood							
Metal							
Other							



**17 DEMOLITION WASTE AUDIT (DWA)**

**.1 Schedule C - Demolition Waste Audit (DWA):**

<b>Material Description</b>	<b>Quantity</b>	<b>Unit</b>	<b>Total</b>	<b>Volume (cum)</b>	<b>Weight (cum)</b>	<b>Remarks</b>
Wood						
Wood Stud						
Plywood						
WD Baseboard						
WD Door Trim						
Cabinet						
Doors and Windows						
Panel Regular						
Slab Regular						
Wood Laminate						
Bi-fold - Closet						
Glazing						

**END OF SECTION**

## **1.1 REFERENCES**

- .1 Canadian Construction Documents Committee (CCDC)
  - .1 CCDC 2-2020, Stipulated Price Contract, as amended.
- .2 ULC Standards
  - .1 CAN/ULC S1001-11, Standard for Integrated Systems Testing of Fire Protection and Life Safety Systems.

## **1.2 SUBSTANTIAL PERFORMANCE AND HOLDBACK**

- .1 Declaration of Substantial Performance: when Consultant considers that deficiencies and defects have been corrected, and it appears requirements of Contract have been substantially performed, make application for certificate of Substantial Performance.
- .2 Commencement of Lien and Warranty Periods: comply with Construction Lien Act, R.S.O. 1990, c. C.30, date of Owner's acceptance of published declaration of Substantial Performance shall be date for commencement for warranty period and commencement of lien period unless required otherwise by Ontario Construction Lien Act.
- .3 Final Payment: when Consultant considers final deficiencies and defects have been corrected and it appears requirements of Contract have been totally performed, make application for final payment. If Work is deemed incomplete by Consultant, complete outstanding items and request re-inspection.
- .4 Payment of Holdback: after issuance of certificate of Substantial Performance of Work, submit application for payment of holdback.

## **1.3 READY-FOR-TAKEOVER**

- .1 The prerequisites to attaining Ready-for-Takeover of the Work are described in the General Conditions of the Contract.

## **1.4 INSPECTION AND REVIEW BEFORE READY-FOR-TAKEOVER**

- .1 Contractor's Inspection: Before applying for the Consultant's review to establish Ready-for-Takeover of the Work:
  - .1 Ensure that the specified prerequisites to Ready-for-Takeover of the Work are completed.
  - .2 Conduct an inspection of the Work to identify defective, deficient, or incomplete work.
  - .3 Prepare a comprehensive and detailed list of items to be completed or corrected.
  - .4 Provide an anticipated schedule and costs for items to be completed or corrected.
- .2 Consultant's Review: Upon receipt of the Contractor's application for review, together with the Contractor's list of items to be completed or corrected, the Consultant and the Contractor shall arrange a mutually satisfactory agreed date and time to jointly review the Work. The Consultant will advise the Contractor whether or not the Work is Ready-for-Takeover. Add additional items, if any, to the Contractor's list of items to be completed or corrected. Provide the Consultant with a copy of the revised list.
- .3 Maintain the list of items to be completed or corrected and promptly correct or complete defective, deficient and incomplete work. The Contractor's inspection and Consultant's review procedures specified above shall be repeated until the Work is Ready-for-Takeover and no items remain on the Contractor's list of items to be completed or corrected.

- .4 When the Consultant determines that the Work is Ready-for-Takeover, the Consultant will notify the Contractor and the Owner in writing to that effect.

## **1.5 PREREQUISITES TO FINAL PAYMENT**

- .1 After Ready-for-Takeover of the Work and before submitting an application for final payment in accordance with the General Conditions of Contract:
  - .1 Correct or complete all remaining defective, deficient, and incomplete work.
  - .2 Remove from the Place of the Work all remaining surplus Products, Construction Equipment, and Temporary Work.
  - .3 Perform final cleaning and waste removal necessitated by the Contractor's work performed after Ready-for-Takeover, as specified in Section 01 74 11 – Cleaning and Section 01 74 19 - Waste Management and Disposal.
  - .4 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 authorities having jurisdiction, fire commissioner and utility companies have been submitted.
    - .5 Verification letter required to confirm integrated systems testing for fire protection and life safety systems has been successfully completed in accordance with CAN/ULC S1001
    - .6 Operation of systems have been demonstrated to Owner's personnel.

## **1.6 CLEANING**

- .1 In accordance with Section 01 74 11 – Cleaning.
- .2 Remove waste and surplus materials, and construction facilities from the site in accordance with Section 01 74 19 - Waste Management and Disposal.

**END OF SECTION**

## 1.1 GENERAL

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .1 Refer to and comply with the requirements of CCDC 2–2020 **GC 12.1 READY-FOR-TAKEOVER**.
- .2 The procedures for completing Contract and acceptance by the Owner shall be as required by Ontario Construction Lien Act, requirements of authorities having jurisdiction, and CCDC 2–2020 as amended.
- .3 Procedures and timelines will be reviewed at the CONSTRUCTION PARTNERING WORKSHOP to ensure that parties understand their responsibilities.
  - 1. Refer to Section 01 31 19 for procedures and requirements.
- .4 Submit to the Consultant a list of closeout submittals required by the Contract Documents.

## 1.2 CLOSEOUT SUBMITTALS

- .1 Collect reviewed submittals, and assemble required closeout submittals executed by Subcontractors, Suppliers, and manufacturers. Prior to submitting closeout submittals to the Consultant, undertake the following:
  - .1 Review maintenance manual contents (operating, maintenance instructions, as-built drawings, materials) for completeness.
  - .2 Review supply and completeness of spare parts required by Contract Documents and manufacturers.
  - .3 Review change orders, holdbacks and other adjustments to the Contract.
  - .4 Review inspection and testing reports to verify conformance to intent of Contract Documents and that changes, repairs or replacements have been completed.
  - .5 Execute transition of performance bond and labour and materials payment bond to warranty period requirements.
  - .6 Submit a final statement of accounting giving total adjustments to the Contract, previous payments, and monies remaining at time of application for completion of the Contract. Consultant will issue a final change order reflecting approved adjustments to Contract Price not previously made.
- .2 No later than 10 Working Days prior to submitting request for Consultant's review to determine if Substantial Performance of the Work has been achieved, submit to the Consultant the closeout submittals specified in this section, including, but not limited to, reviewed shop drawings, Product data sheets, samples, operating instructions, as-built records, fully executed warranties and guarantees, reports recording demonstration and instruction provided to Owner for operation and maintenance of building systems, software required for operation and maintenance of building systems, maintenance materials, and keys.
- .3 For equipment put into use with Owner's permission during the Work, submit required closeout submittals within 10 Working Days after start-up.
- .4 For items of the Work delayed materially beyond date of Substantial Performance of the Work, provide updated closeout submittals within 10 Working Days after acceptance, listing date of acceptance as start of warranty period.
- .5 Neither the Consultant's review to determine if Substantial Performance of the Work has been achieved, nor acceptance of the Work, will take place until receipt, by the Consultant, of acceptable copies of the closeout submittals required herein and by the Contract Documents.

- .6 Record documents:
  - .1 Consultant will provide one electronic set of Contract Documents to the Contractor for the purpose of recording as-built conditions.
  - .2 Accurately record changes to the Work and deviations from Contract Documents as the Work progresses.
  - .3 Mark changes in red ink.
  - .4 Record, without being limited to, the following:
    - .1 Survey of as-built conditions and survey logs prepared by the registered land surveyor responsible for setting out the work and field engineering.
    - .2 Depths of various elements of foundation in relation to survey datum.
    - .3 Horizontal and vertical location of utilities and appurtenances referenced to permanent surface improvement.
    - .4 Other underground installations and services set beneath slabs-on-grade referenced to visible and accessible features of structure.
    - .5 Field changes of dimensions/details.
    - .6 Changes by change order/change directive/supplemental instructions.
    - .7 Locations of interior mechanical and electrical equipment and distribution.
    - .8 Elevations and location depths of services. Identify type and size of service and materials used.
    - .9 As-built specifications manuals: Record as-built Products, including manufacturer, manufacturer's model or system number and finish / finish system.
  - .5 Consultant to provide to Contractor prior to substantial performance an electronic copy of the mechanical and electrical drawings for the Contractor's use in preparation of electronic copy of record drawings. The mechanical and electrical site services drawings have been prepared using current version of AutoCAD.
  - .6 Submit one complete final set of record documents of all contract drawings as an electronic copy (on USB flash drive or uploaded to designated construction management software) of site services, mechanical and electrical drawings.
- .7 Posted operating instructions:
  - .1 Prepare operating instructions in English for posting near equipment and systems. Posted instructions to be glass covered, framed and mounted.
  - .2 Posted instructions to consist of simplified, consolidated equipment, control and power diagrams graphically representing the entire system, including concise instructions on how to start and stop systems, what settings and conditions are to be observed by the operators, and what control adjustments are to be made or maintained by the operator.
  - .3 Posted instructions shall include control diagrams with added specific operating instructions, controls, interlocks, etc.
  - .4 Posted instructions shall include:
    - .1 HVAC controls for each system;
    - .2 One-line schematic diagrams of water supply;
    - .3 One-line isometric diagrams of sanitary drainage;

- .4 One-line diagrams of steam distribution, hot and cold water systems, including risers, valves, control devices, etc.
- .8 Operation and maintenance manuals:
  - .1 Submit one PDF copy on USB flash drive or uploaded to designated construction management software of maintenance manuals, consisting of the following general components:
    - .1 Shop drawing manuals,
    - .2 Warranty manuals, and
    - .3 Project data book.
  - .2 Operation and maintenance manuals shall contain operating and maintenance data and information specified below for supplied Products, in English, and shall be made up as follows:
    - .1 Have a title page, labelled as applicable, with project name, date and list of contents hot-linked to each section and sub-section.
    - .2 Structure the data, including but not limited to preventative maintenance, regular maintenance, and product replacement cycles for the most-critical elements (as determined by Owner).
    - .3 Organize contents into applicable sections of work to parallel project specifications break-down. Label each section clearly.
    - .4 Neatly type lists and notes. Use clear drawings, diagrams of manufacturers' literature.
  - .3 Shop drawing manuals:
    - .1 Submit one electronic copy of each final accepted shop drawing issued for the Work on that have recorded changes made during fabrication and installation caused by unforeseen conditions.
  - .4 Warranty manuals:
    - .1 Submit copies of bonds, guarantees, warranties and extended warranties together in one report binder, complete with an indexed summary list of warranties and expiration dates. Warranties to be in accordance with Contract.
  - .5 Project data book: include the following information supplemented by additional required data specified elsewhere in the Contract Documents:
    - .1 Maintenance instruction for finished surfaces and materials.
    - .2 Electronic copy of hardware and paint schedules.
    - .3 Description, operation and maintenance instructions for equipment and parts list. Indicate nameplate information such as make, size, capacity, serial number.
  - .6 Names, addresses and phone numbers of Subcontractors and Suppliers, as applicable.
  - .7 Additional material used in the Work listed under various sections showing name of manufacturer and source of supply.
  - .8 Charts, diagrams and reports identified in electrical and mechanical divisions of the specifications.

- .9 Report recording demonstration and instruction provided to Owner's personnel for operation and maintenance of building systems as described below in this section.
  - .1 Permits and forms:
    - .1 Occupancy permit; statutory declarations.
    - .2 Workplace Safety & Insurance Board certificate of clearance.
    - .3 Certificates of approval of the Work by local building department (if available).
    - .4 Electrical authority certificate of inspection.
    - .5 Elevator authority certificate of approval.
- .9 Maintenance materials:
  - .1 Provide overage, extra stock, and maintenance materials. For required materials, see individual sections of specifications. Deliver to a location and at a time specified by the Owner.
  - .2 Use unbroken cartons, or if not supplied in cartons, material shall be strongly packaged.
  - .3 Clearly mark cartons or packaging with contents, project name, and Supplier.
  - .4 If applicable, give colour and finish, room number or area where material is used.
  - .5 Replace incorrect or damaged maintenance materials delivered to Owner, including damage through shipment.
  - .6 Provide inventory list of maintenance materials prior to Substantial Performance of the Work application. List all items, complete with quantities, and storage locations.
  - .7 Establish a master list identifying maintenance materials and maintain a log of when materials are turned over to Owner and signing authority for acceptance of materials on behalf of Owner.

### **1.3 SYSTEM DEMONSTRATION AND PROJECT COMMISSIONING**

- .1 Refer to requirements of other Divisions for additional requirements related to demonstration and commissioning for site services, elevators, mechanical systems, and electrical systems.
- .2 Perform system demonstration and commissioning work no later than 10 Working Days prior to submitting request for Consultant's review to determine if Substantial Performance of the Work has been achieved.
- .3 Submit required certificates of approval or acceptance from authorities having jurisdiction.
- .4 Meet with other consultants, including structural, mechanical, electrical, to coordinate demonstration, instruction, commissioning and completion.
- .5 Review condition of equipment such as lighting, elevators and heating system, which has been used in the course of the Work to ensure turning over at completion in "as new condition" with warranties dated and certified from time specified.
- .6 When partial occupancy of uncompleted project is required by Owner, coordinate Owner's uses, requirements, access, and the like, with Contractor's requirements to complete the Work.

- .7 Demonstration and Instruction:
  - .1 Demonstrate operation of each system to Owner.
  - .2 Instruct Owner's personnel in operation, adjustment and maintenance of equipment and systems, using operation and maintenance data provided as the basis for instructions. Arrange and coordinate instruction of Owner's staff in care, maintenance and operation of building systems and finishes by Suppliers and Subcontractors.
  - .3 Contractor, manufacturer's representatives, and responsible personnel from Subcontractors whose work is being demonstrated shall be present at these demonstrations.
  - .4 Instruct Owner's representative on use of software required for operation and maintenance of building systems and provide a toll-free telephone number or website address for further assistance to the Owner.
  - .5 Prepare and insert additional data in the operation and maintenance data manuals when the need for additional data becomes apparent during demonstration or instruction.
  - .6 Demonstration and instruction report: Submit a written report of such demonstration, instruction, and commissioning to the Consultant as part of the contract closeout submittals described earlier in this section. Report shall include time and date of each demonstration, instruction, and commissioning activity, complete with a list of persons present.
- .8 Correct deficiencies and defects identified during demonstration, instruction, or commissioning.
- .9 Attend 'end-of-work' testing and break-in or start-up demonstration.

#### **1.4 SUBSTANTIAL PERFORMANCE OF THE WORK**

- .1 Deficiency review:
  - .1 Consultant will enter observed deficiencies directly into AutoCAD. Contractor is responsible to remedy all and any deficiencies whether observed by Consultant or not; Consultant's review shall not be considered exhaustive or complete.
  - .2 Contractor assumes prime responsibility for ensuring that items shown and described in the Contract Documents are complete. Any reviews to approve the certificate of Substantial Performance of the Work will be immediately cancelled if it becomes obvious to the Consultant that extensive deficiencies are outstanding.
  - .3 The Contractor shall conduct an inspection of the Work to identify deficiencies and defects, which shall be repaired. When the Contractor considers that the Work is substantially performed, the Contractor shall prepare and submit to the Consultant a comprehensive list of items to be completed or corrected and apply for a review of the Work by the Consultant to determine if Substantial Performance of the Work has been achieved.
  - .4 The Contractor's request described above shall include a statement by Contractor that the Work to be reviewed by Consultant for deficiencies is, to the best of the Contractor's knowledge, in compliance with Contract Documents, reviewed shop drawings, and samples, and that deficiencies and defects previously noted by Consultant have been repaired.



- .5 No later than 10 Working Days after the receipt of the Contractor's request described above, but contingent upon the prior receipt, by the Consultant, of the closeout submittals in the manner and form specified in this section, the Consultant and the Contractor will review the Work to identify any defects or deficiencies. If necessary, the Contractor shall tabulate a list of deficiencies to be corrected prior to Substantial Performance of the Work being certified by the Consultant. During review, the Consultant and the Contractor will decide which deficiencies or defects must be rectified before Substantial Performance of the Work can be certified, and which defects are to be treated as warranty items.
- .6 Provide a schedule of planned deficiency review having regard to the foregoing.
- .2 Certification of Substantial Performance of the Work:
  - .1 When the Consultant considers that the deficiencies and defects have been completed and that it appears that the requirements of the Contract Documents have been substantially performed, the Consultant shall issue a certificate of Substantial Performance of the Work to the Contractor, stating the date of Substantial Performance of the Work.
  - .2 Commencement of Lien and Warranty Periods: shall be in compliance with Ontario Construction Lien Act; date of Owner's acceptance of published declaration of Substantial Performance shall be date for commencement for warranty period and commencement of lien period unless required otherwise by Ontario Construction Lien Act.
- .3 Final Inspection for completion of the Contract:
  - .1 Deficiencies and defects shall be made good before the Contractor submits a written request for final review of the Work and before the Contract is considered complete.
  - .2 When Contractor is satisfied that the Work is complete, and after the Contractor has reviewed the Substantial Performance of the Work to verify its completion in accordance with the requirements of the Contract Documents, the Contractor shall submit a written request for a final review by the Consultant, who in turn will notify the Owner.
  - .3 If there are any deficiencies identified as a result of this review, they shall be listed by the Consultant and submitted to the Contractor. This list shall be recognized as the final deficiency list for purposes of acceptance of the Work under the Contract.
  - .4 Such deficiencies shall be corrected by a date mutually agreed upon between Consultant and the Contractor, unless a specific date is required by Contract, and a further review by the Consultant shall be called for by the Contractor following his own review to take place within 7 days from date of request.
  - .5 Contractor shall thereafter submit invoice for final payment.
  - .6 Money shall be withheld for deficiency work and will be released only when all deficiencies have been completed. No partial payment to be recognized until all work is completed.
  - .7 Return Project documentation to Owner at completion of the Contract.

## **1.5 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 Consultant for approval.

- .3 Warranty management plan to include required actions and documents to assure that Owner 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 Consultant for approval prior to each monthly pay estimate.
- .6 Assemble approved information in binder, submit upon acceptance of work and 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 Owner's permission, leave date of beginning of time of warranty until Date of Substantial Performance is determined.
- .8 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, fire protection.
  - .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 Warranties and terms of warranty: include one-year overall warranty of construction. Indicate items that have extended warranties and show separate warranty expiration dates.
    - .6 Cross-reference to warranty certificates as applicable.
    - .7 Starting point and duration of warranty period.
    - .8 Summary of maintenance procedures required to continue warranty in force.
    - .9 Organization, names and phone numbers of persons to call for warranty service.
- .9 Respond in timely manner to oral or written notification of required construction warranty repair work.
- .10 Written verification to follow oral instructions.
  - .1 Failure to respond will be cause for the Consultant to proceed with action against Contractor.

**1.6 PRE-WARRANTY CONFERENCE**

- .1 Meet with Consultant, to develop understanding of requirements of this section. Schedule meeting prior to contract completion, and at time designated by Consultant.
- .2 Consultant 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.

**END OF SECTION**

**1.1 DESCRIPTION**

- .1 Demonstrate scheduled operation and maintenance of equipment and systems to designated personnel two weeks prior to date of Substantial Performance.
- .2 A list of personnel to receive instructions will be provided, and their attendance coordinated at mutually 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 designated personnel, and provide written report that demonstration and instructions have been completed.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit schedule of time and date for demonstration of each item of equipment and each system two weeks prior to agreed dates for Consultant's approval.
- .2 Submit reports within one week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.
- .3 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, 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 Provide trained personnel to instruct operating staff on maintenance, adjustment and operation of mechanical equipment. Instruct staff on changes or modification in equipment made under terms of guarantee.
- .2 Provide instruction during regular work hours prior to acceptance and turnover to operating staff for regular operation.
- .3 Use operation and maintenance data manual for instruction purposes. On completion of instruction, turn one manual over to chief operating engineer, the balance to Consultant.

- .4 Time allocated for Instruction:
  - .1 Section 06 40 00: ½ hour.
  - .2 Operable Windows: 1-hour.
  - .3 Doors with automatic operators: 1-hour.
  - .4 Finishes (floors, walls, ceilings): ½-hour per finish.
  - .5 Division 10: ½ hour each for each Section.
  - .6 Division 12: ½ hour each for each Section.
  - .7 HVAC equipment requiring regular servicing: 4-hours.
  - .8 Division 26 and 27 equipment requiring regular servicing: 2-hours.
  - .9 Plumbing: 2-hours.
  - .10 Fire Suppression: 1-hour.
  - .11 Controls: 40 hours (overall) instruction and support as required during the first year following certificate of Substantial Performance.
  - .12 Division 14: 1 day demonstration and instruction, and ongoing service warranty service for duration of warranty period, and service contract.

**END OF SECTION**

## **COMMISSIONING OF LIFE SAFETY AND FIRE PROTECTION SYSTEMS**

### **01 91 11**

#### **1 GENERAL**

##### **1.1 Scope**

- .1 Provide coordinated commissioning for all life safety and fire protection systems and related equipment as per the latest CAN/ULC S1001 requirements and per the requirements described within this section.
- .2 Coordinate and jointly prepare with the Division 20 and 26 contractors to conduct complete and thorough testing and documentation of the systems interface and integration between various LSFP systems provided under those Divisions, and equipment and/or systems provided under other Divisions of the Work.
- .3 Include all labor and material as required to manage, develop and implement the life safety and fire protection commissioning process.
- .4 This section, including Schedule A and Schedule B, does not limit or otherwise intend to assign the responsibility to solely manage the development and implementation of the LSFPc program to either the Division 20 contractor or Division 26 contractor.
  - .1 For clarity, it is the joint responsibility of the General Contractor or Construction Manager and the trade contractors to manage, develop and implement this program with respect to the Work performed under their respective divisions.
  - .2 For clarity, reference to Division 20 means the Work under Divisions 20, 21, 22, 23 and 25.
  - .3 For clarity, reference to Division 26 means the Work under Divisions 26, 27 and 28.
  - .4 For clarity, it is not the intent of this specification to assign responsibility for commissioning of other fire protection or life safety equipment or systems which form part of other divisions of the Work to the Division 20 and 26 contractors.

##### **1.2 Abbreviations and Definitions**

- .1 Abbreviations:
  - .1 *LSFP* – life safety and fire protection systems provided under Division 20 or 26 as applicable.
  - .2 *LSFPc* – life safety and fire protection systems commissioning.
- .2 Definitions:
  - .1 *Major deficiency* – an item which if not corrected renders the equipment or system unsuitable or un-safe for use by the Owner. Major deficiencies must be corrected as a condition for achieving Substantial Performance and Occupancy Permit.
  - .2 *Minor deficiency* – an item which does not impact on the operation of the equipment or system and will allow the Owner to use the system safely. Minor deficiencies may be corrected before or after Substantial Performance, but will not prevent certification of Substantial Performance of the Work.

##### **1.3 Applicable codes and standards**

- .1 Installation standards and codes:
  - .1 CAN/ULC-S1001 Requirements for Integrated System Testing

## **1.4 Submittals**

- .1 First submittal:
  - .1 Submit a draft of the LSFPCx plan including, the table of contents and one sample test form each for Division 25 and 26, for review and approval by the Owner and Consultant at least six months prior to start of commissioning.
- .2 Second submittal:
  - .1 Submit the completed draft LSFPCx plan and all test procedures for review and approval by the Owner and Consultant at least two months prior to start of commissioning.

## **2 PRODUCTS**

### **2.1 Not Applicable**

## **3 EXECUTION**

### **3.1 Roles and Responsibilities**

- .1 Owner;
  - .1 establishes acceptance criteria and approves LSFP commissioning plan and procedures;
  - .2 provides operations staff to receive training, and to witness any or all tests at their discretion;
  - .3 final acceptance of commissioning results;
  - .4 the Owner reserves the right to approve proposed technicians with regard to the technical skill level required for each type of equipment and/or system, and a willingness by the individual(s) to work within the commissioning team.
- .2 Design Consultant;
  - .1 responsible for the construction review activities in accordance with local building code requirements;
  - .2 review of LSFP commissioning plan, procedures and test results.
- .3 General Contractor / Construction Manager;
  - .1 manages and coordinates the LSFP commissioning activities;
  - .2 integrates commissioning activities into the construction schedule;
  - .3 ensures commissioning procedures are completed and documented, and commissioning records including any required attachments are submitted;
  - .4 provide access for all participants in the LSFPCx program to the contract plans, shop drawings, and equipment cut sheets of all installed equipment.
- .4 Division 20 and Division 26 Contractors;
  - .1 Participate in the development and implementation of the LSFPCx program for the equipment and systems provided under Division 20 and 26, including the development of commissioning test plans.
  - .2 provide the services of qualified technician(s) who are familiar with the construction and operation of the system, to start-up and debug equipment and systems within the Division 20 and Division 26 scope of Work; ensure the qualified technician(s) are available and present during commissioning testing to complete the tests, make adjustments and to assist in problem resolutions,

- .3 should any equipment or system experience performance problems and/or if reconstruction or replacement of components is required, include for additional technician time for subsequent retesting of systems until required system performance is achieved,
- .5 Equipment suppliers;
  - .1 provide the services of manufacturers' service personnel to provide assistance with pre-start and initial start-up of the equipment, as required.

### **3.2 LSFP Commissioning Process**

- .1 LSFPCx mandate: to ensure that project life safety and fire protection systems perform interactively and in strict accordance with the design intent and Owner's operational needs as set forth in the Contract Documents and as required by the Building Code and Fire Code.
- .2 Implementation of the LSFPCx work includes, but is not limited to;
  - .1 chair and manage LSFPCx meetings during the construction period associated with the scheduling, coordination, and implementation of the LSFPCx activities within the overall construction program,
  - .2 developing a coordinated commissioning plan including test procedures,
  - .3 providing qualified personnel for implementing LSFPCx test procedures,
  - .4 start-up of equipment,
  - .5 conduct complete and thorough testing and documentation of the operation and performance of all LSFP equipment, sub-systems and systems,
  - .6 providing equipment, materials, and labor as necessary to correct construction and/or equipment deficiencies found during the LSFPCx process,
  - .7 preparation of a final LSFPCx report, including Schedule B as appended to the end of this section, documenting all test results and submit the report to the Owner and Consultant.

### **3.3 LSFPCx Schedule**

- .1 Completion of the LSFPCx program is a condition precedent for the application for occupancy permit. Schedule and complete the LSFPCx program in its entirety and provide the final report and test results to the Consultant at least one week prior to application for occupancy permit.
- .2 Develop a detailed LSFPCx commissioning schedule for consolidation into the main construction schedule, which identifies each equipment and system by task as well as system integration testing. Include;
  - .1 commissioning plan by each Division,
  - .2 equipment and systems start-up predecessors,
  - .3 time periods for pre-start and start-up testing, verification and validation testing for each equipment and system.

### **3.4 Commissioning Procedures**

- .1 Develop commissioning test procedures and reports for LSFP systems in accordance with the general requirements of Schedule A as appended to the end of this section, and which include, but are not limited to, the following requirements:
  - .1 a comprehensive functional matrix depicting all system inputs and associated output functions,
  - .2 the extent of systems to be tested under the direct supervision of the Division 20 and Division 26 contractors,
  - .3 test processes,



- .4 test scenarios developed to verify appropriate system responses to the functional matrix, and
  - .5 a test event schedule which identifies the tasks and the applicable stakeholders.
- .2 Test procedures are to include start-up verification checklists, performance/control validation checks, integrated system checks, and result records for each test.
- .3 Start-up verification checklists minimum requirements:
- .1 confirmation of authorities inspections, pre-start safety checks (where applicable), and coordination of required supporting systems,
  - .2 verify the installation of equipment, including design document requirements, manufacturer installation requirements, and other experience-related items,
  - .3 verification of the installation of the complete system,
  - .4 use of pre-printed manufacturer installation and start-up checklists are permitted and encouraged.
- .4 Performance/controls validation procedure:
- .1 specific test procedures and record documentation requirements for performance measurements and control validation of the various systems,
  - .2 step-by-step testing methodologies to prove the functional operation of control systems, for normal and abnormal operating conditions, and alarm conditions.
- .5 Integrated system testing procedure:
- .1 step-by-step test methodology to prove functional operation of integrated control systems, interlocks, and system response performance, including power failure re-start on generator power, and revert to normal power.

### **3.5 Operator Training**

- .1 In addition to training requirements described in other specification sections, provide the following training on LSFP system integration.
- .1 Include classroom instruction, delivered by competent instructors such as manufacturer installation and service personnel.
  - .2 Training topics to include;
    - (a) types of installed systems,
    - (b) overall integration structure,
    - (c) integration and interlocking hardware and wiring,
    - (d) workflow sequences between interlocked systems,
    - (e) system timing response,
    - (f) system initialization and resetting,
    - (g) different operating modes – automatic smoke control, manual fan operation, etc
    - (h) operation of smoke control station,
    - (i) service, maintenance, diagnostics and repairs,
    - (j) use of reports and logs,
    - (k) troubleshooting.
  - .3 Structure each session to start with the classroom instruction for the overall system, followed by hands-on instruction for each equipment, with the services of the manufacturers' representative as required. Demonstrate the start-up and shutdown of each system.
  - .4 Organize and schedule each training session to deliver the required instruction in an efficient and effective manner on a schedule agreed upon with the Owner. Allow for two (2) training sessions for each topic, separated by approximately one week each, to allow for Owner's shift coverage.

- .5 Structure each training session based on type of maintenance personnel attending the training session, i.e. electricians, general maintenance, controls technicians, etc. Develop the proposed training plan and obtain approval from the Owner before commencing the training.
  - .6 Complete the training as close to Substantial Performance as possible, so that the Owner's operations staff are prepared to operate the system after Substantial Performance is certified.
- .2 Provide training manuals which documents the above specified training topics.
    - .1 Provide training material hand-outs for each session.
    - .2 Collect training material and bind into separate binders.

### **3.6 Test Issues Log**

- .1 Maintain a record of faults, failures, and discrepancies discovered through the testing process in a deficiency test record, which lists;
  - .1 each separate finding and its corresponding resolution, including dates of discovery and resolution, and
  - .2 corrective action taken which describes the specific and detailed description of actions taken to remediate faults, failures, and discrepancies discovered during the testing process,
- .2 Manage the test log documentation, tracking and disposition of issues, and make a copy available of the test log to the Owner or Consultant when requested.
- .3 Verify the rectification of each fault, failure or discrepancy. Include in the test log the date the correction was verified and the person who conducted the verification.
- .4 At completion of LSFP commissioning, include the final test log with the LSFPcX completed commissioning report.

### **3.7 Test Equipment**

- .1 Furnish tools and equipment required during all stages of the LSFPcX processes.
- .2 Utilities (water, gas, fuel oil, electrical power) are provided by the Owner or as specified in the Contract documents.
- .3 Provide any test equipment and software required for pretesting and start-up testing, whether specified or not.
- .4 Manufacturer provides test equipment and personnel as required for the startup and testing of their equipment and assists in the LSFPcX process as needed.

### **3.8 Acceptance**

- .1 Any identified deficiencies will be reviewed by the Consultant to determine if correction of the deficiency is as a result of a defect in the equipment or installation and whether it is a major or minor deficiency.
- .2 Correction of all major deficiencies is required for application for occupancy permit.
- .3 If it is determined the performance deficiency is as a result of a defect in the equipment or its installation, rectify the deficiency and repeat the performance test until the required performance levels are achieved.

- .4 If it is determined the equipment or system has been constructed in accordance with the contract documents, the Owner shall decide whether to accept the performance as is, or, the Owner through the Consultant shall direct the installation contractor to make changes to the system as required to obtain performance levels which meet the design intent, and retest the system.

### **3.9 Close-out Documentation Deliverable**

- .1 At completion of the LSFP commissioning, submit three (3) bound hard-copies and an electronic copy in PDF format of the completed and approved commissioning program including;
  - .1 completed Schedule B,
  - .2 LSFPCx commissioning plan, including a copy of Schedule A,
  - .3 LSFPCx commissioning test procedures,
  - .4 completed LSFPCx commissioning test records,
  - .5 completed training log and a copy of the final training manuals,
  - .6 completed test issues log,
- .2 Provide two (2) back-up copies on CD or DVD media of control software code or configuration that has been modified as a result of the commissioning process,
- .3 The above requirements are in addition to any other requirements for general commissioning and submittals.

### **3.10 Schedule A**

- .1 Schedule A – *“General Requirements for Test Procedures”* follows.

### **3.11 Schedule B**

- .1 Schedule B – *“Life Safety and Fire Protection Commissioning Checklist Form”* follows.

**END OF SECTION**

## **4 SCHEDULE A**

### **GENERAL REQUIREMENTS FOR TEST PROCEDURES**

#### **4.1 General**

- .1 This Schedule A describes the performance objectives to be achieved by the coordinated commissioning of LSFP systems provided under Divisions 8, 20 and Division 26. A common objective for the procedures is to demonstrate compliance with the Building Code, the Fire Code and the design specification requirements.
- .2 Each test record shall identify;
  - .1 the location of each piece of equipment,
  - .2 the date of test,
  - .3 name of individuals conducting the test,
  - .4 the participants in the test by name and company, and
  - .5 the Owner as the acceptance authority.

#### **4.2 Fire Stopping**

- .1 Objective:
  - .1 Verification of the installation of fire stop materials where building services penetrate fire separations.
- .2 Procedures:
  - .1 Purpose written test procedure to inspect installation of fire-stopping materials, which includes identifying locations of materials by room, suitability of products used, and compliance with manufacturers listed instructions.
- .3 Records:
  - .1 Purpose written test record identifying location of fire-stopping. A fire-stopping manufacturer's inspection report is acceptable.

#### **4.3 Security Doors**

- .1 Objective:
  - .1 Verification that doors equipped with security locking devices, both mechanical and electrical, which are located in any means of egress will open to permit exiting from a building on total loss of power.
- .2 Procedure:
  - .1 Purpose written test procedure and record to verify all doors will open without power.
- .3 Record:
  - .1 A test record listing each security door and confirmation of door being able to open in the direction of exiting the building.

#### **4.4 Closures in Fire Separations and Smoke Separations**

- .1 Objective:

- .1 Verification of the installation and operation of fire dampers, smoke dampers and combination fire/smoke dampers in HVAC ductwork.
- .2 Procedures:
  - .1 Purpose written test procedure to verify the installation and operation control of;
    - (a) fire dampers in accordance with NFPA 80,
    - (b) smoke dampers in accordance with NFPA 105, and
    - (c) combination smoke and fire dampers in accordance with NFPA 80 and NFPA 105.
- .3 Records:
  - .1 Purpose written test record identifying inspection of each damper; includes damper location, damper type, summary of results for static and operating tests, accessibility, and maximum air velocity confirmation.

#### **4.5 Fire Alarm Systems**

- .1 Objective:
  - .1 Verification of the installation and operational performance of the fire alarm system in accordance with the requirements of CAN/ULC-S524.
  - .2 Verification performed by a third party other than the consultant or the installer.
- .2 Procedures:
  - .1 Tested and verified in accordance with CAN/ULC-S537.
  - .2 Purpose written test procedure to verify;
    - (a) joint annunciation and trouble conditions to connected buildings,
    - (b) annunciation to remote fire department services or security service, and
    - (c) where controlled by the Fire Alarm System, the operation of stairwell, vestibule, vertical service shaft and elevator pressurization fans and/or ventilation dampers.
- .3 Record:
  - .1 Fire alarm installation report in accordance with CAN/ULC-S537.
  - .2 Purpose written test record identifying each fan and damper used for pressurization, venting, or smoke control, including confirmation of operational control to the end device and monitoring of status of device at Fire Alarm System panel.

#### **4.6 Emergency Lighting and Control**

- .1 Objective:
  - .1 Verification of the emergency lighting system, including battery lighting units, and associated lighting control systems.
- .2 Procedures:
  - .1 Purpose written test procedure to verify emergency lighting levels, duration of battery lighting units, and bypass of lighting control systems.
- .3 Records:
  - .1 Purpose written test record identifying lighting levels and locations measured, battery lighting unit locations, and lighting control bypass locations; includes date of inspection and initials of qualified person conducting the inspection.

#### **4.7 Fire Alarm System and Security System Interconnection**

- .1 Objective:
  - .1 Verification of interconnection of the fire alarm system to security system devices.
- .2 Procedures:
  - .1 Purpose written test procedures to verify the release of security system devices including electromagnetic locking devices under fire alarm system control.
- .3 Records:
  - .1 Purpose written test record identifying each electromagnetic locking device and confirmation of their release function, including applicable fire alarm stage.

#### **4.8 Fire Alarm System and Building Automation System Interconnection**

- .1 Objective:
  - .1 Verification of communications between the Fire Alarm System and the Building Automation System, specifically with regards to identification of fire zone and resulting action by the Building Automation System.
- .2 Procedures:
  - .1 Purpose written test procedure to verify ;
    - (a) transmission of identification of each fire zone from the FAS to the BAS,
    - (b) transmission of confirmation of status of each emergency equipment device from the BAS to the FAS, and
    - (c) confirmation of intended functional operation (e.g., operation of fan).
- .3 Records:
  - .1 Purpose written test record identifying each fire detection zone, and resulting action on a end-to-end basis, including status confirmation device.

**END OF SCHEDULE "A"**

**5 SCHEDULE B**

**LIFE SAFETY AND FIRE PROTECTION COMMISSIONING CHECKLIST FORM**

This form is to be completed by the General Contractor/Construction Manager and the Division 20 and 26 contractors as applicable, and submitted with the final LSFPCx report.

Project Name:	Pleasant View Branch Renovation
Loring Project No.:	13175
General Contractor:	
Name:	
Signed:	
Mechanical Contractor:	
Name:	
Signed:	
Electrical Contractor:	
Name:	
Signed:	
Report Completion Date:	
Reviewed by Consultant	
Name:	
Signed:	

The following life safety and fire protection equipment and systems have been commissioned, and associated commissioning plan and test records are appended to this form. Contractor shall initial and date each item as and when completed.

No.	Task	Contractor Completion	
		Initials	Date
<b>1.0</b>	<b>General Items</b>		
1.1	<p>Fire stopping installed in accordance with manufacturer's instructions. Copy of instructions included in LSFP report.</p> <p><b>Division 20:</b> Name of specialist firm: _____</p> <p>Name of technician: _____</p> <p><b>Division 26:</b> Name of specialist firm: _____</p> <p>Name of technician: _____</p>		
1.2	Seismic engineer (if applicable) has reviewed the installation of seismic restraints of equipment and line systems and has submitted their general review report.		
1.3	All security doors (manual or remotely controlled) located in a means of egress will open under loss of power in the building to allow movement from the building to the outdoors.		
<b>2.0</b>	<b>Closures in Fire Separations and Smoke Separations</b>		
2.1	<p>Ductwork fire dampers:</p> <ul style="list-style-type: none"> <li>— installed with required clearances to openings, and secured with required retaining angles. Sealant has NOT been installed in clearance spaces.</li> <li>— Ductwork secured to damper sleeves with break-away joints.</li> <li>— Each damper linkage is accessible for testing; access doors provided in ductwork, access doors provided in drywall where applicable.</li> <li>— Each fire and smoke damper is operated to full closure and there are no obstructions under static conditions.</li> <li>— For dynamic dampers, dampers are rated for expected operating air velocity.</li> <li>— Fire, Smoke, and Fire/Smoke Damper Test Record is completed and attached.</li> </ul>		
2.2	<p>Motorized fire and smoke dampers:</p> <ul style="list-style-type: none"> <li>— Power is provided and tested for motorized fire dampers and smoke dampers.</li> <li>— Dampers are cycle tested while associated fan systems are operating; dampers fully close and re-open.</li> </ul>		
<b>3.0</b>	<b>Emergency Power Supply Systems</b>		
3.1	<p>Equipment supplier (generator, transfer switches) site testing documentation has been completed and submitted including:</p> <ul style="list-style-type: none"> <li>— 4 hour site heat run test at maximum rated capacity</li> <li>— 1 hour black-start load test</li> </ul>		
3.2	3 <sup>rd</sup> party pre-service inspection and witness test report completed and submitted		
3.3	<p>Power transfer timing after loss of power confirmed.</p> <ul style="list-style-type: none"> <li>— 15 seconds for non-health care facilities</li> <li>— 10 seconds for healthcare facilities</li> </ul>		



No.	Task	Contractor Completion	
		Initials	Date
3.4	Return-to-normal power transition test completed and supported systems restarts.		
3.5	Generator emission test report completed and submitted		
3.6	Coordination study affecting life safety power distribution system has been completed and implemented.		
3.7	Elevator operation on emergency power confirmed by function testing.		
3.8	Dedicated life safety distribution system does not have any non-life safety loads connected to it.		
3.9	Electrical safety authority having jurisdiction has completed final inspection of emergency power system.		
<b>4.0</b>	<b>Emergency Power Fuel Systems</b>		
4.1	Piping pressure testing completed and test record attached.		
4.2	Supervision monitoring to BAS or other supervised location installed and tested.		
4.2	Fuel oil piping flushed and cleaned.		
4.3	Fuel system operated and tested under full load conditions during emergency generator load test.		
4.4	Fuel level controls and safety devices tested for no-power fault condition operation.		
4.5	Where a day tank has less than 2 hr capacity, fuel piping between main supply tank and day tank is provided with a fire protection system, and redundant controls and power wiring has been fault tested.		
4.6	Field inspected by authority having jurisdiction, including field approval of applicable variances. A copy of the approved field inspection is attached.  Inspection Date: _____		
4.7	Fuel system filled at completion of work.		
<b>5.0</b>	<b>Fire Alarm Systems</b>		
5.1	Fire alarm verification test to ULC-S524 completed and test certificate issued.		
5.2	If VESDA system is used, system supplier test report or 3 <sup>rd</sup> party verification report has been issued.		
5.3	Door hold-open devices all release on FAS command (end-to-end test)		
5.4	Elevator recall to home position confirmed on signal from FAS (end-to-end test)		
5.5	Horn audibility level test completed and report submitted, and identifies the nature of the background ambient noise conditions at time of test.		
5.6	FAS supervision of fire protection systems (automatic sprinklers, standpipes and other fire suppression systems) including zone valve supervision and flow alarm devices, has been functional tested (end-to-end test) and test results included in the FAS verification report.		
<b>6.0</b>	<b>Fire Protection Systems</b>		
6.1	Standpipe systems have been installed and tested in accordance with NFPA 14.  "Contractor's Material and Test Certificate for Aboveground Piping" in accordance with NFPA 14 is completed and attached.		

No.	Task	Contractor Completion	
		Initials	Date
6.2	Sprinkler systems have been installed and tested in accordance with NFPA 13.  "Contractor's Material and Test Certificate for Aboveground Piping" in accordance with NFPA 13 is completed and attached.		
6.3	Pre-action sprinkler systems have been tested for applicable <ul style="list-style-type: none"> <li>— cross-zone detection,</li> <li>— interlocked or non-interlocked release</li> <li>— single or double interlocking release</li> </ul> Test record includes documentation of controller configuration for method of release control.		
6.4	Dry sprinkler systems have been tested for release of valve on loss of supervisory air pressure.		
6.5	Foam water spray systems have been installed and tested in accordance with NFPA 16.  Fire protection contractor's commissioning test report which includes NFPA 16, chapter 8 acceptance requirements, is completed and attached.		
6.6	Fine water spray systems have been installed and tested in accordance with NFPA 750.  Fire protection contractor's commissioning test report which includes NFPA 750, chapter 12 acceptance requirements, is completed and attached.		
6.7	Carbon Dioxide extinguishing systems have been installed and tested in accordance with NFPA 12.  Fire protection contractor's commissioning test report is completed and attached.		
6.8	Clean Agent suppression systems have been installed and tested in accordance with specification requirements.  Fire protection contractor's commissioning test report is completed and attached		
6.9	Fire pumps have been installed and tested in accordance with NFPA 20.  Fire protection contractor's commissioning test report which includes NFPA 20 chapter 14 acceptance testing and performance requirements, is completed and attached and as a minimum includes: <ul style="list-style-type: none"> <li>— Suction pipe flushing rate</li> <li>— Suction and discharge piping hydrostatic pressure test.</li> <li>— Field acceptance test record</li> <li>— Pump performance meets or exceeds certified pump curve</li> <li>— Pump flow test</li> <li>— Variable speed pressure limiting control (for VFD pumps)</li> <li>— Applicable measurement procedure documented</li> <li>— Pump controller acceptance test</li> <li>— Alternate power source test</li> <li>— Record drawings, test reports, manuals, special tools and spare parts provided to Owner.</li> </ul>		
6.4	Owner's representatives, insurers, and/or building authorities invited to system testing. <ul style="list-style-type: none"> <li>— Attendance sheets attached.</li> </ul>		

No.	Task	Contractor Completion	
		Initials	Date
	<ul style="list-style-type: none"> <li>• AHJ inspection report (if issued) attached.</li> </ul>		
6.5	Owner's operations staff have completed training on each system.		
<b>7.0</b>	<b>Smoke Control and Smoke Venting Systems</b>		
7.1	<p>Stairwell and vestibule pressurization fans and equipment have been adjusted to provide sufficient airflow to maintain:</p> <ul style="list-style-type: none"> <li>• minimum 12 Pa pressure differential across doors opening onto floors (with all doors closed which connect to stairwell or vestibule);</li> <li>• with pressurization fan operating, the door opening force into the stair or vestibule does not exceed 70 kN for combined air pressure and door closure force, and</li> <li>• where relief damper or other device is used, damper or device is adjusted to limit pressure rise in stair or vestibule.</li> </ul> <p>Pressure test record completed and attached.</p>		
7.2	Interconnected building vestibule venting dampers are installed and tested to open on command from fire alarm system or building automation system as applicable.		
7.3	Where vertical service spaces serving floors above and below the floor below the lowest exit storey is provided with a non-combustible smoke barrier at the floor level of the storey below the lowest exit storey.		
7.4	Where vertical service spaces serving floors above and below the floor below the lowest exit storey and which is provided with a vent located at the top of the vertical service space opening to atmosphere, the vent damper can be operated locally and be remotely operated from the smoke control panel.		
7.5	Where elevators serving floors above and below the floor below the lowest exit storey and is provided with a vent at the top of the elevator shaft, the vent damper can be operated locally and be remotely operated from the smoke control panel.		
7.6	<p>On-floor airflow tests for "Smoke venting to aid fire fighters" is completed and a minimum of 6 ACH achieved for each floor.</p> <p>Airflow measurement and test record completed and attached.</p>		
7.7	<p>Fan shut-down override control functions at the smoke control panel have been tested.</p> <p>Test record for each function completed and attached.</p>		
<b>8.0</b>	<b>Emergency Lighting and Control</b>		
8.1	Light levels of 1 foot candle (10 Lux) in exits have been measured and recorded in a test report. Location of each test is marked on a plan drawing.		
8.2	Emergency power lighting comes on within 15 seconds of loss of utility power.		
8.3	Battery power emergency lighting units are installed, connected to power circuits, and have been function tested.		
8.4	<p>Lighting control system interface with FAS:</p> <ul style="list-style-type: none"> <li>• Low ambient lighting increases to minimum emergency lighting levels on signal from FAS.</li> </ul>		

No.	Task	Contractor Completion	
		Initials	Date
<b>9.0</b>	<b>Kitchen Grease Hood Exhaust System</b>		
9.1	Kitchen-grease hood fire-suppression system installed and tested in accordance with manufacturer's written instructions.		
9.2	Where kitchen hood is provided with a fire damper, damper and linkage have been tested.		
9.3	Kitchen-grease duct is installed in accordance with the requirements of NFPA 96.		
9.4	Where energy recovery or pollution control equipment is installed in the kitchen grease duct, the ductwork installed downstream of such equipment is constructed as a grease duct in accordance with NFPA 96.		
9.5	For kitchen appliances which require a grease hood, the energy source is interlocked with the kitchen exhaust fan, and is tested to shut-down the fuel source when exhaust fan is shut-down.		
<b>10.0</b>	<b>Fire Alarm System and Fire Suppression Systems Interconnection</b>		
10.1	Fire suppression valves are monitored by the FAS and annunciate a trouble condition when moved from the open position.		
10.2	Grease hood suppression systems alarm to the FAS.		
10.3	Fire suppression system flow detection is wired to the FAS and generates an alarm on flow.		
<b>11.0</b>	<b>Fire Alarm System and Security System Interconnection</b>		
11.1	Release of magnetic-locks on stage 1 or stage 2 (depending on occupancy) fire alarm signal is function tested (end-to-end test).  Describe where locks release on Stage 1:  Describe where locks release on Stage 2:		
11.2	Release of magnetic-locks through associated pull station is function tested (end-to-end test).		
11.3	Release of magnetic-locks through the Fire Alarm control panel is function tested (end-to-end test).		
<b>12.0</b>	<b>Fire Alarm System and B.A.S. Interconnection</b>		
12.1	Direct FAS control* of HVAC equipment is confirmed for operational state (end-to-end test). Interlocking between FAS and fans and dampers, including override provisions, are completed and tested. <ul style="list-style-type: none"> <li>• each FAS command initiates required action at fan or damper,</li> <li>• FAS override of normal manual or automatic controls confirmed.</li> <li>• status confirmation of fan or damper state is achieved at Smoke Control Station.</li> </ul> Tested systems include: <ul style="list-style-type: none"> <li>• Shut-down of fans</li> <li>• Operation of motorized fire and smoke/fire dampers</li> <li>• Operation of smoke control equipment including fans and dampers</li> <li>• Operation of smoke venting equipment including</li> </ul> *Only applies where FAS directly controls HVAC equipment		

No.	Task	Contractor Completion	
		Initials	Date
12.2	<p>FAS zone annunciation and trouble signals to BAS system** confirmed and coordinated testing with BAS vendor completed.</p> <p>Interlocking between FAS and the BAS is installed and tested</p> <ul style="list-style-type: none"> <li>• FAS identifies fire zone to BAS</li> <li>• BAS implements corresponding smoke control functions applicable to the fire zone.</li> <li>• status confirmation of fan or damper state is achieved at Smoke Control Station.</li> </ul> <p>Test report for each zone command function completed and attached.</p> <p><i>**Only applies where BAS implements smoke control functions directly.</i></p>		
<b>13.0</b>	<b>Total Building Test</b>		
13.1	Total building test ("black-start" or "pull the plug" test) completed and test record attached.		

**END OF SCHEDULE "B"**

**Part 1 General**

**1.1 SUMMARY**

- .1 Section includes methods and procedures for demolishing, salvaging, recycling, and removing site items designated for removal, completely or in part, and for backfilling and compacting resulting trenches and excavations.
- .2 Coordinate with requirements indicated on Drawings.

**1.2 RELATED REQUIREMENTS**

- .1 Section 03 01 30 – Concrete Repairs.
- .2 Division 31 – Earthwork.
- .3 Division 32 – Exterior Improvements.
- .4 Division 33 – Utilities.

**1.3 REFERENCES**

- .1 Canadian Federal Legislation
  - .1 Motor Vehicle Safety Act (MVSA), 1995
  - .2 Hazardous Materials Information Review Act, 1985
- .2 CSA Group
  - .1 CSA S350 M1980 (R2003), Code of Practice for Safety in Demolition of Structures.
- .3 National Fire Protection Association (NFPA)
  - .1 NFPA 241-2022, Standard for Safeguarding Construction, Alteration, and Demolition Operations.
- .4 Provincial Legislation
  - .1 Building Code Act and Regulations (Ontario).
  - .2 Legislation specific to Authority having Jurisdiction for work governed by this Section.
- .5 Municipal Requirements
  - .1 Applicable City of Toronto by-laws and ordinances.

**1.4 DEFINITIONS**

- .1 Demolition: rapid destruction of building following removal of hazardous materials.
- .2 Deconstruction: systematic dismantling of structure in a manner that achieves safe removal/disposal of hazardous materials and maximum salvage/recycling of materials.
  - .1 Ultimate objective is to recover potentially valuable resources while diverting from landfill what has traditionally been significant portion of waste system.
- .3 Hazardous Materials: dangerous substances, dangerous goods, hazardous commodities and hazardous products, may include but not limited to: asbestos, lead-based paint, PCBs, CFCs, HCFCs, poisons, corrosive agents, flammable substances, ammunition, explosives, radioactive substances, or other material that can endanger human health or wellbeing or environment if handled improperly.
- .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, cleaning, treating, and reconstituting solid waste and other discarded materials for purpose of using in altered form.
  - .1 Recycling does not include burning, incinerating, or thermally destroying waste.
- .6 Reuse: repeated use of product in same form but not necessarily for same purpose.  
Reuse includes:
  - .1 Salvaging reusable materials from remodelling projects, before demolition stage, for resale, reuse on current project or for storage for use on future projects.
  - .2 Returning reusable items including pallets or unused products to vendors.
- .7 Salvage: removal of structural and non-structural materials from deconstruction/ disassembly work for purpose of reuse or recycling.
- .8 Waste Management Coordinator (WMC): contractor representative responsible for supervising waste management activities as well as coordinating related, required submittal and reporting requirements.
- .9 Waste Audit (WA): detailed inventory of materials in building. Involves quantifying by volume/weight amounts of materials and wastes generated during construction, demolition, deconstruction, or renovation project. Indicates quantities of reuse, recycling and landfill.
- .10 Waste Reduction Workplan (WRW): written report that addresses opportunities for reduction, reuse, or recycling of materials. WRW is based on information acquired from WA.

## **1.5 ADMINISTRATIVE REQUIREMENTS**

- .1 Pre-Construction Meeting: Arrange a pre-construction meeting attended by Contractor's key personnel, Subcontractors' representatives, and Consultant to discuss the following:
  - .1 Verify project requirements
  - .2 Review demolition conditions
  - .3 Coordination with other Subcontractors affected by work of this Section
  - .4 Examine existing site conditions adjacent to demolition work, prior to start of Work
  - .5 Waste reporting requirements

## **1.6 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Certificates: Submit copies of certified weigh bills, bills of lading or receipts from authorized disposal sites and re-use and recycling facilities for material removed from site on weekly basis.

## **1.7 QUALITY ASSURANCE**

- .1 Regulatory Requirements: Perform work as follows; use most restrictive requirements where differences occur between the municipal, provincial, and federal jurisdictions:
  - .1 Provincial and Federal Requirements: Perform work in accordance with governing environmental notification requirements and regulations of the Authority Having Jurisdiction.
  - .2 Municipal Requirements: Perform hauling and disposal operations in accordance with regulations of Authority Having Jurisdiction.

## **1.8 DELIVERY, STORAGE AND HANDLING**

- .1 Storage and Protection.
  - .1 Protect existing items designated to remain and items designated for salvage. In event of damage to such items, immediately replace or make repairs to acceptance of Consultant and at no cost to the Owner.
  - .2 Remove and store materials to be salvaged, in manner to prevent damage.
  - .3 Store and protect in accordance with requirements for maximum preservation of material.
  - .4 Handle salvaged materials as new materials.

## **1.9 SITE CONDITIONS**

- .1 Protect open excavations in accordance with requirements of the Authorities Having Jurisdiction.
- .2 Protect existing site features to remain or identified for salvage or re-use; make repairs and restore to a similar condition to existing where damage to these items occurs as directed by the Consultant and at no cost to Owner:
  - .1 Remove and store salvaged materials to prevent damage.
  - .2 Store and protect salvaged materials as required for maximum preservation of material.
  - .3 Handle salvaged materials the same as new materials.
- .3 Perform selective site demolition work to prevent adverse effects to adjacent watercourses, groundwater, and wildlife, and to prevent excess air and noise pollution:
  - .1 Do not dispose of volatile waste materials including but not limited to, mineral spirits, oil, petroleum based lubricants, or toxic cleaning solutions into watercourses, storm or sanitary sewers; follow proper disposal procedures throughout the project.
  - .2 Do not pump water containing suspended materials into watercourses, storm, or sanitary sewers or onto adjacent properties.
  - .3 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with Authorities Having Jurisdiction.
- .4 Protect existing site features and structures, trees, plants and foliage on site that are to remain, and adjacent properties.
- .5 Notify Consultant before disrupting adjacent building access or services.

## **Part 2 Products**

### **2.1 EQUIPMENT**

- .1 Use equipment suitable for work required.
- .2 Leave machinery running only while in use, except where extreme temperatures prohibit shutting machinery down.

## **Part 3 Execution**

### **3.1 PREPARATION**

- .1 Inspect site with Consultant and verify extent and location of items designated for removal, disposal, alternative disposal, recycling, salvage and items to remain.



- .2 Locate and protect utilities. Preserve active utilities traversing site in operating condition.
- .3 Notify and obtain approval of utility companies and Owner before starting demolition.
- .4 Immediately notify Consultant and utility company concerned in case of damage to any utility or service, designated to remain in place.
- .5 Immediately notify the Consultant should uncharted utility or service be encountered, and await instruction in writing regarding remedial action.

### **3.2 PROTECTION**

- .1 Prevent movement, settlement, or damage to adjacent structures, utilities, and landscaping features and parts of building to remain in place. Provide bracing and shoring required.
- .2 Keep noise, dust, and inconvenience to occupants of adjacent properties to a minimum.
- .3 Protect adjacent property systems, services, and equipment.
- .4 Provide temporary dust screens, covers, railings, supports, and other protection as required to meet regulations and requirements of authorities having jurisdiction.
- .5 Do Work in accordance with the Occupational Health and Safety Act of Ontario, and applicable Regulations.

### **3.3 REMOVAL OPERATIONS**

- .1 Remove items as indicated; refer to Drawings. Salvage removed items for reuse as indicated.
- .2 Do not disturb items designated to remain in place.
- .3 Removal of Pavements, Curbs and Gutters:
  - .1 Square up adjacent surfaces to remain in place by saw cutting or other method approved by Consultant.
  - .2 Protect adjacent joints and load transfer devices.
  - .3 Protect underlying and adjacent granular materials.
- .4 Prevent contamination with base course aggregates, when removing asphalt pavement for subsequent incorporation into hot mix asphalt concrete paving,
- .5 Excavate minimum 300 mm below pipe inverts, when removing pipes under existing or future pavement area.
- .6 Remove only trees and other plant material designated for removal, and approved in writing by Consultant; prevent damage to trees and plant material to remain; obtain written permission from Consultant prior to removal of trees or plant material not identified on Drawings:
  - .1 Sell or donate trees identified for removal and that are healthy and marketable; remove trees that are not healthy or marketable using alternate disposal methods.
  - .2 Grind, chip, or shred other vegetation for mulching and composting.
- .7 Disposal of Material: Dispose of materials not designated for salvage or reuse at authorized facilities.

### **3.4 SELECTIVE DEMOLITION**

- .1 Demolish and remove existing construction only to extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

- .1 Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on next lower level.
- .2 Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
- .3 Cut or drill from exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
- .4 Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame cutting operations. Maintain fire watch and portable fire suppression devices during flame cutting operations.
- .5 Maintain adequate ventilation when using cutting torches.
- .6 Remove decayed, vermin infested, or otherwise dangerous or unsuitable materials and promptly dispose of off site.
- .7 Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
- .8 Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
- .9 Dispose of demolished items and materials promptly.
- .10 Return elements of construction and surfaces that are to remain to condition existing before selective demolition operations began.
- .2 Comply with Project Manager's requirements for using and protecting elevators, stairs, walkways, loading docks, building entries, and other building facilities during selective demolition operations.
- .3 Removed and Reinstalled Items:
  - .1 Clean and repair items to functional condition adequate for intended re use. Paint equipment to match new equipment.
  - .2 Protect items from damage during storage.
  - .3 Reinstall items in locations indicated.
  - .4 Comply with installation requirements for new materials and equipment.
  - .5 Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- .4 Existing Items to Remain:
  - .1 Protect construction indicated to remain against damage and soiling during selective demolition.
  - .2 Items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.
- .5 Concrete:
  - .1 Demolish in small sections.
  - .2 Cut concrete full depth at junctures with construction to remain and at regular intervals, using power driven saw, then remove concrete between saw cuts.
  - .3 Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete indicated for selective demolition.

- .4 Neatly trim openings to dimensions indicated.
- .6 Concrete Slab Reinforcing:
  - .1 Locate location of reinforcing steel in concrete slabs prior to cutting or coring using non-destructive, non-ionizing radio frequency locators.
  - .2 Core concrete slabs to avoid reinforcing steel, electrical conduit, or water pipes; adjust core location and coordinate with Project Manager where slab features interfere with core drilling.
  - .3 Notify Project Manager immediately for further instructions where coring or cutting will damage existing slab features.
- .7 Concrete Slabs on Grade: Saw cut perimeter of area to be demolished, then break up and remove.
- .8 Below Grade Construction: Demolish foundation walls and other below grade construction including, but not limited to, the following:
  - .1 Basements.
  - .2 Foundation walls.
  - .3 Footings.
- .9 Masonry:
  - .1 Demolish in small sections.
  - .2 Cut masonry at junctures with construction to remain, using power driven saw, then remove masonry between saw cuts.
- .10 Roofing: Remove no more existing roofing than can be covered in one day by new roofing. Refer to applicable specification section for new roofing requirements.
- .11 Air Conditioning Equipment: Remove equipment without releasing refrigerants.

### **3.5 RESTORATION**

- .1 Restore areas and existing works outside areas of demolition to conditions that existed prior to beginning of Work.
- .2 Comply with the requirements of Section 01 73 29 – Cutting and Patching.
- .3 Make good floor, wall, and ceiling finishes to remain that have been damaged by demolition operations. Repair materials shall be of highest quality and finished work shall match appearance of adjacent finishes. Repair substrates to full structural integrity, level and flush with adjacent substrate surfaces.
- .4 Make good fire separations in compliance with Code requirements, to Section 07 84 00 – Firestopping and Smoke Seals. Firestop holes to maintain required fire separation rating.
- .5 Floors and Walls:
  - .1 Where walls or partitions that are demolished extend from one finished area into another, patch and repair floor and wall surfaces in the new space.
  - .2 Provide a level and smooth surface having uniform finish colour, texture, and appearance.
  - .3 Remove existing wall coverings and replace with new materials, if necessary, to achieve uniform colour and appearance.
  - .4 Patch with durable seams that are as invisible as possible.
  - .5 Provide materials and comply with installation requirements specified in other Sections of these Specifications.
  - .6 Where patching occurs in a painted surface, apply primer and intermediate paint coats over patch and apply final paint coat over entire unbroken surface

containing patch. Provide additional coats until patch blends with adjacent surfaces.

- .7 When requested, test and inspect patched areas after completion to demonstrate integrity of installation.
- .6 Ceilings: Patch, repair, or re-hang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

### **3.6 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning. 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. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3 Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 - Construction Waste Management.

### **3.7 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 01 73 29 – Cutting and Patching.
- .2 Section 02 41 19 – Selective Demolition.
- .3 Section 09 05 23 – Common Work Results for Flooring Preparation.

**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, and Commentary.
  - .2 ACI 301-16, Specification for Structural Concrete.
  - .3 ACI 302.1R-15, Guide for Floor and Slab Construction.
- .2 ASTM International (ASTM)
  - .1 ASTM C1107/C1107M-20, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
  - .2 ASTM D1751-18, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
  - .3 ASTM D1752-18, Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
- .3 CSA Group (CSA)
  - .1 CSA A23.1:19/A23.2:19, Concrete materials and methods of concrete construction / Test methods and standard practices for concrete.
- .4 International Concrete Repair Institute (ICRI)
  - .1 ICRI Technical Guideline No. 310.2R-2013, Guideline for Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair.

**1.3 QUALITY ASSURANCE**

- .1 Concrete work shall conform to CSA A23.1/CSA A23.2.

**1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit manufacturer's printed product literature, specifications and data sheet for each product specified.
- .2 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 ENVIRONMENTAL REQUIREMENTS**

- .1 Temporary lighting: Minimum 1200 W light source, placed 2.5 m above floor surface, for each 40 sq m of floor being treated.
- .2 Electrical power: Provide sufficient electrical power to operate equipment normally used during construction.

- .3 Work area: Make work area watertight protected against rain and detrimental weather conditions.
- .4 Temperature: Maintain ambient temperature of not less than 10°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: Ensure concrete substrate is within moisture limits prescribed by roofing membrane manufacturer.

## 1.1 WARRANTY

- .1 For the work of this Section, the 12-month warranty period prescribed in Contract is extended to 24 months.

## Part 2 Products

### 2.1 MATERIALS

- .1 Concrete Repair Mortar - Vertical and Overhead Locations: polymer-modified, cementitious, two-component, fast-setting mortar with migrating corrosion inhibitor added. Formulated for trowel application, designed especially for repair of overhead and vertical surfaces at temperatures between -5 and 10°C (23 and 50°F).
  - .1 Minimum bond strength at 28 days shall be 17 MPa; minimum compressive strength at 28 days shall be 50 MPa; minimum tensile splitting strength at 21 days shall be 5 MPa.
  - .2 Basis-of-Design:
    - .1 SikaTop®-123 PLUS.
- .2 Concrete Repair Mortar - Vertical and Horizontal Locations: polymer-modified, cementitious, two-component, fast-setting mortar with migrating corrosion inhibitor added. Formulated for trowel application, designed for use as structural repair material at parking structures at vertical and horizontal surfaces at temperatures between -5 and 10°C (23 and 50°F).
  - .1 Minimum bond strength at 28 days shall be 19 MPa; minimum compressive strength at 28 days shall be 50 MPa; minimum tensile splitting strength at 21 days shall be 5.5 MPa.
  - .2 Basis-of-Design:
    - .1 SikaTop®-122 PLUS.
- .3 Featheredging Materials: polymer-modified, with migrating corrosion inhibitor added, cementitious, two-component, fast-setting, trowel or rub applied, thin-coat mortar for concrete repairs, for skin coats, filling bugholes, honeycombing and for feather edging.
  - .1 Minimum bond strength at 28 days shall be greater than concrete; minimum compressive strength at 28 days shall be 35 MPa.
  - .2 Basis-of-Design:
    - .1 SikaTop®-121 PLUS.
- .4 Structural Grout: high-performance, non-shrink, fluid, cementitious grout with silica fume and two-stage shrinkage mechanism; compensating for shrinkage in both the plastic and the hardened states. It shall be non-metallic, contain no chlorides and able to be placed at various consistencies ranging from flowable to fluid by adjusting quantity of mix water.
  - .1 Minimum compressive strength to CAN/CSA A23.2 at 28 days shall be 62 MPa; Bond to steel: > 0.2 MPa; Meets ASTM C1107, Grade C type grouts.

- .2 Basis-of-Design:
  - .1 SikaGrout®-212 HP.

### **Part 3 Execution**

#### **3.1 EXAMINATION**

- .1 Verify that concrete surfaces are ready to receive work of this Section.

#### **3.2 GENERAL**

- .1 Comply with manufacturers' printed installation instructions and illustrations, technical datasheets, and specifications.
- .2 Perform GPR or other approved scanning procedure to determine locations of existing reinforcing prior to cutting, coring, and drilling.
- .3 Apply repair materials as required to result in a solid, uniform, smooth, flat concrete surface, with cracks, grooves and other damage repaired. Fill in hollows, low spots, and grooves, and grind high spots, bumps and peaks to produce smooth, level floors. Smooth out rough areas. Finish floor patches and repairs to a magnesium trowel finish.
- .4 Floor level tolerances:
  - .1 Apply repair materials as required to achieve a smooth, level floor having a straightedge value of  $\pm 3$  mm over 3050 mm. Straight edge testing on site will be performed by Consultant to verify compliance.
- .5 Prepare concrete in compliance with ICRI Technical Guideline No. 310.2R recommendations.

#### **3.3 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 Consultant's permission.
- .2 Defective Areas: where patches are allowed, repair and patch areas to match surrounding areas in texture and colour.

#### **3.4 FORMED CONCRETE**

- .1 The basic treatment of all formed concrete surfaces, exposed or unexposed, shall be to CSA A23.1/A23.2.
- .2 Do not repair honeycomb areas until inspected by Consultant. Fill honeycomb in non-structural elements with mortar; repair honeycomb in structural elements in accordance with CSA Standard.

#### **3.5 FILLING**

- .1 Apply thick bed mortar or self-levelling and smoothing underlayment as required to bring slab to within specified floor level tolerances, working into all nooks, cracks and spaces to fill flush with top of floor slab. Trowel to a smooth polished surface.
- .2 Use featheredging method to fill and level depressions up to 19 mm (5/8") in thickness, to fill cracks, holes, chips etc. where topping must be finished to a featheredge. Apply in strict accordance to manufacturer's instructions.

- .3 At juncture of resilient flooring and exposed concrete to provide feather edging for a distance of 150 mm (6") from + 3 mm to 0 mm (+ 1/8" to 0"), as indicated.
- .4 Prepare substrate and install as per manufacturers recommendations, smooth finish.

### **3.6 PATCHING**

- .1 Patch core holes, and chipped or gouged concrete surfaces using specified materials.
- .2 Mix and install materials in compliance with manufacturer's instruction.

### **3.7 ANCHORING IN EXISTING CONCRETE**

- .1 Perform GPR or other approved scanning procedures to determine locations of existing reinforcing in existing concrete elements before installing anchor systems. Advise Consultant of findings before proceeding with the Work, and revise penetration and anchor locations as required and directed by Consultant.
- .2 Core holes and set anchors in structural grout as required. Install per grout manufacturer's specifications.

### **3.8 EXISTING SLAB CLEANING AND PREPARATION**

- .1 Prepare concrete surfaces as recommended by ICRI Technical Guideline No. 310.2R.
- .2 Scarify concrete slab at areas to receive concrete repair materials and toppings.
- .3 Scarify concrete slab at areas to receive resilient and/or tile floor finishes.
- .4 Clean floors as required and specified by floor finish manufacturer.
- .5 Vacuum clean and remove dust and debris. Leave slab clean, ready for new applications. Do not use power wash equipment.

### **3.9 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning. 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. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3 Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 – Waste Management and Disposal.

### **3.10 PROTECTION**

- .1 Protect installed products and components from damage during construction. Prohibit traffic on floor for 48 hours after installation.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**END OF SECTION**



**Part 1 General**

**1.1 SUMMARY**

- .1 Section includes finishing requirements for cast-in-place concrete construction.

**1.2 RELATED REQUIREMENTS**

- .1 Division 03 Cast-in-Place Concrete.

**1.3 REFERENCES**

- .1 American Concrete Institute (ACI)
  - .1 ACI 117-10 (R2015), Specification 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, Guide for Concrete Floor and Slab Construction.
  - .4 ACI 302.2R-06, Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.
- .2 ASTM International (ASTM)
  - .1 ASTM C309-19, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
  - .2 ASTM D1751-18, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
  - .3 ASTM D1752-18, Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
  - .4 ASTM E1155-14 Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers.
  - .5 ASTM E1486-14, Standard Test Method for Determining Floor Tolerances Using Waviness, Wheel Path and Levelness Criteria.
  - .6 ASTM F710-19e1, Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
- .3 CSA Group (CSA)
  - .1 CAN/CSA A23.1:19/A23.2:19, Concrete materials and methods of concrete construction / Test methods and standard practices for concrete.
- .4 International Concrete Repair Institute (ICRI)
  - .1 ICRI 3102R13, Guideline for Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair.
- .5 South Coast Air Quality Management District (SCAQMD), California State
  - .1 SCAQMD Rule 1113-16, Architectural Coatings.

**1.4 CONCRETE FLOOR FINISHING CONFERENCE**

- .1 Schedule meeting before concreting processes commence.
- .2 Where concrete floor areas will receive flooring materials, such as epoxy coatings, hard tile, resilient flooring, and so on, arrange a meeting between the affected Division 09 trades and the concrete finishing trade to ensure requirements for flatness and smoothness are communicated, coordinated, and met.

- .3 Meeting shall address and propose procedures to address surface irregularities such as protrusions and depressions so that floor flatness and smoothness meet the requirements of the Division 09 flooring trades.
- .4 Record meeting outcomes and recommended procedures, and submit an electronic copy to the Contractor and Consultant within 3 days after the meeting.

## **1.5 ACTION AND INFORMATIONAL 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 Include application instructions for concrete floor treatments.
- .2 Submit written declaration that components used are compatible and will not adversely affect finished flooring products and their installation adhesives.
- .3 Mix designs shall be prepared by a Professional Engineer (P.Eng.) licenced to practice in Ontario, and engaged for those purposes by the Contractor. Mix designs shall be stamped and signed by Contractor's P.Eng.. Coordinate with the Work of Division 03 Cast-in-Place Concrete.
- .4 Submit closeout data in accordance with 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.

## **1.6 QUALITY ASSURANCE**

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Minimum 2 weeks prior to starting concrete finishing work, provide proposed quality control procedures for review by Consultant.
- .3 Mock-Ups:
  - .1 Provide required mock-up in accordance with Section 01 45 00 – Quality Control.
  - .2 Construct mock-ups as follows:
    - .1 Finished concrete stairs and benches as designated by Consultant.
  - .3 Consultant will evaluate mock-ups and may request changes or variation to materials.
  - .4 Accepted mock-ups will form standard for remaining concrete finishing work.

## **1.7 ENVIRONMENTAL REQUIREMENTS**

- .1 Temporary lighting: Minimum 1200 W light source, placed 2.5 m above floor surface, for each 40 m<sup>2</sup> of floor being treated.
- .2 Electrical power: Provide sufficient electrical power to operate equipment normally used during construction.
- .3 Work area: Make the work area watertight protected against rain and detrimental weather conditions.
- .4 Temperature: Maintain ambient temperature of not less than 10°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: Ensure concrete substrate is within moisture limits prescribed by flooring manufacturer.

- .6 Safety: 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 Concrete finishing: to CSA A23.1-14/A23.2.
- .2 Non-Critical Floor Slabs: Floors having an overall F-number of FF 20 x FL 15; similar to CSA A23.1 Class A Slab Finishing.
- .3 Light Duty Industrial or Commercial Floors: Floors having an overall F-number of FF 25 x FL 20; similar to CSA A23.1 Class B Slab Finishing.
- .4 Flat Institutional or Commercial Floors: Floors having an overall F-number of FF 35 x FL 25; similar to CSA A23.1 Class C Slab Finishing.
- .5 Have floor flatness monitored, measured and supervised during finishing processes by a professional engineer (P.Eng.) licenced to practice in Ontario.

### **2.2 LEVELLING, SLOPING, PATCHING AND REPAIRING MATERIALS**

- .1 Underlayment / Topping: rapid setting, rapid hardening, polymer modified, pre-blended, cement based mortar bed and sloping mortar for leveling and ramping up to 3" on horizontal substrates; up to 5" thick in confined areas such as trenches. Product shall be designed to set to a walkable hardness within 1 to 2 hours after application.
  - .1 Standard of Acceptance:
    - .1 CUSTOM® SpeedSlope® - Rapid Setting Sloping Mortar, by Custom® Building Products, or approved equivalent sloping cementitious underlayment.
- .2 Concrete Repair Mortar - Vertical and Overhead Locations: polymer-modified, cementitious, two-component, fast-setting mortar with migrating corrosion inhibitor added. Formulated for trowel application, designed especially for repair of overhead and vertical surfaces at temperatures between -5 and 10°C (23 and 50°F).
  - .1 Minimum bond strength at 28 days shall be 17 MPa; minimum compressive strength at 28 days shall be 50 MPa; minimum tensile splitting strength at 21 days shall be 5 MPa.
  - .2 Basis-of-Design:
    - .1 SikaTop®-123 PLUS.
- .3 Concrete Repair Mortar - Vertical and Horizontal Locations: polymer-modified, cementitious, two-component, fast-setting mortar with migrating corrosion inhibitor added. Formulated for trowel application, designed for use as structural repair material at parking structures at vertical and horizontal surfaces at temperatures between -5 and 10°C (23 and 50°F).
  - .1 Minimum bond strength at 28 days shall be 19 MPa; minimum compressive strength at 28 days shall be 50 MPa; minimum tensile splitting strength at 21 days shall be 5.5 MPa.
  - .2 Basis-of-Design:

- .1 SikaTop®-122 PLUS.
- .4 Featheredging Materials: polymer-modified, with migrating corrosion inhibitor added, cementitious, two-component, fast-setting, trowel or rub applied, thin-coat mortar for concrete repairs, for skin coats, filling bugholes, honeycombing and for feather edging.
  - .1 Minimum bond strength at 28 days shall be greater than concrete; minimum compressive strength at 28 days shall be 35 MPa.
  - .2 Basis-of-Design:
    - .1 SikaTop®-121 PLUS.
- .5 Structural Grout: high-performance, non-shrink, fluid, cementitious grout with silica fume and two-stage shrinkage mechanism; compensating for shrinkage in both the plastic and the hardened states. It shall be non-metallic, contain no chlorides and able to be placed at various consistencies ranging from flowable to fluid by adjusting quantity of mix water.
  - .1 Minimum compressive strength to CAN/CSA A23.2 at 28 days shall be 62 MPa; Bond to steel: > 0.2 MPa; Meets ASTM C1107, Grade C type grouts.
  - .2 Basis-of-Design:
    - .1 SikaGrout®-212 HP.
- .6 Supply fast-set structural grout, including type 304 stainless steel drop-in anchors and threaded rod to anchor furniture and other fixed equipment. Confirm acceptability of selections prior to ordering and distribution.

## **2.3 CURING-SEALING COMPOUNDS**

- .1 Interior grade curing-sealing compound; water-based: transparent, to ASTM C309 Type 1, Class A, VOC-compliant.
  - .1 Standard of Acceptance:
    - .1 Florseal WB-18, by Sika Canada Inc., or approved equivalent.

## **2.4 CONCRETE SEALERS**

- .1 Clear - Standard of Acceptance:
  - .1 Sikagard® High Gloss Clear Sealer, by Sika Canada, or approved equivalent.

## **2.5 MIXES**

- .1 Mixing, ratios and application in accordance with manufacturer's instructions and approved mix designs.
- .2 Coordinate with Division 03 cast-in-place concrete and Division 32 site concrete work.

## **2.6 ACCESSORIES**

- .1 Water: potable.
- .2 Slab-on-Grade Joint Filler: self-leveling, 100% solids, flexible, two component, rapid curing polyurea elastomer joint filler:
  - .1 Standard of Acceptance:
    - .1 VersaFlex SL/75, VersaFlex Incorporated, Sika® Loadflex-524 EZ, or approved equivalent.
- .3 Slab-to-Foundation Perimeter Joint Filler: two-part, pourable consistency, premium-grade, moisture-insensitive, semi-rigid epoxy joint filler formulation. When cured, it is semi-rigid, with a Shore D Hardness of 60:
  - .1 Standard of Acceptance:
    - .1 REZI-WELD FLEX, W. R. Meadows, or approved equivalent.

## **Part 3 Execution**

### **3.1 SAFETY**

- .1 Comply with the Province of Ontario Occupational Health and Safety Act and applicable regulations made under the Act, CSA S350, and NFPA 241.
- .2 Saw cutting of placed and cured concrete, if required at all, shall be carefully managed with strict location and depth control in consultation with the structural engineer (P.Eng.) of record. Use non-destructive means to locate structural members, reinforcement bars, conduits and pipe before considering or planning any saw cutting or coring operations. Do not saw cut near columns and beams. Confirm cutting locations with the structural engineer (P.Eng.) of record before cutting (provide minimum 72 hours for engineer's review).

### **3.2 GENERAL CONCRETING PROCEDURES**

- .1 Comply with requirements of Section 03 30 00 – Cast-in-Place Concrete, and as follows:
  - .1 Avoid over-troweling.
  - .2 Do not finish concrete surfaces when bleed water is present.
  - .3 Keep concrete continuously moist for at least 24 hours.
  - .4 Never add water on site to plant-supplied concrete during placement or finishing.
  - .5 Maintain concrete above 10°C during and for three days after concrete placement.
  - .6 Protect fresh concrete from rapid drying, direct sun and wind.
  - .7 Supply and place layer of sand over vapour retarder to allow some moisture loss at bottom of slab.
  - .8 Never place concrete on frozen substrate.
  - .9 Locate mesh no more than 50 mm below surface of slab. Lap mesh at least one square. Use chairs to support mesh at the correct height during concrete placement (do not use the hook and pull method).
  - .10 Ensure the minimum concrete cover over reinforcing steel is at least 76 mm.
  - .11 Lap steel at least 24 bar diameters, but not less than 300 mm.
  - .12 Install insulation at perimeter of grade beams, and insulate exterior vertical face of grade beams. Refer to Section 07 21 13.01 – Foundation Board Insulation for insulation specifications.

### **3.3 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 required.

### **3.4 MEASURING**

- .1 Classification of Surface Irregularities:
  - .1 Local surface irregularities are classified as abrupt or gradual.
  - .2 Abrupt irregularities mean offsets or fins caused by displaced or misplaced form sheeting, lining, or form sections or by defective form lumber, or improper screeding or trowelling. Abrupt irregularities also include any isolated irregularity in which the maximum dimension of the irregularity perpendicular to the surface is greater than the maximum dimension of the irregularity in the plane of the surface.
  - .3 Gradual irregularities mean bulges or depressions resulting in gradual changes in the concrete surface.

- .2 Measuring Surface Irregularities:
  - .1 Measure irregularities as deviations from a surface, with a straightedge or shaped template authorized by the Consultant. Move the position of the straightedge about the irregularity as necessary to locate the point where the maximum height and slope exists. Provide 3 m long straightedges for taking measurements.
  - .2 For irregularities protruding above surface, place one end of straightedge on top of irregularity. The height of irregularity is determined by measuring the gap perpendicular to straightedge. The length of irregularity is determined by measuring the distance along straightedge from gap to point of contact at top of irregularity.
  - .3 For irregularities extending below the surface, place the straightedge across the irregularity. The height of the irregularity is determined by measuring the gap between the straightedge and the surface. The length of the irregularity is the distance along the straightedge from the gap to the point of contact with the surface.
  - .4 Check finished concrete surfaces immediately after final working, and again at the end of the curing period and verify their compliance with the specified tolerances.
- .3 Correct irregularities using the specified levelling and patching materials as required to meet the floor flatness and smoothness of Division 09 flooring trades, and as agreed during the

### **3.5 REPAIR OF CAST-IN-PLACE CONCRETE**

- .1 Examine all concrete surfaces and clearly mark out defective areas to be repaired. Obtain the Consultant's authorization of the delineated repair areas and the proposed method and equipment to be used for the repairs prior to commencing with the work.
- .2 Completely remove all damaged, deteriorated, loosened, or unbonded concrete down to sound concrete. Remove micro-fractured surfaces resulting from the initial concrete removal process.
- .3 Sawcut the perimeter of areas requiring concrete removal and replacement perpendicular to the surface to a minimum depth of 25 mm. Do not use any repair method that produces a featheredge.
- .4 Prior to filling, provide a repair area that is clean and saturated surface dry except where the repair technique requires a dry surface.
- .5 Use dry-pack mortar for filling holes left by the removal of form ties, for narrow grooves cut for repair of cracks, and for repair of small honeycombed areas where lateral restraint can be obtained. Pre-soak the repair area, allow the area to attain a saturated surface dry condition, and apply a cement paste bond coat prior to filling with mortar. Dry-pack mortar shall consist of 1 part Portland cement to 2.5 parts sand, by mass.
- .6 At exposed exterior walls, supply and install recessed grey plastic plugs at tie holes.
- .7 Mortar filling with a polymerized mortar placed under pressure by use of a mortar gun or head box may be used for repairing defects that are too wide for dry-pack filling, too shallow for concrete placement, and no deeper than the far side of the reinforcement that is nearest the surface. Treat the surface of the concrete to be repaired with a compatible acrylic bonding agent as authorized by the Consultant prior to mortar filling.

- .8 Completely remove honeycombed areas down to sound concrete or to the required depth behind the reinforcing steel, whichever is greater. The depth required beyond the reinforcing steel is 1.5 times the maximum aggregate size of the replacement concrete or 25 mm, whichever is greater. Treat the surface of the concrete to be repaired with a high percentage solids epoxy bonding agent or acrylic bonding agent as authorized by the Consultant prior to concrete replacement. Construct the repair area slightly proud of the general surface and then grind it to match within the specified tolerances.
- .9 Repair abrupt and gradual irregularities that exceed the specified tolerances by no more than 10 mm by grinding. Limit the depth of grinding such that no aggregate particles are exposed more than 3 mm in cross section at the finished surface.
- .10 Where surface grinding results or will result in exposure of aggregate particles that exceed the specified limits, or where the abrupt and gradual irregularities exceed the specified tolerances by more than 10 mm, repair the irregularities by removing the concrete to a depth below the reinforcing steel of 1.5 times the maximum aggregate size of the replacement concrete or 25 mm, whichever is greater. Treat and construct the repair area as specified for honeycombed areas.
- .11 Provide replacement concrete that has the same strength and durability characteristics as the adjacent specified concrete. Use cement that provides a finish colour that matches the surrounding concrete surfaces in areas that are permanently exposed.
- .12 Following repairs, promptly initiate curing. Provide completed repair areas that are tightly bonded.

### **3.6 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 Finishes: Provide following finishes as applicable when finish of formed surface 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 'Sack Rubbed Finish' for concrete surfaces exposed to view or to be painted.
- .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.

### **3.7 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 Float (Initial) Finishing:
  - .1 Consolidate surface with power driven floats or by hand floating if area is small or inaccessible to power driven floats.
  - .2 Re-straighten, cut down high spots, and fill low spots.
  - .3 Repeat float passes and re-straightening until surface is left with a uniform, smooth, granular texture.
  - .4 Apply float finishing to surfaces receiving trowel finishing and receiving sheet waterproofing and floor finishes.
- .3 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.
- .4 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.
- .5 Broom Finishing:
  - .1 Apply a fine 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 Consultant before application.

### **3.8 CURING**

- .1 Comply with the requirements of Division 03 cast-in-place concrete and Drawings.

### **3.9 JOINT FILLERS**

- .1 After floor treatments are dry, seal all horizontal, isolation, expansion and control joints with joint filler as specified.

### **3.10 FILLING**

- .1 Level floors as required per flooring finish manufacturer's requirements.
- .2 Apply thick bed mortar or self-levelling and smoothing underlayment (Contractor's discretion at approval of Consultant) working into all nooks, cracks and spaces to fill flush with top of floor slab. Trowel to a smooth polished surface.



- .3 Use featheredging method to fill and level depressions up to 19 mm (5/8") in thickness, to fill cracks, holes, chips etc. where topping must be finished to a featheredge. Apply in strict accordance to manufacturer's instructions.
- .4 At juncture of resilient flooring and exposed concrete to provide feather edging for a distance of 150 mm (6") from + 3 mm to 0 mm (+ 1/8" to 0"), as indicated.
- .5 Prepare substrate and install as per manufacturers recommendations, smooth finish.

### **3.11 PATCHING**

- .1 Patch all core holes, or chipped or gouged concrete surfaces using specified materials.
- .2 Mix and install materials in compliance with manufacturer's instruction.

### **3.12 ANCHORING AND CORING**

- .1 Perform non-destructive, non-ionizing radio frequency scanning or other approved scanning procedures to determine locations of existing reinforcing or conduit in existing concrete elements before installing anchor systems or coring concrete. Advise Consultant of findings before proceeding with the Work, and revise penetration and anchor locations as required and directed by Consultant. Core holes and set anchors in fast-set grout as required. Install per grout manufacturer's specifications.

### **3.1 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning. 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. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3 Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 – Waste Management and Disposal.

### **3.2 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**END OF SECTION**

**Part 1 General**

**1.1 SUMMARY**

- .1 Work of this section includes:
  - .1 Provision of labour, materials, products, equipment, and services to complete the plant-precast architectural concrete Work.
  - .2 Compliance with CSA A23.3, CSA A23.4, CSA W59, CSA W186.

**1.2 RELATED REQUIREMENTS**

- .1 Division 03 Cast-in-Place Concrete
- .2 Division 05 Structural Steel
- .3 Section 05 41 00 – Structural Metal Stud Framing
- .4 Section 05 50 00 – Metal Fabrications
- .5 Section 06 10 00 – Rough Carpentry
- .6 Section 07 21 13 – Board Insulation
- .7 Section 07 21 13.01 – Foundation Board Insulation
- .8 Section 07 21 19 – Foam-in-Place Insulation
- .9 Section 07 27 14 – Air Barriers
- .10 Section 07 92 00 – Joint Sealants

**1.3 REFERENCES**

- .1 American Welding Society (AWS)
  - .1 AWS D1.6/D1.6M:2007, Structural Welding Code - Stainless Steel.
- .2 ASTM International (ASTM)
  - .1 ASTM A123/A123M-24, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - .2 ASTM A153/A153M-23, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
  - .3 ASTM A325-14, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
  - .4 ASTM A484/A484M-24b, Standard Specification for General Requirements for Stainless Steel Bars, Billets, and Forgings.
  - .5 ASTM A666/A666M-24, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
  - .6 ASTM A747/A747M-23, Standard Specification for Steel Castings, Stainless, Precipitation Hardening.
  - .7 ASTM A780/A780M-20, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
  - .8 ASTM C260/C260M-10a, Standard Specification for Air-Entraining Admixtures for Concrete.
  - .9 ASTM F593-24, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
  - .10 ASTM F738M-02(2008), Standard Specification for Stainless Steel Metric Bolts, Screws, and Studs.

- .3 Canadian Institute of Steel Construction (CISC) / Canadian Paint Manufacturers Association (CPMA)
  - .1 CISC/CPMA 2-75 Primer for Structural Steel.
- .4 Canadian Precast Prestressed Concrete Institute (CPCI)
  - .1 CPCI Handbook.
- .5 CSA Group (CSA)
  - .1 CSA A23.1:24/A23.2:24- Concrete materials and methods of concrete construction / Test methods and standard practices for concrete.
  - .2 CSA A23.3:24, Design of Concrete Structures.
  - .3 CSA A23.4-16, Precast Concrete - Materials and Construction.
  - .4 CSA A266.4-M78, Guidelines for the Use of Admixtures in Concrete.
  - .5 CSA A266.5-M1981, Guidelines for the Use of Superplasticizing Superplasticizing Admixtures in Concrete.
  - .6 CSA A283:19, Qualification Code for Concrete Testing Laboratories.
  - .7 CAN/CSA A3000:23, Cementitious materials compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
  - .8 CAN/CSA G30.18-21, Billet-Steel Bars for Concrete Reinforcement.
  - .9 CAN/CSA G40.20/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel.
  - .10 CSA S16:24, Design of Steel Structures.
  - .11 CSA W47.1:19, Certification of Companies for Fusion Welding of Steel.
  - .12 CSA W186:21, Welding of Reinforcing Bars in Reinforced Concrete Construction.
- .6 Precast/Prestressed Concrete Institute (PCI)
  - .1 PCI MNL 117, Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products.
  - .2 PCI MNL 120, PCI Design Handbook-Precast and Prestressed Concrete.

#### **1.4 DESIGN CRITERIA**

- .1 Design loads shall be as calculated from the Ontario Building Code based on 50-year probability.
- .2 Design architectural precast concrete work and connections to safely sustain or transmit loads and to comply with the applicable building code, CSA A23.4 except where greater requirements are specified, and CSA A23.1, CSA A23.2, CSA A23.3, and CSA S16.1 as applicable.
- .3 Design architectural precast concrete elements to carry handling and service loads without cracking.
  - .1 Adequately sustain precast panel loads, and superimposed wind, snow and rain loads, and seismic loads, without exceeding deflection of  $L/360$ .
  - .2 Compensate for unevenness and dimensional differences in structure to which they are secured.
  - .3 Tolerate structural deflection of  $L/360$  due to live load and distortion of structure, under design criteria conditions, without imposing load on panel assembly.
  - .4 Permit no water infiltration into the building under design loads.
- .4 Do engineering design of all reinforcing, anchorage and connections necessary to comply with size, profiles and jointing of members indicated on Drawings.

- .5 Design connections to structure and to precast concrete units to facilitate future removal, giving preference to bolted connections.
- .6 Design for use in below-grade conditions, as indicated on Drawings.
- .7 Design units and connections to safely withstand imposed wind loads determined by the Ontario Building Code, gravity loads, earthquake (seismic), temperature and shrinkage stresses and other superimposed loads, all within deflection limitations governed by design of the supporting structure. Reinforce panels, and areas of panels thicker than 150 mm, on each face.
- .8 Reinforce all bearing areas against diagonal tension, splitting, rupture, and flexure. Place extra ties, stirrups, and reinforcing bars at support points. Allow no bearing pressure on edges of unreinforced sections.
- .9 Do not chamfer top of panels where masonry is bearing on top.
- .10 Be responsible for engineering design of units and connections. Drawings are diagrammatic and indicate profiles and configurations required together with relationship to structural frame and building interior elements.
- .11 Provide connections between panels at corners to prevent mitre joints from opening. Reinforce around cast-in anchors.
- .12 Where access from either side is limited or not possible, provide connections to allow installation from one side only, using galvanized connectors that will be concealed in the completed work.
- .13 Connections or specially manufactured and fabricated inserts may be required to be tested by the Consultant. Such testing, if required, will be paid by Owner.
- .14 Design and cast handling connections, loops, eyes, etc. into units to ensure safe efficient handling; connections shall not be on exposed faces or visible in completed Work.
- .15 Consider limitations of transport from shop to site, building structure, on site conditions, schedules, and sequence of operations.
- .16 Design anchors and inserts to precast concrete elements to carry design loads.
- .17 Design precast concrete to support window washing systems and loading of swing stages.
- .18 Provide for positive drainage of water entering at joints to exterior face of wall in accordance with NRC "Rain Screen Principle."
- .19 Ensure stress on sealants is within the sealant manufacturer's recommended maximum.
- .20 Continuity: Be responsible to ensure the air retarders, vapour retarders and thermal barriers are continuous with and connected to air retarders, vapour retarders and thermal barriers of adjacent and connecting assemblies without loss of performance of the building envelope.

## **1.5 ADMINISTRATIVE REQUIREMENTS**

- .1 Convene pre-installation meeting one week prior to beginning Work of this Section, with waterproofing contractor's representative, Engineer, Consultant, and Contractor 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 trades.
  - .4 Review manufacturer's installation instructions and warranty requirements.
- .2 Coordination: Supply information required for installation of bracing, supports, inserts and similar accessories required for work under this contract supplied and installed by others.

## **1.6 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Comply with CSA A23.3 and CSA A23.4 as applicable to shop drawings.
  - .2 Each shop drawing submitted shall bear professional seal and signature of professional engineer licensed to design structures and registered in the Province of Ontario.
  - .3 Indicate on shop drawings the following:
    - .1 Formwork showing detailed layout of form panels, ties, reglets, recesses, built-in items, as well as typical details of form materials, nailing, corner ties, methods of aligning forms, stripping procedures and other pertinent information;
    - .2 Dimensions of units, location in completed structure and finish of each unit;
    - .3 Jointing clearances and clearances between units and other building components;
    - .4 Joint sealant details, openings, sleeves, inserts, weepholes, cavity venting provisions, reglets, recesses, built-in items including related reinforcement;
    - .5 Location and details of lifting hooks and handling points, methods of handling and placing;
    - .6 Methods and sequence of erection, relationship to adjacent assemblies, special handling or bracing requirements and identifying marks for each unit;
    - .7 Special precautions to be taken by other contractors and Subcontractors affecting work specified herein;
    - .8 Structural design calculations;
    - .9 Tables and bending diagrams of reinforcing steel, grade, finish and details of reinforcing;
    - .10 Concrete strength and admixtures;
    - .11 Complete connection and insert details including materials, finishes, size and length of welds.
  - .4 Submit detailed welding procedure covering all specified welds, on erection and shop drawings, if requested by the Consultant.
  - .5 Obtain approval of shop drawings by the authorities having jurisdiction prior to precast concrete installation.
- .2 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Provide samples of precast panels for approval as follows:
    - .1 Minimum sample size: 450 mm x 450 mm x 30 mm
    - .2 Sample finishes shall be representative of finishes specified for this project. Work shall match the approved production run panel colour range. Show maximum colour and texture variation expected.

## **1.7 QUALITY ASSURANCE**

- .1 Engineering and Design: Have work of this section designed by a professional engineer licensed to design structures and registered in the Province of Ontario.
- .2 Manufacturer, Installer:
  - .1 Manufacturer and erector of architectural precast concrete elements shall be certified by CSA as meeting requirements of CSA A251 for Category AC products.

- .2 Use only workers skilled in fabrication and erection of architectural precast concrete.
- .3 Sample Field Installation:
  - .1 Following review of shop drawings, produce, deliver and erect where directed by the Consultant in permanent location on the Project, full size precast concrete units incorporating required details and showing colour, finish and quality in conjunction with air and vapour barrier(s), insulation, and other components and conditions of assembly. The sample installation shall also include window, and pressure equalization details, closures and venting. Sample installation shall be minimum two adjacent precast concrete units.
  - .2 Use the sample installation to confirm the adhesion of the air retarder/vapour retarder system.
  - .3 Sample installation will serve for initial review purposes by Consultant.
  - .4 Correct deficiencies as directed by Consultant. Accepted sample installation may be incorporated in the finished Work.
- .4 Source Quality Control:
  - .1 Provide Consultant, as part of the work of this section, with certified copies of quality control tests related to this Project as stated in CSA A23.4.
  - .2 Testing required by authorities having jurisdiction, or by the Contractor for his own quality control and for any other reason of his own shall be paid by Contractor.
  - .3 Refer to Section 01 45 00 - Quality Control. Inspector may be appointed by Owner to test materials and inspect fabrication and erection methods used for precast work; such testing and inspection, if required, will be paid by Owner except that Contractor shall pay for subsequent inspections or tests necessary to verify corrected work.
  - .4 Materials and workmanship shall be subject to inspection at any time. Cooperate in permitting access for inspections to all places where work is being done or stock is stored.

## **1.8 DELIVERY, STORAGE AND HANDLING**

- .1 Protect units from weather, dirt, damage, contact with earth or other staining influences by acceptable means. Protect holes and reglets from water and ice during freezing weather. Provide and secure non-staining waterproof coverings and other protection devices.
- .2 Stack units on cushioned supports to protect edges; do not permit units to rest on corners. Stack units on acceptable supports and block up units level with spacers between each unit, provide air circulation.
- .3 Deliver, handle, and store prefabricated units in accordance with manufacturer's instructions.

## **1.9 PROTECTION**

- .1 Protect existing structure below while upper work is in progress.
- .2 Protect work at openings, exposed corners and other areas where damage may occur, with substantial non-staining coverings.

## **1.10 WARRANTY**

- .1 Warrant the work of this section against defects in materials and workmanship for a period of 5 years from date of Substantial Performance of the Work. Without restricting the generality of the warranty, defects shall include failure of structural soundness, change of colour, fading, crazing, spalling, cracking, pitting, failure to maintain true line, plumbness, and weathertightness under all conditions and other such defects.
- .2 Repair or replace defective work as directed by Consultant, make good damage to property, Work and other areas due to replacement or repair.

## **Part 2 Products**

### **2.1 STANDARD OF ACCEPTANCE**

- .1 CAAST Ultra High Performance Concrete Panels by Spring Valley Corp., or approved equivalent, dimensions as indicated, with the following minimum performance criteria:
  - .1 Compressive strength: 112 MPa.
  - .2 Flexural: 10 MPa.
  - .3 Young's Modulus (E): 40 GPa.
  - .4 Direct Tension: 4 MPa.
  - .5 Freeze/thaw (after 300 cycles): 95-100%.
  - .6 Carbonation depth: <0.02 inch.
  - .7 Density: 2.2 – 2.5 S.G.
  - .8 Capillary porosity: < 1%.
  - .9 Post-cure shrinkage: <10<sup>-5</sup>.

### **2.2 MATERIALS**

- .1 Compliance: comply with the requirements of Section 01 61 00 - Common Product Requirements.
- .2 Cement, grey cement, colouring material, aggregates, water admixture: to CSA A23.4 and CSA A23.1. Supplementary cementing materials: to CSA A3000.
  - .1 Colouring admixture. Colour to be selected by Consultant from manufacturer's full range.
- .3 Use same brands and source of cement and aggregate for entire project to ensure uniformity of colouration and other mix characteristics.
- .4 Reinforcing steel: to CSA A23.1
- .5 Forms: to CSA A23.4.
- .6 Hardware and miscellaneous materials: to CSA A23.1.
- .7 Anchors and supports: to CSA G40.21, Type 400W.
- .8 Welding materials: to CSA W47.1 and CSA W186
- .9 Galvanizing: hot dipped galvanizing with minimum zinc coating of 610 g/m<sup>2</sup> to CAN/CSA G164.
- .10 Steel primer: to CISC/CPMA 2-75 Primer for Structural Steel.
- .11 Air entrainment admixtures: in accordance with ASTM C260, refer to CSA A23.1 for location and exposure requirements.
- .12 Chemical Admixtures: to CAN/CSA A23.1/A23.2

- .13 Bearing pads: smooth, high impact plastic.
- .14 Bearing pads: neoprene, 50 to 70 shore A durometer hardness to ASTM D2240, and 17 MPa minimum tensile strength to ASTM D412, moulded to size or cut from moulded sheet.
- .15 Shims: plastic.
- .16 Zinc-rich primer: to ASTM A780: DOD P 21035 zinc rich paint.
- .17 Insulation: to Section 07 21 13 – Board Insulation.
- .18 Curing compound: not permitted without prior approval of Consultant.
- .19 Joint Sealants: to Section 07 92 00. Sealant colours to be selected by Consultant from manufacturer's full range.

## **2.3 CONCRETE MIXES**

- .1 Concrete Mix: designed to produce a minimum of 120 MPa compressive cylinder strength at 28 days, with a maximum water/cement ratio to CSA A23.4.
- .2 Facing matrix: use grey cement.
- .3 Air Entrainment of Concrete Mix: Refer to CSA A23.4
- .4 Use of calcium chloride not permitted.
- .5 Colour: cured colour as determined by Consultant per submitted samples.

## **2.4 REINFORCEMENT AND ANCHORS**

- .1 Reinforcement: to CSA W186.
- .2 Reinforcing Steel: to CSA G30.18

## **2.5 FABRICATION**

- .1 Manufacture units in accordance with CSA A23.4.
- .2 Mark each precast unit to correspond to identification mark on shop drawings for location with date cast on part of unit that will not be exposed.
- .3 Design and attach anchors and inserts to precast concrete elements to carry design loads.
- .4 Hot dip galvanize anchors after fabrication to ASTM A153/A153M. Touch up anchors with zinc rich primer after welding, minimum DFT 8 mils.
- .5 Ensure surfaces to receive sealant are smooth and free of laitance to provide a suitable base for adhesion. Ensure that release agents do not deleteriously affect the sealing of the joints.
- .6 Cast panels in accurate rigid moulds designed to withstand high frequency vibration. Set reinforcing anchors and auxiliary items as shown on the drawings. Cast in anchors, blocking and inserts supplied by other Sections as required to accommodate their work.
- .7 Anchors, lifting hooks, shear bars, spacers and other inserts or fittings: as recommended and/or designed by manufacturer for a complete and rigid installation. Conform to requirements of local building code. Size lift hooks to safely handle panels according to panel dimension and weight. Conceal anchors/inserts where practical.
- .8 Burn off exposed lift cables paint and fill in if required.

## **2.6 FINISHES**

- .1 Finish and colour of precast units to match sample in Consultant's office.



- .2 Smooth finish: as-cast using smooth steel form liners.
- .3 Interior panel finish to be smooth steel trowel or smooth form finish.

### **Part 3 Execution**

#### **3.1 GENERAL**

- .1 Erect precast work in accordance with CSA A23.4.
- .2 Supply anchors for precast units required to be cast into the concrete frame to Contractor for installation. Provide such items in ample time to meet construction program. Supply layout drawings locating accurately the position of all cast in items to be installed by other Sections.

#### **3.2 PREPARATION**

- .1 General: Install air and vapour barrier and thermal installation as indicated, and as required to maintain continuity of performance with other systems of the building enclosure. Overlap and tie-in to systems as required.
- .2 Air and vapour barriers: to Section 07 27 16 - Air and Vapour Membranes.
- .3 Thermal Insulation: to Section 07 21 13 – Board Insulation.

#### **3.3 INSTALLATION**

- .1 Erect precast elements within allowable tolerances. Set precast concrete units, straight, level, plumb, and square.
- .2 Non-cumulative erection tolerances in accordance with CSA A23.4, and as follows:
  - .1 Joint dimensions: Nominal 15 mm - to vary not more than +/- 5 mm.
  - .2 Joint taper: unit edges at joint not out of parallel over 0.6 mm in 300 mm (1/40" per 1 ft.), but not more than 2.9 mm total.
  - .3 Edge alignment: alignment of panel edges not to exceed 5 mm.
  - .4 Faces of adjacent panels: Offset in faces of adjacent panels to be not more than 3 mm.
  - .5 Bowed Panels: Bowed panels, within allowable bowing tolerances, arranged so offset between adjacent panels does not exceed 5 mm.
- .3 Set elevations and alignment between units to within allowable tolerances before connecting units.
- .4 Grout underside of unit bearing plates with shrinkage compensating grout.
- .5 Fasten units in place by welding wherever possible. Protect work from damage by weld splatter.
- .6 Provide temporary erection anchorage for welded anchorage system.
- .7 Uniformly tighten bolted connections with torque indicated.
- .8 Do not weld or secure bearing plates at sliding joints.
- .9 Set units dry, without mortar, attaining specified joint dimension with plastic shims.
- .10 Where bolts are used for installation, tighten with equal torque. Secure bolts with lockwashers or tackweld nut to bolt.
- .11 Clean field welds with wire brush and touch-up galvanized finish with zinc-rich primer.
- .12 Remove shims and spacers from joints of non-load bearing panels after fastening, but before sealant is applied.

- .13 Provide and install sufficient temporary bracing to brace precast units adequately at all stages of construction so that units will safely withstand loads to which they may be subjected. This temporary bracing shall remain in position until all connections have been completed.
- .14 Apply sealant and joint backing to exterior and interior joints to provide a complete weathertight installation to Section 07 92 00 – Joint Sealants. All exterior joints are to be vented. Sealant colours to be selected by Consultant.
- .15 Apply graffiti control system applications, to Section 09 91 00 – Painting.

### **3.4 WELDING**

- .1 Do welding to CSA W59 for welding to steel structures and to CSA W186 for welding of reinforcement.

### **3.1 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning. 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. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3 Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 – Waste Management and Disposal.

### **3.2 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

### **3.3 SCHEDULE**

- .1 Supply and install as indicated.

**END OF SECTION**

**Part 1 General**

**1.1 SUMMARY**

- .1 Design wall framing system to resist wind loads and building loads, including the following components:
  - .1 Studs subjected to lateral loads.
  - .2 Top and bottom tracks.
  - .3 Bridging and bracing.
  - .4 Top and bottom track connections to main structure, including fabrications to accommodate main structure deflections; top of wall anchor allowing for dead load deflections during construction and live load deflections after construction.
  - .5 Head, sill, and jamb members at wall openings.
  - .6 Framing component connections.

**1.2 RELATED REQUIREMENTS**

- .1 Refer to Drawings for Scope of Work for:
  - .1 Rough Carpentry.
  - .2 Gypsum Board Assemblies.
- .2 Section 06 16 43 – Gypsum Sheathing.
- .3 Section 07 27 14 – Air Barriers.
- .4 Section 08 11 14 – Metal Doors and Frames.

**1.3 REFERENCES**

- .1 ASTM International (ASTM)
  - .1 ASTM A653/A653M-20, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .2 ASTM A780/A780M-20, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
  - .3 ASTM A792/A792M-10(2015), Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
  - .4 ASTM F3125/F3125M-19e1, Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength.
- .2 CSA Group (CSA)
  - .1 CSA G164-18, Hot Dip Galvanizing of Irregularly Shaped Articles, Includes Update No.1 (2020).
  - .2 CSA S136-16, North American Specification for the Design of Cold-Formed Steel Structural Members.
  - .3 CSA W47.1:19, Certification of Companies for Fusion Welding of Steel.
  - .4 CSA W55.3-08 (R2013), Certification of Companies for Resistance Welding of Steel and Aluminum.
  - .5 CSA W59-18, Welded Steel Construction.
- .3 Canadian Sheet Steel Building Institute (CSSBI)
  - .1 CSSBI 51-06, Lightweight Steel Framing Design Manual – 2<sup>nd</sup> Edition.

- .2 Sheet Steel Facts (SSF) 3 – January 2017, Care and Maintenance of Prefinished Sheet Steel Building Products.
- .3 CSSBI Technical Bulletin Vol. 7, No. 2, Standard Thicknesses for Canadian Lightweight Steel Framing Applications.
- .4 CSSBI S5-11, Guide Specification for Wind Bearing Steel Studs.

#### **1.4 DEFINITIONS**

- .1 Minimum Uncoated Steel Thickness: Minimum uncoated thickness of lightweight steel framing: not less than 95% of thickness used in design for framing system:
  - .1 Lesser thicknesses may be permitted at bends arising from the cold forming process.
  - .2 Metal thicknesses listed in this section are minimum uncoated steel thickness, exclusive of subsequent coatings or treatments.

#### **1.5 ADMINISTRATIVE REQUIREMENTS**

- .1 Coordination: Coordinate work of this Section with work of other sections that may have items supported by or built into axially load bearing lightweight structural steel framing systems including; but not limited to, masonry and stone supports and connectors, doors, windows, architectural woodwork, pre-manufactured casework, building signage, plumbing fixtures, and electrical fixtures and panels.

#### **1.6 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit product data in accordance with Section 01 33 00 – Submittal Procedures:
  - .1 Submit product data for mechanical fasteners, indicating sizes, shear, and pull-over loading capacity where applicable. Provide data indicating thickness and type of corrosion protection coating.
- .2 Submit engineered shop drawings in accordance with Section 01 33 00 – Submittal Procedures:
  - .1 Shop Drawings shall bear the stamp and signature of the Subcontractor's structural engineer.
  - .2 Indicate member sizes, framing layout, design thickness exclusive of coatings, coating specifications, connection and bracing details, screw sizes, and spacing and anchors.
  - .3 Indicate welds using CWB symbols, distinguishing between shop and field welds and show size, length, and type of each weld.
- .3 Provide setting diagrams, templates, instructions, and directions for installation of components supplied by this Section to other Subcontractors and necessary for the completion of Work of this Section.
- .4 Certification:
  - .1 Submit two certified copies of mill reports covering material properties.
  - .2 Provide letter of certification by the Canadian Welding Bureau (CWB) that firms are currently in good standing.
  - .3 Submit confirmation by the Subcontractor's structural engineer that fabrication and erection complies with the requirements of the Contract Documents.

## **1.7 QUALITY ASSURANCE**

- .1 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 Document requirements, including the following:
  - .1 Design metal fabrication items as required to resist dead, live, lateral, wind, and seismic loads in accordance with the Ontario Building Code.
  - .2 Structural design.
  - .3 Review, stamp, and sign Shop Drawings.
  - .4 Conduct shop and on-Site inspections.
  - .5 Prepare and submit inspection reports.
- .2 Provide certification that welding procedures will be in accordance with CSA W47.1.
- .3 Execute welding by firms certified in accordance with CSA W47.1.
- .4 Ensure welding operators are licensed in accordance with CSA W47.1 for types of welding required by the Work.
- .5 Clearly mark steel thickness exclusive of coating by embossing, stamping with indelible ink or by colour coding.
- .6 Provide minimum 72 hours' notice to Consultant prior to commencement of work of this Section; increase notice period where time spans weekends or statutory holidays.
  - .1 Do not conceal lightweight steel framing system until reviewed by Consultant.

## **1.8 DELIVERY, STORAGE AND HANDLING**

- .1 Protect steel studs during transportation, site storage, and installation in accordance with CSSBI Sheet Steel Facts #3.
- .2 Steel framing and related accessories shall be stored and handled in accordance with CSA S136.
- .3 Handle and protect galvanized materials from damage to zinc coating.
- .4 Store materials flat, blocked off the ground in a manner to prevent kinking or permanent set.
- .5 Bent, kinked, or twisted studs and track will be rejected.

## **Part 2 Products**

### **2.1 PERFORMANCE AND DESIGN CRITERIA**

- .1 Perform design, fabrication, and erection of the work of this Section based on Limit States Design principles using factored loads and resistances, determined in accordance with CSA S136.
- .2 Conform to the requirements of indicated fire resistance ratings.
- .3 Design wall framing system to OBC requirements, and capable of withstanding design loads within limits and under design loads indicated on Drawings, and as follows:
  - .1 Dead Loads: Weights of materials and construction.
  - .2 Lateral Loads: Design for wind loads using high importance factors listed in the Building Code for deflection and strength, modified by the appropriate exposure, gust and pressure (internal and external) factors in accordance with Building Code structural commentaries.

- .3 Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 70°C.
- .4 Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure upward and downward movement of 19 mm; or larger gap as may be required to accommodate structural movement.
- .5 Design deflection detail so that free floating vertical members are restrained from horizontal movement by means of continuous bridging, nested or boxed tracks, or sliding or flexible web connections.
- .6 Maximum allowable deflection under 1 in 50-year sustained wind loading shall be as follows: stud deflection limited to  $L/720$ .
- .7 Allow for movement of the structure; design lightweight steel framing end connections to accommodate floor and roof deflections such that framing are not loaded axially; limit free play and movement in connections perpendicular to the plane of framing to  $\pm 0.50$  mm relative to the building structure.
- .8 Design connections between light steel framing members using bolts, welding or sheet metal screws.
- .9 Design bridging to prevent member rotation and member translation perpendicular to the minor axis, and as follows:
  - .1 Design for secondary stress effects due to torsion between lines of bridging.
  - .2 Design exterior wall framing to accommodate horizontal deflection without allowing for collateral contribution of sheathing materials.
  - .3 Design bridging at 1530 mm centres maximum, closer spacing may be required by design to satisfy structural requirements; spaced at even intervals over the span of the member.

## 2.2 MATERIALS

- .1 Steel: to CSA S136, fabricated from ASTM A653/A653M, Grade A to D steel.
- .2 Zinc coated steel sheet: quality to ASTM A653/A653M, with Z275 designation coating.
- .3 Thicknesses of framing members specified are exclusive of galvanized coating.
- .4 Fasteners and Welding Material; finish – hot dip galvanized:
  - .1 Welding materials conforming to CSA W59; electrodes minimum 480 MPa tensile strength.
  - .2 Bolts and nuts conforming to ASTM F3125/F3125M as required, with washers; hot-dip galvanized finish.
  - .3 Metal-to-Metal: Sheet metal screws conforming to ASME 18, with minimum 0.008 mm thick galvanized coating and #8 Ø; self-drilling, self-threading, case hardened type; hex, pan, and low-profile head profile type to suit application; length sufficient to penetrate not less than 3 fully exposed threads beyond joined materials; hot dip galvanized.
  - .4 Metal-to-Concrete: Hilti drilled insert, minimum 8 mm Ø; do not use Powder Actuated Fasteners; hot dip galvanized.
  - .5 Metal-to-Structural Steel: Secure track to structural steel over 8 mm thickness with Hilti DX fastening system with X-U nails or X-S nails.

- .6 Concrete-to-Steel Top Track Corrugated Ties: Corrugated steel conventional strip tie; 22 mm wide x 100 mm total length including 20 mm up stand x minimum 0.76 mm nominal core metal thickness, hot dip galvanized; corrugations 2.5 mm deep x 10 mm apart; meeting requirements of CSA A370:
  - .1 Standard of Acceptance Material: Fero Corporation, Conventional Corrugated Strip Tie; hot dip galvanized.
- .7 Drilled Inserts: Steel, hot dipped galvanized, sizes as required.
- .5 Touch-up primer: touch-up galvanized surfaces with zinc rich coating, to ASTM A780: DOD-P-21035 zinc rich paint, minimum DFT 8 mils.
- .6 Sill gasket tape: self-adhesive flexible closed cell polyethylene foam gasketing material, minimum 10 mm thick x 140 mm wide x 2030 mm long, bonded to a layer of 20-mil peel and stick rubberized asphalt.
  - .1 Top of Foundation: sill seal rubberized asphalt shall have 120 mm wide peel-and-stick T-shaped cross-section flange at 90-degree angle to the foam gasket, designed to seal outside face of concrete foundations and to the wall sheathing above.
    - .1 Standard of Acceptance:
      - .1 Triple Guard Energy Sill Sealer, by Protecto Wrap.
  - .2 Sill Gasketing at Other Surfaces:
    - .1 Standard of Acceptance:
      - .1 FoamSealR, by Owens Corning.
      - .2 Energy Plate Liner, by Protecto Wrap.
- .7 Thermal Insulation: as indicated in Section 07 21 16.
- .8 Shims: Load-bearing, high-density, multi-monomer plastic, non-leaching.

## **2.3 STEEL STUD DESIGNATIONS**

- .1 Framing identification: Each structural “C” stud component shall be identified with a factory applied marking denoting the manufacturer’s name and gauge thickness of the steel. Studs manufactured from 230 MPa (33 ksi) material or 350 MPa (50 ksi) steel shall be appropriately marked to designate their properties. The framing Subcontractor shall be responsible for notifying the manufacturer in writing of this requirement.
- .2 Colour code: to CSSBI Technical Bulletin Vol.7, No. 2.

## **2.4 METAL FRAMING**

- .1 Minimum steel thicknesses of framing elements: to engineered Shop Drawings.
  - .1 Steel studs: In accordance with CSA S136, fabricated from hot dip galvanized steel, depth as indicated.
  - .2 Stud tracks: Fabricated from the same material and finish as steel studs, depth to suit.
  - .3 Bottom track: Single piece.
  - .4 Top track: Single piece or two-piece telescoping as indicated in the engineered Shop Drawings.
  - .5 Bridging: Fabricated from the same material and finish as studs, 38 mm x 12 mm.
  - .6 Angle clips: Fabricated from the same material and finish as studs, 38 mm x 38 mm x depth of steel stud.
  - .7 Tension straps and accessories: Recommended by the manufacturer.

## **2.5 SOURCE QUALITY CONTROL**

- .1 Ensure mill reports covering material properties are reviewed by Consultant.

## **Part 3 Execution**

### **3.1 GENERAL**

- .1 Fabrication and erection shall conform to the engineered Shop Drawings. Modifications required to accommodate as-built conditions (other than minor dimensional changes) shall be submitted to Consultant for review.
- .2 Perform welding in accordance with CSA W59.
- .3 Certification of companies: CSA W47.1 for fusion welding and CSA W55.3 for resistance welding.
- .4 Do work to CSSBI 51 guidelines and CSSBI S5.

### **3.2 FASTENERS AND WELDS**

- .1 Ensure that connected parts are in contact. Provide clamping before installing screws as required.
- .2 Sheet metal screws shall be not less than a #8 size and as recommended by the stud framing manufacturer.
- .3 Penetration of sheet metal screws beyond joined materials shall be more than three exposed threads.
- .4 Sheet metal screw thread types, drilling capability, and installation shall conform to the manufacturer's printed recommendations.
- .5 Sheet metal screws covered by sheathing materials shall have low profile heads.
- .6 Install concrete expansion anchors in accordance with manufacturer's printed recommendations. Anchor framing to structure with concrete drilled anchors and sleeves, maximum spacing shall be 400 mm on centre, or as otherwise indicated on engineered Shop Drawings. Anchor bolt lengths shall not be less than 80 mm long and 12 mm in diameter. Ensure full embedment in concrete slab.
- .7 Companies engaged in welding shall be certified by the Canadian Welding Bureau in accordance with CSA W47.1. Companies shall have welding procedures approved, and welders qualified, for the base material types and thicknesses that are to be welded.
- .8 Welds shall be in accordance with CSA S136, CSA W48, CSA W59, as applicable.
- .9 For material less than 3 mm thick, effective throats of welds shall not be less than thickness of thinnest connected part.
- .10 Touch-up welds and coatings damaged by welding with VOC-compliant, zinc-rich paint. Prior to touching up, prepare the surface in accordance with the paint manufacturer's printed recommendations.

### **3.3 ERECTION**

- .1 Anchor tracks securely to structure at 800 mm on center maximum unless lesser spacing is indicated on the engineered Shop Drawings.
- .2 Erect steel studs spaced as indicated on the engineered Shop Drawings.
- .3 Erect studs plumb, aligned, and securely attached with two screws, minimum.
- .4 Seat studs into bottom tracks and top track.



- .5 Install 50 mm minimum telescoping track at top of walls when required to accommodate vertical deflection. Nest top track into deflection channel minimum 30.0 mm and maximum 40.0 mm. Do not fasten tracks together. Stagger joints.
- .6 Install studs at not more than 50 mm from abutting walls, openings, and each side of corners and terminations with dissimilar materials.
- .7 Brace steel studs with horizontal internal bridging at 1200 mm maximum, or as otherwise indicated on the Shop Drawings. Fasten bridging to steel clips fastened to steel studs with screws.
- .8 Frame openings in stud walls to carry loads adequately by use of additional framing members and bracing as required.
- .9 Provide cut-outs centred in the webs of members to accommodate services and through the knockout style of bridging.
- .10 Unless otherwise detailed, supply and install studs at each side of openings and triple studs at wall corners. Continue regular stud spacing above and below openings.
- .11 Supply and install continuous bent galvanized metal angles at perimeter of door, curtainwall, window, and louvre openings where indicated, minimum 2 mm thick. Secure angle to wall studs with 2 rows of screws, staggered. Design to allow for connection loads from window, curtain wall, door, and louvre systems to walls.

### 3.4 ERECTION TOLERANCES

- .1 Plumb: not to exceed 1/500th of member length.
- .2 Camber: not to exceed 1/1000th of member length.
- .3 Spacing: not more than +/- 3.0 mm from design spacing.
- .4 Gap between end of stud and track web: not more than 4.0 mm.

### 3.5 CUT-OUTS

- .1 Maximum size of cut-outs for services as follows:

Member Depth	Across Member Depth	Along Member Length	Centre to Centre Spacing (mm)
90	40 max.	105 max.	600 min.
100	40 max.	105 max.	600 min.
150	65 max.	115 max.	600 min.

- .2 Limit distance from centerline of last unreinforced cut-out to end of member to not less than 300 mm.

### 3.6 FIELD QUALITY CONTROL

- .1 The Subcontractor's structural engineer shall provide periodic field review during construction and shall submit reports as specified. Field review shall include review of mill test reports, welded and screwed connections, connections to the main structure, member sizes, location and material thickness, coating thickness, erection tolerances, bolted connections, and field cutting.
  - .1 Shop testing shall be paid for by supplier, field verification/testing by Owner.
- .2 At the election of Owner, additional inspection and testing of materials and workmanship may be carried out by a qualified independent inspection agency appointed by the Owner.

- .1 Provide the necessary cooperation and access required to ensure that inspections can proceed.
- .2 The inspection provided does not relieve the Subcontractor of its responsibility for the performance of the Contract. The Subcontractor is solely responsible for quality control and shall implement its own supervisory and quality control procedures.
- .3 The Subcontractor cannot rely on timely discovery and reporting of defective Work. Materials or workmanship not conforming to the requirements of the Contract may be rejected at any time during the progress of the Work at no cost to Owner, even if the Subcontractor has to destroy and rebuild other work as a result.

### **3.7 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning. 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. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3 Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 – Waste Management and Disposal.

### **3.8 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

### **3.9 SCHEDULE**

- .1 Install as indicated, and as follows:
  - .1 All bottom plates/tracks around building envelope to be set on sill gaskets and be anchored as per structural design Drawings.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 06 10 00 – Rough Carpentry.
- .2 Section 08 11 14 – Metal Doors and Frames.
- .3 Section 08 31 00 – Access Doors and Panels.
- .4 Section 09 21 16 – Gypsum Board Assemblies.
- .5 Section 10 28 10 – Toilet and Bath Accessories.
- .6 Other Sections requiring metal fabrications, and as indicated on the design Drawings.

**1.2 REFERENCES**

- .1 American Association of State and Highway Transportation Officials (AASHTO)
  - .1 AASHTO M 300-03(2017), Standard Specification for Inorganic Zinc-Rich Primer.
- .2 ASTM International (ASTM)
  - .1 ASTM A53/A53M-18, Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc Coated Welded and Seamless.
  - .2 ASTM A123/A123M-17, 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 A307-14e1, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.
  - .5 ASTM A780/A780M-09(R2015), Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
  - .6 ASTM A786/A786M-15, Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.
  - .7 ASTM B188-15e1, Standard Specification for Seamless Copper Bus Pipe and Tube.
  - .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 B632/B632M-18, Standard Specification for Aluminum-Alloy Rolled Tread Plate.
  - .11 ASTM F468-16, Standard Specification for Nonferrous Bolts, Hex Cap Screws, Socket Head Cap Screws, and Studs for General Use.
  - .12 ASTM F3125/F3125M-18, Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength.
- .3 Canadian Institute of Steel Construction (CISC)
  - .1 Code of Standard Practice for Structural Steel, 2010.
  - .2 Guide for Specifying Architecturally Exposed Steel, 2nd Edition.
  - .3 Handbook of Steel Construction - 11th Edition.
  - .4 Limit States Design in Structural Steel, 11th Edition.

- .5 Steel Fabrication Quality Systems Guideline, 2nd Edition with Commentary.
- .4 CSA Group (CSA)
  - .1 CSA G40.20-13/G40.21-13 (R2018), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel, Includes Update No. 1 (2014).
  - .2 CSA S16-14, Design of steel structures, Includes Update No. 1 (2016).
  - .3 CSA W47.1-09 (R2014), Certification of companies for fusion welding of steel.
  - .4 CSA W48-18, Filler metals and allied materials for metal arc welding.
  - .5 CSA W55.3-08(R2018), Certification of companies for resistance welding of steel and aluminum.
  - .6 CSA W59-18, Welded Steel Construction.
  - .7 CSA W178.2-18, Certification of Welding Inspectors.
- .5 National Association of Architectural Metal Manufacturers (NAAMM)
  - .1 NAAMM MBG 531-09, Metal Bar Grating Manual.
  - .2 NAAMM MBG 532-09, Heavy Duty Metal Bar Grating Manual.
  - .3 NAAMM MBG 534-14, Metal Bar Grating Engineering Design Manual.
  - .4 NAAMM AMP 555 92, Code of Standard Practice for the Architectural Metal Industry.).
- .6 National Ornamental & Miscellaneous Metals Association (NOMMA)
  - .1 NOMMA Guideline 1: Joint Finishes, 1994.
- .7 Steel Structures Painting Council (SSPC), Systems and Specifications Manual, Volume 2.

### **1.3 ADMINISTRATIVE REQUIREMENTS**

- .1 Pre-Installation Meetings: convene pre-installation meeting in accordance with Section 01 31 19 – Project Meetings to:
  - .1 Verify project requirements.
  - .2 Review project schedule milestones.
  - .3 Review installation and substrate conditions.
  - .4 Review coordination requirements with other building sub-trades, and identify items to fabricate and supply to be built-in or cast in place.
  - .5 Review manufacturer's installation instructions.

### **1.4 ITEMS SUPPLIED BUT NOT INSTALLED UNDER THIS SECTION**

- .1 Supply following products for installation under other Sections:
  - .1 Anchor bolts, bearing plates, sleeves, and other inserts to be built into concrete and masonry elements and required for anchorage and support of fabricated steel components.
  - .2 Fabricated steel components to be built into concrete and masonry.
- .2 Supply instructions and templates as required for accurate setting of inserts and components.

### **1.5 ACTION AND INFORMATIONAL 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 Provide two copies of WHMIS SDS - Safety Data Sheets acceptable to Labour Canada, and Health and Welfare Canada and indicate VOC content for:
  - .1 Finishes, coatings, primers, and paints.
- .2 Submit engineered shop drawings in accordance with Section 01 33 00 – Submittal Procedures:
  - .1 Indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.
  - .2 Provide shop drawings signed and sealed by a Professional Engineer (P.Eng.) responsible for the design and registered in the Province of Ontario.
    - .1 Conform to requirements of Section 01 35 01 – Delegated Design.

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

## **1.7 DELIVERY, STORAGE, AND HANDLING**

- .1 Exercise due care in storing, handling and erecting all materials and support materials properly at all times so that no piece will be bent, twisted, or otherwise damaged structurally or visibly.
- .2 Correct damaged material and where the Consultant deems damage irreparable, replace affected items at no additional expense to the Consultant or Owner.
- .3 Apply protective covering to face of 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 place of installation.

## **1.8 JOB CONDITIONS**

- .1 Coordinate this Work with the remainder of the Work and exercise necessary scheduling to ensure that all Work is carried out and all items incorporated during 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 PERFORMANCE AND DESIGN CRITERIA**

- .1 Provide delegated design as required.
- .2 Design Requirements:
  - .1 Design metal construction and connections in accordance with OBC and amendments for vertical and horizontal live load requirements.
  - .2 Detail pipe railings to NAAMM Pipe Railing Manual.
- .3 Comply with CISC Code of Standard Practice for Structural Steel, Appendix I, Architecturally Exposed Structural Steel.
- .4 Fabricate and finish guardrails/balustrades, and handrails in accordance with CISC Guide for Specifying Architecturally Exposed Steel: to AESS 3 *Feature Elements* (see Table 1 – AESS Category Matrix).
- .5 Comply with CISC Code of Standard Practice for Structural Steel, Appendix I, Architecturally Exposed Structural Steel.
- .6 The ultimate support for miscellaneous fabrications is the building's structural framing. The miscellaneous metals contractor is responsible for design, fabrication and installation of all aspects of required items including direct support methodology to building's structural framing in locations and configurations as described on the structural consultant documents.

### **2.2 MATERIALS**

- .1 Dielectric Separator / Isolation Coating: CRL Black Bituminous Paint – aerosol or paint, by C.R. Laurence of Canada.
- .2 Steel channels, angles and plates: to CSA G40.20/G40.21, Grade 300W.
- .3 Hollow structural sections (HSS): to CAN/CSA G40.20/G40.21, Grade 350W, Class C.
- .4 Steel plate: to CAN/CSA G40.20/G40.21, Grade 260 W.
- .5 Rolled steel sections: to CSA G40.21, 350W.
- .6 Steel pipe: to ASTM A53/A53M standard weight (Schedule 40), galvanized finish.
- .7 Welding materials: to CSA W59.
- .8 Welding electrodes: to CSA W48 Series.
- .9 Fasteners: bolts, nuts, washers, rivets, lock washers, anchor bolts, machine screws, and machine bolts.
- .10 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 thickness of material being joined, but not projecting more than 6 mm beyond nut, without use of washers.

.11 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.
- .2 For joining stainless steel components use stainless steel fasteners of same type.
- .3 Structural bolts: to ASTM F3125.

.12 Grout: non-shrink, non-metallic, flowable, 15 MPa at 24 hours.

**2.3 PIPE BOLLARDS**

- .1 Fabricate round pipe bollards from Schedule 40 steel pipe.
- .2 Fabricate removable bollards with HSS and steel plate to CSA G40.20/G40.21.
- .3 Finish: Galvanize to ASTM A123/A123M, followed by powder coat paint in accordance with Section 09 96 53 – Powder Coating.
- .4 Reflective tape: 50 mm wide, prismatic.
  - .1 Acceptable material: 3M Scotchlite Reflective Tape.
- .5 Concrete Fill: comply with requirements of Section 03 30 00 - Cast-in-Place Concrete.

**2.4 FABRICATION - GENERAL**

- .1 Fabricate and finish railings and guardrails in accordance with CISC Guide for Specifying Architecturally Exposed Steel: to AESS 3 *Feature Elements* (see Table 1 – AESS Category Matrix).
- .2 Other welded joints: Finish #1, to NOMMA Guideline 1: Joint Finishes.
- .3 Fabricate in compliance with OBC and amendments.
- .4 Fabricate railings in accordance with NAAMM AMP 521 as applicable.
- .5 Shop-fabricate sections as large and complete as practicable.
- .6 Fabricate in compliance with OBC and amendments.
- .7 Form metal fabrications from materials of size, thickness, and shapes indicated but not less than that needed to comply with performance requirements indicated. Work to dimensions indicated or accepted on shop drawings, using proven details of fabrication and support. Use type of materials indicated or specified for various components of each metal fabrication.
- .8 Fabricate work square, true, straight and accurate to required size, with joints closely fitted and properly secured.
  - .1 Allow for thermal movement resulting from the following maximum change (range) in ambient temperature in the design, fabrication, and installation of installed metal assemblies to prevent buckling, opening up of joints, and overstressing of welds and fasteners. Base design calculations on actual surface temperatures of metals due to both solar heat gain and nighttime sky heat loss. Temperature change (Range): 100 deg F (38 deg C).
- .9 Shear and punch metals cleanly and accurately. Remove burrs.

- .10 Ease exposed edges to radius of approximately 0.794 mm (1/32 inch), unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- .11 Remove sharp or rough areas on exposed traffic surfaces.
- .12 Weld corners and seams continuously to comply with American Welding Society (AWS) recommendations, and the following:
  - .1 Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - .2 Obtain fusion without undercut or overlap.
  - .3 Remove welding flux immediately.
  - .4 At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing and contour of welded surface matches those adjacent.
- .13 Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.
- .14 Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to provide adequate support for intended use.
- .15 Shop Assembly: pre-assemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- .16 Cut, reinforce, drill, and tap miscellaneous metalwork as indicated to receive finish hardware, screws, and similar items.
- .17 Ensure exposed welds are continuous for length of each joint.
- .18 Grind or file exposed welds and steel sections smooth and flush with adjacent surfaces. Weld locations not to be visible after application of paint finishes.
- .19 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.
- .20 Accurately form connections with exposed faces flush; miters and joints tight.
- .21 Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.
- .22 All welding is to be performed by CWB Certified Welders.

## **2.5 MISCELLANEOUS FABRICATIONS**

- .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 Miscellaneous Framing and Supports: Provide steel framing and supports for applications indicated as required to complete work.
- .3 Signage support: Fabricate anchors, hangers, suspension, and support for signage as indicated. Provide temporary spacers where required for maintaining correct placement during construction. Signage support shall be smooth steel members.



- .4 Sleeves:
  - .1 Supply pipe sleeves to respective trade for building in. Where required install pipe sleeves as they pass through walls, floors, and ceilings.
  - .2 Size sleeves to clear insulated surfaces, pipes, and conduits with 13 mm minimum, unless noted otherwise.
  - .3 Terminate sleeves flush with surfaces of walls and ceiling and extend 38 mm above floors, unless noted otherwise.
  - .4 Seal and make waterproof and watertight sleeves of type suitable for application after installation of conduit or conductors.
  - .5 For sleeves, other than waterproofed sleeves seal or pack void between sleeve and pipe, conduit, or penetrations in accordance with ULC requirements for hourly rating of surface being penetrated.
- .5 Anchors and Fastening:
  - .1 Provide anchor bolts and expansion bolts or other means of anchorage required for building into floors, walls, and ceilings, where necessary to secure metal and wood to concrete, masonry or steel work, other than anchorages specified under other Sections. Fasten components and items securely. Provide adequate reinforcing to ensure safe rigid installation. Set anchor bolts in locations indicated and spaced as shown or, if not shown, as may be required for properly securing Work.
    - .1 Include thermal breaks between Canopy structure and renovated/conditioned space.
  - .2 Use weld studs of size not larger than 10 mm for attaching miscellaneous materials and equipment to building steel. If weight of item requires larger fasteners use clips or brackets and secure by welding or through bolting.
  - .3 Use self-drilling expansion type concrete anchors for attaching to masonry and concrete.
  - .4 Do not secure items to steel deck.
  - .5 Use steel beam clamps of 2 bolt design to transmit load to beam web. Do not use 'C' and 'I' clamps.
- .6 Inserts and Hangers:
  - .1 Install inserts, hangers, and supports. Make inserts drilled lug or expansion type.
  - .2 Before openings are cut through structure, obtain Consultant's written acceptance for procedures, locations and reinforcements required.
  - .3 Do not weld hangers to structural steel members or burn holes in structural steel.
  - .4 Do not suspend items from steel decking.
- .7 Mechanical Equipment and Supports:
  - .1 Design supplementary steel structures to support toilet partitions and mechanical equipment in locations and elevations indicated on the Drawings.
  - .2 Obtain dimensions and weights of partitions and equipment from reviewed architectural and mechanical shop drawings and product data.
  - .3 Arrangement in accordance with Drawing details where indicated, and in accordance with partition and equipment supplier's recommendations.
  - .4 Submit shop drawings of support for each type and size of partition and equipment, designed, reviewed, and sealed by a professional engineer. Information should include:
    - .1 Partition and Equipment loads and connections.
    - .2 Connect details to building structure.

- .3 Locations of partitions and equipment.
- .4 Loads at each connection point to building structure.
- .5 Refer to technical specification Sections for particular requirements. Toilet Partitions and Mechanical equipment requiring supplementary steel supports include but are not limited to:
  - .1 Toilet Partitions.
  - .2 Piping.
  - .3 Equipment-support beams.
  - .4 Ductwork.
- .8 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.
- .9 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.
- .10 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 cut-outs, fittings, and anchorages as required for coordination for assembly and installation with other work.

## **2.6 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.

## **2.7 HSS MEMBERS**

- .1 Provide HSS member reinforcement within partitions, cabinet work, and exterior locations where indicated. Provide concealed mounting plates top and bottom. Allow for structural deflection at top of connection.
- .2 Hot-dip-galvanize all HSS members required at exterior locations after fabrication, and powder coat as required.

## **2.8 FINISHES**

- .1 Prior to applying primer or other finishes, clean metal to equivalent of commercial sand blast SSPC SP6, remove sandblasting residue.
- .2 All exterior steel, including steel incorporated into construction of exterior wall and roof assemblies, shall be hot-dipped galvanized with minimum zinc coating of 705 g/m<sup>2</sup> conforming to ASTM A123 for fabricated assemblies.
  - .1 Hot dip galvanize exterior metal fabrications and metal fabrications incorporated into exterior wall and roof assemblies; hot dip galvanize after fabrication.
  - .2 Conform to ASTM A153/A153M for steel hardware (average zinc coating 380 g/m<sup>2</sup>).
- .3 Touch-up galvanized surfaces with zinc rich coating, to ASTM A780: DOD-P-21035 zinc rich paint, minimum DFT 8 mils.
- .4 Galvanized primer: one-component, ready-mixed zinc rich primer, to AASHTO-M-300 or DOD-P-21035.

- .5 Isolation Coating: Apply isolation coating to contact surfaces in contact with cementitious materials, wood materials and dissimilar metals.
- .6 Shop coat primer: to CAN/CGSB-1.40.
- .7 Powder coated steel fabrications (coat after fabrication): to Section 09 96 53 – Powder Coating.
- .8 Finish paint finishes: to Division 09 Painting.
- .9 Schedules for finish and colour: refer to Drawings.

## **2.9 ISOLATION COATING**

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

## **2.10 SHOP PAINTING**

- .1 Clean surfaces in accordance with Steel Structures Painting Council Manual Volume 2, minimum SSPC SP6.
- .2 Apply one coat of shop primer to metal items, with exception of galvanized or concrete encased items.
- .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, grease, do not paint when temperature is below 7°C.
- .5 Do not paint surfaces to be field-welded.
- .6 Prime after fabrication and before damage to surface occurs from weather or other exposure.
- .7 Protect machine finished or similar surfaces that are not to be coated, but that do require protection, with coating of rust inhibitive petroleum, molybdenum disulphide, or other coating approved by the Consultant.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions are acceptable for product installation in accordance with manufacturer's written instructions.
  - .1 Check and verify that no irregularities exist that would affect quality of execution of work specified.
  - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

### **3.2 ERECTION AND INSTALLATION OF METAL FABRICATIONS**

- .1 Apply isolation coating to contact surfaces in contact with cementitious materials, wood materials, and dissimilar metals.

- .2 Apply coating into all drilled holes, onto all fasteners (e.g., bolts, screws, rivets) and between all flat surfaces (e.g., behind door handles, hinges, lamp-housings, diamond plate, mirror housing, latches, brackets, door trim, frame rails, suspension mounts, etc).
- .3 Generally, 2 – 3 mil thickness is required per application. Apply enough product so that excess material "oozes out" during assembly to ensure proper sealing.
- .4 Assemble and wipe away excess product.
- .5 Erect to OBC and amendments, CSA S16, and Code of Standard Practice for Structural Steel.
- .6 Install in required locations using welded connections wherever possible to provide rigid structure. Provide anchor bolts, bolts, and plates for connecting stairs and railings to structure.
- .7 Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates.
- .8 Install Work in accordance with manufacturer's or fabricator's (as applicable) written instructions, job-specific details, and Drawings.
- .9 Perform welding work in accordance with CSA W59 unless specified otherwise.
- .10 Supply finished items to be built in to those trades along with instructions for proper installation.
- .11 Apply architectural metalwork using hidden mechanical fasteners. Installation shall be by skilled Architectural metalworkers experienced in highest quality work.
- .12 Fasteners to draw adjoining sections together in proper, true alignment, and are capable of field adjustment.
- .13 All fasteners, mountings to be non-loosening and installed so that they will be hidden at completion.
- .14 Install Work to true, straight lines, accurate to profile, all properly aligned.
- .15 Isolate dissimilar metals in a manner approved by the Consultant to prevent electrolytic action or corrosion.
- .16 Install finish hardware supplied under other Sections required for completion of components of this Section.
- .17 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.
- .18 Provide suitable means of anchorage acceptable to Consultant such as dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.
- .19 Make field connections with high tensile bolts to CSA S16 and weld to prevent loosening.
- .20 Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates.
- .21 Touch-up rivets, field welds, bolts and burnt or scratched surfaces after completion of erection with primer.

### **3.3 PIPE BOLLARDS**

- .1 Anchor bollards in place with concrete footings. Support and brace bollards in position in footing excavations until concrete has been placed and cured.
- .2 Fill bollards solidly with concrete, mounding top surface.

### **3.4 MISCELLANEOUS ITEMS**

- .1 Supply and install miscellaneous metal fabrications as indicated or specified, or as otherwise required in accordance with the design intent of the project.

### **3.5 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning. 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. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3 Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 – Waste Management and Disposal.

### **3.6 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

### **3.7 SCHEDULE**

- .1 This schedule shall not be considered to represent a complete schedule of all metal fabrications required in the Work. Thorough scrutiny of the complete Contract Documents is required to obtain a complete schedule of metal fabrications required in the Work.
- .2 Include miscellaneous framing and supports that are not included under work indicated on structural drawings.
- .3 Provide the following metal fabrications:
  - .1 Metal Fabrications Shown on Structural Drawings:
    - .1 Refer to Drawings; fabrication work includes, but is not limited to:
      - .2 Masonry support steel.
      - .3 Mechanical roof support piers and framing.
      - .4 Structural steel Work at outdoor canopy.
      - .5 Additional steel components shown on structural design Drawings.
  - .2 Metal fabrications as shown on design Drawings.
  - .3 Overhead door frames, including jamb extensions and mounting plates.
  - .4 Steel angle at perimeter of louvres and exterior metal door frame openings.
  - .5 Counter and cabinetry support framing.
  - .6 HSS members, as indicated.
  - .7 Metal fabrications at outdoor structural steel canopies.
  - .8 Steel brick ledges on 2" HSS vertical lags, per Section 04 22 00 requirements.
  - .9 All steel structures, fabrications and connections exposed to the exterior or used within the shell assembly must be hot dipped galvanized after fabrication, and the approved methodology for painting galvanized surfaces must be followed where painting is required.
  - .10 Lateral support angles at top of masonry partitions and walls in accordance with details on structural drawings where not provided by Section 04 22 00.
  - .11 Miscellaneous steel angles, plates, and lintels required but not included on Structural Drawings.

.12 Other metal fabrications indicated and not specifically covered in other Sections.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 05 50 00 - Metal Fabrications.

**1.2 REFERENCES**

- .1 The Aluminum Association Inc. (AA)
  - .1 Specifications for Aluminum Sheet Metal Work in Building Construction.
  - .2 DAF 45-03, Designation System for Aluminum Finishes.
- .2 ASTM International (ASTM)
  - .1 ASTM A276/A276M-24a, Standard Specification for Stainless Steel Bars and Shapes
  - .2 ASTM B26/B26M-18e1, Standard Specification for Aluminum-Alloy Sand Castings.
  - .3 ASTM B32-20, Standard Specification for Solder Metal.
  - .4 ASTM B209/B209M-21a, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
  - .5 ASTM B210/B210M-19a, Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes.
  - .6 ASTM B221-21, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
  - .7 ASTM B221M-21, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).
  - .8 ASTM B247-20, Standard Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings, and Rolled Ring Forgings.
  - .9 ASTM B308/B308M-20, Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
  - .10 ASTM B429/B429M-20, Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
  - .11 ASTM B632/B632M-24, Standard Specification for Aluminum-Alloy Rolled Tread Plate.
  - .12 ASTM C864-05 (2019), Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.
  - .13 ASTM C1107/C1107M-20, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
  - .14 ASTM D1187/D1187M-97(2024), Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal.
  - .15 ASTM E488/E488M-22, Standard Test Methods for Strength of Anchors in Concrete Elements.
  - .16 ASTM F468-23, Standard Specification for Nonferrous Bolts, Hex Cap Screws, Socket Head Cap Screws, and Studs for General Use.
  - .17 ASTM F593-24, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
  - .18 ASTM F3125/F3125M-23, 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.
- .3 American Welding Society (AWS)

- .1 AWS C3.7M/C3.7:2011, Specification for Aluminum Brazing.
- .2 AWS D1.2/D1.2M:2014, Structural Welding Code - Aluminum - includes 2014 Errata.
- .4 CSA Group
  - .1 CAN/CSA G40.2013/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
  - .2 CSA S16:24, Design and construction of steel structures.
  - .3 CSA S157-17/S157.1-17, Strength Design in Aluminum / Commentary on CSA S157-05, Strength Design in Aluminum.
  - .4 CSA W47.1:19, Certification of companies for fusion welding of steel.
  - .5 CSA W47.2-11(R2020), Certification of companies for fusion welding of aluminum.
  - .6 CSA W48:23, Filler metals and allied materials for metal arc welding.
  - .7 CSA W55.3-08(R2023), Certification of companies for resistance welding of steel and aluminum.
  - .8 CSA W59:24, Welded steel construction.
  - .9 CSA W178.2-18, Certification of welding inspectors.
- .5 Fenestration and Glazing Industry Alliance (FGIA)
  - .1 AAMA 2604-22, Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix)
  - .2 AAMA 2605-22, Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix)
- .6 National Association of Architectural Metal Manufacturers (NAAMM)
  - .1 NAAMM AMP 500-06, Metal Finishes Manual.
  - .2 NAAMM AMP 555-92, Code of Standard Practice for the Architectural Metal Industry.
- .7 National Ornamental & Miscellaneous Metals Association (NOMMA)
  - .1 NOMMA Guideline 1: Joint Finishes, 1994.
- .8 SAE International (The Society of Automotive Engineers)
  - .1 SAE steel grades.

### **1.3 DESIGN RESPONSIBILITY**

- .1 Drawings and details are diagrammatic and are intended to show design concept, configuration, components and arrangements; they are not intended to identify nor solve completely the problems of thermal and structural movements, assembly framing and attachment to structure, fixings and anchorages, orientation, size and shape of assemblies, and problems associated with installation, movements, and weather seal.
- .2 The design, engineering, procurement, fabrication and erection of the perforated sheet metal assemblies as required to meet these performance specifications shall be the responsibility of the Contractor.



#### **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, Consultant, installer, manufacturer's representative to:
  - .1 Verify project requirements.
  - .2 Review installation and substrate conditions.
  - .3 Coordination with other building subtrades.
  - .4 Review construction tolerances for supporting structures and substrates; for example, tolerances for HSS construction.
  - .5 Review requirements of engineered shop drawings, and any site constraints impacting the work.

#### **1.5 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Division 01 requirements.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and technical datasheets.
- .3 Engineered Shop Drawings:
  - .1 Shop drawings shall bear the stamp and signature of a Professional Engineer licensed to design structures and registered in Ontario.
  - .2 Submit shop drawings showing fabrication and installation of perforated sheet metal assemblies, include plans, elevations, sections, details, and attachments to other work and to structure.
  - .3 Submit shop drawings for work of this Section, including details. Details shall show perforated sheet metal assembly, attachment to structure, retainers, and anchorages. Indicate fabrication and construction details, layout, sizes, sections, materials, thicknesses, finishes, connections, joints, locations of joints, method of anchorage, number of anchors, supports, welds, reinforcement, details, relationship and connections to adjacent materials and work, accessories, sizes of sections to be delivered, and other pertinent data.
- .4 Samples:
  - .1 Submit duplicate 300 x 300 mm samples of perforated sheet metal showing representative materials, finishes and colours. Include anchors, supports, fasteners, closures, and other panel accessories for assembly approval.
- .5 Manufacturer's Instructions:
  - .1 Submit manufacturer's installation instructions and special handling criteria, installation sequence and cleaning procedures.
- .6 Manufacturers' Field Reports: Submit copies of manufacturer's field reports.
- .7 Submit quality assurance submittals in accordance with Division 01 requirements.
  - .1 Submit design data for installed expanded metal mesh assemblies showing compliance with design loadings; include structural analysis data, signed and sealed by the Professional Engineer responsible for their preparation.

#### **1.6 QUALITY ASSURANCE**

- .1 Regulatory Requirements: to Division 01 requirements.

- .2 Retain a professional engineer registered in Ontario to design fabrication and erection of the Work of this Section in accordance with applicable Building Code and Contract Document requirements including, but not limited to, the following:
  - .1 Seal and signature to shop drawings and design submittals requiring structural engineering.
  - .2 Field review of installed components.

## **1.7 MOCK-UPS**

- .1 Mock-ups: construct one mock-up of perforated sheet metal panel assembly in accordance with Division 01 requirements and to requirements supplemented as follows:
  - .1 Provide mock-up for evaluation of fabrication and erection details, finishes and workmanship.
  - .2 Construct mock-up indicating relationship between wall panels and other construction.
  - .3 Coordinate type and location of mock-ups with project requirements.
  - .4 Accepted units will be used as standard for acceptance for project.
  - .5 Remove and replace units that are not accepted.
  - .6 Do not proceed with remaining work until construction, workmanship, colour, and finish are reviewed by Consultant.
  - .7 Refinish mock-up area as required to produce acceptable work.
  - .8 When accepted, mock-up will demonstrate minimum standard of quality required for this work. Approved mock-up may remain as part of finished work.

## **1.8 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Division 01 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.

## **Part 2 Products**

### **2.1 PERFORMANCE/DESIGN CRITERIA**

- .1 Have work of this Section designed by a Professional Engineer (P.Eng.) licensed to design structures and registered in Ontario.
- .2 Design Work of this Section to meet or exceed the requirements of Ontario Building Code (OBC), and requirements of authorities having jurisdiction.
- .3 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 1:75 years.
- .4 Minimum Erection Tolerances:
  - .1 Design and install assemblies 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.
- .5 Design assemblies and connections to meet or exceed Code requirements without failure or damage to any component in assembly.
- .6 Thermal Movements: Provide assemblies that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, over stressing of components, failure of connections, and other detrimental effects. Base engineering calculations on surface temperatures of materials due to both solar heat gain and nighttime heat loss.
  - .1 Temperature Change (Range): 67 deg C, ambient; 100 deg C, material surfaces.
- .7 Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
- .8 Maintain profiles indicated on Drawings. Strengths, thicknesses, supports and reinforcements indicated in Contract Documents are a minimum requirement; increase as necessary to support design loads.
- .9 Make design and detail modifications only as may be necessary to meet performance requirements and to coordinate the work. Variations in details and materials that do not adversely affect appearance, durability or strength shall be submitted for review. Maintain the general design concept without altering profiles and alignments shown.
- .10 Assemblies shall be designed, assembled and secured to the structure in a manner which will permit adequate freedom of movement to compensate for anticipated deflections as well as dimensional changes induced by temperature variations and building movements.

## **2.2 CARBON STEEL MATERIALS**

- .1 Carbon Steel Materials and Fabrications: to Section 05 50 00 - Metal Fabrications.

## **2.3 ALUMINUM MATERIALS**

- .1 Perforated sheet metal: to ASTM B209, aluminum alloy 3003-H14.
- .2 Extruded Bar and Tube: to ASTM B221 (ASTM B221M), alloy 6063-T5/T52.
- .3 Extruded Structural Pipe and Tube: to ASTM B429, alloy 6063-T6.
- .4 Drawn Seamless Tube: to ASTM B210 (ASTM B210M), alloy 6063-T832.
- .5 Plate and Sheet: to ASTM B209 (ASTM B209M), alloy 6061-T6.
- .6 Die and Hand Forgings: to ASTM B247 (ASTM B247M), alloy 6061-T6.
- .7 Castings: to ASTM B26/B26M, alloy A356-T6.

## **2.4 FASTENERS**

- .1 Fasteners - General: Types and sizes indicated in engineered shop drawings and engineering report
- .2 Aluminum fasteners: to ASTM F468, alloy 6063-T5; 6061-T6 for structural applications.
- .3 Stainless steel fasteners, washers and nuts: to ASTM F593, SAE Type 316L austenitic stainless steel, sized as required for purpose intended, or as otherwise indicated. Cold Finished Materials: Condition B, cold worked, to ASTM A276. Exposed Fasteners: Stainless steel countersunk screws or bolts, consistent with design intent.
  - .1 Anchors shall be fabricated from stainless steel with capability to sustain, without failure, load imposed within a safety factor of 4, as determined by testing to ASTM E488.
- .4 Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as perforated sheet metal unless otherwise indicated.
  - .1 Provide cast brackets with flange tapped for concealed anchorage to threaded hanger bolt.
  - .2 Provide formed or cast brackets with predrilled hole for exposed bolt anchorage.
  - .3 Provide formed steel brackets with predrilled hole for bolted anchorage and with snap-on cover that matches rail finish and conceals bracket base and bolt head.
  - .4 Provide brackets with interlocking pieces that conceal anchorage. Locate screws on bottom of bracket.
- .5 Fasteners for Anchoring Perforated Sheet Metal to other Construction: Select fasteners of type, grade and class required to produce connections suitable for anchoring perforated sheet metal panels to other types of construction indicated and capable of withstanding design loads.
- .6 Cast-in-Place and Post-Installed Anchors: Anchors of type indicated below, fabricated from corrosion-resistant materials with capability to sustain, without failure, a load equal to six times the load imposed when installed in concrete, as determined by testing per ASTM E488 conducted by qualified independent testing agency.
  - .1 Cast-in-place anchors.
  - .2 Chemical anchors.
  - .3 Expansion anchors.
- .7 Typical joinery shall be attached with concealed, non-corrosive fasteners. When exposed fasteners are required in isolated conditions, fastener shall be obscured in the panel joinery, exposed fasteners shall be stainless steel or as otherwise indicated (refer to Drawings).

## **2.5 MISCELLANEOUS MATERIALS**

- .1 Nonshrink, Non-metallic Grout: Premixed, factory-packaged, non-staining, noncorrosive, nongaseous grout complying with ASTM C1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- .2 Interior Anchoring Cement: Factory-packaged, non-shrink, non-staining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound. Use for interior applications only.
- .3 Welding materials: to CSA W59.2 for aluminum; CSA W59 for steel. Welds shall be invisible at all exposed locations.
- .4 Welding rods shall be of same material composition or slightly higher chromium-nickel content than hardness to suit conditions.

- .5 Solder and flux: to ASTM B32, alloy composition 85 Tin/15 Zinc for aluminum. Flux: rosin, cut hydrochloric acid, or commercial preparation suitable for materials to be soldered.
- .6 Emulsified asphalt protective coating for metals to provide dielectric separation: to ASTM D1187/D1187M.
- .7 Gaskets (to separate dissimilar materials): isolation gaskets shall be EPDM to ASTM C864, with dimensional tolerances and durometer hardness and of suitable size and shape to meet the requirements of their specific application and designed to remain flexible at low temperatures.
- .8 Vibration Isolation Gaskets: silicone rubber vibration isolation gaskets, BISCO® Silicone HT-1250, 50 Durometer hardness, or similar to same effect and having the same or better physical properties and performance characteristics.

## **2.6 FABRICATION - GENERAL**

- .1 Aluminum perforated sheet metal panel assemblies shall comply with contract Drawings and reviewed engineered shop drawings.
- .2 All components shall be factory fabricated to the extent practicable, ready for field installation. All components shall match quality and installation of accepted mock-up specified above.
- .3 Panel dimensions shall allow for field adjustment and thermal movement.
- .4 Panel lines, breaks and curves shall be sharp, smooth and free of warps or buckles.
- .5 Panel shall be formed/shaped to achieve required wall radius shown on Drawings.
- .6 Panel surfaces shall be free of scratches or marks caused during fabrication.

## **2.7 FABRICATION**

- .1 Perforated Aluminum Sheet:
  - .1 Hole Pattern: 1/2 inch diameter holes at 11/16 inch staggered spacing.
  - .2 Minimum Thickness: 1.016 mm (18 gauge), or as otherwise required, if thicker, to meet loads imposed per engineered shop drawings, calculated to OBC as amended.
  - .3 Finish: Powder coating finish to AAMA 2604, applied to all exposed surfaces, both faces, and within circumference of perforations.
    - .1 Colour: To match curtain wall system.
  - .4 Acceptable material:
    - .1 AMICO Perforated Metal panels by AMICO Canada.
- .2 Stainless steel (mill finish) fastening system by manufacturer, SAE Type 316L stainless steel.
- .3 Panel dimensions vary and are as per Drawings.
- .4 Provide 10 mm gap between panels, or as otherwise shown on Drawings.

## **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 structural support is aligned and condition is acceptable.
- .3 Ensure all painting of components that will be hidden by other construction or that other construction will prevent from painting has been performed, reviewed and accepted.
- .4 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.
- .5 Inspect perforated sheet metal panels and components before installation and verify that there is no shipping damage.
- .6 Do not install damaged panels; repair or replace as required for smooth and consistent finished appearance.

### **3.3 INSTALLATION**

- .1 Install structural elements as required and indicated, true, level, square and plumb, to tolerances specified in this Section.
- .2 Install perforated sheet metal assemblies in accordance with engineered shop drawings, to tolerances specified in this Section. Allow for thermal movement.
- .3 Erect panels plumb, level, square and true.
- .4 Do not install component parts that are observed to be defective, including warped, bowed, dented, scraped and broken members.
- .5 All fasteners shall be installed to penetrate structural framing. Where fastener does not penetrate framing, do not remove fastener where removal of fastener will damage integrity of air and vapour barrier performance. Realign fastener location and install new fastener in close proximity to original fastener.
- .6 Install pre-fabricated corners and end enclosures, sealed to arrest direct weather penetration.
- .7 Ensure panels are aligned vertically and horizontally as required.
- .8 Assemble and secure assemblies so stresses on sealants are within manufacturer's recommended limits.
- .9 Separate dissimilar metals; use appropriate gasket and fasteners to minimize corrosive or electrolytic action between metals.
- .10 Install vibration isolation as indicated.

### **3.4 FIELD QUALITY CONTROL**

- .1 Contractor's Delegated Design Engineer responsible for engineered shop drawings shall periodically visit site to review installations and shall review shop fabrications prior to delivery to site.
- .2 Submit Delegated Design Engineer's field reports to Consultant within 3 working days of review.

### **3.5 CLEANING**

- .1 Progress Cleaning: clean in accordance with Division 01 requirements. Leave Work area clean at end of each day.

- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3 Manage and dispose of demolition and construction waste materials in accordance with Division 01 requirements.

### **3.6 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Division 03 Cast-in-Place Concrete.
- .2 Section 04 22 00 – Unit Masonry.
- .3 Section 09 21 16 – Gypsum Board Assemblies.
- .4 Division 09 floor, wall and ceiling finishes.
- .5 Drawings.

**1.2 REFERENCES**

- .1 ASTM International (ASTM)
  - .1 ASTM D1227/D1227M-13 (2019)e1, Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing.
  - .2 ASTM D4479/D4479M-07(2018), Standard Specification for Asphalt Roof Coatings - Asbestos-Free.
  - .3 ASTM D4586/D4586M-07(2018), Standard Specification for Asphalt Roof Cement, Asbestos-Free.
- .2 CSA Group (CSA)
  - .1 CAN/CSA A123.4-04 (R2018), Asphalt for Construction Built-Up Roof Coverings and Waterproofing Systems.
- .3 ULC Standards
  - .1 CAN/ULC S701.1:2017, Thermal Insulation, Polystyrene Boards.
  - .2 CAN/ULC S704.1:2017, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate, Boards, Faced.
  - .3 CAN/ULC S706.1:2016, Standard for Wood Fibre Insulating Boards for Buildings.
- .4 National Ornamental & Miscellaneous Metals Association (NOMMA)
  - .1 NOMMA Guideline 1: Joint Finishes, 1994.

**1.3 ADMINISTRATIVE REQUIREMENTS**

- .1 Convene pre-installation meeting one week prior to starting any concrete or steel work, with Contractor, Consultant, installer, manufacturer's representative to review:
  - .1 Expansion joint placement and alignment, and installation of block outs
  - .2 Establishing minimum nominal joint width to suit ambient conditions at time of installation of expansion joint materials
  - .3 Protection of expansion joints during construction and after installation of expansion joint materials
  - .4 Include follow-up agenda item for subsequent progress meetings to identify ongoing coordination and responsibilities relating to installation of expansion joints.

**1.4 ACTION AND INFORMATIONAL SUBMITTALS**

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



- .3 Submit manufacturer's printed installation instructions and illustrations.
- .4 Submit detailed shop drawings for each different type of joint system specified, provide placement drawings including; but not limited to, the following:
  - .1 Include line diagrams showing plans, elevations, sections, details, splices, block-out requirements, entire route of each joint system, and attachments to other work. Where joint systems change planes, provide isometric or clearly detailed drawing depicting how components interconnect.
- .5 Submit 300 mm long samples of each type, colour, and finish of expansion joint cover assemblies.
- .6 Submit manufacturer's written instructions for repair and maintenance procedures for expansion control systems, include name of original installer and contact information in accordance with Section 01 78 00 - Closeout Submittals.

## **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 Qualifications: Provide proof of qualifications when requested by Consultant.
  - .1 Source Limitations: Obtain expansion control systems through one source from a single manufacturer.
  - .2 Installer: Use installers certified or approved by expansion control system manufacturer having a minimum of three years of experience with projects having similar complexity and scope as required by work of this Section.
  - .3 Engineered Judgements: Use manufacturers who have capability to provide engineered judgements for fire rated systems
- .4 Architectural Appearance: Drawings indicate size, profiles, and dimensional requirements of expansion control systems and may be based on specific systems requirements for aesthetic appearance:
  - .1 Do not modify intended aesthetic effects, as judged solely by Consultant, except with Consultant's approval.
  - .2 Submit comprehensive explanatory data to Consultant for review where modifications are proposed.

## **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 JOB CONDITIONS**

- .1 Site Measurements: Verify dimensions by site measurements before ordering products and indicate measurements on shop drawings where expansion control systems are indicated to fit between or around other construction; coordinate fabrication schedule with construction progress to avoid delaying the Work.
- .2 Established Dimensions: Establish dimensions and proceed with ordering products without site measurements where site measurements cannot be made without delaying

the Work; coordinate construction to ensure that actual site dimensions correspond to established dimensions; allow for trimming and fitting.

- .3 Ambient Conditions: Confirm opening width of Products based on actual site installation temperature to prevent extrusion or crushing of materials specified in this Section after installation.

## **1.1 WARRANTY**

- .1 Contractor agrees to correct any deficiencies found in work performed for 2-years from date of Substantial Performance.

## **Part 2 Products**

### **2.1 DESIGN REQUIREMENTS**

- .1 Design expansion joint assemblies to permit movement of  $\pm 35\%$ , or as otherwise indicated or noted on the structural Drawings, without detrimental effects.
- .2 Provide factory-fabricated expansion control systems capable of withstanding types of loads and of accommodating kinds of movement, and other functions for which they are designed, including those specified below, without failure.
  - .1 Exterior Joints: Maintain continuity of weather enclosure.
  - .2 Joints in Fire Resistance Rated Assemblies: Maintain fire resistance ratings of assemblies.
  - .3 Joints in Smoke Barriers: Maintain integrity of smoke barrier.
  - .4 Joints in Acoustically Rated Assemblies: Inhibit passage of airborne noise.
  - .5 Other Joints: Where indicated, provide joint systems that prevent penetration of water, moisture, and other substances deleterious to building components or content.
  - .6 Seismic Joints: Remain in place on exposure to seismic activity (movement).
  - .7 Joints in Surfaces with Architectural Finishes: Serve as finished expansion control closures.
- .3 Service Temperature: design exterior expansion joint cover assemblies to accommodate joint movements within service temperature range of  $-35^{\circ}\text{C}$  to  $65^{\circ}\text{C}$ .
- .4 Coordinate compatibility of products supplied by this Section with adjoining joint systems specified in other Sections.

### **2.2 MATERIALS AND FABRICATIONS**

- .1 Dielectric Separator / Isolation Coating: bituminous paint or aerosol, by C. R. Laurence, or approved equivalent.
- .2 General Fabrication Requirements:
  - .1 Provide units that can accommodate joint widths indicated including alignment variations in adjacent surfaces.
  - .2 Prefabricate transition pieces.
  - .3 Flexible gaskets and seals shall be key-locked to aluminum retainers.
  - .4 Select widths of covers and firestopping assemblies to suit conditions and joint size.
  - .5 Provide units in longest practicable lengths to minimize number of end joints. Provide hairline mitred corners where joint changes directions or abuts other materials.

- .6 Include closure materials and transition pieces, tee joints, corners, curbs, cross connections, and other accessories as required to provide continuous joint systems.
- .7 Frames for Strip Seals: Designed with semi-closed cavity that provides a mechanical lock for seals of type indicated.
- .8 Public Area Seals: Non-slip seals designed to lie flat with adjacent surfaces, and complying with handicapped accessibility guidelines for public areas.
- .9 Shop-apply 2 mil thick coat of zinc chromate primer at contact surfaces of aluminum assemblies in direct contact with cementitious materials.
- .10 Flexible seals and gaskets: colours as selected by Consultant from manufacturer's full range.
- .3 Exterior Wall Joints:
  - .1 C/S Group Model VF - size to suite expansion joint width. Custom colours to Consultant's later selection.
- .4 Exposed Interior Wall and Ceiling Joints:
  - .1 FWF Expansion Joint Covers, by C/S Group, or equivalent; widths and types as required to suit conditions and location.
  - .2 Gasket Colours: as selected by Consultant.
- .5 Exposed Floor Joints:
  - .1 Floor joints: GFT & GFTW Series, by C/S Group, or equivalent; widths and types as required to suit conditions and location.
  - .2 50 mm wide joints: GFT-200 or GFTW-200, by C/S Group.
  - .3 Gasket Colours: as selected by Consultant.
- .6 Exposed Floor and Wall Joints at Fire-Rated Assemblies:
  - .1 Multiflex® (MFX), by C/S Group, or equivalent.
  - .2 Gasket Colours: as selected by Consultant.
- .7 Concealed Joints:
  - .1 50 mm wide joints:
    - .1 Cover: formed, V-shaped, hot dipped galvanized after fabrication (Z275 coating), minimum 0.8 mm thick sheet steel.
    - .2 Void Filler: mineral slag wool board insulation, Rockboard® 40 by Rockwool Canada.
- .8 Miscellaneous: Emseal Colourseal VHE, colours as determined by Consultant.
- .9 Firestopping Assemblies:
  - .1 Refer to Section 07 84 00 - Firestopping and Smoke Seals.

## **2.3 ACCESSORIES**

- .1 Accessories: Manufacturer's standard anchors, clips, fasteners, set screws, spacers, flexible moisture barrier and filler materials, drain tubes, lubricants, adhesives, and other accessories compatible with material in contact, as indicated or required for complete installations.

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**Part 3                      Execution**

**3.1                      COMPLIANCE**

- .1      Comply with manufacturer's printed preparation and application instructions, details, technical datasheets and specifications.

**3.2                      EXAMINATION AND PREPARATION**

- .1      Examine block-outs and expansion joints for the presence of voids, honeycombing, and spalling, and to confirm joint dimensions.
- .2      Clean block-outs and joints, ensuring they are clean, dry, free of dust, dirt, loose materials, grease, oils, and other foreign materials detrimental to installation of expansion joint assemblies.
- .3      Prepare substrates according to expansion control system manufacturer's written instructions.
- .4      Coordinate and Provide anchorages, Placement Drawings, and instructions for installing joint systems to be embedded in or anchored to concrete or to have recesses formed into edges of concrete slab for later placement and grouting in of frames.
- .5      Fastening to In Place Construction: Provide anchorage devices and fasteners where necessary to secure joint systems to in place construction, including threaded fasteners with drilled in expansion shields for masonry and concrete where anchoring members are not embedded in concrete. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of joint systems.

**3.3                      ISOLATION COATING**

- .1      Apply isolation coating to contact surfaces in contact with cementitious materials, wood materials, and dissimilar metals.
- .2      Apply isolation coating into all drilled holes, onto all fasteners (e.g., bolts, screws, rivets) and between all flat surfaces (e.g., behind door handles, hinges, lamp-housings, diamond plate, mirror housing, latches, brackets, door trim, frame rails, suspension mounts, etc).
- .3      Generally, 2 – 3 mil thickness is required per application. Apply enough product so that excess material "oozes out" during assembly to ensure proper sealing.
- .4      Assemble and wipe away any excess product.

**3.4                      INSTALLATION**

- .1      Comply with manufacturer's printed instructions for handling and installing expansion control assemblies and materials, unless more stringent requirements are indicated.
- .2      Coordinate installation of expansion control assembly materials and associated work so complete assemblies comply with assembly performance requirements.
- .3      Terminate exposed ends of exterior expansion control assemblies with factory fabricated termination devices to maintain waterproof system.
- .4      Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required to install joint systems.
  - .1      Install joint cover assemblies in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
  - .2      Allow adequate free movement for thermal expansion and contraction of metal to avoid buckling.
  - .3      Set covers in horizontal surfaces at elevations that place exposed surfaces flush with adjoining finishes.

- .4 Locate covers in continuous contact with adjacent surfaces.
- .5 Securely attach in place with required accessories.
- .6 Locate anchors at interval recommended by manufacturer, but not less than 75 mm from each end and not more than 610 mm on center.
- .5 Continuity:
  - .1 Maintain continuity of joint systems with minimum number of end joints and align metal members.
  - .2 Cut and fit ends to produce joints that will accommodate thermal expansion and contraction of metal to avoid buckling of frames.
  - .3 Adhere flexible filler materials, if any, to frames with adhesive or pressure sensitive tape as recommended by manufacturer.
- .6 Extruded Preformed Seals: Install seals to comply with manufacturer's written instructions and with minimum number of end joints.
  - .1 For straight sections, provide preformed seals in continuous lengths.
  - .2 Vulcanize or heat weld field splice joints in preformed seal material to provide watertight joints using procedures recommended by manufacturer.
  - .3 Apply adhesive, epoxy, or lubricant adhesive approved by manufacturer to both frame interfaces before installing preformed seals.
  - .4 Seal transitions according to manufacturer's written instructions.
- .7 Joint Systems with Seals: Seal end joints within continuous runs and joints at transitions according to manufacturer's written instructions to provide a watertight installation.
- .8 Seismic Seals: Install interior seals in continuous lengths. Install exterior seal in standard lengths and vulcanize or heat weld field splice joints to provide watertight joints using manufacturer's recommended procedures. Seal transitions and end joints according to manufacturer's written instructions.
- .9 Fire Barriers: Refer to Section 07 84 00 - Firestopping and Smoke Seals.

### **3.5 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning. 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. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3 Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 – Waste Management and Disposal.

### **3.6 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**END OF SECTION**

**Part 1            General**

**1.1            RELATED REQUIREMENTS**

- .1    Section 05 50 00 - Metal Fabrications.
- .2    Section 07 52 00 - Modified Bituminous Membrane Roofing.
- .3    Section 07 62 00 - Sheet Metal Flashing and Trim.
- .4    Refer to Drawings.

**1.2            REFERENCES**

- .1    ASTM International (ASTM)
  - .1    ASTM A307-21, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .2    ASTM C954-18, 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.
  - .3    ASTM D1761-20, Standard Test Methods for Mechanical Fasteners in Wood and Wood-Based Materials.
  - .4    ASTM D2559-12a(2018), Standard Specification for Adhesives for Bonded Structural Wood Products for Use Under Exterior Exposure Conditions.
  - .5    ASTM D3498-19a, Standard Specification for Adhesives for Field-Gluing Wood Structural Panels (Plywood or Oriented Strand Board) to Wood Based Floor System Framing.
  - .6    ASTM F1667-21, Standard Specification for Driven Fasteners: Nails, Spikes, and Staples.
- .2    American Wood Council (AWC)
  - .1    AWC Wood Design Package - 2018 Edition.
- .3    American Wood Preservers Association (AWPA)
  - .1    AWPA Book of Standards, 2021.
- .4    CSA Group (CSA)
  - .1    CAN/CSA O80 SERIES-15 (R2020), Wood Preservation, Includes Update No. 1 (2017) and Update No. 2 (2019).
  - .2    CSA O121-17, Douglas Fir Plywood.
  - .3    CSA O141-05(R2019), Softwood Lumber.
  - .4    CAN/CSA O325:21, Construction sheathing (Adopted NIST PS 2-18, with Canadian deviations), Includes Administrative Update (2021).
  - .5    CSA S16:19, Design of steel structures, Includes Errata (2019).
- .5    National Lumber Grading Association (NLGA)
  - .1    Standard Grading Rules for Canadian Lumber 2021.
- .6    Telecommunication Industry Association (TIA)
  - .1    ANSI/TIA-569-E: Telecommunications Pathways and Spaces, 2019.
- .7    ULC Standards
  - .1    CAN/ULC S102-18, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

### **1.3 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 Consultant.
  - .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 consultant gives prior approval. Use of No. 3 and Stud Grade framing material will not be allowed for any horizontal applications.

### **1.4 ACTION AND INFORMATIONAL 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 SDS sheets or official manufacturer literature stating no urea-formaldehyde was used in the manufacturing of composite wood.
- .2 Submit engineered, stamped shop drawings designed by a structural engineer (P.Eng.) licensed to practice in Ontario for wood frame construction, including details, elevations, sections, and plans. Include engineering calculations with submissions.

### **1.5 QUALITY ASSURANCE**

- .1 Work shall meet or exceed the applicable requirements of the AWC Wood Design Package and OBC.
- .2 Lumber identification: Grade stamp of an agency certified by the Canadian Lumber Standards Accreditation Board.
- .3 Plywood identification: Grade mark in accordance with applicable CSA standards.
- .4 Each board of fire retardant treated material to shall bear the ULC label indicating 'Flame Spread Classification' (FSC), and smoke developed.
- .5 Engage the services of a structural engineer (P.Eng.), to Section 01 35 01 - Delegated Design, licenced to practice in Ontario to design, draw and stamp the engineered shop drawings and review the site as required by Code.

### **1.6 DELIVERY, STORAGE, AND HANDLING**

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

## **Part 2 Products**

### **2.1 LUMBER**

- .1 Supply and install all structural wood elements and accessories as required in accordance with the structural design Drawings and schedules.

- .2 Selection of lumber in each instance shall meet or exceed AWC Wood Design Package and OBC requirements and comply with Contractor's delegated design stamped and signed engineered shop drawings.
- .3 Provide engineered trusses as noted on structural design Drawings. Reinforce as required.
- .4 Select wood for exposed locations for appearance as well as performance; organize and plan the work so grade stamps or knots or mars are not visible in exposed work.
- .5 Lumber:
  - .1 Fabricate lumber from dimension lumber of sizes indicated, and into shapes shown on drawings.
  - .2 Moisture Content: 19% maximum for lumber items not specified to receive wood preservative treatment.
  - .3 Grade: provide #2 Grade per NLGA, S2S, kiln-dried.

## **2.2 PANEL MATERIALS**

- .1 Interior plywood: Plywood panels to CSA O325, thickness as indicated.
- .2 Exterior grade plywood: exterior grade Douglas Fir (DFP), Spruce (SPF) to CSA O121, thickness as indicated; waterproof glue bond.
- .3 Fire Rated Plywood Panels, to CSA O325, Class A fire retardant produced under Performance Standard PS-1, certified by the American Plywood Association. Fire-Rated Materials: ULC-labelled fire resistant, provide grade stamp or certification as noted for fire retardant pressure treated lumber.
  - .1 Basis-of-Design:
    - .1 Purekor Fire Retardant Plywood.
- .4 Panels shall have no added urea formaldehyde.

## **2.3 WOOD PRESSURE TREATMENTS**

- .1 Where lumber or plywood is indicated as preservative treated or is specified to be treated, treat in accordance with CAN/CSA O80.9M and AWWA.
- .2 Pressure preservative treat deck boards with Micronized Copper Azole (MCA) preservative with a at a 3.684 kg/m<sup>3</sup> (Critical Structure) retention level. Pressure preservative treat sleepers with Chromated Copper Arsenate (CCA) preservative at a retention level of 3.684 kg/m<sup>3</sup>. 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.
  - .3 Wood framing members less than 18-inches above grade.
- .3 Pressure treat wood members in contact with ground or freshwater with Copper Azole (CA-B) preservative to a minimum AWWA retention of 3.4 kg/m<sup>3</sup>.
- .4 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.
  - .3 Acceptable materials:



- .1 Dricon FRT, by Lonza.
- .2 D-Blaze Fire Retardant Treated Wood, by Viance.
- .3 Pyro-Guard, by Hoover Treated Wood Products, Inc.
- .5 Complete fabrication of treated items before treatment where possible. If cut or drilled after treatment, apply field treatment to cut and drilled surfaces.
- .6 Wood Preservatives: Maximum allowable VOC limit 350 g/L in accordance with SCAQMD Rule #1113 - Architectural Coatings.

## **2.4 ACCESSORIES**

- .1 Joint Sealants: in accordance with Section 07 92 00 – Joint Sealants. Maximum allowable VOC limit 250 g/L in accordance with SCAQMD Rule 1168.
- .2 Structural Adhesive: LePage PL 400, or equivalent with same or better physical, application and performance properties per technical data sheet.
  - .1 Required Application Locations: adhesive required for subfloor plywood to subfloor joists/structure.
- .3 Screws for Fastening to Cold-Formed Metal Framing: to ASTM C954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
- .4 Rough Hardware (bolts, nuts, washers, etc.): hot dip galvanized in conformity to ASTM A153.
- .5 Proprietary fasteners: hot dip galvanized or type 316 stainless steel toggle bolts, expansion shields and lag bolts, screws and lead plugs, recommended for purpose by manufacturer.
- .6 Wood Screws – select screws to suit location, site conditions and purpose, and of sufficient length for adequate penetration of structural elements, to OBC.
  - .1 Strong-Drive® SDWS FRAMING Screws, or equivalent.
  - .2 Strong-Drive® SDWH TIMBER-HEX Screws, or equivalent.
  - .3 Strong-Drive® SD CONNECTOR SS Screws, or equivalent.
  - .4 Strong-Drive® SDS HEAVY-DUTY CONNECTOR Screw, or equivalent.
  - .5 Strong-Drive® DWP WOOD SS Screws, or equivalent.
  - .6 Other screw types as required.
- .7 Spiral nails and spikes: shall be spiral shank type, to ASTM F1667; finish: hot dipped galvanized, or type 316 stainless steel for exterior work and pressure preservative and fire-retardant treated materials.
- .8 Dielectric Separator / Isolation Coating: CRL Black Bituminous Paint – aerosol or paint, by C.R. Laurence of Canada, or equivalent.

## **2.5 FASTENER FINISHES**

- .1 Stainless steel: use SAE Type 316 stainless steel fasteners for exterior applications, and at pressure-preservative or fire-retardant treated wood products.
  - .1 Galvanizing: use hot-dipped galvanized fasteners complying with ASTM A153 and connectors complying with ASTM A653, class G185, for all other applications.
- .2 For roof sheathing, use type 316 stainless steel or hot dipped galvanized exterior-grade wood deck screw fasteners of sufficient length to adequately penetrate structural members.

## **2.6 FINISHING**

- .1 All exterior wood construction, wood elements in contact with concrete or ground, and all sill plates, shall be pressure-treated as specified.

## **Part 3 Execution**

### **3.1 COMPLIANCE**

- .1 Fabrication, erection and installation shall meet or exceed the requirements of OBC, errata and amendments, and AWC Wood Design Package.
- .2 Accurately and properly fabricate, assemble and install rough carpentry work as required. Include all necessary nails or other connectors.
- .3 Use dust collectors and high-quality respirator masks when cutting or sanding wood panels.

### **3.2 ISOLATION COATING**

- .1 Apply isolation coating to contact surfaces in contact with cementitious materials, wood materials, and dissimilar metals.
- .2 Apply isolation coating into all drilled holes, onto all fasteners (e.g., bolts, screws, rivets) and between all flat surfaces (e.g., behind door handles, hinges, lamp-housings, diamond plate, mirror housing, latches, brackets, door trim, frame rails, suspension mounts, etc).
- .3 Generally, 2 – 3 mil thickness is required per application. Apply enough product so that excess material “oozes out” during assembly to ensure proper sealing.
- .4 Assemble and wipe away excess product.

### **3.3 INSTALLATION**

- .1 Comply with requirements of OBC 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 Install furring and strapping as indicated.
  - .1 Align and plumb faces of strapping, furring, and blocking to tolerance of 1:600.
- .6 Install rough bucks, nailers and linings to rough openings as required to provide backing for frames and other work.
- .7 Install wood cants, fascia backing, nailers, curbs and other wood supports as required and secure using Type 316 stainless steel fasteners.
- .8 Install sleepers as indicated.
- .9 Use dust collectors and high quality respirator masks when cutting or sanding wood panels.

### **3.4 FASTENINGS AND ROUGH HARDWARE**

- .1 Unless indicated otherwise, fasten to hollow masonry units with toggle bolts; to solid masonry or concrete surfaces with expansion shields and bolts.
- .2 Where screws are required use lead or inorganic fibre plugs. Wood or organic plugs not permitted.

- .3 Powder actuated fasteners may be used in lieu of bolts if approved by the Consultant in writing prior to materials arriving on site.
- .4 Provide all rough hardware such as nails, bolts, nuts, washers, screws, clips and strap metal.
- .5 Install wood stud framing for temporary weather closure and cladding. Construct to resist wind pressures.

### **3.5 PRESSURE PRESERVATIVE TREATED WOOD INSTALLATION**

- .1 Re-treat surfaces exposed by cutting, trimming or boring with liberal brush application of preservative before installation. Allow first coating to fully soak into grain before applying second coating in accordance with manufacturer's instructions.
- .2 Remove with fine sandpaper chemical deposits on treated wood to receive applied finish.
- .3 Use only hot dipped galvanized, corrosion resistant nail or screw fasteners. Staples are not acceptable for installation of preservative treated materials.
- .4 Use water borne preservative treated wood for:
  - .1 Wood in contact with masonry or concrete,
  - .2 Wood in contact with flashings,
  - .3 Wood in contact with waterproofing membranes, confirm compatibility with membrane manufacturer prior to application.

### **3.6 POWER, TELECOMMUNICATIONS AND DATA PANEL BOARDS**

- .1 Provide 19 mm fir plywood boards in telephone rooms to receive wiring and equipment. Install minimum 1220 mm x 2440 mm panels on all periphery walls over 305 mm wide, mounted 150 mm off of finished floor.
- .2 Paint panels with 2 coats of light-coloured fire retardant paint finish; coat all sides of panels (back, front and sides) in accordance with TIA/EIA 569 requirements; coordinate with electrical trades as required.

### **3.7 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning. 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. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3 Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.

### **3.8 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

### **3.9 SCHEDULE**

- .1 Fabricate, erect and install wood construction in accordance with the design Drawings, and stamped and signed engineered shop drawings.
- .2 Provide stamped, signed engineered shop drawings for wood frame construction and construction supporting wall-hung cabinetry, washroom accessories and other wall-supported equipment or elements; construct accordingly.

- .3 Wood stairs: Construct from S-P-F lumber to CSA O141.
- .4 Exterior wood canopy: Construct from pressure-treated S-P-F lumber to CSA O141 and CSA O80 Series.
- .5 For finish carpentry, millwork, and architectural woodwork, refer to the architectural design Drawings and interior design Drawings.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 05 41 00 – Structural Metal Stud Framing.
- .2 Section 07 21 16 – Blanket Insulation.
- .3 Section 07 27 14 – Air Barriers.
- .4 Section 07 92 00 – Joint Sealants.

**1.2 REFERENCES**

- .1 ASTM International (ASTM)
  - .1 ASTM C475/C475M-17 (2022), Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
  - .2 ASTM C840-20, Specification for Application and Finishing of Gypsum Board.
  - .3 ASTM C954-22, Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness.
  - .4 ASTM C1002-22, Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
  - .5 ASTM C1047-19, Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
  - .6 ASTM C1177/C1177M-17, Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
  - .7 ASTM C1280-18, Specification for Application of Exterior Gypsum Panel Products for Use as Sheathing.
- .2 Gypsum Association
  - .1 GA 253-2018, Application of Gypsum Sheathing.
- .3 ULC Standards
  - .1 CAN/ULC S102-18, Surface Burning Characteristics of Building Materials and Assemblies.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data: Manufacturer's data sheets on each product to be used, including:
  - .1 Preparation instructions and recommendations.
  - .2 Storage and handling requirements and recommendations.
  - .3 Design data test reports.
  - .4 Installation methods.
- .3 Shop Drawings:
  - .1 Submit shop drawings showing elevations, sections and details of construction.
- .4 Verification Samples: For each product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product.
- .5 Manufacturer's Certificates: Certify products meet or exceed specified requirements.
- .6 Submit warranty.

#### **1.4 QUALITY ASSURANCE**

- .1 Single Source Responsibility: Obtain gypsum sheathing products, joint treatment, and accessories from a single manufacturer or from manufacturers recommended by prime manufacturer of gypsum sheathing products.
- .2 Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum ten years' documented experience.
- .3 Installer Qualifications: Company specializing in performing Work of this section with minimum three years' documented experience.

#### **1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Store products in manufacturer's packaging indicating manufacturer and product name and protect until ready for installation.
- .2 Store materials protected against damage from weather, direct sunlight, surface contamination, construction traffic, or other causes.
- .3 Stack sheathing flat on leveled supports off the ground, under cover, and fully protected from weather.
- .4 Store and support boards in flat stacks to prevent sagging. Protect materials to keep them dry. Protect boards to prevent damage to edges and surfaces.

#### **1.6 SITE 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.

#### **1.7 WARRANTY**

- .1 Manufacturer standard warranty against delamination of facing and degradation of sheet for 12 months from installation of board.

### **Part 2 Products**

#### **2.1 GYPSUM MATERIALS**

- .1 Exterior Grade 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 GlasRoc Exterior Sheathing, CertainTeed.
    - .2 Securock Glass Mat Sheathing, CGC Inc.
    - .3 Gold Bond® BRAND eXP® Extended Exposure Gypsum Sheathing, National Gypsum Company.
    - .4 Dens-Glass Gold, Georgia-Pacific Canada, Inc.

#### **2.2 FRAMING MATERIALS**

- .1 Structural metal stud framing: as specified in Section 05 41 00 – Structural Metal Stud Framing.

## **2.3 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS**

- .1 Silicone Emulsion Sealant: Meeting ASTM C920, Type S, Grade NS, compatible with glass fiber mesh tape and for covering exposed fasteners.
- .2 Glass-Fiber Mesh Tape: Self-adhering glass-fiber tape, nominal 2 inches (51 mm) wide, 10 x 10 or 10 x 20 threads/inch (390 x 390 or 390 x 780 threads/m), of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing board and with a history of successful in-service use.

## **2.4 ACCESSORIES**

- .1 Screws: Provide wafer-head screws with countersinking ribs to prevent strip-out, self-drilling points, self-tapping, Clima-Seal (copolymer coating) finish, designed for use with structural steel stud framing.
  - .1 #8 x 32 mm (1-1/4") for single thickness board fastening.
  - .2 #8 x 41 mm (1-5/8") for double thickness board fastening, unless otherwise required.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Do not begin installation until supports and substrates have been properly prepared.
- .2 Verify that framing and supports are ready to receive work and opening dimensions are as indicated on the Drawings.
- .3 If support and substrate preparation is the responsibility of another installer, notify Consultant of unsatisfactory preparation before proceeding.

### **3.2 PREPARATION**

- .1 Clean surfaces thoroughly prior to installation.
- .2 Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

### **3.3 GYPSUM SHEATHING INSTALLATION**

- .1 Install in accordance with manufacturer's written instructions, ASTM C1280, GA-253 and applicable building codes.
- .2 Install sheathing with acrylic coated side (logo side) out.
- .3 Cut boards at penetrations, edges, and other obstructions of work and fit tightly against abutting construction, unless otherwise indicated.
- .4 Install boards with 3/8-inch (10 mm) setback where non-load-bearing construction abuts structural elements.
- .5 Install boards with 1/4-inch (6 mm) setback where they abut masonry or similar materials that might retain moisture, to prevent wicking.
- .6 Allow no joints greater than 1/8 inch (3 mm).
- .7 Coordinate sheathing installation with flashing and joint-sealant installation so materials are installed in sequence and manner that prevents exterior moisture from passing through completed exterior wall assembly.

- .8 Apply fasteners so screw heads bear tightly against face of sheathing boards but do not cut into facing.
- .9 Do not bridge building expansion joints with sheathing; cut and space edges to match spacing of structural support elements.
- .10 Horizontal Installation: Install sheathing with long edges in contact with edges of adjacent boards without forcing.
  - .1 Abut ends of boards over centers of stud flanges, and stagger end joints of adjacent boards not less than one stud spacing.
  - .2 Screw-attach boards at perimeter and within field of board to each steel stud.
  - .3 Space fasteners approximately 8 inches (200 mm) on center (or tighter spacing if recommended by manufacturer for specific application) and set back minimum 3/8 inch (10 mm) from edges and ends of boards.
  - .4 Treat board joints, when required by local building code or exterior finish system, per manufacturer's written instructions.

### **3.4 SHEATHING JOINT-AND-PENETRATION TREATMENT**

- .1 Seal all sheathing joints, as required, according to sheathing manufacturer's written recommendations.
  - .1 If weather seal is required before application of water-resistive barrier, apply silicone emulsion sealant on joints and trowel flat. Apply sufficient quantity of sealant to completely cover joints after troweling. Seal other penetrations and openings. Check with water-resistive barrier manufacturer for installation instructions prior to application of sealant.
  - .2 As an alternate to separate water-resistive barrier - Apply glass-fiber mesh tape to fiberglass reinforced gypsum sheathing board joints, and apply and trowel silicone emulsion sealant to embed sealant in entire face of tape. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

### **3.5 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning. Leave Work area clean at end of each day.
  - .1 Prevent overspray and/or splashes to adjacent surfaces.
  - .2 Clean spills, splashes and/or or overspray immediately using manufacturer's recommended cleaners and procedures.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3 Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 – Waste Management and Disposal.

### **3.6 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**END OF SECTION**



**Part 1 General**

**1.1 SUMMARY**

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

**1.2 RELATED REQUIREMENTS**

- .1 Section 05 50 00 – Metal Fabrications
- .2 Section 06 10 00 – Rough Carpentry
- .3 Section 06 40 00 – Architectural Woodwork
- .4 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.
- .2 ASTM International (ASTM):
  - .1 ASTM C635/C635M-17, Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay in Panel Ceilings.
  - .2 ASTM D1037-12 (2020), Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials.
  - .3 ASTM E84-21, Standard Test Method for Surface Burning Characteristics of Building Materials.
  - .4 ASTM E1264-19, Standard Classification for Acoustical Ceiling Products.
  - .5 ASTM E1333-14, Standard Test Method for Determining Formaldehyde Concentrations in Air and Emissions Rates from Wood Products Using a Large Chamber.
  - .6 ASTM F1667-18a, Standard Specification for Driven Fasteners: Nails, Spikes, and Staples.
- .3 American Wood Protection Association (AWPA):
  - .1 AWPA E16-16, Standard Field Test for Evaluation of Wood Preservatives to be used Above Ground (UC3B); Horizontal Lap-Joint Test.
- .4 Architectural Woodwork Manufacturers Association of Canada (AWMAC) and Architectural Woodwork Institute (AWI):
  - .1 North American Architectural Woodwork Standards (NAAWS), Most Recent Edition.
- .5 California Air Resources Board (CARB):
  - .1 Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products (2007).
- .6 Canadian Plywood Association (CanPly)
  - .1 The Plywood Handbook 2005.

- .7 Canadian Standards Association (CSA International)
  - .1 CSA B111-1974 (R2003), Wire Nails, Spikes and Staples.
  - .2 CSA-G164-18, Hot Dip Galvanizing of Irregularly Shaped Articles, Includes Update No 1 (2020).
  - .3 CAN/CSA O80 Series-15 (R2020), Wood Preservation, Includes Update No. 1 (2017) and Update No. 2 (2019).
  - .4 CSA O115-M1982 (R2001), Hardwood and Decorative Plywood.
  - .5 CSA O121-17, Douglas Fir Plywood.
  - .6 CSA O141-05 (R2019), Softwood Lumber.
  - .7 CSA O151-17, Canadian Softwood Plywood.
  - .8 CSA O153:19, Poplar Plywood.
  - .9 CSA Z760-94 (R2001), Life Cycle Assessment.
- .8 Hardwood, Plywood and Veneer Association (HPVA):
  - .1 HPVA HP-1-2009, Standard for Hardwood and Decorative Plywood.
- .9 National Hardwood Lumber Association (NHLA)
  - .1 Rules for the Measurement and Inspection of Hardwood and Cypress 2011.
- .10 National Lumber Grades Authority (NLGA)
  - .1 Standard Grading Rules for Canadian Lumber 2017.
- .11 South Coast Air Quality Management District (SCAQMD), California State (SCAQMD)
  - .1 SCAQMD Rule 1113-16, Architectural Coatings.
  - .2 SCAQMD Rule 1168-17, Adhesive and Sealant Applications.
- .12 ULC Standards (ULC)
  - .1 ULC-104, Standard Method for Fire Tests of Door Assemblies (CAN/ULC-S104-15).
  - .2 ULC 105, Standard Specification for Fire Door Frames Meeting the Performance Required by CAN/ULC-S104 (CAN/ULC-S105:2016).

#### **1.4 ADMINISTRATION REQUIREMENTS**

- .1 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.

#### **1.5 ACTION SUBMITTALS / INFORMATIONAL SUBMITTALS**

- .1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.
  - .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 – Submittal Procedures.
  - .1 Submit samples, 300 mm x 300 mm of each wood species with finish, to the Consultant 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.

## **1.6 CLOSEOUT SUBMITTALS**

- .1 Provide operations and maintenance data in accordance with Section 01 78 00 – Closeout Submittals.

## **1.7 QUALITY ASSURANCE**

- .1 Architectural Woodwork Standards (NAAWS) 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 NAAWS, the more restrictive requirement shall prevail.
- .2 Any reference to Custom or Premium grade in this specification shall be as defined in the NAAWS.
- .3 Any item not given a specific quality grade shall be Custom grade as defined in the NAAWS.
- .4 A copy of the NAAWS 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 NAAWS.
- .6 Materials and installation shall be in Metric measurements as specified.

## **1.8 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 two Care and Storage of the NAAWS.
- .3 Delivered materials which are damaged in any way or do not comply with these specifications will be rejected by the Consultant and shall be removed from the job site and replaced with acceptable materials.
- .4 Packaging Waste Management.
  - .1 Separate waste materials for recycling in accordance with Section 01 74 21 - Waste Management and Disposal.

## **1.9 SITE CONDITIONS**

- .1 Comply with the NAAWS 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.

## **Part 2 Products**

### **2.1 LUMBER MATERIAL**

- .1 Hardwood lumber: [white oak] [red oak] [white maple] [birch] 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 National Hardwood Lumber Association (NHLA).
  - .2 NAAWS custom grade, moisture content as specified.

## **2.2 PANEL MATERIAL**

- .1 Hardwood plywood: to CSA O115, of thickness indicated, and maximum size sheets application and as follows:
  - .1 NAAWS custom grade, for transparent finish.
  - .2 Face Veneer: Veneer Grade A:
    - .1 Minimum 150 mm flitch width.
    - .2 Continuous across face of panel, no end matching allowed.
    - .3 Birch, flat cut, single sheet match and symmetry.
    - .4 Minimum veneer thickness, 0.50 mm.
    - .5 Vertical grain direction.
  - .3 Core Construction: Medium Density Fibreboard.
  - .4 Back Veneer: #1 Backing Grade.
  - .5 Panel 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 Particleboard: to ANSI A208.1, Grade M-2 or better, minimum 720 kg/m<sup>3</sup> density and Grade M-3, minimum 750 kg/m<sup>3</sup> 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, Arauco.
    - .2 Purekor Platinum Particleboard, Panel Source International.
    - .3 Encore SDF Sustainable Particleboard, SierraPine Ltd.
  - .2 Urea-formaldehyde free.
- .3 Medium Density Fibreboard (MDF): Meeting ASTM D1037 and ANSI A208.2, Custom Grade for interior use, minimum 750 kg/m<sup>3</sup> density; formaldehyde emissions shall be 0.30 ppm or less per 0.424m<sup>2</sup>/m<sup>3</sup> of room value.
  - .1 Urea-formaldehyde free.
  - .2 Acceptable Materials:
  - .3 Acceptable Materials for high moisture areas (e.g., bathrooms):
    - .1 Medex MDF, Roseburg.
    - .2 Flakeboard Premier Plus Moisture Resistant MDF, Flakeboard.
  - .4 Acceptable Materials for standard applications:
    - .1 Medite II MDF, Roseburg.
    - .2 Flakeboard Premier MDF, Flakeboard.
  - .5 Basis-of-Design Materials for thin paper laminates and thermally fused melamine:
    - .1 Flakeboard Premier Plus MDF, Flakeboard.
  - .6 Acceptable Materials for fire resistant core:
    - .1 Medite MDF FR, Roseburg.
    - .2 Flakeboard Premier MDF FR, Flakeboard.

## **2.3 PERFORMANCE / DESIGN CRITERIA FOR WALL AND CEILING MOUNTED WOOD**

- .1 Surface Performance Characteristics: Tested in accordance with ASTM E84 and complying with ASTM E1264 for Class A products and as follows:

- .1 Flame Spread: 25 or less.
- .2 Smoke Developed: 50 or less.
- .2 Attachment Devices: Size for five times design load indicated in ASTM C635, Table One, Direct Hung.

## **2.4 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.

## **2.5 ACCESSORIES**

- .1 Fasteners: to suit size and nature of components being fastened.
- .2 Nails and staples: to CSA B111; galvanized to 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: metal.
- .5 Adhesive: recommended by manufacturer.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Contractor, Owner, and Consultant 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 Perform finish carpentry to Quality Standards of the NAAWS, 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 NAAWS, 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 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.
- .4 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.

**END OF SECTION**

**Part 1            General**

**1.1            SUMMARY**

- .1    The work of this section includes the supply installation of shop manufactured architectural woodwork in accordance with Architectural Woodwork Standards (NAAWS).
- .2    Cabinet hardware to be supplied by this section.

**1.2            RELATED REQUIREMENTS**

- .1    Section 05 50 00 – Metal Fabrications
- .2    Section 06 10 00 – Rough Carpentry
- .3    Section 06 20 00 – Finish Carpentry
- .4    Section 07 92 00 – Sealants
- .5    Section 08 14 16 – Wood Doors
- .6    Section 09 21 16 – Gypsum Board Assemblies
- .7    Section 09 65 00 – Resilient Flooring
- .8    Section 09 91 00 – Painting
- .9    Division 22 – Mechanical: Sinks in countertops

**1.3            REFERENCES**

- .1    American National Standards Institute (ANSI)
  - .1    ANSI A208.1-2009, Particleboard.
  - .2    ANSI A208.2-2009, Medium Density Fiberboard (MDF) for Interior Applications.
  - .3    ANSI/NEMA LD 3-2005, High-Pressure Decorative Laminates. (HPDL)
- .2    ASTM International (ASTM)
  - .1    ASTM D1037-12 (2020), Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials.
  - .2    ASTM D2555–17a, Standard Practice for Establishing Clear Wood Strength Values.
  - .3    ASTM D2559–12a (R2018) Standard Specification for Adhesives for Bonded Structural Wood Products for Use Under Exterior Exposure Conditions.
  - .4    ASTM D2832-92(2016), Standard Guide for Determining Volatile and Nonvolatile Content of Paint and Related Coatings.
  - .5    ASTM D3574-17, Standard Test Methods for Flexible Cellular Materials-Slab, Bonded, and Molded Urethane Foams.
  - .6    ASTM D4300-01(2021)e1, Standard Test Methods for Ability of Adhesive Films to Support or Resist the Growth of Fungi.
  - .7    ASTM D5116-17, Standard Guide for Small-Scale Environmental Chamber Determinations of Organic Emissions from Indoor Materials/Products.
  - .8    ASTM D5672/D5672M-22, Standard Test Method for Testing Flexible Cellular Materials Measurement of Indentation Force Deflection Using a 25-mm (1-in.) Deflection Technique.
  - .9    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 North American Architectural Woodwork Standards (NAAWS), Most Recent Edition.
- .4 California Air Resources Board (CARB)
  - .1 Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products (2007).
- .5 CSA Group
  - .1 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.
  - .2 CAN/CSA O80 Series-15 (R2020), Wood Preservation, Includes Update No. 1 (2017) and Update No. 2 (2019).
  - .3 CSA O112.9-10(R2019), Evaluation of Adhesives for Structural Wood Products (Exterior Exposure), Includes Update No. 1 (2011).
  - .4 CSA O112.10-08 (R2017), Evaluation of Adhesives for Structural Wood Products (Limited Moisture Exposure), Includes Update No. 1 (2010), Update No. 2 (2010).
  - .5 CSA O115-M1982 (R2001), Hardwood and Decorative Plywood.
  - .6 CSA O121-17, Douglas Fir Plywood.
  - .7 CSA O141-05 (R2019), Softwood Lumber.
  - .8 CSA O151-17, Canadian Softwood Plywood.
  - .9 CSA O153:19, Poplar Plywood.
- .6 Hardwood, Plywood, and Veneer Association
  - .1 HPVA HP-1-2009, Standard for Hardwood and Decorative Plywood.
- .7 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.
- .8 National Electrical Manufacturers Association (NEMA)
  - .1 ANSI/NEMA LD-3-2005, High-Pressure Decorative Laminates (HPDL).
- .9 National Hardwood Lumber Association (NHLA)
  - .1 Rules for the Measurement and Inspection of Hardwood and Cypress 2011.
- .10 National Lumber Grades Authority (NLGA)
  - .1 Standard Grading Rules for Canadian Lumber 2017.
- .11 South Coast Air Quality Management District (SCAQMD), California State (SCAQMD)
  - .1 SCAQMD Rule 1113-16, Architectural Coatings.
  - .2 SCAQMD Rule 1168-17, Adhesive and Sealant Applications.
- .12 ULC Standards
  - .1 CAN/ULC-S102:2018, Standard Method for Surface Burning Characteristics of Building Materials and Assemblies.

#### **1.4 ACTION SUBMITTALS / INFORMATIONAL SUBMITTALS**

- .1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.
  - .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 Provide seaming diagram for solid surface finishes.
- .4 Show materials, thicknesses, finishes and hardware.
- .5 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 – Submittal Procedures.
  - .1 Submit two finished samples, 610 mm x 610 mm of each finish to be applied at the factory, to the Consultant 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 Consultant for approval.
  - .3 Reviewed samples shall become the standard for the work.

#### **1.5 CLOSEOUT SUBMITTALS**

- .1 Project Record Sheet: Submit to the Consultant two copies of the project record sheet identifying the project title and address, Owner, Consultant, 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 – Closeout Submittals.

#### **1.6 QUALITY ASSURANCE**

- .1 Architectural Woodwork Standards (NAAWS) 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 NAAWS.
- .4 Any item not given a specific quality grade shall be Custom grade as defined in the NAAWS.
- .5 A copy of the NAAWS 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 NAAWS.
- .7 Perform the Work in accordance with the definition of 'Good Workmanship' as defined in the NAAWS.
- .8 Remove and replace finish carpentry Work which does not conform to the NAAWS.
- .9 Materials and installation shall be in metric measurements.
- .10 Mock-Ups:
  - .1 Provide mock-ups in accordance with requirements of Section 01 45 00 – Quality Control.
  - .2 Construct mock-ups for each form of construction and finish required to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution before fabricating and installing interior casework.
  - .3 Build full size mock-ups on site using specified materials and hardware required for the completed work, and as follows:
    - .1 Place mock-ups in location and size indicated.

- .2 Notify Consultant seven days in advance of dates and times when mock-ups will be fabricated and installed.
- .3 Demonstrate the proposed range of aesthetic effects and workmanship; Consultant may request minor changes to finish, fabrication or hardware that does not affect Contract Price.
- .4 Obtain Consultant's acceptance of mock-ups prior to starting interior casework fabrication.
- .5 Maintain mock-ups during construction in an undisturbed condition as a standard for judging the completed work.
- .6 Mock-ups may form a part of the completed work when accepted by the Consultant.

## **1.7 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver, store, and handle materials in accordance with the NAAWS. Control the temperature and humidity in accordance with NAAWS 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.
- .4 Packaging Waste Management
  - .1 Separate waste materials for recycling in accordance with Section 01 74 21 - Waste Management and Disposal.

## **1.8 SITE CONDITIONS**

- .1 Comply with the NAAWS 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.

## **1.9 WARRANTY**

- .1 Provide manufacturer's standard ten year warranty for solid surfacing against defects in materials and workmanship; including material and labour to repair or replace defective materials.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Use clean stock only and comply with NAAWS for quality grades specified.
- .2 Furring, Blocking, Shims, and Hanging Strips: Fire retardant treated softwood, Softwood or hardwood lumber, kiln dried to less than 8% moisture content.

- .3 Panel Materials: Provide panel materials meeting requirements for moisture content and grades in accordance with NAAWS requirements and as specified below. Panel products must be manufactured with no added urea-formaldehyde.
- .4 Douglas fir sheathing, Grade B-B; exposure durability rating shall be 'EXTERIOR', and the glue used shall be a fully waterproof structural adhesive
- .5 Baltic Birch Plywood: Grade B/BB, urea-formaldehyde free.
- .6 Softwood Plywood: Meeting CSA O121 or CSA O151, cross-banded, sanded G2S, thickness as indicated.
- .7 Poplar plywood: to CSA O153, utility interior moisture resistant type.
- .8 Hardwood plywood: to CSA O115, of thickness indicated, maximum size sheets application, and as follows:
  - .1 NAAWS custom grade, for transparent finish.
  - .2 Face Veneer: Veneer Grade A:
    - .1 Minimum 150 mm flitch width.
    - .2 Continuous across face of panel, no end matching allowed.
    - .3 Quarter cut, single sheet match and symmetry.
    - .4 Species: Refer to Finishes Legend.
    - .5 Minimum veneer thickness: 0.50 mm.
    - .6 Vertical grain direction.
  - .3 Core Construction: industrial particleboard meeting requirements of NAAWS. Provide exterior waterproof grade plywood veneer core for countertops to receive sinks and in wet areas.
  - .4 Back Veneer: #1 Backing Grade.
  - .5 Panel 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.
- .9 Medium Density Fibreboard (MDF): Meeting ASTM D1037 and ANSI A208.2, [Premium] [Custom] Grade for interior use, minimum 700 kg/m<sup>3</sup> density; formaldehyde emissions shall be 0.30 ppm or less per 0.424m<sup>2</sup>/m<sup>3</sup> 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 Basis-of-Design Materials for thin paper laminates and thermally fused melamine:
    - .1 Flakeboard Premier Plus MDF, Flakeboard.
  - .5 Acceptable Materials for fire resistant core:
    - .1 Medite MDF FR, Roseburg.
    - .2 Flakeboard Premier MDF FR, Flakeboard.
- .10 Particleboard: to ANSI A208.1, Grade M-2 or better, minimum 720 kg/m<sup>3</sup> density [and Grade M-3, minimum 750 kg/m<sup>3</sup> 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, Arauco.
  - .2 Purekor Platinum Particleboard, Panel Source International.
  - .3 Encore SDF Sustainable Particleboard, SierraPine Ltd.
- .11 Lumber:
  - .1 Softwood: to CSA O141, kiln dried to maximum moisture content of 12%, dressed 4 sides.
  - .2 Hardwood: to Canadian Hardwood Lumber Association, selected to meet NAAWS custom grade, Birch, plain sawn for clear finish.
- .12 High Pressure Decorative Laminate (HPDL): to ANSI/NEMA LD3; Grades and application in accordance with applicable NAAWS 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 Bases-of-Design:
    - .1 Refer to Finishes Legend.
  - .7 Acceptable Materials:
    - .1 Arborite.
    - .2 Formica.
    - .3 Lamin-Art.
    - .4 Nevamar.
    - .5 Pionite.
    - .6 Wilsonart.
- .13 Low Pressure Decorative Laminate: to ANSI/NEMA LD3, in accordance with applicable NAAWS 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:
  - .1 Refer to Finishes Legend.
- .14 Solid-Surfacing Material: Cast, nonporous, filled polymer, with through body colour meeting requirements of ANSI/NEMA LD 3, and having the following nominal properties:
  - .1 Thickness: 13 mm.
  - .2 Surface Burning Characteristics: in accordance with CAN/ULC S102 and as follows:
    - .1 Flame Spread: Maximum 25.
    - .2 Smoke Developed: Maximum 25.
  - .3 Colour Bases-of-Design: Refer to Finishes Legend.
  - .4 Acceptable Materials:
    - .1 Avonite, Avonite, Inc.
    - .2 Corian, Dupont Polymers.
    - .3 Surell, Formica Corporation.
    - .4 Gibraltar, Wilsonart International.
- .15 Edging:
  - .1 Edge type shall conform to NAAWS requirements.
  - .2 Solid, high impact, purified, colour-thru, acid resistant, PVC edging.
    - .1 3 mm edging at counter tops, drawers, doors, and splashes.
    - .2 1 mm edging at cabinet boxes, exposed shelving, and concealed shelving.
  - .3 High Pressure Decorative Laminate Edging:
  - .4 Horizontal General Purpose Grade (HGS): thickness of 1.2 mm  $\pm$  0.12 mm, colour and finish to match surface finish.
  - .5 All edges of door and drawer panels shall be finished the same as face and back (6 sides finished).
  - .6 Post-forming (VGP): maximum thickness of 1mm, colour and finish to match surface finish.
- .16 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.
  - .2 Edge banding: Thermoplastic hot melt, synthetic resin suitable for applying thin veneer wood edge banding and film overlays.
  - .3 Solid surface adhesive: as recommended by manufacturer.
- .17 Sealant: in accordance with Section 07 92 00 – Sealants.

## **2.2 CABINET WORK**

- .1 Work shall conform to applicable NAAWS 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 Consultant.
- .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, plywood, 19 mm;
    - .8 Countertop cores, Plywood with non-telegraphing grain, 19 mm with 38 mm edge, for wet areas, use plywood with type two adhesive and ensure that all cut-outs are sealed prior to installation of sinks, primer is not considered to be an appropriate sealer;
      - .1 Laminated Plastic Countertops:
        - .1 Core material: exterior grade hardwood plywood with a non-telegraphing grain.
        - .1 Wet tops: Water resistant MDF.
        - .2 Back splashes: per drawings.
        - .3 Front edges: As shown on plans.
      - .2 Solid Surface Countertops:
        - .1 Back splashes: per details.
        - .2 Front edges: per details.
  - .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 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 Consultant; 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, Knap & Vogt Canada.
    - .2 BP5162G, Richelieu
- .5 Spacers: Rigid PVC to size and profile indicated.
- .6 Access Panel Connectors
  - .1 Basis-of-Design Materials:
    - .1 Type JCB-A0101C complete with Tee-Nut 261.12, Richelieu.
- .7 Grommets for electrical cords through counter tops, as indicated on drawings.
  - .1 Acceptable Materials:
    - .1 Refer to Finishes Legend.
- .8 Pulls: Typical drawers and doors.
  - .1 Bar Pulls: Refer to Finishes Legend.
- .9 Undermount Drawer Slides: the following list of drawer slides is provided to indicate general conformance requirements only; notify the Consultant where drawer width, height or intended use differs from that indicated in the general description and the requirements of the manufacturer:
  - .1 Medium duty drawer slides and high height drawers ( $\geq 150$  mm,  $\leq 305$  mm): 40 kg capacity, undermount, full extension and soft closers:
    - .1 Acceptable Materials:
      - .1 Refer to Finishes Legend.
  - .2 Heavy duty drawer slides: 68 kg capacity, undermount, full extension and soft closers:
    - .1 Acceptable Materials:
      - .1 Refer to Finishes Legend.
- .10 Drawer Slides: Following list of drawer slides is provided to indicate general conformance requirements only; notify the Consultant 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 and soft closers:
    - .1 Acceptable Materials:
      - .1 Refer to Finishes Legend uride.
  - .2 Medium duty drawer slides: 41 kg capacity, full extension and soft closers:
    - .1 Acceptable Materials:
      - .1 Refer to Finishes Legend.
  - .3 Heavy duty drawer slides: 68 kg capacity, full extension and soft closers:
    - .1 Acceptable Materials:

- .1 Refer to Finishes Legend.
- .11 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, and soft closers, size and profile to suit cabinet construction:
    - .1 Acceptable Materials:
      - .1 Refer to Finishes Legend.
    - .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, and soft closers, size and profile to suit cabinet construction:
      - .1 Acceptable Materials:
        - .1 CLIP top Series, Blum Canada Ltd.
        - .2 Tiomos, GRASS Canada.
        - .3 Salice 700 Series, Häfele Canada Inc.
        - .4 Sensys, Hettich Canada LP.
    - .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, and soft closers, size and profile to suit cabinet construction:
      - .1 Acceptable Materials:
        - .1 Aximat SM Series with soft-close device, Häfele Canada Inc..
        - .2 Selektä Pro 2000 Series with soft-close device, Hettich Canada LP.
        - .3 MB 8000 Series, with Blumotion 971a Richelieu.
  - .12 Locks: Refer to Finishes Legend
  - .13 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:
        - .1 36752G, Richelieu.
    - .2 Magnetic Catch:
      - .1 Basis-of-Design Materials:
        - .1 BP504510, Richelieu.
    - .3 Roller latches for closet doors, heavy duty, double roller type, zinc finish:
      - .1 Basis-of-Design Materials:
        - .1 6032G, Richelieu.
  - .14 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 Series 331/325 grommet, Knappe & Vogt Canada.
        - .2 5829-180/2292-180, Richelieu.
    - .2 Surface wall mounted pilaster with shelf rests sized for shelf depth, nickel finish.
      - .1 Basis-of-Design Materials:



- .1 Knappe & Vogt.
- .3 Flush mounted pilaster with shelf rests sized for shelf depth, nickel finish.
  - .1 Basis-of-Design Materials:
    - .1 Knappe & 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 00120, Hettich Canada LP.
    - .2 255/256, Knappe & Vogt.
    - .3 2552G/CP2562G, Richelieu.

## 2.5 UPHOLSTERY WORK

- .1 Cushion Material: Manufactured to the Standards of the Polyurethane Foam Association and meeting the requirements of ASTM D5672/D5672M for indentation resistance, combustion modified high resiliency flexible polyurethane foam with the following properties:
  - .1 Seat Cushion:
    - .1 Core: High Resiliency Foam, 50 mm thickness(per section until reach total thickness) having nominal density of 40 kg/m<sup>3</sup> +5%, having a nominal 45 IFD at 36 kg/m<sup>2</sup> and 25% CFD with a minimum 2.5 CM.
    - .2 Overlay: Filled Conventional Foam, 25 mm thickness(per section until reach total thickness) having nominal density of 29 kg/m<sup>3</sup> +5%, having a nominal 30 IFD at 36 kg/m<sup>2</sup> and 25% CFD with a minimum 2.0 CM.
    - .3 Compression Set: After Humid Aging in accordance with ASTM D3574, Procedure J.1; and Compression Set in accordance with ASTM D3574 except samples shall be deflected 75% of the original sample height; Compression Set calculations shall be done in accordance with ASTM D3574 Section 42.1.1, as follows:
      - .1 Filled Conventional Foam: 10% maximum compression set, after humid aging.
      - .2 High Resiliency Foam: 30% maximum compression set.
      - .3 Profile seat cushion to full wrap, bevels and profiles indicated on Drawing.
  - .2 Seat Backs:
    - .1 Core: Filled Conventional Foam, 32 mm thickness (per section until reach total thickness), having nominal density of 29 kg/m<sup>3</sup> +5%, having a nominal 30 IFD at 36 kg/m<sup>2</sup> and 25% CFD loading with a minimum 2.0 CM.
    - .2 Profile seat back cushion to full wrap, bevels and profiles indicated on Drawing.
- .2 Covering Materials:
  - .1 Ticking: Fire retardant treated separation sheet to prevent foam catching on material and to provide a moisture resistant separation between foam and fabric:

- .2 Fabric: anti-microbial treated, washable and scrubbable material:
  - .1 Basis-of-Design Materials: Refer to Finishes Legend.
- .3 Fastening Devices: Woven nylon hook and loop fastener tape, high use rated with stitched and fastened to fabricated seat cushions, backs and base, 50 mm width by maximum possible length, colour black.
  - .1 Basis-of-Design Materials:
    - .1 Velcro Canada.
- .4 Fabricate upholstery items so that seams are stitched watertight, cushions and backs held in place by hook and loop tapes, padding can be removed from cushions using a concealed zipper, and box work completed similar to casework specified.

## **2.6 FACTORY FINISHING – CABINET WORK**

- .1 Cabinet work for Transparent Finish:
  - .1 NAAWS Quality Grade Custom.
  - .2 Construction: Cabinet work shall conform to applicable NAAWS requirements.
  - .3 Semi-Exposed and Exposed Parts: Birch veneer and solids, as specified above.
  - .4 Drawer Boxes: Baltic Birch veneer plywood core.
  - .5 Factory finish cabinet work as follows:
    - .1 Finishes shall be applied in accordance with Section 5 of the NAAWS.
    - .2 Clear Finish (NAAWS Finish System 2):
      - .1 Exposed parts requiring clear finish shall have 4 coats of NAAWS pre-catalyzed lacquer, satin gloss, premium grade lacquer coating.
      - .2 Semi-Exposed parts requiring clear finish shall have NAAWS pre-catalyzed lacquer finish to match exposed components, including all surfaces of reveals and returns, underside of items and inside. Semi-exposed parts shall match exposed parts for finishing.
      - .3 Drawer box requiring clear finish shall have NAAWS pre-catalyzed lacquer, satin gloss, premium grade lacquer coating.
      - .4 All exposed wood shall be fabricated using solid White Birch for clear finish. All drawer boxes shall be Baltic Birch for clear finish.
- .2 Cabinet work for High Pressure Decorative Laminate Finish:
  - .1 NAAWS Quality Grade Custom.
  - .2 Construction: Cabinet work shall conform to applicable sections of the NAAWS.
  - .3 Exposed Parts: High pressure decorative laminate, plywood with non-telegraphing grain as indicated.
  - .4 Semi-Exposed Parts: Low pressure decorative laminate, plywood with non-telegraphing grain as specified above.
  - .5 Concealed parts: Low pressure decorative laminate backer to balance face materials.
- .3 Laminate Countertops and Backsplashes:
  - .1 Countertops shall be self edge type to applicable NAAWS requirements.
  - .2 Backsplash shall conform to Section 6 of the NAAWS.
  - .3 Custom counter shall be seamless.

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**Part 3            Execution**

**3.1                EXAMINATION**

- .1      Site Conditions for installation of architectural woodwork shall be in accordance with applicable NAAWS requirements.
- .2      Verify condition and dimensions of previously installed work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

**3.2                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      Verify that solid blocking for support and anchoring of woodwork is installed where required. Confirm exact height and location with Drawings and Consultant.
- .4      Protect finished surfaces and materials of other trades from damage.
- .5      Ensure services and roughing-in which affect or are connected to or through this work are complete and acceptable.
- .6      Back prime cabinet work immediately after delivery to site.

**3.3                INSTALLATION**

- .1      Install work to applicable NAAWS and Quality Assurance requirements.
- .2      Install cabinet work in its indicated locations, plumb, level, and true.
- .3      Anchor to floor, walls, blocking, 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.

### **3.4 INSTALLATION, SOLID SURFACING**

- .1 Install components plumb and level, in accordance with shop drawings and manufacturers written installation requirements.
- .2 Form joints and seams between solid polymer components using manufacturer's approved seam adhesive. Joints shall be inconspicuous in appearance and without voids to create a monolithic appearance.
- .3 Rout and finish component edges to a smooth, uniform appearance and finish. Edge shapes and treatments, including any inserts, shall be as detailed on the drawings. Rout all cutouts, then sand all edges smooth. Repair or reject defective or inaccurate work.
- .4 Adhere sinks to countertops using manufacturer's recommended adhesive and mounting hardware.
- .5 Install backsplashes and end splashes as indicated on Drawings; adhere to countertops using manufacturer's standard colour matched silicone sealant.
- .6 Coordinate plumbing connections and electrical requirements with affected Sections of work.

### **3.5 ADJUSTING**

- .1 During and after installation adjust all hardware and operating parts as necessary to ensure smooth and proper operation.

### **3.6 CLEANING**

- .1 Clean all cabinet, countertops, shelves and fixtures.
- .2 Repair any marks, scratches or marring.
- .3 Remove and replace damaged, marked, or stained finish carpentry.

**END OF SECTION**

## **1.1 RELATED REQUIREMENTS**

- .1 Section 03 30 00 – Cast-In-Place Concrete
- .2 Section 06 10 00 – Rough Carpentry
- .3 Section 07 26 16 – Underslab Vapour Retarders
- .4 Section 07 27 14 – Air Barriers
- .5 Section 07 92 00 – Joint Sealants

## **1.2 REFERENCES**

- .1 ASTM International
  - .1 ASTM D412-16 (2021), Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
  - .2 ASTM D1621-16, Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
  - .3 ASTM D5261-10 (2018), Standard Test Method for Measuring Mass per Unit Area of Geotextiles.
  - .4 ASTM D6364-06 (2018), Standard Test Method for Determining Short-Term Compression Behavior of Geosynthetics.
  - .5 ASTM E96/E96M-22, Standard Test Method for Water Vapor Transmission of Materials.
  - .6 ASTM E154/E154M-08a(2019), Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.
- .2 ULC Standards
  - .1 CAN/ULC S701.1-22, Standard for Thermal Insulation, Polystyrene Boards.

## **1.3 ADMINISTRATIVE REQUIREMENTS**

- .1 Convene pre-installation meeting one week prior to beginning waterproofing Work, with waterproofing contractor's representative, Engineer, Consultant, 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 ACTION SUBMITTALS / INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures:
- .2 Product data:

- .1 Provide electronic copy of most recent technical waterproofing components data sheets describing material physical properties and include product characteristics, performance criteria, physical size, finish, and limitations.
- .2 Submit membrane manufacturer's standard details to be utilized for this project, indicate changes to make details project specific, for review by Consultant.
- .3 Provide one electronic copy of WHMIS SDS - Safety Data Sheets in accordance with WHMIS acceptable to Labour Canada, and Health and Welfare Canada and indicate VOC content for:
  - .1 Primers.
  - .2 Sealants.
  - .3 Solvents.
  - .4 Membrane.
- .3 Shop drawings:
  - .1 Indicate flashing, control joints, insulation, and penetration details.
  - .1 Provide typical details of penetrations and transitions.
  - .2 Manufacturer's Certificate: certify that products meet or exceed specified requirements.
  - .3 Manufacturer's Installation Instructions: indicate special precautions required for seaming the membrane.
  - .4 Manufacturer's field report: in accordance with Section 01 45 00 - Quality Control.
  - .5 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 minimum three 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 ensure materials supplied are compatible. Ensure waterproofing materials are compatible with air and vapour retarder specified under Section 07 27 14 – Air Barriers.
- .3 Coordinate between installers of each component of membrane to ensure continuity of system and that junctions between various components are effectively sealed.

## **1.6 FIRE PROTECTION**

- .1 Fire Extinguishers:
  - .1 Maintain clean site, with one approved ABC fire extinguisher within 6 meters of each torch. Respect 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 heat detector gun to spot smouldering or concealed fire at end of each workday. Establish 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°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.
- .9 Packaging Waste Management:
  - .1 Separate and recycle waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.

## **1.8 SITE CONDITIONS**

- .1 Ambient Conditions
  - .1 Do not install waterproofing when temperature remains below manufacturers' recommendations for application.
  - .2 Minimum temperature for solvent-based adhesive is -5°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 following manufacturers are acceptable. Contractor retains responsibility to provide only compatible products within assembly.
  - .1 Soprema.
  - .2 Henry Company.
  - .3 IKO.
  - .4 Siplast.
  - .5 W.R. Meadows.

### **2.2 PERFORMANCE / DESIGN CRITERIA**

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

### **2.3 SELF-ADHESIVE WATERPROOFING MEMBRANE SYSTEM MATERIALS**

- .1 Primer: water based primer as recommended by membrane manufacturer.
  - .1 Acceptable Materials:
    - .1 Elastocol Stick H2O, Soprema.
- .2 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, MD/XD (ASTM D412): 11.2/13.1 MPa.
- .3 Ultimate elongation, MD/XD (ASTM D412): 88%/55%.
- .4 Flexibility at cold temperature (ASTM D5147): -35°C.
- .5 Water vapour permeance (ASTM E96 procedure B: < 2.5 ng/Pa·s·m<sup>2</sup>).
- .6 Puncture Resistance (ASTM E154): 747 N.
- .7 Acceptable Materials:
  - .1 Colphene 3000, Soprema.

## **2.4 INSULATION**

- .1 Below-Grade Insulation: to Section 07 21 13.01 – Foundation Board Insulation, including accessories.

## **2.5 DRAINAGE BOARD**

- .1 Drainage Board (foundation wall applications): high-strength drainage panel consisting of polyethylene or polypropylene core and factory-laminated geotextile, for installation over waterproof membrane.
  - .1 Thickness: 10 mm.
  - .2 Compressive strength (ASTM D1621): 525 kPa.
  - .3 Flow rate (ASTM D4491): 6000 L/min/m<sup>2</sup>.
  - .4 Acceptable Materials:
    - .1 Soprema Sopradrain 10-G.
- .2 Provide drainage board fasteners, mould strips, sealants, termination edges, and other accessories as required for complete installation as recommended by drainage board manufacturer.

## **2.6 ACCESSORIES**

- .1 Waterproofing Mastic: single component sealing compound to seal exterior, vertical and horizontal terminations as recommended by manufacturer.
- .2 Termination Bars: high strength plastic composite, ultraviolet resistant as recommended by membrane manufacturer.

## **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 manufacturers' recommendations.
- .3 Do not install materials in conditions of snow or rain.
- .4 Cure concrete minimum 14 days, perform adhesion test before membrane application.
- .5 Verify compatibility of membrane components with curing compounds, coatings, or other materials already installed on surfaces to be treated.
- .6 Abrasive blast surface if required to promote adhesion.
- .7 Report cracks over 3 mm wide to Consultant. Fill crack with waterproofing mastic. Apply 150 mm wide strip of membrane centered over crack.



### **3.2 INSTALLATION - GENERAL**

- .1 Perform Work on 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 same day, re-prime surfaces.

### **3.4 SELF-ADHESIVE WATERPROOFING MEMBRANE INSTALLATION**

- .1 Select waterproofing membrane according to temperatures during application. For membrane applications (not including primer) at temperature below -10°C, contact membrane manufacturer.
- .2 Install membrane in accordance with manufacturer's written instructions or specification requirements whichever is more stringent.
- .3 Apply pre-stripped membrane and seal with waterproofing mastic to protrusions through waterproofing membrane.
- .4 Align first roll of membrane to previously drawn chalk line.
- .5 Pre-strip edges with 150 mm wide strip of membrane centered on corner. Install membrane in direct contact with substrate, without voids under membrane strip.
- .6 Install membrane onto primed surface by peeling back paper backing on underside and adhering membrane to surface.
- .7 Install subsequent rolls in same manner, aligned with preceding roll with side lap of at least 75 mm. Overlap end laps at least 150 mm.
- .8 Repair holes and tears in membrane with appropriate membrane material. Make repair exceed affected surface area by at least 75 mm. Apply membrane piece for repair with mastic sealant around edges.
- .9 Use roller approved by manufacturer to apply pressure over entire surface of membrane to ensure perfect adhesion.
- .10 Verify membrane installation at end of each day of work and before application of membrane protection system and backfilling.
- .11 Seal inside corner overlaps with bead of mastic after membrane installation.
- .12 Mechanically fasten uppermost edge of membrane to concrete substrate using applicable fasteners and termination bars.
- .13 Apply mastic on top edge of membrane to prevent water infiltration.
- .14 Protect waterproofing membrane left exposed after backfilling from UV and mechanical damage.

### **3.5 DRAINAGE BOARD**

- .1 General Sheet Installation: Start at lowest point and work to top, running length of sheets horizontally and overlapping upper sheets in shingled fashion at least 6 inches (150 mm); lap vertical joints at least 6 inches (150 mm).
  - .1 Install sheets without gaps, wrinkles, creases, or tears.
  - .2 Align and interlock overlapping layers.
  - .3 Secure to substrate at edges and in field of sheet using fasteners and methods recommended by sheet manufacturer, stagger fasteners in alternate rows.

- .4 Flash and seal top edges, around openings and penetrations, and other locations as recommended by manufacturer.
- .2 Drainage Sheets: In addition to general sheet installation specified above:
  - .1 Install with cup side on side facing surface waterproofed.
  - .2 Unless otherwise indicated, fasten dimpled sheets using specified fasteners with dimpled washers interlocked with sheet at not more than 12 inches (305 mm) on center.
  - .3 At top, install with flat edge secured with mould strip. Fasten at maximum 8 inches (200 mm) on center.
  - .4 At joints, apply continuous bead of sealant between layers and fasten through both layers with specified fasteners with dimpled washers.
  - .5 At vertical joints, overlap sheets at least 6 inches (150 mm) and interlock dimples, making full contact with sealant.
  - .6 At horizontal joints overlap upper sheet over flat flange of lower sheet and fasten through both sheets at lower edge of upper sheet at 36 inches (910 mm) on center.
  - .7 At inside and outside corners, install sheet as close to substrate as possible without breaking and fasten along both sides entire length of corner, not closer than 5 inches (125 mm) to corner.
  - .8 At bottom of walls, extend a single sheet from wall over footing to drainage pipe.
- .3 Repairs to Dimpled Sheet: Apply patch made of same material interlocked, with continuous sealant bead around tear or penetration.

### **3.6 PROTECTION**

- .1 Do not leave installed membrane exposed to sunlight for more than 30 days after installation; to cover, complete backfill operation or cover with protection board.
- .2 Prior to backfilling, inspect waterproofing system for tears and other damage and repair.
- .3 Take care when backfilling to avoid damage to membrane; replace membrane damaged during backfilling.
- .4 Protect installed products until completion of project.
- .5 Touch-up, repair or replace damaged products before Substantial Completion.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Division 03 Cast-in-Place Concrete
- .2 Section 05 41 00 – Structural Metal Stud Framing
- .3 Section 06 16 43 – Gypsum Sheathing
- .4 Section 07 21 19 – Foamed-in-Place Insulation
- .5 Section 07 27 14 – Air Barrier
- .6 Section 07 46 16 – Preformed Metal Siding
- .7 Section 07 62 00 – Sheet Metal Flashing and Trim
- .8 Section 08 44 13 – Glazed Aluminum Framing Systems

**1.2 REFERENCES**

- .1 ASTM International (ASTM)
  - .1 ASTM A653/A653M-20, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .2 American Society of Heating Refrigeration and Air-Conditioning (ASHRAE)
  - .1 ASHRAE 90.1-2019(I-P), Standard 90.1-2019 (I-P Edition) -- Energy Standard for Buildings Except Low-rise Residential Buildings. (ANSI Approved; IES Cosponsored)
- .3 CSA Group
  - .1 CSA B149.1:20, Natural Gas and Propane Installation Code.
  - .2 CSA B149.3:20, Code for the Field Approval of Fuel-Burning Appliances and Equipment.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Safety Data Sheets (SDS).
- .5 ULC Standards
  - .1 CAN/ULC-S102-2018, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
  - .2 CAN/ULC-S114-2018, 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 S702.1:2021, Standard for Mineral Fibre Thermal Insulation for Buildings, Part 1: Material Specification.
  - .5 CAN/ULC-S702.2-15, Mineral Fibre Thermal Insulation for Buildings, Part 2: Application Guidelines.
  - .6 CAN/ULC-S770-15 (R2020), Standard Test Method for Determination of Long-Term Thermal Resistance of Closed-Cell Thermal Insulating Foams.

**1.3 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's representative and Consultant 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 ACTION SUBMITTALS / INFORMATIONAL 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.
  - .2 Provide one electronic copy of WHMIS SDS - Safety Data Sheets in accordance with WHMIS acceptable to Labour Canada, and Health and Welfare Canada. Indicate VOCs for 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.
- .2 Packaging Waste Management
  - .1 Separate and recycle waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.

### **Part 2 Products**

#### **2.1 INSULATION MATERIALS**

- .1 Semi-rigid Insulation for Exterior Wall Assemblies (**INS-1**): Non-combustible, semi-rigid, water repellent, mineral wool insulation board to ASTM C612, Type IVB and CAN/ULC S702.1 Type 1.
  - .1 Fire Performance:
    - .1 Non-combustibility: To CAN/ULC S114.

- .2 Surface Burning Characteristics: To CAN/ULC S102.
  - .1 Flame spread: 0.
  - .2 Smoke developed: 0.
- .2 Thermal Resistance (ASTM C518): RSI 0.76/25 mm minimum.
- .3 Moisture sorption (ASTM C1104/C1104M): 1% maximum.
- .4 Density (ASTM C303):
  - .1 Thicknesses 65 mm and greater:
    - .1 Outer layer: 100 kg/m<sup>3</sup>.
    - .2 Inner layer: 60 kg/m<sup>3</sup>.
- .5 Fungi resistance (ASTM C1338): zero mould growth.
- .6 Acceptable Materials:
  - .1 Cavityrock, by Rockwool Inc.

## 2.2 ACCESSORIES

- .1 Insulation clips for rigid and semi-rigid mineral wool insulation board:
  - .1 99% thermally efficient, purpose made, gas fired direct-fasten type anchor, comprised of high density polyethylene (HDPE) shaft and integrated washer/cap with steel pin tip. Shaft point designed to pierce rigid and semi-rigid insulations.
  - .2 Anchor washer to have 60 mm (2-3/8 inch) holding diameter. Anchor shaft length to match insulation thickness.
  - .3 Anchor tip to have 50 mm (2 inch) spiral steel stud pins of zinc plated heat-treated carbon steel to penetrate through the gypsum sheathing and securely fasten anchor into steel studs.
  - .4 Fasteners to be colour coded to substrate applications.
    - .1 White Fasteners: Concrete and concrete block.
    - .2 Black Fasteners: Steel stud.
  - .5 Acceptable material:
    - .1 Ramset T3 Insulfast System by ITW Construction Products, as available through Action Fasteners or HD Supply Brofasco, or approved equivalent.
  - .6 Self-adhesive or metal stick pins are not acceptable.

## 2.3 ACCESSORIES

- .1 Screw Fasteners: 316 Stainless steel, of type to suit installation and to support all superimposed loads.
- .2 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 Acceptable Materials:
      - .1 Insulation Fasteners, Ucan Fastening Systems.
      - .2 Ramset Insulfast.
  - .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:

.1 Gemco Insulation Fasteners, Insulation Hanger.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Examine substrates and immediately inform Consultant in writing of defects.

### **3.2 PREPARATION**

- .1 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 INSTALLATION: GENERAL**

- .1 Comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.
- .2 Install insulation after building substrate materials are dry.
- .3 Install insulation to maintain continuity of thermal protection to building elements and spaces.
- .4 Fit insulation tight (maximum 3 mm air gap) around electrical boxes, wires, plumbing and heating pipes and ducts, around exterior doors and windows and other protrusions.
- .5 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 CSA-B149.1 and CSA-B149.2 type B and L vents.
- .6 Use only insulation boards free from chipped or broken edges that are dry, and unsoiled and that has not been left exposed at any time to ice and snow.
- .7 Use largest possible dimensions to reduce number of joints.
- .8 Offset both vertical and horizontal joints in multiple layer applications.
- .9 Do not enclose insulation until it has been reviewed by Consultant.
- .10 Install rigid insulation to maintain continuous thermal insulation, vapour barrier and air tightness for building spaces and elements.
- .11 Saw-cut and trim insulation neatly to fit spaces. Butt edges and ends tight (maximum 3 mm air gap). 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 - Foam-in-Place Insulation.
- .12 Install insulation horizontally. Offset vertical joints minimum 300 mm.
- .13 Leave insulation joints unbonded over line of expansion and control joints; bond continuous 150 mm wide strip of primary vapour membrane over expansion and control joints using compatible adhesive.

### **3.4 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 tight fit to substrate materials, provide adhesive and additional fasteners where uneven substrates cause air spaces behind insulation; apply adhesive to substrate in continuous film minimum 3 mm thick when wet and bed insulation into adhesive before adhesive loses tack or skins over.
  - .2 Apply insulation fasteners using minimum six fasteners in two rows located near centre of board along narrow dimension and near third points along long dimension; secure boards with two clips at centre where both dimensions are less than 600 mm.
  - .3 Apply sheet membrane vapour retarder behind Z-bars prior to installation of insulation between Z-bars supporting preformed metal cladding.
  - .4 Install insulation clips to walls before sheet membrane vapour retarders are applied.

### **3.5 CLEANING**

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

### **3.6 PROTECTION**

- .1 Protect installed board insulation from damage due to harmful weather exposures, physical abuse, and other causes.
- .2 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 REQUIREMENTS**

- .1 Division 03 cast-in-place concrete.
- .2 Section 07 13 52 – Modified Bituminous Sheet Waterproofing.
- .3 Section 07 26 16 - Underslab Vapour Retarder.

**1.2 REFERENCES**

- .1 ASTM International (ASTM)
  - .1 ASTM D1621-16, Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
  - .2 ASTM D2842-19, Standard Test Method for Water Absorption of Rigid Cellular Plastics.
- .2 ULC Standards
  - .1 CAN/ULC 701.1-17, Standard for Thermal Insulation, Polystyrene, Boards.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's published product literature, specifications, and technical datasheets.
  - .2 Submit manufacturer's published installation instructions.
- .3 Shop Drawings:
  - .1 Submit shop drawings showing locations for placement.
- .4 Submit warranties.

**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, criteria, and physical requirements.

**1.5 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 in dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
  - .2 Protect 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 insulating materials to Project site before installation time.
    - .3 Complete installation and concealment of materials as rapidly as possible in each area of construction.



- .4 Care for insulation in accordance with PIMA technical bulletin 109.

## **1.6 WARRANTIES**

- .1 Submit manufacturer's standard limited warranty for each product specified in this Section.

## **Part 2 Products**

### **2.1 FOUNDATION INSULATION**

- .1 Extruded polystyrene, under-slab as indicated: to CAN/ULC S701.1 and as follows:
  - .1 Type: 4.
  - .2 Thermal Resistance: RSI 0.87/25 mm minimum.
  - .3 Edges: square.
  - .4 Size: 1220 mm x 2440 mm x thickness as indicated on Drawings.
  - .5 Compressive Strength (ASTM D1621): minimum 275 kPa (40 psi) at 10% deformation.
  - .6 Water Absorption (ASTM D2842): maximum 0.7% (% by volume).
  - .7 Standard of Acceptance:
    - .1 DuPont™ Styrofoam™ Brand SM Extruded Polystyrene (XPS) Foam Insulation.
    - .2 Owens-Corning Foamular NGX 400.

### **2.2 ACCESSORIES AND ANCILLARY PRODUCTS**

- .1 Supply accessories and ancillary products recommended by insulation manufacturer and as required for complete installations.

## **Part 3 Execution**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's published installation instructions and illustrations, technical datasheets, and specifications.

### **3.2 EXAMINATION**

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

### **3.3 COORDINATION AND SEQUENCING**

- .1 Coordinate and cooperate with other trades as required to maintain schedule and expedite work.

### **3.4 INSULATION INSTALLATION – GENERAL**

- .1 Install insulation after building substrate materials are dry.
- .2 Install insulation to maintain continuity of thermal protection to building elements and spaces.

- .3 Use insulation boards free from chipped or broken edges, dry, and unsoiled and that has not been left exposed to ice and snow.
- .4 Use largest possible dimensions to reduce number of joints.
- .5 Offset vertical and horizontal joints in multiple layer applications.
- .6 Do not enclose insulation until it has been reviewed by Consultant.
- .7 Follow instructions for use of materials of insulation and accessory manufacturers.
- .8 Leave insulation joints unbonded over line of expansion and control joints; bond continuous 150 mm wide strip of primary vapour membrane over expansion and control joints using compatible adhesive.

### **3.5 UNDERSLAB INSULATION**

- .1 Ensure fill is level, flat and smooth, and has been fully compacted and reviewed by Consultant prior to placing insulation boards.
- .2 Install rigid board insulation at floor slab locations shown on compacted, level fill prior to installation of underslab vapour retarder and placement of concrete floor slab.
- .3 Install boards in accordance with manufacturer's published preparation and installation instructions, technical datasheets, and specifications.

### **3.6 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning. 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. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3 Manage and dispose of waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.

### **3.7 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**END OF SECTION**

**Part 1            General**

**1.1            RELATED REQUIREMENTS**

- .1    Section 04 22 00 – Unit Masonry.
- .2    Section 05 41 00 – Structural Metal Stud Framing.
- .3    Section 06 10 00 – Rough Carpentry.
- .4    Section 06 16 43 – Gypsum Sheathing.
- .5    Section 07 27 14 – Air Barriers.

**1.2            REFERENCES**

- .1    ASTM International (ASTM)
  - .1    ASTM C411-17, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
  - .2    ASTM C518-17, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
  - .3    ASTM C755-10(2015)e1, Standard Practice for Selection of Water Vapor Retarders for Thermal Insulation.
  - .4    ASTM C1338-14, Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.
  - .5    ASTM D1621-16, Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
  - .6    ASTM D1622/D1622M-14, Standard Test Method for Apparent Density of Rigid Cellular Plastics.
  - .7    ASTM D1623-17, Standard Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics (Type C sample).
  - .8    ASTM D2126-15, Standard Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging.
  - .9    ASTM D2369-10(2015)e1, Standard Test Method for Volatile Content of Coatings.
  - .10    ASTM D2842-12, Standard Test Method for Water Absorption of Rigid Cellular Plastics.
  - .11    ASTM D4541-17, Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
  - .12    ASTM D6226-15, Standard Test Method for Open Cell Content of Rigid Cellular Plastics.
  - .13    ASTM D7234-12, Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers.
  - .14    ASTM E96/E96M-16, Standard Test Methods for Water Vapor Transmission of Materials.
  - .15    ASTM E2178-13, Standard Test Method for Air Permeance of Building Materials.
- .2    Canadian Urethane Foam Contractors' Association Inc. (CUFCA)
- .3    ULC Standards
  - .1    CAN/ULC S101-14, Standard Methods of Fire Endurance Tests of Building Construction and Materials.
  - .2    CAN/ULC S102:2018, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

- .3 CAN/ULC S127-14, Standard Corner Wall Method of Test for Flammability Characteristics of Non-Melting Building Materials.
- .4 CAN/ULC S705.1-15, Amendment 3 to Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density, Material Specification, Includes Amendments 1, 2.
- .5 CAN/ULC S705.2-05, Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density, Application.
- .6 CAN/ULC S741-08, Standard for Air Barrier Materials – Specification.
- .7 CAN/ULC S742-11, Standard for Air Barrier Assemblies – Specification.
- .8 CAN/ULC S770-15, Standard Test Method for Determination of Long-Term Thermal Resistance of Closed-Cell Thermal Insulating Foams.
- .9 CAN/ULC S774-14, Standard Laboratory Guide for the Determination of Volatile Organic Compound Emissions from Polyurethane Foam.

### **1.3 SYSTEM DESCRIPTION**

- .1 Materials of this section shall provide continuity of vapour barrier, air barrier and thermal insulation at building enclosure in conjunction with thermal materials and membranes as specified and installed by other trade packages.

### **1.4 PRE-INSTALLATION MEETING**

- .1 To ensure isolation of the immediate spray area and non-interference with other trades a pre installation meeting shall be held prior to the commencement of spray operations. Coordinate meeting through the Contractor.
- .2 Review and coordinate construction details for areas to receive spray polyurethane foam insulation, such as at parapet conditions, with the Contractor and the responsible sub-trades. In cooperation with the Contractor and related responsible sub-trades, plan these areas to permit access and complete installation of the polyurethane foam.

### **1.5 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit product data in accordance with Section 01 33 00 – Submittal Procedures:
  - .1 Submit product data including manufacturer's literature for spray polyurethane foam insulation components and accessories, indicating compliance with specified requirements and material characteristics.
  - .2 Submit list on spray polyurethane foam insulation manufacturer's letterhead of materials, components and accessories to be incorporated into Work
  - .3 Include details of insulation joints with sealants.
  - .4 Include product names, types and series numbers.
  - .5 Include contact information for spray polyurethane foam insulation manufacturer and their representative for this Project.
  - .6 Provide two copies of WHMIS SDS - 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 spray insulation and thermal barrier 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 Provide CCMC Evaluation Report and manufacturer's documentation confirming material has been evaluated and conforms to requirements of CAN/ULC S705.1.
- .4 Applicator qualifications: submit letter on spray polyurethane foam insulation manufacturer's letterhead verifying applicator's license for work similar to Work of this Section.
- .5 Submit proof of license of the applicator by CUFCA (Canadian Urethane Foam Contractors Association Inc.) prior to commencing the work. Licensing is required by CAN/ULC S705.2. Alternatively, licensed applicators can conform to a Quality Assurance Program managed by the insulation manufacturer.
- .6 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, trouble shooting guide and cleaning procedures for spray applied insulation and cementitious thermal barrier.
- .7 Provide schedule indicating thermal barrier material to be used, surfaces to be protected, material thickness to be provided and appropriate references.
- .8 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 Applicators to conform to CUFCA Quality Assurance Program or to a Quality Assurance Program managed by the insulation manufacturer that follows the requirements of CAN/ULC S705.1 and CAN/ULC S705.2 and meets all other quality assurance requirements of this specification.
- .2 Contractor performing spray applied insulation work under this section shall be licensed under the SPF Quality Assurance Program (QAP) used by CUFCA (Canadian Urethane Foam Contractors Association) or licensed under a Quality Assurance Program. The contractor shall, under the QAP Licensing Agreement and as required by CAN/ULC S705.2, only purchase and install material that meets or exceeds requirements of CAN/ULC S705.1.
- .3 Installers (applicators) performing spray applied insulation work under this section must be licensed under the SPF Quality Assurance Program. The installer shall be trained by CUFCA/NECA (National Energy Conservation Association) or by manufacturer and certified by PSDI (Professional Skills Development Institute Inc.) or by the manufacturer's Quality Assurance Program in accordance with the training requirements outlined in the CAN/ULC S705.2 05. Applicators shall have their photo identification certification cards in their possession and available on the project site, for inspection upon request.
- .4 The licensed installer/applicator (Trade Contractor) shall conduct the on-site daily testing as required by CAN/ULC S705.2. The licensed installer shall complete the Daily Work Report as required by the CAN/ULC S705.2. The licensed Trade Contractor shall forward to the owner copies of Daily Work Record upon request. The licensed Trade Contractor shall submit copies of the Daily Work Records or a monthly summary sheet to the CUFCA office or the manufacturer's Canadian office, on a monthly basis, as required by the SPF Quality Assurance Program.
- .5 Manufacturer's obligations:
  - .1 The manufacturer shall play an active role in the application of their product during the period of this contract.
  - .2 The manufacturer shall be represented at all relevant meetings by a qualified technical representative, trained, with a minimum of 5 years' experience.
  - .3 The technical representative shall be approved by the Consultant.
  - .4 The project shall be subdivided into "Sectors of Work".

- .5 A minimum of three inspections per sector from the Manufacturer's representative must be made prior to and during application of this work to ensure proper application.
- .6 After each visit provide a written report to the Contractor and Consultant within 5-working days.
- .6 Health and Safety Requirements: Worker protection:
  - .1 Protect workers as recommended by CAN/ULC S705.2 and manufacturer's recommendations:
  - .2 Workers must wear gloves, respirators, dust masks, long sleeved clothing, eye protection, and protective clothing when applying foam insulation.
  - .3 Workers must not eat, drink or smoke while applying foam insulation.
- .7 Independent Testing Agency:
  - .1 Arrange for site reviews by Manufacturer's authorized agent. Schedule the number of site reviews in accordance with the following schedule:
 

Coverage Area, sq. m. (sq. ft.)	No. of Site Reviews
3,252 – 6,503 (35,000 – 70,000)	1
6,503 – 9,755 (70,001 – 105,000)	2
9,755 – 13,006 (105,001 – 140,000)	3
Over 13,006 (over 140,000)	4+

## 1.7 **MOCK-UPS**

- .1 Construct mock-up in accordance with Section 01 45 00 – Quality Control.
- .2 Construct mock-up 50 sq.ft. (5 m<sup>2</sup>) minimum, of spray applied insulation for each assembly type and include all components of the work such as attachments, penetrations and corners.
- .3 The mock-up shall be reviewed by the Contractor and the Consultant to verify conformance with specifications, workmanship, material application, and appearance. Recommended changes to installation methods and procedures may be agreed to at this time.
- .4 Allow Consultant 24-hours minimum prior to inspection of mock up.
- .5 Do not proceed with work prior to receipt of written acceptance of mock up by Consultant and Contractor.
- .6 When accepted, mock-up will demonstrate minimum standard of quality required for work of this Section.
- .7 Perform an additional mock-up at the foundation wall, 25 sq.ft. (2.5 sq.m.), testing adhesion of application to the waterproofing membrane. After cure of materials, perform pull-off tests to ASTM D4541. Adjust the adhesive or primer that is applied on the waterproofing membrane exposed surface as required to achieve an acceptable bond of the spray-applied material to the waterproofing membrane.
- .8 Approved mock-ups may remain part of finished work.

## 1.8 **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 original containers and packaged with appropriate SDS and labels in accordance with manufacturer's written instructions.

- .3 Store materials in a safe manner as recommended by the manufacturer and as required by the CAN/ULC S705.2. Store materials off ground and protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.
- .4 Containers shall be marked as required by the CAN/ULC S705.1. Ensure "use before" date is included on drum label.

## **1.9 SEQUENCING AND SCHEDULING**

- .1 Coordinate spray applied insulation and thermal barrier work with the work of all sections referencing this work and with the Consultant.
- .2 Sequencing with the installation of the roof parapets, metal siding system and aluminum curtain wall system is critical.
- .3 All foam insulation closures and substrates shall be completed and secure before the work of this section commences.

## **1.10 SITE CONDITIONS**

- .1 Ventilate work areas in accordance with Section 01 51 00 – Temporary Utilities.
- .2 Ventilate areas to receive insulation by introducing fresh air and exhausting air continuously during and 24 hours after application to maintain non-toxic, unpolluted, safe working conditions.
- .3 Provide temporary enclosures to prevent spray and noxious vapours from contaminating air beyond application area.
- .4 Protect adjacent surfaces and equipment from damage by overspray, fall-out, and dusting of insulation materials.
- .5 Apply insulation only when surfaces and ambient temperatures are within manufacturers' prescribed limits.

## **1.11 WARRANTY**

- .1 Submit manufacturer's 20-year warranty.
- .2 For the spray applied insulation work under this section, the 12-month warranty period is extended to 2-years from date of Substantial Performance of the Work.
- .3 Submit a printed warranty against defects in materials and workmanship for a period of 2-years from date of Substantial Performance.
- .4 Warranty is to include coverage of installed membrane air/vapour barrier and spray applied insulation which fails to cure, achieve airtight and watertight seal, exhibits any loss of adhesion or delaminates, including loss of adhesion to substrate, delamination of membrane from the substrate or delamination of the insulation from the membrane.
- .5 Promptly rectify, at the contractor's expense, defects or deficiencies that become apparent during the warranty period.
- .6 All work shall be covered by the third-party warranty program as set forth by the SPF Manufacturer's Quality Assurance Program.

## **Part 2 Products**

### **2.1 SPRAY-APPLIED POLYURETHANE FOAM SYSTEM**

- .1 Spray applied polyurethane foam (**INS-3**): closed cell, medium density, spray applied polyurethane foam insulation to CAN/ULC S705.1.

- .1 Zero ODP (utilizes zero ozone depleting blowing agents).
- .2 Core Density (ASTM D1622): 2.0 – 2.3 pcf.
- .3 Water Vapour Permeance (ASTM E96): 0.54 Perms at 2 inch thickness.
- .4 Open Cell Content (ASTM D6226): 6.4%.
- .5 Compressive Strength (ASTM D1621): 32 psi.
- .6 Tensile Strength (ASTM D1623): 44 psi.
- .7 Water Absorption (by Volume), to ASTM D2842: 0.3%.
- .8 Surface Flame Spread Rating, to CAN/ULC S127:  $\leq 265$ .
- .9 Smoke Developed Classification, to CAN/ULC S102:  $\leq 500$ .
- .10 Fungus Testing (ASTM C1338): No Growth.
- .11 Acceptable material:
  - .1 SOPRA-SPF 200 by Soprema.
- .2 Provide primers and/or adhesives as required: in accordance with spray polyurethane, and/or air/vapour barrier, and/or waterproofing membrane manufacturers' recommendations for surface conditions. The type of primers and/or adhesives selected and their installation shall comply with the published requirements of the manufacturer for the surface conditions involved.
- .3 Provide system accessories as required: typical accessories include transition membranes, though-wall flashings, penetration seals, and other components as required. Refer to the manufacturer's air barrier system technical guide specification for more information.
- .4 Thermal Barrier:
  - .1 Factory blended cementitious thermal barrier, spray applied, for use on urethane foam plastics to meet the requirements of CAN/ULC S124B.
  - .2 Acceptable Material: Monokote Z-3306 as manufactured by W.R. Grace and Co. or similar acceptable to spray-applied urethane foam manufacturer.
  - .3 Accessories: bonding agent, approved by both the thermal barrier manufacturer and the urethane foam manufacturer.

## **2.2 AIR BARRIER MEMBRANE COMPONENTS**

- .1 Air Barrier Membrane Components: to Section 07 27 14 – Air Barriers.

## **2.3 EQUIPMENT**

- .1 Equipment used to spray polyurethane foam material: in accordance with CAN/ULC S705.2 and equipment manufacturer's recommendations for each specific type of application and condition required for this project.
- .2 Record equipment settings on Daily Work Record as required by CAN/ULC S705.2.
- .3 Each proportioner unit to supply only one spray gun.



## **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 AND QUALITY ASSURANCE**

- .1 Verify that conditions of substrate are acceptable for closed cell polyurethane foam insulation application in accordance with manufacturer's written recommendations, as outlined in this section and as indicated on the drawings.
- .2 Perform pull-off tests on applied sheet membrane products to ensure adequate adhesion of the membrane to the substrate using equipment specifically design for that purpose. Pull-off adhesion shall be  $\geq 15$  psi to ASTM D4541 or ASTM D7234 depending on substrate (modified, 100 mm wood puck). Ensure that adhesion test results meet these criteria before Work by other trades proceeds. Re-perform deficient work at no extra cost to Contract as required to achieve adequate adhesion.
  - .1 Perform at least one test randomly per every 25 m<sup>2</sup> as directed by manufacturer's Quality Assurance Provider; repair test areas at no extra cost to Contract.
  - .2 Document test results in the Daily Work Record.
- .3 Prior to commencement of work report in writing to the Contractor and Consultant any defects in surfaces or conditions that may adversely affect the performance of products installed under this section.
- .4 Commencement of spray applied insulation work outlined in this section shall be deemed as acceptance of existing work and conditions

### **3.3 PREPARATION**

- .1 Coordination and Sequencing;
  - .1 Ensure that work by other trades that may penetrate through the air barrier system is in place and complete.
- .2 Protection:
  - .1 Mask and cover adjacent areas to protect from over spray.
  - .2 Ensure any required foam stop or back-up materials are in place to prevent over spray and achieve complete seal.
  - .3 Seal off existing ventilation equipment. Install temporary ducting and fans to ensure exhaust fumes. Provide for make-up air.
  - .4 Erect barriers, isolate area and post warning signs to advise non protected personnel to avoid the spray area.
- .3 Surface Preparation:
  - .1 Surfaces to receive spray applied foam insulation shall be clean, dry and properly fastened to ensure adhesion of the polyurethane foam to the membrane.
  - .2 Ensure that all work by other trades that may penetrates through the foam insulation is in place and complete.
  - .3 Apply primer in accordance with manufacturer's written instructions.
  - .4 Prime all metal and non-porous surfaces when required by polyurethane foam manufacturer's written instructions. If adhesion is in doubt, perform a mock-up and perform pull-off tests

- .5 Following application of the spray applied foam insulation and prior to the application of the thermal barrier material, apply a bonding agent to all areas to receive the thermal barrier application.
- .4 Air Barrier Membrane Applications:
  - .1 Prepare surfaces and install membrane materials, accessories and ancillary products in accordance with the requirements of Section 07 27 14 - Air and Vapour Membranes.
  - .2 Provide transition membranes, pre-cut, pre-fabricated window, door and sill flashings, and through-wall flashings to ensure continuity or air control layer (air barrier) performance, and drainage of any water entering the wall assembly system to the building exterior prior to polyurethane foam application.
  - .3 Ensure that transitions to spray applied foam insulation and other systems in the wall assembly are fully adhered and fully air-sealed.
  - .4 Field Quality Control: Conduct periodic adhesion and air leakage tests as required to confirm that installed work is air-tight.

### **3.4 APPLICATION**

- .1 Select product grade (regular, fast, cold weather) based on site conditions at time of application.
- .2 Do not apply spray foam insulation material in excess of 50 mm (two inches) per pass due to the product's exothermic effect. Allow appropriate cooling times between passes.
  - .1 After spraying a pass, cooling time must be allowed for the dissipation of heat before spraying another pass. Not allowing adequate cooling time raises the risk of scorching and/or fire and affects product mileage.
- .3 Meet or exceed requirements of Ontario Building Code and amendments.
- .4 Spray application of medium density, closed-cell polyurethane foam shall be performed in accordance with CAN/ULC S705.2 and the manufacturer's product-specific and grade-specific printed instructions and details.
- .5 Apply only when surfaces and environmental conditions are within limits prescribed by the material manufacturer and the CAN/ULC S705.2 Installation Standard.
- .6 Apply primers or adhesives as recommended by manufacturer, or as otherwise required to achieve adequate bond of materials.
- .7 Site-mix liquid components in accordance with manufacturer's written recommendations.
- .8 Apply in consecutive passes as recommended by manufacturer to thicknesses indicated on drawings. Passes shall be not less than 16 mm (5/8") and not greater than 50 mm (2"). Allow to cool before applying subsequent passes. Under all circumstances, adjust application thicknesses as required by environmental conditions to ensure that the heat generated by the application process dissipates at the required rate to ensure the adhesion of the self-adhered membrane and the rigidity of the substrate are not affected or compromised.
- .9 Do not install spray polyurethane foam within 75 mm (3") of heat emitting devices such as light fixtures and chimneys.
- .10 Finished surface of foam insulation to be free of voids and imbedded foreign objects.
- .11 Remove masking materials and over spray from adjacent areas immediately after foam surface has hardened. Ensure cleaning methods do not damage work performed by other sections.

- .12 Trim, as required, any excess thickness that would interfere with the application of cladding/covering system by other trades. Where insulation must be cut back the cut surface must be patched to the requirements of the manufacturer to provide a water shedding surface.
- .13 When installed inside a building, protect foam in accordance with Ontario Building Code requirements using a layer of gypsum board or a suitable thermal barrier.
  - .1 Thermal Barrier Application: apply bonding agent over exterior surface of spray applied foam insulation in accordance with manufacturer's written instructions. Apply thermal barrier over bonding agent where required by Ontario Building Code in accordance with the material manufacturer's application instructions to meet the requirements of CAN/ULC S124, Classification B (17 mm minimum).

### **3.5 FIELD QUALITY CONTROL**

- .1 Site Tests:
  - .1 The licensed installer/applicator shall conduct daily visual inspection, adhesion/cohesion testing and density measurements as outlined by CAN/ULC S705.2.
  - .2 The licensed installer/applicator shall complete the Daily Work Record and record all information required including the results of the testing. The Daily Work Record shall be kept on site for routine inspection. Copies of the Daily Work Record shall be forwarded to the Contractor, Consultant and/or Owner's representative upon request. Copies of the Daily Work Record or monthly summaries shall be sent to the SPF manufacturer on a monthly basis as required by the Quality Assurance Program.
  - .3 The costs incurred for daily testing and inspection by the Licensed Installer and the completion of the Daily Work Record shall be borne by the licensed installer/applicator (Trade Contractor).
- .2 Third-Party Inspection:
  - .1 Coordinate and arrange third-party site inspection by manufacturer's Quality Assurance Provider. The cost of inspections shall be included in the bid provided by the licensed installer/applicator (Trade Contractor).
  - .2 The third-party site inspection shall verify conformance with manufacturer's instructions, CAN/ULC S705.2 and this section of the project specification.
  - .3 If the inspection reveals any defects, the Licensed Contractor shall immediately rectify all such defects at his cost.
  - .4 Schedule site visits to review work as follows:
    - .5 Twice during progress of work; at 25% and 60% complete.
    - .6 Upon Substantial Completion of Work, after cleaning is carried out.
    - .7 Report deficiencies immediately to Consultant and Contractor.
    - .8 Obtain reports within 5-days of review and submit immediately to Consultant and Contractor.
- .3 Manufacturer's Field Services:
  - .1 Coordinate manufacturer's services. Have manufacturer's technical representative review work involved in handling, application and protection of closed cell spray polyurethane foam insulation, and submit written reports in acceptable format to verify compliance of Work with Contract conditions.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for product application review in accordance with manufacturer's written recommendations. Report any inconsistencies from manufacturer's recommendations immediately to Consultant and Contractor.

- .3 Schedule site visits to review work at stages listed:
- .4 After delivery and storage of closed cell spray polyurethane foam insulation, and when preparatory work on which Work of this Section depends is complete, but before application begins.
- .5 Twice during application of the Work.
- .6 Upon completion of Work, after cleaning is carried out.

### **3.6 TOLERANCES**

- .1 Maximum variation from indicated thickness: minus (-) 3 mm (1/8"); plus (+) 13 mm (1/2").

### **3.7 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning. 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. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3 Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 – Waste Management and Disposal.

### **3.8 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 05 41 00 - Structural Metal Stud Framing.
- .2 Section 06 16 43 - Gypsum Sheathing.
- .3 Section 07 27 14 - Air Barriers.
- .4 Section 09 21 16 - Gypsum Board Assemblies.
- .5 Section 09 22 00 - Non-Structural Metal Framing.

**1.2 REFERENCES**

- .1 ASTM International (ASTM)
  - .1 ASTM C167-18, Standard Test Methods for Thickness and Density of Blanket or Batt Thermal Insulations.
  - .2 ASTM C553-13(2019), Standard Specification for Mineral Fibre Blanket Thermal Insulation for Commercial and Industrial Applications.
  - .3 ASTM C665-17, Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
  - .4 ASTM C1320-20, Standard Practice for Installation of Mineral Fiber Batt and Blanket Thermal Insulation for Light Frame Construction.
  - .5 ASTM F1667-18a, Standard Specification for Driven Fasteners: Nails, Spikes, and Staples.
- .2 CSA Group (CSA)
  - .1 CSA B149.1:20, Natural Gas and Propane Installation Code.
  - .2 CSA B149.2-10, Propane Storage and Handling Code.
- .3 ULC Standards
  - .1 CAN/ULC S102-18, Standard Method of Test For Surface Burning Characteristics of Building Materials and Assemblies.
  - .2 CAN/ULC S114-18, Standard Method of Test for Determination of Non-Combustibility in Building Materials.
  - .3 CAN/ULC S604:16, Standard for Factory Built Type A Chimneys.
  - .4 CAN/ULC S702.1-14 (R2019), Standard for Mineral Fibre Thermal Insulation for Buildings, Part 1: Material Specification.
  - .5 CAN/ULC S702.2, Mineral Fibre Thermal Insulation for Buildings, Part 2: Application Guidelines.

**1.3 ACTION AND INFORMATIONAL 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 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.

## **Part 2 Products**

### **2.1 INTERIOR PARTITION BATT INSULATION**

- .1 Mineral wool insulation for fire and smoke rated assemblies: un-faced preformed GreenGuard™ certified formaldehyde-free fibrous insulation to CAN/ULC S702.1; having maximum flame spread and smoke developed of 20/20 to CAN/ULC S102 and being non-combustible to CAN/ULC S114, and as follows:
  - .1 Thickness: as indicated on Drawings, or, if between studs, then minimum full depth of stud cavity space.
  - .2 Acceptable Materials:
    - .1 JM Mineral Wool Sound Attenuation Fire Batt (SAFB) Insulation, by Johns Manville.
    - .2 Rockwool AFB®, by Rockwool International A/S.
    - .3 Thermafiber® SAFB™ Mineral Wool Acoustic Batt Insulation, by Thermafiber, Inc.
- .2 Mineral wool insulation for non-rated assemblies: unfaced preformed GreenGuard™ certified formaldehyde-free fibrous insulation meeting the requirements of CAN/ULC S702.1, and as follows:
  - .1 Thickness: as indicated on Drawings, or, if between studs, then minimum full depth of stud cavity space.
  - .2 Standard of Acceptance:
    - .1 JM Mineral Wool Sound Attenuation Fire Batts (SAFB), by Johns Manville.
    - .2 Rockwool ComfortBatt® SS, by Rockwool International A/S.
    - .3 Thermafiber® UltraBatt™ Mineral Wool Thermal Batt Insulation, by Thermafiber, Inc.

## **Part 3 Execution**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's printed installation instructions, data sheets, standard details, and specifications.

### **3.2 EXAMINATION**

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

### **3.3 SEQUENCING**

- .1 Do not perform the Work of this Section until installation of vapour-permeable air barrier has been reviewed by the Consultant, to Section 07 27 14 - Air Barriers.

### **3.4 INSULATION – GENERAL**

- .1 For applications over 50 mm thick: Install insulation in multiple layers, with joints between layers vertically and horizontally offset.
- .2 Install insulation after building substrate materials are dry.
- .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 CAN/ULC S604 type A chimneys and CAN/CGA B149.1 and CAN/CGA B149.2 type B and L vents.
- .5 Use largest possible dimensions to reduce number of joints.
- .6 Do not enclose insulation until it has been reviewed by Consultant.
- .7 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.
- .8 Follow instructions for use of materials of insulation and accessory manufacturers.
- .9 Install insulation horizontally.
  - .1 Offset vertical joints minimum 300 mm.
  - .2 Offset both vertical and horizontal joints in multiple layer applications minimum 100 mm.
- .10 Leave insulation joints unbonded over line of expansion and control joints; bond continuous 150 mm wide strip of primary vapour membrane over expansion and control joints using compatible adhesive.
- .11 Do not enclose or cover insulation until it has been reviewed by Consultant.
- .12 Use only dry and unsoiled insulation boards.
- .13 Cut top of insulation as indicated to form snug fit under sloping through-wall flashing supported on sheet metal per Section 07 62 00. Fit tight behind continuous shelf angle and supports as required.
- .14 Insulate stud cavities where mechanical and plumbing lines run through. Pack drainage offsets within dropped ceiling spaces with mineral wool insulation to surround pipes.
- .15 Insulate and wrap exterior drains that extend through heated space with continuous vapour retarder.
- .16 Gaps in exterior wall and roof sheathing around openings, at wall intersections, at wall/roof intersections, around penetrations through sheathing, etc., to be filled using foam-in-place insulation, to Section 07 21 19 - Foam-in-Place Insulation.
- .17 Fasteners:
  - .1 In accordance with insulation manufacturer's recommended spacing and as required to suit project design requirements.
  - .2 Minimum spacing of fasteners to be not less than 5 equally spaced insulation fasteners per 610 x 1220 mm (24 x 48 inches) insulation board area: Position one fastener 3 inches from each corner of board and one in center of each board (dice 5 pattern).

### **3.5 CONTINUOUS MINERAL WOOL INSULATION**

- .1 Fit courses of insulation between z-girts and other confining obstructions in cavity; butt edges tightly in vertical and horizontal directions and as follows:
  - .1 Install insulation in multiple layers with joints between layers, both vertically and horizontally, offset. Install insulation with snug fit to substrate materials.
  - .2 Secure insulation boards mechanically at all locations. Provide sufficient means of insulation securement to ensure firm and uniform securement of insulation to substrate.
  - .3 Install Insulation fasteners as required to hold insulation in place pending installation of cladding sub-girt assemblies. Install 150 x 150 mm square of self-adhesive air barrier membrane over each clip assembly (or caulk with exterior-grade commercial silicone sealant) with fastener impaling centre of square; press air barrier square firmly in place, fully adhering sheet to air barrier material previously installed over wall assembly substrate. Provide minimum 4 fasteners per insulation board.
  - .4 Apply air barrier membrane, to Section 07 27 14, behind Z-girts prior to installation of insulation between Z-girts supporting preformed cladding.
  - .5 Install insulation fasteners to walls before sheet membrane air barrier is applied.
  - .6 Near wall corners, at parapets, at perimeter of openings and other locations where insulation not secured by sub-girts, provide insulation fasteners to secure insulation, installed 150 mm or less from corners or jambs. Space clips at maximum 600 mm on centre along edge of boards, minimum 2 fasteners per insulation board edge or as otherwise required to meet 600 mm spacing requirement.
- .2 At soffit assemblies, install insulation to underside of sheathing to entire soffit area following air barrier membrane installation. Fit around Z-girt substructure. Secure insulation mechanically at all locations with insulation fasteners (minimum 4 per board) as at walls.

### **3.6 BATT INSULATION – GENERAL**

- .1 Install insulation in accordance with insulation manufacturer's published installation instructions, and in accordance with CAN/ULC 702.2.
- .2 At exterior wall structural metal stud framing, install batt insulation where indicated between studs with continuous vapour retarder installed on warm side of insulation in accordance with ASTM C1320. Install after exterior sheathing has been installed.
- .3 Fit insulation closely around electrical boxes, pipes, ducts, frames, and other objects in or passing through insulation.
- .4 Install batts between studs, framing members, structural components, and other items, snug and tight.
- .5 Cut and trim batts neatly to fit spaces. Use batts free from ripped or damaged back and edges.
- .6 Completely fill spaces with insulation, leaving no gaps or voids. Fill stud spaces completely with insulation, full depth.
- .7 Do not pack insulation tighter than manufactured density of materials.
- .8 Insulation specified shall be placed in jamb and header assemblies that will be inaccessible after their installation into wall. Ensure that insulation is kept dry and not compressed more than manufactured density.



- .9 Keep insulation minimum 75 mm from heat emitting devices, such as recessed light fixtures and other heat-emitting items.

### **3.7 FIELD QUALITY CONTROL**

- .1 Field Inspection: Coordinate field inspection in accordance with Division 01 General Requirements.
- .2 Manufacturer's Services:
  - .1 Coordinate manufacturer's services with Division 01 General Requirements.
  - .2 Have manufacturer review work involved in handling, installation, protection, and cleaning of insulation and accessories, and submit written reports in acceptable format to verify compliance of Work with Contract conditions.
  - .3 Manufacturer's Field Services: Provide manufacturer's field services consisting of product use recommendations and periodic site visits for product installation review in accordance with manufacturer's instructions.
  - .4 Report any inconsistencies from manufacturer's recommendations immediately to Consultant.

### **3.8 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning. 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. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3 Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.

### **3.9 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**END OF SECTION**

**Part 1 General**

**1.1 SUMMARY**

- .1 Foam-in-place insulation at perimeter of exterior window and door frames.
- .2 Foam-in-place insulation at penetrations of building enclosure thermal control layer.

**1.2 REFERENCES**

- .1 Canadian Urethane Foam Contractors' Association Inc. (CUFCA)
- .2 ASTM International (ASTM)
  - .1 ASTM C518-17, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
- .3 ULC Standards
  - .1 CAN/ULC S101-14, Standard Methods of Fire Endurance Tests of Building Construction and Materials.
  - .2 CAN/ULC S102-18, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
  - .3 CAN/ULC S102.2-18, Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings, and Miscellaneous Materials and Assemblies.
  - .4 CAN/ULC S705.1-15, Amendment 3 to Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density, Material Specification.
  - .5 CAN/ULC-S705.2-05, Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density, Application.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit product data in accordance with Section 01 33 00 – Submittal Procedures:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .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.

**1.4 QUALITY ASSURANCE**

- .1 Comply with the requirements of Section 01 83 00 - Building Enclosure Performance Requirements.
- .2 Qualifications:
  - .1 Installers: Use companies that are members and licensed CUFCA having trained and certified installers in accordance with CUFCA requirements.
  - .2 Manufacturer: Obtain foam-in-place materials from a single manufacturer regularly engaged in manufacturing the products specified in this Section.

- .3 Cooperate and coordinate with the requirements of other units of work specified in other sections.

## **1.5 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.

## **1.6 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 Foam-in-place thermal insulation, having the following minimum physical properties:
  - .1 Application temperature range: -15 °C to +35 °C.
  - .2 Material temperature resistance range: -40 °C to + 80 °C.
  - .3 Flame Spread, when tested to ULC S102: 0.
  - .4 Smoke Developed, when tested to ULC S102: 0.
  - .5 R-Value (ASTM C518): ≥ 3.29 per inch.
  - .6 Standard of Acceptance:
    - .1 CF-I XTW WD Extreme-Weather Window and Door Insulating Foam Sealant, by Hilti (Canada) Corporation.
- .2 Thermal Barrier: spray-applied fire-retardant overcoat meeting applicable requirements of OBC for thermal barrier of foamed plastic, and acceptable to foam-in-place manufacturer.

## **Part 3 Execution**

### **3.1 PREPARATION**

- .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: HOLLOW STEEL DOOR FRAMES**

- .1 Fill exterior hollow steel door frames 75% full with foam-in-place insulation prior to installation of frames. Fill remainder of frame after installation, through gap between frame and wall construction.

**3.3 INSTALLATION: AROUND EXTERIOR WINDOW AND DOOR FRAMES**

- .1 Install foam-in-place insulation around exterior window and door frames to maintain continuity of thermal control layer.
- .2 Ensure that foam completely fills spaces without voids, and that foam is continuous at corners.

**3.4 INSTALLATION: AROUND PENETRATIONS THROUGH EXTERIOR ENCLOSURE**

- .1 Install foam-in-place insulation around penetrations through exterior building envelope to achieve and maintain continuity of thermal control layer.

**3.1 INSTALLATION: MISCELLANEOUS LOCATIONS**

- .1 Install foamed-in-Place insulation around mechanical exhaust boxes, perimeter of curtain wall framing, and fill voids at perimeter of doorframes and other uninsulated gaps and cavities at exterior enclosure.

**3.2 THERMAL BARRIER**

- .1 Separate all foam plastic insulation exposed to the interior of the facility, including at attics, crawlspaces, ceilings, soffits and spaces with access restricted to service of utilities, by installation of an approved thermal barrier that meets or exceeds OBC requirements.

**3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning. 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. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3 Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 – Waste Management and Disposal.

**3.4 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**3.5 SCHEDULE**

- .1 Install at exterior pressed steel door frames, penetrations through thermal control layer, and at exterior window and door framing as required to maintain continuity of thermal control performance.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 05 41 00 – Structural Metal Stud Framing.
- .2 Section 07 26 00 – Vapour Retarders.
- .3 Section 09 21 16 – Gypsum Board Assemblies

**1.2 REFERENCES**

- .1 Green Seal Environmental Standards
  - .1 Standard GS-11, Paints, Coatings, Stains and Sealers, 2015.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 SDS - Safety Data Sheets.
- .3 South Coast Air Quality Management District (SCAQMD), California State SCAQMD Rule 1113-06, Architectural Coatings.
- .4 ULC Standards
  - .1 CAN/ULC-S101-14, Standard Method of Fire Endurance Tests of Building Construction and Materials.
  - .2 CAN/ULC-S102:2018, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
  - .3 CAN/ULC-S102.2:2018, Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings, and Miscellaneous Materials and Assemblies
  - .4 CAN/ULC-S703-09 (R2020), Standard for Thermal Insulation, Cellulose Fibre Insulation (CFI) for Buildings

**1.3 ACTION SUBMITTALS / INFORMATIONAL SUBMITTALS**

- .1 Submit product data in accordance with Section 01 33 00 – Submittal Procedures:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Provide one electronic copy of WHMIS SDS - 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.

**1.4 QUALITY ASSURANCE**

- .1 Health and Safety Requirements: Worker protection:
  - .1 Protect workers as recommended by manufacturer's recommendations:

- .2 Workers must wear gloves, respirators, dust masks, long sleeved clothing, eye protection, and protective clothing when applying cellulose insulation.
- .3 Workers must not eat, drink or smoke while applying cellulose insulation.
- .2 Cooperate and coordinate with the requirements of other units of work specified in other sections.

## **1.5 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.

## **1.6 SITE ENVIRONMENTAL REQUIREMENTS**

- .1 Apply insulation only when surfaces and ambient temperatures are within manufacturers' prescribed limits.
- .2 Safety: comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of insulation materials.
- .3 Ventilation:
  - .1 Ventilate enclosed spaces in accordance with Section 01 51 00 - Temporary Utilities.
  - .2 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.
- .4 Protection:
  - .1 Provide temporary enclosures to prevent dust from contaminating air beyond application area.
  - .2 Protect adjacent surfaces and equipment from damage by fall-out, and dust.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Cellulose fibre insulation (**INS-2**): to CAN/ULC-S703, cellulose fibres, chemically impregnated to resist mould, mildew and fire.
  - .1 Flame Spread classification to CAN/ULC-S102: < 25
  - .2 Smoke Developed to CAN/ULC-S102.2: < 45
  - .3 Acceptable Materials:
    - .1 SOPRA-CELLULOSE by Soprema.
- .2 Primers: in accordance with manufacturer's recommendations for surface conditions.
  - .1 Maximum VOC limit 100 g/L to SCAQMD Rule 1113.

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**Part 3            Execution**

**3.1                PREPARATION**

- .1      Clean spaces that are to receive insulation, of dirt, dust, grease, loose material or other foreign matter that may inhibit adhesion.
- .2      Protect adjacent surfaces from overspray and dusting.
- .3      Prior to application, slightly moisten surfaces to which cellulose insulation is being applied, to accelerate curing.
- .4      Temporarily brace frames as may be required to prevent possible bowing of frames due to over expansion of the cellulose insulation.

**3.2                INSULATION APPLICATION**

- .1      Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.
- .2      Ensure that wall cavity is not obstructed.
- .3      Pneumatically place loose fibre insulation in walls between studding to provide minimum thermal resistance value RSI as indicated.

**3.3                CLEANING**

- .1      Clean in accordance with Section 01 74 00 - Cleaning.
- .2      Remove insulation material spilled during installation and leave work area ready for application of wall board.
- .3      Leave Work area clean at end of each day.
- .4      Final Cleaning: Upon completion, remove surplus materials, rubbish, tools, and equipment.
- .5      Waste Management: Remove waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 05 41 00 – Structural Metal Stud Framing.
- .2 Section 07 21 23 – Cellulose Insulation.
- .3 Section 09 21 16 – Gypsum Board Assemblies
- .4 Refer to Drawings for Wall assembly schedule: fibreglass-mat gypsum sheathing.
- .5 Division 26 – distribution wiring and outlets

**1.2 REFERENCES**

- .1 ASTM International (ASTM)
  - .1 ASTM D4397-16, Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications.

**1.3 ADMINISTRATIVE REQUIREMENTS**

- .1 Coordination:
  - .1 Coordination between related Work is essential to ensure continuity of vapour control system and that junctions between various components are effectively sealed.
- .2 Sequencing:
  - .1 Sequence work in accordance with project schedule.
  - .2 Sequence work to permit installation of materials in conjunction with related materials and seals to ensure proper tie-ins and continuity of performance.

**1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data: Submit manufacturer's published product literature, specifications, and datasheets, and include product characteristics, performance criteria, physical size, finish, and limitations.
- .3 Samples: duplicate 200 mm x 200 mm samples of vapour retarder intended for use.

**1.5 QUALITY ASSURANCE**

- .1 Comply with requirements of 01 45 00 - Quality Control.

**1.6 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with manufacturer's instructions and Section 01 61 00 – Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect specified materials from damage.
  - .3 Replace defective or damaged materials with new.



## **1.7 WARRANTIES**

- .1 Contractor agrees to correct deficiencies of labour or material found in the work performed for 2 years from date of Substantial Performance.

## **Part 2 Products**

### **2.1 VAPOUR RETARDER (MB 2)**

- .1 Vapour Retarder: to CAN/CGSB 51.33, vapour retarder membrane, polypropylene mesh reinforcement, with variable permeance adaptive to relative humidity.
  - .1 Thickness: 17 mil.
  - .2 Vapour permeance (ASTM E96):
    - .1 Method A, 25% relative humidity: 45 ng/Pa·s·m<sup>2</sup>.
    - .2 Method B, 75% relative humidity: 175 ng/Pa·s·m<sup>2</sup>.
  - .3 Acceptable materials:
    - .1 Sopraseal HVM by Soprema.

### **2.2 ACCESSORIES**

- .1 Joint sealing tape: air resistant pressure sensitive adhesive tape, type recommended by vapour retarder manufacturer.
  - .1 Acceptable materials:
    - .1 Sopraseal Stick Flashpro HT by Soprema.
- .2 Sealant: compatible with vapour retarder materials, recommended by vapour retarder manufacturer, to Section 07 92 00 - Joint Sealants.
  - .1 Acceptable materials:
    - .1 Sopraseal Sealant by Soprema.
- .3 Moulded box vapour barrier: factory-moulded polyethylene box purpose made for use with recessed electric switch and outlet device boxes.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate are acceptable for vapour retarder installation in accordance with manufacturer's written instructions.
  - .1 Proceed with installation only after unacceptable conditions have been remedied.

### **3.2 COORDINATION**

- .1 Coordinate with other trades as required to ensure continuity of vapour retarder performance at entire enclosure perimeter. Tie-in to adjacent systems as required, and seal transitions.

### **3.3 INSTALLATION**

- .1 Ensure services are installed and inspected prior to installation of retarder.
- .2 Install sheet vapour retarder in assemblies as indicated.
- .3 Use sheets of largest practical size to minimize joints.

- .4 Inspect for continuity. Repair punctures and tears with sealing tape before work is concealed.

### **3.4 EXTERIOR SURFACE OPENINGS**

- .1 Cut sheet vapour retarder to form openings and ensure material is lapped and sealed to frame.

### **3.5 PERIMETER SEALS**

- .1 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 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.

### **3.6 LAP JOINT SEALS**

- .1 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 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.

### **3.7 ELECTRICAL BOXES**

- .1 Seal electrical switch and outlet device boxes that penetrate vapour retarder as follows:
  - .1 Install moulded box vapour retarder. Wrap boxes with film sheet providing minimum 300 mm perimeter lap flange.
  - .2 Apply sealant to seal edges of flange to main vapour retarder and seal wiring penetrations through box cover.

### **3.1 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning. 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. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3 Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 – Waste Management and Disposal.

### **3.2 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Division 03 Cast-in-Place Concrete.
- .2 Section 07 21 13.01 - Foundation Board Insulation.
- .3 Section 33 46 17 - Subgrade Drainage Network.
- .4 Division 31 – Earthwork

**1.2 REFERENCES**

- .1 ASTM International (ASTM)
  - .1 ASTM D698-12e2, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)).
  - .2 ASTM D6506/D6506M-01(2018)e1, Standard Specification for Asphalt Based Protection Board for Below-Grade Waterproofing.
  - .3 ASTM E96/E96M-16, Standard Test Methods for Water Vapor Transmission of Materials.
  - .4 ASTM E154-08a(2019), Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.
  - .5 ASTM E1643-18a, Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
  - .6 ASTM E1745-17, Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.
  - .7 ASTM E2178-13, Standard Test Method for Air Permeance of Building Materials.
  - .8 ASTM F1249-13, Standard Test Method for Water Vapour Transmission Rate Through Plastic Film and Sheet Using a Modulated Infrared Sensor.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .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.

**1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.
- .2 Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- .3 Store materials in clean, dry area in accordance with manufacturer's instructions.
- .4 Protect materials during handling and application to prevent damage.

## **Part 2 Products**

### **2.1 VAPOUR RETARDER MATERIAL**

- .1 Performance Criteria: Vapour retarder membrane, when tested according to all requirements of ASTM E1745, Class A, shall meet or exceed the following minimum performance requirements:
  - .1 Maximum Water Vapour Permeance (to ASTM E154 Sections 7, 8, 11, 12, 13, by ASTM E96, Method B or to ASTM F1249):
    - .1 As received:  $\leq 0.0063$  perms.
    - .2 After Wetting and Drying:  $\leq 0.0052$  perms.
    - .3 Resistance to Plastic Flow and Temperature:  $\leq 0.0057$  perms.
    - .4 Effect Low Temperature and Flexibility:  $\leq 0.0052$  perms
    - .5 Resistance to Deterioration from Organisms and Substances in Contacting Soil:  $\leq 0.0052$  perms.
  - .2 Puncture Resistance (ASTM D1709):  $> 3,200$  grams.
  - .3 Tensile Strength ASTM E154, Section 9:  $\geq 72$  Lb. Force/Inch.
- .2 Vapour Retarder for installation under concrete slabs shall meet or exceed the requirements of ASTM E1745, Class A, minimum 0.38 mm thick (15 mils).
  - .1 Acceptable materials:
    - .1 VaporBlock VB15, by Raven Industries Inc..
    - .2 Moistop Ultra 15 Underslab Vapour Retarder, by Fortifiber Building Systems Group.
    - .3 Florprufe 120 by Grace Construction Products.
    - .4 VapourFLEX 15 by Layfield Geosynthetics & Industrial Fabrics.
    - .5 Viper Vaporcheck II 15 Mil, by Soprema.
    - .6 Perminator 15 mil Underslab Vapour Barrier by W. R. Meadows.

### **2.2 ACCESSORIES**

- .1 Joint sealing tape: air resistant pressure sensitive adhesive tape, cloth fabric duct tape, 100 mm wide for lap joints and perimeter seals, 50 mm wide elsewhere.
- .2 Sealants: Sealant: Asbestos-free non-hardening sealant, compatible with vapour retarder materials, recommended by vapour retarder manufacturer.

## **Part 3 Execution**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: install products in accordance with manufacturer's printed preparation and installation instructions, technical datasheets, installation illustrations and guide specifications.

### **3.2 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for vapour retarder installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Consultant.
  - .2 Inform Consultant of unacceptable conditions immediately upon discovery.

- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

### **3.1 PREPARATION**

- .1 Perform excavating, trenching, and backfilling as indicated, and in accordance with the requirements of Division 31 Earthworks.
- .2 Trim and compact base and subbase to provide firm uniform support throughout footprint of slab and foundations.
  - .1 Level subbase and compact to 100% SPD, to ASTM D698.

### **3.2 UNDERSLAB VAPOUR RETARDER**

- .1 Prepare surfaces in accordance with manufacturer's printed instructions.
- .2 Install continuous vapour retarder around underground ducts in accordance with the Sheet Metal and Air Conditioning Contractors' National Association's (SMACNA) construction standards. Coordinate Work with other trades.
- .3 Install in accordance with manufacturer's printed instructions, and requirements of ASTM E1643.
- .4 Unroll vapour retarder with longest dimension parallel with direction of pour.
- .5 Lap vapour retarder over footings and seal to foundation walls.
- .6 Overlap joints 150 mm and seal with manufacturer's seam tape.
- .7 Seal penetrations (including pipes) with manufacturer's pipe boots.
- .8 No penetration of vapour retarder is permitted, except for permanent utilities, unless approved in writing by Consultant. Seal penetrations as recommended by manufacturer.
- .9 Repair damaged areas by cutting patches of vapour retarder, overlapping damaged area 150 mm, and taping all four sides with tape.

### **3.3 FIELD QUALITY CONTROL**

- .1 Have vapour retarder manufacturer's technical representative or quality control team review the installation when substantially installed together with the Consultant.
- .2 Correct deficiencies at no additional cost to Contract.
- .3 Review does not relieve the Contractor from responsibility to install Work according to Contract and to provide a continuous vapour retarder control layer.
- .4 Testing shall be performed in accordance with the requirements of Section 01 83 00 - Building Enclosure Performance Requirements.

### **3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning. 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. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3 Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 – Waste Management and Disposal and local requirements.

**3.5 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**3.6 SCHEDULE**

- .1 Install vapour barrier under all slab-on-ground locations, maintaining continuity of seal at all transitions and terminations.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 ASTM International (ASTM)
  - .1 ASTM C755-20, Standard Practice for Selection of Water Vapor Retarders for Thermal Insulation.
  - .2 ASTM C1136-21, Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
  - .3 ASTM D412-16(2021), Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension.
  - .4 ASTM D882-18, Standard Test Method for Tensile Properties of Thin Plastic Sheeting.
  - .5 ASTM D903-98(2017), Standard Test Method for Peel or Stripping Strength of Adhesive Bonds.
  - .6 ASTM D1709-16ae1, Standard Test Methods for Impact Resistance of Plastic Film by the Free-Falling Dart Method.
  - .7 ASTM D2103-15, Standard Specification for Polyethylene Film and Sheeting.
  - .8 ASTM D2582-21, Standard Test Method for Puncture-Propagation Tear Resistance of Plastic Film and Thin Sheeting.
  - .9 ASTM D4397-16 Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications.
  - .10 ASTM D4541-09e1, Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
  - .11 ASTM D7234-21, Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers.
  - .12 ASTM E96/E96M-16, Standard Test Methods for Water Vapor Transmission of Materials.
  - .13 ASTM E283-19, 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 E1643-18a, Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
  - .15 ASTM E2178-21a, Standard Test Method for Air Permeance of Building Materials.
  - .16 ASTM E2357-18, Standard Test Method for Determining Air Leakage of Air Barrier Assemblies.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB 51.32-M89, Sheathing, Membrane, Breather Type.
- .3 ULC Standards
  - .1 CAN/ULC S741-08 (R2020), Standard for Air Barrier Materials – Specification.

**1.2 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 that 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 trades involved with installation procedures of building products incorporated into air barrier elements including, but not limited to, various membranes, coating, and sealants and continuity with roofing membrane.
- .2 Pre-installation Meeting:
  - .1 Convene one 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.
  - .3 Overlap materials in shingled fashion to direct water down and away from the structure.

### 1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 – Submittal Procedures:
  - .1 Submit manufacturer's printed product literature, specifications, and datasheets, and include product characteristics, performance criteria, physical size, finish, and limitations.
  - .2 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 Consultant.
  - .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.

### 1.4 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 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.

## **1.5 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.

## **1.6 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.

## **1.7 WARRANTIES**

- .1 Contractor agrees to correct any deficiencies of labour or material found in the work performed for a period of 2 years from date of Substantial Performance.

## **Part 2 Products**

### **2.1 AIR BARRIER**

- .1 Air Barrier Membrane: tri-layer laminated polypropylene sheet, vapour permeable.
  - .1 Thickness: 1 mm to 1.5 mm
  - .2 Tensile strength, MD/XD (ASTM D882): 5.95/3.65 kN/m.
  - .3 Cold bending (CAN/CGSB 51.32): no cracking at -30 C°
  - .4 Air permeance (CAN/ULC S741): <0.001 L/s·m<sup>2</sup>.
  - .5 Water vapour permeability (ASTM E96-B): 972 ng/Pa·s·m<sup>2</sup>.
  - .6 Tear resistance, MD/XD (CAN/CGSB 51.32): 64 N/54 N.
  - .7 Lap adhesion (ASTM D1876): 300 N/m
  - .8 Acceptable Materials:
    - 1. Sopraseal Stick VP, Soprema.
- .2 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 Acceptable Materials: as recommended by membrane manufacturer for substrate and site conditions.

### **2.2 THROUGH-WALL FLASHING MEMBRANE**

- .1 Self-adhesive membrane composed of SBS modified bitumen and a white tri-laminated woven polyethylene facer. Underface covered with silicone release film.
  - .1 Acceptable material:
    - .1 Sopraseal Stick 1100 T by Soprema.

## **2.3 TERMINATION SEALANT**

- .1 Adhesive sealant made of moisture cure polyether, with solvent free, low VOC and isocyanates free. Application temperature must be above 0°C.
  - .1 Acceptable material:
    - .1 Sopraseal Sealant by Soprema

## **2.4 ACCESSORIES AND ANCILLARY PRODUCTS**

- .1 Accessories and Ancillary Products: supply manufacturer's recommended and/or supplied seam tape, sealants, adhesives, prefabricated sill pan flashings, through-wall flashing, termination mastic, termination bars and fasteners, and other accessories and ancillary products as required for complete installation that properly directs moisture and water to building exterior and maintains performance continuity of air control layer.

# **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 Install membrane 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 Consultant's approval before proceeding with Work.

## **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, and 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 Consultant in writing.
- .7 Do not start work until deficiencies have been corrected. Beginning of Work implies acceptance of conditions.

## **3.4 APPLICATION OF SELF-ADHERED MEMBRANE AIR BARRIER SYSTEMS**

- .1 When primer is required before membrane installation, prime surfaces to manufacturer's instructions. Primed surfaces not covered the same day must be re-primed.
- .2 Apply self-adhesive air barrier membrane complete and continuous to prepared substrate in overlapping shingle method. Stagger vertical joints.
- .3 Install membrane onto surface by peeling back release film and rolling membrane onto surface. Align and position self-adhesive membrane, remove protective film and press firmly into place. Provide minimum 2 inches (50 mm) lap to all substrates.

- .4 Roll membrane with neoprene roller to ensure positive contact.
- .5 At end of each workday, seal top edge of membrane where it meets substrate with termination sealant. Trowel apply feathered edge to seal termination and shed water.
- .6 Install air barrier membrane to create continuous seal at construction elements such as foundations, roofs and walls, and at junctures of different materials or construction types.

### **3.5 THROUGH-WALL FLASHING MEMBRANE INSTALLATION**

- .1 Prime surfaces to manufacturer's instructions. Primed surfaces not covered the same day must be re-primed.
- .2 Install flashing membrane onto primed surface by peeling back release film and rolling membrane onto surface. Align and position self-adhesive flashing membrane, remove protective film and press firmly into place. Provide minimum 2 inches (50 mm) lap to all substrates.
- .3 Return and end dam flashing membrane at intersecting wall openings.
- .4 Roll membrane with neoprene roller to ensure positive contact.
- .5 Treat terminations with specified termination mastic trowel to shed water.

### **3.6 MEMBRANE INSTALLATION AT OPENINGS**

- .1 Place specified self-adhesive flashing membrane across windowsills. Pre-treat inside corners with gussets. Install membrane and end dam terminations, seal cuts and terminations with termination sealant.
- .2 Wrap jamb of rough openings with specified self-adhesive air barrier flashing membrane as detailed.
- .3 Extend specified self-adhesive air barrier flashing membrane into rough window openings sufficient to provide connection to window thermal break.
- .4 Prime surfaces to manufacturer's instructions and allow to dry.
- .5 Align and position self-adhesive flashing membrane, remove protective film and press firmly into place.
- .6 Ensure minimum 2 inches (50 mm) overlap at side laps and minimum 3 inches (75 mm) overlap at end laps of membrane.
- .7 Roll laps and membrane with neoprene roller to ensure positive contact.

### **3.7 APPLICATION OF TERMINATION SEALANT**

- .1 Apply termination sealant along the leading edge of the termination and cuts.
- .2 Trowel apply termination sealant over area and feather out to shed water.

### **3.8 FOAM-IN-PLACE INSULATION**

- .1 Install foamed-in-place insulation as required at penetrations and gaps to maintain continuity of the thermal control layer.

### **3.9 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 Consultant shall inspect installed membrane for continuity of air barrier prior to placement of insulation or covering by other materials that prevent inspection.

### **3.10 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning. 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. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3 Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.

### **3.11 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 05 41 00 - Structural Metal Studs.
- .2 Section 06 16 43 – Gypsum Sheathing.
- .3 Section 07 21 13 – Board Insulation.
- .4 Section 07 92 00 - Joint Sealants.
- .5 Section 08 11 14 - Metal Doors and Frames.
- .6 Section 08 44 13 - Glazed Aluminum Framing Systems.

**1.2 REFERENCES**

- .1 American Society of Mechanical Engineers (ASME)
  - .1 ASME B18.6.3-2013, Machine Screws, Tapping Screws, and Metallic Drive Screws (Inch Series).
- .2 ASTM International (ASTM)
  - .1 ASTM A653/5653M-20, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .2 ASTM C1107/C1107M-20, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
  - .3 ASTM D2369-20, Standard Test Method for Volatile Content of Coatings.
  - .4 ASTM D2832-92(2016), Standard Guide for Determining Volatile and Nonvolatile Content of Paint and Related Coatings.
  - .5 ASTM D5116-17, Standard Guide For Small-Scale Environmental Chamber Determinations of Organic Emissions From Indoor Materials/Products.
  - .6 ASTM F1667-18a, Standard Specification for Driven Fasteners: Nails, Spikes, and Staples.
  - .7 ASTM F3125/F3125M-19e1, Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength.
- .3 CSA Group (CSA)
  - .1 CSA G40.20-13/G40.21-13(R2018), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel, Includes Update No.1 (2014).
  - .2 CSA S16:19, Design of steel structures, Includes Errata (2019).
  - .3 CSA S136-16, North American Specification for the Design of Cold-Formed Steel Structural Members.
  - .4 CSA W59-18, Welded Steel Construction.
  - .5 CSA W55.3-08(R2018), Certification of companies for resistance welding of steel and aluminum.

**1.3 PRE-INSTALLATION MEETING**

- .1 Convene pre-installation meeting one week prior to beginning work of this Section and on-site installation, with Contractor, Consultant, installer, manufacturer's representative to:
  - .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 Manufacturer's representative shall also provide frequent inspection visits during the course of work of this Section to assure quality and competence of membrane installation and panel alignment.

#### **1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications, and datasheets.
- .3 Shop Drawings:
  - .1 Shop drawings shall be engineered, and bear the stamp and signature of Subcontractor's designated design engineer. Include calculations used to establish structural designs. Refer to item 2.1 PERFORMANCE/DESIGN CRITERIA.
  - .2 Indicate layout, profiles and product components including anchorage, accessories, finish colours and textures.
  - .3 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.
- .4 Samples:
  - .1 Submit duplicate 300 x 300 mm samples of wall system, representative of materials, finishes and colours.
  - .2 Prior to ordering materials, provide to consultant the following for verification purposes: three samples of colour of finish specified.
- .5 Manufacturer's Instructions:
  - .1 Submit manufacturer's installation instructions.
- .6 Manufacturer's Field Reports: Submit copies of manufacturers field reports.

#### **1.5 QUALITY ASSURANCE**

- .1 Comply with the requirements of Section 01 45 00 – Quality Control.
- .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.
- .4 Installer Qualifications: Engage experienced installer, with minimum 5 years' experience, who has completed systems similar in material, design, and extent to that indicated for Project and with record of successful performance.
- .5 Delegated design: retain a professional engineer, registered in the province of the Work, to design fabrication and erection of the Work of this specification section in accordance with Ontario Building Code and Amendments, and Contract Document requirements including, but not limited to, the following:
  - .1 Seal and signature to shop drawings and design submittals requiring structural engineering.
  - .2 Field review of installed components.

- .3 Completion of Letters or Commitment and Supervision.

## **1.6 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver and store materials in accordance with manufacturer's instructions.
- .2 Protect panels during transportation, unloading, storing, and erecting to prevent bending, warping, twisting, and surface damage.

## **1.7 WARRANTY**

- .1 Submit manufacturer's warranty.
- .2 Contractor agrees to correct deficiencies found in the Work performed for 2-years from date of Substantial Performance.

## **Part 2 Products**

### **2.1 PERFORMANCE/DESIGN CRITERIA**

- .1 Design metal panel wall system in accordance with applicable portions of CSA S136 and as required to meet or exceed requirements of Ontario Building Code as amended.
- .2 Design metal panel wall to provide for thermal movement of component materials caused by ambient temperature range of 60 degrees Celsius without causing buckling, failure of joint seals, undue stress on fasteners or other detrimental effects.
- .3 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.
- .4 Design members to withstand dead load and wind loads calculated in accordance with Ontario Building Code and amendments, and applicable local regulations, to maximum allowable deflection of  $L/180$ .
  - .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 of  $\pm 1$  kPa.
- .5 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".
- .6 Provide minimum thermal resistance of  $RSI 2.1 \text{ W/m}^2 \cdot \text{K}$ .
- .7 Permeance through wall system not to exceed  $1 \text{ ng}/(\text{Pa} \cdot \text{s} \cdot \text{m}^2)$ .
- .8 Design wall system to accommodate specified erection tolerances of structure.
- .9 Design wall system to allow for movement of air between exterior and interior side of metal cladding.
- .10 Provide effective air barrier to prevent infiltration and/or exfiltration of air through wall assembly.

### **2.2 SHEET METAL CLADDING (MT 4)**

- .1 Sheet metal cladding: Zinc alloy metal wall panels, factory formed.
  - .1 Base Steel Thickness: 1.0 gauge.
  - .2 Zinc content: 99.995%, alloyed with titanium and copper.
  - .3 Profile: as selected by Consultant from manufacturer's full range.
  - .4 Finish: as selected by Consultant from manufacturer's full range.

- .5 Acceptable material:
  - .1 VMZinc.
  - .2 RHEINZINK.
- .2 Trims: same material as cladding, provide as required for complete installation.

## **2.3 ACCESSORIES**

- .1 Sub-girts: minimum 1.22 mm base metal thickness, galvanized steel to ASTM A653/A653M, Grade 230, hot dipped galvanized steel after fabrication with zinc coating minimum 275 g/m<sup>2</sup>; profiled to accept exterior sheet with structural attachment to building frame. Exposed materials of wall assembly to match panel finish and colour.
- .2 Furring channels: galvanized steel to ASTM A653/A653M, Grade 230, hot dipped galvanized steel after fabrication with zinc coating minimum 275 g/m<sup>2</sup>; profiled to accept exterior sheet with structural attachment to building frame, 22 mm deep profile, thickness as required to meet design criteria.
  - .1 Acceptable product: ClarkDietrich.
- .3 Fasteners: Manufacturer's standard to suit design loads and applications.
  - .1 Screws to ASME B18.6.4.
  - .2 All fasteners shall be hot dipped galvanized steel after fabrication with zinc coating of minimum 275 g/m<sup>2</sup>; exposed heads silicone modified polyester coat finished to match finish and colour of exterior sheet.
- .4 Isolation coating: bituminous paint.
- .5 Exterior corners: of same profile, material and finish as adjacent cladding material, shop cut and brake formed to required angle, concealed corner brace, pop rivet connections with painted head to match cladding.
- .6 Exposed joints (perpendicular to profile): ends of cladding sheet shop cut clean and square, backed with tight fitting filler lapping back of joint, exposed components colour matched to cladding.
- .7 Accessories: cap flashings, drip flashings, internal corner flashings, copings and closures for heads, jambs, sills, and corners, of same material, thickness and finish as exterior cladding, brake formed to shape.
- .8 Expansion joints: as recommended by Manufacturer's Instructions.
- .9 Sheet Metal Flashing and Trim: Sheet zinc as for cladding panels, minimum thickness 0.7 mm.
- .10 Joint Sealants: as indicated in Section 07 92 00 and as recommended by manufacturer. Colour of exposed sealant to match adjacent panel.
- .11 Air Barrier: to Section 07 27 14 - Air and Vapour Barriers.
- .12 Insulation: to Section 07 21 13 - Board Insulation.

## **Part 3 Execution**

### **3.1 COMPLIANCE**

- .1 Comply with manufacturer's printed installation instructions, installation details and illustrations, technical datasheets, and engineered shop drawings.



### **3.2 EXAMINATION**

- .1 Verification of Conditions:
  - .1 Examine substrates to receive work and surrounding adjacent surfaces for conditions affecting installation. Coordinate with related sections to ensure proper dimensions are maintained.
  - .2 Verify site dimensions by accurate field measurements so that work will be accurately designed, fabricated and fitted to structure.
  - .3 All penetrations through façade for the work of other trades shall be fitted with watertight sleeves. Verify flashings are in place, sealed with waterproof membrane and covered with building membranes.
  - .4 Maintain sheathing membrane integrity.
- .2 Notify Consultant in writing of conditions that are not acceptable.
- .3 Proceed with installation after verification and correction of surface conditions acceptable to manufacturer. Commencement of work means acceptance of conditions.

### **3.3 SEQUENCING AND COORDINATION**

- .1 Do not perform the Work of this Section until installation of air barrier has been reviewed by the Consultant. Refer to Section 07 27 14 - Air Barriers.
- .2 Air barrier and insulation shall be installed, reviewed and in compliance with specifications and Drawing details prior to installation of preformed metal siding assembly; refer to Section 07 27 14 - Air Barriers and Section 07 21 13 - Board Insulation for specifications.
- .3 Coordinate with other trades as required.

### **3.4 PREPARATION**

- .1 Protect metal surfaces in contact with concrete, masonry mortar, plaster or other cementitious surface with isolation coating.
- .2 Touch-up building framing members with primer as required.
- .3 Clean surfaces thoroughly prior to installation.
- .4 Repair substrate flaws or defects before applying siding or soffits.
- .5 Install sub-girt system as required to establish even plane free from obstructions, dimensions as required to accommodate insulation.
- .6 Coordinate with other trades as required.
- .7 Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under project conditions.

### **3.5 INSTALLATION**

- .1 Install cladding horizontal on curved walls in accordance with CGSB 93.5, and manufacturer's written instructions
- .2 Install continuous starter strips, inside and outside corners, edgings, soffits, drips, caps, sills, and window/door opening flashings as indicated.
- .3 Install outside corners, fillers, and closure strips with carefully formed and profiled work.
- .4 Maintain joints in exterior cladding, true to line, tight fitting, hairline joints.
- .5 Attach components in manner not restricting thermal movement.

- .6 Caulk junctions with adjoining work with sealant. Perform work in accordance with Section 07 92 00 – Joint Sealants.

### **3.6 CONTROL AND EXPANSION JOINTS**

- .1 Construct control and expansion joints as indicated.
- .2 Use cover sheets, of brake formed profile, of same material and finish as adjacent material.
- .3 Use mechanical fasteners to secure sheet materials.
- .4 Assemble and secure wall system to structural frame so stresses on sealants are within manufacturers' recommended limits.

### **3.7 CONSTRUCTION TOLERANCES**

- .1 Installation Tolerances: Shim and align panels and cladding system within installed tolerance of 6 mm in 6100 mm on level, plumb, and location lines as indicated, and within 3 mm offset of adjoining faces and of alignment of matching profiles.

### **3.8 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 Submit reports to Consultant within three days of review and submit.

### **3.9 PROJECT CLEANING - GENERAL**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning. 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. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3 Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 – Waste Management and Disposal.

### **3.10 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**END OF SECTION**

**Part 1 General**

**1.1 SUMMARY**

- .1 Products supplied for Work of this section must be from a single manufacturer and compatible with adjacent products.

**1.2 RELATED REQUIREMENTS**

- .1 Section 05 31 00 – Steel Decking
- .2 Section 06 10 00 – Rough Carpentry
- .3 Section 07 27 14 – 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.

**1.3 REFERENCES**

- .1 ASTM International (ASTM).
  - .1 ASTM C473-19, Standard Test Methods for Physical Testing of Gypsum Panel Products.
  - .2 ASTM C1002-18, Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
  - .3 ASTM C1278/C1278M-17, Standard Specification for Fiber-Reinforced Gypsum Panel.
  - .4 ASTM D3273-21, Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
  - .5 ASTM E96/E96M-16, Standard Test Methods for Water Vapor Transmission of Materials.
- .2 Canadian Roofing Contractors Association (CRCA)
  - .1 CRCA Roofing Specifications Manual.
- .3 CSA Group
  - .1 CSA A123.21:20, Standard Test Method for the Dynamic Wind Uplift Resistance of Membrane Roofing Systems.
  - .2 CSA A123.23-15, Product specification for polymer-modified bitumen sheet, prefabricated and reinforced.
- .4 Department of Justice Canada (Jus).
  - .1 Canadian Environmental Protection Act, 1999 (CEPA).
- .5 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
  - .1 Safety Data Sheets (SDS).
- .6 ULC Standards

- .1 CAN/ULC S102-2018, 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 S704.1:2017, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.

#### **1.4 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.

#### **1.5 ACTION SUBMITTALS / INFORMATION SUBMITTALS**

- .1 Submit product data in accordance with Section 01 33 00 – Submittal Procedures:
  - .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 SDS 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 – Submittal Procedures:
  - .1 Indicate flashing, control joints, tapered insulation details, slope, minimum and maximum thicknesses, board size, layout, and numbering and elevation datums at low and high points.
  - .2 Provide installation details for parapets, curbs, and roof penetrations.
  - .3 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 field report: in accordance with Section 01 45 00 – Quality Control.
- .6 Reports: indicate procedures followed, ambient temperatures and wind velocity during application.
- .7 Manufacturer's Installation Instructions: indicate special precautions required for seaming the membrane.
- .8 Declaration of Materials Compatibility: submit written declaration stating that materials are compatible with the membrane and substrates and adjacent air/vapour barrier membrane, and are acceptable to the membrane manufacturer. Include a list of materials, suppliers, and manufacturers.

## **1.6 QUALITY ASSURANCE**

- .1 Single-Source Responsibility: obtain roofing membrane 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 and to meet the warranty requirements.
- .2 Installer Qualifications: company or person specializing in application of modified bituminous roofing systems with five 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.

## **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 selvage edge up.
  - .4 Remove only in quantities required for same day use.
  - .5 Place plywood runways over completed Work to enable movement of material and other traffic.
  - .6 Store sealants at +5°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.
- .3 Packaging Waste Management
  - .1 Separate and recycle waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.

## **1.8 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 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.

## **1.9 SITE CONDITIONS**

- .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 The Contractor shall provide a Roofing Warranty certificate with a Five year Roofing Warranty Period, signed by both the Contractor and the Warrantor stating:
  - .1 The Roofing System has been constructed in accordance with the Contract Documents;
  - .2 The Roofing Warranty Period;
  - .3 Moisture leaks to be corrected within a timeframe determined by the Owner
  - .4 The Owner as the warrantee, and stating that roofing work will remain in place and be free of any defects in materials and workmanship for the stated Roofing Warranty Period; and either:
    - .1 If a five, ten or 15-year Roofing Warranty Period is required: Warrantor shall, at no additional expense to the Owner, repair any roofing failures (of the Roofing System including: moisture penetration, installation errors, manufacturers defects) which includes the replacement of all affected components of the Roofing System, occurring between the date of Substantial Performance of the Work and the end of the Roofing Warranty Period.
- .2 In addition to other Contractual requirements, the Contractor shall provide documents ensuring the performance of the Contractor's obligations under the Roofing Warranty in a form acceptable to the Owner either:
  - .1 For a five, ten, or 15-year Roofing Warranty Period:
    - .1 Ensure that the following is in place:
      - .1 Ensure that a Roofing Maintenance Bond is in place for the Roofing Warranty Period of Five years, starting on Substantial Performance of the Work; and
      - .2 Manufacturers Warranty certificate(s), signed by the Contractor and the Roofing System manufacturer includes all roofing materials and assemblies installed by the Contractor. The Roofing System manufacturer's Warranty must be for a minimum Roofing Warranty Period of Five years, starting on Substantial Performance of the Work; and
      - .3 A Canadian Roofing Contractors Association ("CRCA") membership; and
      - .4 Listing of 10 successfully completed low-slope roofing projects, within climate zone 7a or colder per National Energy Code of Canada 2011; and
      - .5 In force General Liability insurance coverage for the work, for minimum \$5,000,000.00 and endorsed for Hot Works.
      - .6 Contractor to demonstrate successful installation of low Slope roofing for a minimum of 5 years in climate zone 7A or colder per National Energy Code of Canada.
    - .2 Ensure that equivalent warranty provisions acceptable to the Owner, is in place for the Roofing Warranty Period starting on Substantial Performance of the Work.

#### **1.11 THIRD PARTY ROOFING INSPECTION**

- .1 The Owner will engage third party roofing inspection. The Inspector will provide numerous inspections and reports to the Owner during the progress of the roofing work,

to help ensure the roofing work is provided as set out in this Contract. Upon notice from the Owner, the Contractor shall expediently perform all steps and make changes as identified by the roofing inspector, at no cost to the Owner. The involvement of the roofing inspector does not relieve the Contractor of the responsibility to supervise, inspect and provide the roofing work as set out in this Contract.

- .2 The Construction schedule shall include roofing inspections. The Owner will provide the number of roofing inspections and the frequency. The Owner, Consultant, roofing inspector(s), and Roofing System manufacturer, at reasonable times, shall have proper and safe access to the Work, including parts of the Work in preparation at locations other than the Place of the Work, for the purposes of observation, inspection and testing.
- .3 Provide copies of the manufacturer's site reports to the Owner, Consultant, and roofing inspector, prior to Substantial Performance of the Work.

## **Part 2 Products**

### **2.1 PERFORMANCE / DESIGN CRITERIA**

- .1 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.
- .2 Roofing System: to CSA A123.21 for wind uplift resistance.

### **2.2 DECK COVERING**

- .1 Glass Mat Faced Roof Boards: to ASTM C1177 for manufacturing and ASTM D3273 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 Securock Gypsum Fiber Roof Board, CGC.
    - .2 Dexcell Glass Mat Roof Board, National Gypsum.
    - .3 DensDeck, Georgia Pacific.
- .2 Sheathing board attachment to steel deck: Corrosion-resistant, self-tapping screws and plates, capable of meeting Performance Criteria specified.
  - .1 Minimum Fastener Properties:
  - .2 Nominal 8 mm diameter fastener with oversized head.
  - .3 Buttress Threads: 12 threads per inch.
  - .4 Pull-out value in 22 gauge Grade E steel deck: 4.2 kN.
  - .5 Typical Static Back-Out: 5.1 N-m.
  - .6 Length to be sufficient to penetrate steel deck by minimum recommended length.

### **2.3 PRIMER**

- .1 Primer comprised of SBS synthetic rubber, volatile solvents and adhesive enhancing additives as recommended by membrane roofing manufacturer to suit substrate and installation conditions.

- .1 Acceptable Materials:
  - .1 Elastocol Stick, Soprema.

## 2.4 VAPOUR BARRIER

- .1 Vapour Barrier (**MB4**): Self-adhesive vapour barrier membrane composed of SBS modified bitumen with thermoplastic polymers and laminated woven polyethylene film.
  - .1 Thickness: Minimum 0.8 mm.
  - .2 Cold Bending: -30°C.
  - .3 Tear resistance MD/XD (ASTM D5147): 400 N/350 N.
  - .4 Water Vapour Permeance (ASTM E96): 2.5 ng/Pa·s·m<sup>2</sup>.
  - .5 Acceptable Materials:
    - .1 Sopravap'R, Soprema.
- .2 Vapour barrier 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 Sopraseal Stick 130, Soprema.

## 2.5 INSULATION

- .1 Primary Flat and Sloped Insulation (**INS4**): to CAN/ULC S704.1, Type II, closed-cell polyisocyanurate foam core laminated to organic facers; largest panels practical, square edges, with drainage channels on one face.
  - .1 Thermal resistance (CAN/ULC S770): LTTR RSI 1.00/25 mm.
  - .2 Compressive strength (ASTM D1621): 140 kPa (20 psi).
  - .3 Acceptable Materials:
    - .1 Sopra-ISO, Soprema.
- .2 Sloped insulation: provide sloped insulation as required to achieve slopes indicated on Drawings perpendicular from edge of roof to a minimum thickness of 50 mm.

## 2.6 BASE SHEET PANEL AND CAP SHEET MEMBRANE

- .1 Base sheet panel: composed of SBS-modified bitumen membrane laminated to high density polyisocyanurate support panel underface, with selvages for side laps.
  - .1 Application: Adhered.
  - .2 Total panel thickness: 14.9 mm.
  - .3 Membrane: CSA A123.23, Type B, Grade 3.
  - .4 Polyisocyanurate compressive strength (ASTM D1621): 550 kPa.
    - .1 Polyisocyanurate thickness: 12.7 mm.
  - .5 Top surface: Thermofusible film.
  - .6 Acceptable Materials:
    - .1 2-1 Soprasmart ISO HD, Soprema.
- .2 Membrane base sheet flashing (stripping): to CSA A123.23, Type C, Grade 3; high performance base sheet composed of SBS-modified bitumen membrane with composite reinforcement.
  - .1 Application: self-adhesive.
  - .2 Top surfaces: Thermofusible plastic film.



- .3 Acceptable Materials:
  - .1 Sopraply Flam Stick, Soprema.
- .4 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.
  - .1 Acceptable material:
    - .1 Elastocol Stick, Soprema.
- .3 Cap sheet membrane: to CSA A123.23, Type C, Grade 1, Styrene-Butadiene-Styrene (SBS) elastomeric polymer prefabricated sheet, composite reinforcement, with selvedge.
  - .1 Application: Heat-welded.
  - .2 Top surface: granules.
  - .3 Bottom surfaces: Thermofusible plastic film.
  - .4 Acceptable Materials:
    - .1 Sopraply Traffic Cap, Soprema.

## **2.7 ADHESIVE**

- .1 Insulation and Base Sheet Panel Adhesive: low-rise, two component polyurethane adhesive:
  - .1 Acceptable Materials:
    - .1 Duotack by Soprema.

## **2.8 ACCESSORIES**

- .1 Perimeter Fire Seal: SBS modified bitumen, minimum 60 gm/m<sup>2</sup> 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 Sopraguarde Tape, Soprema.
- .2 Flashing and sheet metal in accordance with section 07 62 00 – Sheet Metal Flashing and Trim.
  - .1 Colour: To match curtain wall framing.
- .3 Waterproofing Mastic: Black, solvent based mastic containing SBS modified bitumen, fibres and mineral fillers.
- .4 Waterproofing liquid flashing: two component PMMA liquid membrane with fleece fabric.
  - .1 Acceptable Materials:
    - .1 RS 230 Field, Soprema Alsan with Alsan RS 230 Flash, Soprema.
- .5 Expansion Joint Waterproofing Membrane: EPDM-based synthetic rubber flexible membrane as recommended by waterproofing system materials manufacturer.
  - .1 Acceptable Materials:
    - .1 Soprajoint Plus, Soprema.
- .6 Torches: Use only torches designed for torching roofing material and acceptable to manufacturer.

## **2.9 PIPE SUPPORTS**

- .1 Roof drain pans, vent stack covers and other roof penetration flashings: pre-manufactured, stainless steel construction, purpose-made to suit application and location, designed to tie-in to SBS modified membrane roofing systems.
  - .1 Basis-of-Design Materials:
    - .1 Materials as required (coordinate with electrical and mechanical Drawings), by Thaler Metal Industries Ltd., including submittal of manufacturer's 20-year Warranty.
- .2 Premanufactured Pipe Supports: fabricated from 100% recycled content, with 2.7 mm thickness galvanized steel frame, 150 mm wide x 100 mm tall x length to suit installation; including fasteners, bridge components, and angled supports as required for a complete installation and having the following accessories:
  - .1 Pipe and Conduit Support: Galvanized pipe clamp sized to suit gas pipe in accordance with manufacturers instructions.
  - .2 Multi-Pipe and Conduit Support: Galvanized pipe support system size and number to suit pipes being supported in accordance with manufacturer's instructions.
  - .3 Extendable Height Support: Galvanized steel pipe extensions to suit installation in accordance with manufacturer's instructions.
  - .4 Basis-of-Design Materials:
    - .1 C-Port, Clearline Technologies.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Perform examination, preparation and roofing Work in accordance with Roofing Manufacturer's Specification Manual and CRCA Roofing Manual.
- .2 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.
- .3 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.

### **3.2 PREPARATION**

- .1 Provide fire protection during installation.
- .2 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.

- .3 Assembly, component and material connections to be made in consideration of appropriate design loads.
- .4 Cover walls, walks, sloped roofs and adjacent work where materials hoisted or used. Roofing Contractor shall assume full responsibility for damage.
- .5 Use warning signs and barriers. Maintain in good order until completion of Work.
- .6 Clean off drips and smears of bituminous material immediately.
- .7 Dispose of rainwater off roof and away from face of building until roof drains or hoppers installed and connected.
- .8 Repair or replace defaced or disfigured finishes caused by work of this section.

### **3.3 DECK SHEATHING**

- .1 Mechanically fasten glass mat gypsum board to deck with plates and screws, in patterns and quantities as recommended by manufacturer for applicable wind uplift conditions.
- .2 Install sheathing with end joints staggered and fully supported.

### **3.4 PRIMING DECK**

- .1 Prime deck in accordance with manufacturers written recommendations.
- .2 Apply deck primer to deck substrate at the rate recommended by manufacturer.
- .3 Surfaces to be primed must be free of rust, dust or any residue that may hinder adherence.
- .4 Cover primed surfaces with roofing membrane within time limits recommended by roofing membrane system manufacturer.

### **3.5 VAPOUR BARRIER INSTALLATION**

- .1 Install self adhering vapour barrier membrane by unrolling 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; 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 vapour barrier to wall air barrier using compatible continuity strip to provide continuity of building envelope.

### **3.6 GENERAL MEMBRANE INSTALLATION**

- .1 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.
- .2 Clean off drips and smears of bituminous material immediately.
- .3 Dispose of rainwater off roof and away from face of building until roof drains or hoppers installed and connected.
- .4 Do not install roofing materials during rain or snowfall.

- .5 Provide fire protection during installation.
- .6 Metal connectors and decking shall be treated with rust proofing or galvanization.

### **3.7 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 minimum two layers with staggered joints, and in firm contact with one another.
  - .3 Cut end pieces to suit.
  - .4 Apply adhesive in continuous ribbons at 300 mm on centre.
- .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 Base Sheet Panel:
  - .1 Adhere base sheet board using adhesive applied in continuous strips spaced as required and based on manufacturer's instructions and 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 Torch 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 joints between two membranes. Leave no zone untorched. In cold weather, adjust torch 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 Weld cap sheet to base sheet membrane 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
- .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.

### 3.8 FIELD QUALITY CONTROL

- .1 Inspection and testing of roofing application to be carried out by accepted testing laboratory designated by Owner in cooperation with Consultant.

- .2 Inspection fees to be paid by Owner, in accordance with Section 01 45 00 – Quality Control.
- .3 Manufacturer 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 field services: provide manufacturer 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.

### **3.9 CLEANING**

- .1 Clean off drips and smears of bituminous material immediately.
- .2 Remove bituminous markings from finished surfaces.
- .3 In areas where finished surfaces are soiled caused by work of this section, consult manufacturer of surfaces for cleaning advice and complying with their documented instructions.

### **3.10 PROTECTION**

- .1 Protect roof from traffic and damage. Comply with precautions deemed necessary by Consultant.

**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
- .3 Section 07 92 00 - Sealants

**1.2 REFERENCES**

- .1 ASTM International, (ASTM)
  - .1 ASTM A653/A653M-20, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .2 ASTM A755/A755M-18, Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products.
  - .3 ASTM A792/A792M-10(2015), Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot Dip Process.
  - .4 ASTM C303-21, Standard Test Method for Dimensions and Density of Preformed Block and Board-Type Thermal Insulation.
  - .5 ASTM D523-14(2018), Standard Test Method for Specular Gloss.
  - .6 ASTM D822/D822M-13(2018), Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings.
- .2 Canadian Roofing Contractors Association (CRCA)
  - .1 CRCA Roofing Specifications Manual- Current Version
- .3 CSA Group
  - .1 CSA A123.22:08 (R2023), Self-adhering polymer modified bituminous sheet materials used as steep roofing underlayment for ice dam protection.
  - .2 CSA S136-16, North American Specification for the Design of Cold Formed Steel Structural Members.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 SDS - Safety Data Sheets.
- .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 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
  - .1 Architectural Sheet Metal Manual, 7th Edition, 2012.
- .7 ULC Standards
  - .1 CAN/ULC-S102-2019, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies. (ULC S102)
  - .2 CAN/ULC-S114-2018, Standard Method of Test for Determination of Non-Combustibility in Building Materials.
  - .3 CAN/ULC-S704.1:2017, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.

**1.3 ACTION SUBMITTALS / INFORMATIONAL SUBMITTALS**

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

- .1 Submit WHMIS SDS - Safety Data Sheets in accordance with WHMIS acceptable to Labour Canada, and Health and Welfare Canada.
- .2 Submit product data sheets for sheet metal roofing system products. Include:
  - .1 Product characteristics.
  - .2 Performance criteria.
  - .3 Limitations.
- .2 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures:
  - .1 Indicate arrangements of sheets and joints, types and locations of fasteners and special shapes and relationship of panels to structural frame.
- .3 Submit samples in accordance with Section 01 33 00 – Submittal Procedures:
  - .1 Submit duplicate 300 x 300mm samples of each sheet metal material.
- .4 Submit proof of manufacturer's CCMC Listing and listing number to Consultant.
- .5 Manufacturer's Instructions: Provide to indicate special handling criteria, installation sequence and cleaning procedures.

#### **1.4 QUALITY ASSURANCE**

- .1 Installer Qualifications: Engage experienced installer with a minimum of five years experience who has completed systems similar in material, design, and extent to that indicated for Project and with record of successful performance.
- .2 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 Field review of installed components.
- .3 Obtain each type of metal roofing system through one source from a single manufacturer.
- .4 Mock-Ups
  - .1 Submit mock-ups in accordance with Section 01 45 00 - Quality Control.
  - .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 by Consultant before proceeding with sheet metal flashing 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.

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver and store materials in accordance with manufacturer's instructions.
- .2 Protect panels during transportation, unloading, storing, and erecting to prevent bending, warping, twisting, and surface damage.
- .3 Packaging Waste Management
  - .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Waste Management and Disposal.



## **1.6 WARRANTY**

- .1 Manufacturers Warranty for Finishes: 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, manufacturers offering products that may be incorporated into the Work include the following:
  - .1 Behlen Industries.
  - .2 Berridge Manufacturing Company.
  - .3 Garland Canada Inc.
  - .4 Vicwest Steel Inc.
  - .5 Westform Metals.

### **2.2 PERFORMANCE / DESIGN CRITERIA**

- .1 General: The complete roof cladding system shall meet the following performance/design criteria and maintain its intended appearance, remain wind and watertight, allow for expansion and contraction of metal components and transmit loads to the supporting structural back-up.
- .2 The design, and erection of a complete metal roof system is the responsibility of this subcontractor and are based on the performance criteria specified. The method assembly, reinforcing and anchorage is schematic and shows general intent only. Location and methods of providing same shall be this subcontractor's responsibility who shall design the assembly, reinforcing and anchorage to suit specific conditions in an acceptable manner complying with the requirements specified herein.
- .3 Provide flashing as shown and required to make the system wind and watertight, and still allow for thermal movement.
- .4 All fastenings shall be concealed where possible. Where exposed in finished surfaces, screw heads shall be neat and symmetrical, made completely watertight and capable of allowing expansion and contraction of metal roof cladding. Exposed fasteners shall be color-matched to finished metal cladding or stainless steel and as scheduled.
- .5 Thermal Movements and Wind Loads: The metal roof and associated flashing systems shall be so designed and constructed as to provide for such expansion and contraction of component materials as will be caused by an ambient temperature range of -40°C to +60°C without causing harmful buckling, failure of joint seals, undue stress on fasteners or other detrimental effects.
- .6 Provide and/or make allowances for free noiseless vertical and horizontal thermal and wind loading movement, due to the contraction and expansion of any and all component parts.
- .7 Assembly and erection procedures shall take into account the ambient temperature range and wind pressure at the time of installation.
- .8 The system shall provide clear internal paths of drainage in order to drain any trapped moisture to the exterior, discharging moisture in a manner avoiding staining of architectural finishes, collecting in puddles, formation of unsafe icicles and dripping onto pedestrians.
- .9 Fasten panel assembly to building structure in a manner, which transmits all loads to the main structure without exceeding the capacity of any fastener.

## **2.3 SHEET METAL MATERIALS (MT 5)**

- .1 Zinc coated steel sheet to ASTM A653/A653M, commercial quality (CS), with Z275 galvanized coating; or aluminum-zinc alloy coated steel sheet to ASTM A792/A792M, commercial quality (CS), grade 275 with AZ150 galvalume coating:
  - .1 Base Metal Thickness: 0.76 mm.
  - .2 Surface: regular spangle.
  - .3 Finish: prefinished as specified below.
  - .4 Profile: As selected by Consultant from manufacturer's full range.
    - .1 Seam Profile: Standing Seam.

## **2.4 PREFINISHED STEEL SHEET**

- .1 Prefinished steel with factory applied 70% polyvinylidene fluoride (PVDF) coating.
  - .1 Class: F1S.
  - .2 Colour: selected by Consultant from manufacturer's full range.
  - .3 Specular gloss: 30 units +/-5 to ASTM D523.
  - .4 Coating thickness: not less than 22 micrometres.
  - .5 Resistance to accelerated weathering for chalk rating of eight, colour fade five units or less and erosion rate less than 20% to ASTM D822 as follows:
    - .1 Outdoor exposure period 2500 hours.
    - .2 Humidity resistance exposure period 5000 hours.

## **2.5 DECK COVERING**

- .1 Glass Mat Faced Roof Boards: to ASTM C1177 for manufacturing and ASTM D3273 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 Securock Gypsum Fiber Roof Board, CGC.
    - .2 Dexcell Glass Mat Roof Board, National Gypsum.
    - .3 DensDeck, Georgia Pacific.
- .2 Sheathing board attachment to steel deck: Corrosion-resistant, self-tapping screws and plates, capable of meeting Performance Criteria specified.
  - .1 Minimum Fastener Properties:
  - .2 Nominal 8 mm diameter fastener with oversized head.
  - .3 Butress Threads: 12 threads per inch.
  - .4 Pull-out value in 22 gauge Grade E steel deck: 4.2 kN.
  - .5 Typical Static Back-Out: 5.1 N-m.
  - .6 Length to be sufficient to penetrate steel deck by minimum recommended length.

## **2.6 PRIMER**

- .1 Primer comprised of SBS synthetic rubber, volatile solvents and adhesive enhancing additives as recommended by membrane roofing manufacturer to suit substrate and installation conditions.

- .1 Acceptable Materials:
  - .1 Elastocol Stick, Soprema.

## 2.7 VAPOUR RETARDER

- .1 Vapour Retarder (**MB4**): Self-adhesive vapour barrier membrane composed of SBS modified bitumen with thermoplastic polymers and laminated woven polyethylene film.
  - .1 Thickness: Minimum 0.8 mm.
  - .2 Cold Bending: -30°C.
  - .3 Tear resistance MD/XD (ASTM D5147): 400 N/350 N.
  - .4 Water Vapour Permeance (ASTM E96): 2.5 ng/Pa·s·m<sup>2</sup>.
  - .5 Acceptable Materials:
    - .1 Sopravap'R, Soprema.
- .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 Sopraseal Stick 130, Soprema.

## 2.8 INSULATION

- .1 Insulation (**INS4**): Closed-cell polyisocyanurate foam core laminated to heavy non-asphaltic glass fibre reinforced facers; 1219 x 1219 mm, having square edges; conforming to CAN/ULC-S704.1, Class 2, Type II, to a tolerance not exceeding 3 mm from nominal size in any dimension, and as follows:
  - .1 Overall thickness: as indicated to RSI required, achieved in minimum two layers, and with joints offset 100 mm.
  - .2 Acceptable Materials:
    - .1 SOPRA-ISO, Soprema.

## 2.9 UNDERLAYMENT MEMBRANE

- .1 Underlayment (**MB6**): self adhering roof underlayment to CSA A123.22, modified bitumen laminated to slip resistant woven polyethylene.
  - .1 Thickness: 1.0 mm.
  - .2 Service temperature: -45°C to +115°C.
  - .3 Primer: as recommended by manufacturer.
  - .4 Acceptable Materials:
    - .1 Lastobond Shield HT, Soprema.

## 2.10 FABRICATION

- .1 Fabricate components of system in factory, ready for field installation.
- .2 Provide roof sheet and accessories in longest practicable length to minimize field lapping of joints.

## 2.11 ACCESSORIES

- .1 Provide components required for complete metal roofing system assembly including trim, copings, fasciae, corner units, ridge cap, ridge closures, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items; match material and finish of metal roofing system.

- .2 Isolation coating: alkali resistant bituminous paint.
- .3 Plastic cement: to CAN/CGSB-37.5.
- .4 Slip sheet: reinforced sisal paper or a heavy felt kraft paper.
- .5 Bearing plates: sheet steel, Z-275 galvanized, thickness to suit design requirements, pre-drilled or pre-punched with installation holes.
- .6 Expansion clips: sheet steel, Z-275 galvanized, minimum thickness 1.22 mm, fabricated to allow for thermal expansion and contraction of roofing sheet metal.
- .7 Ridge Vent: Manufacturer's standard aluminum ridge vent, 203 mm wide x 43 mm high x 3048 mm lengths, equipped with built-in weather baffle, install with end caps and fastening straps.
  - .1 Basis-of-Design Materials:
    - .1 MasterFlow 10' Aluminum Ridge Vent, GAF.
- .8 Sealant: Asbestos-free sealant, compatible with systems materials, recommended by system manufacturer and as indicated in Section 07 92 00 - Sealants.
- .9 Rubber-asphalt sealing compound: to CAN/CGSB-37.29.
- .10 Cleats: of same material, and temper as sheet metal, minimum 50 mm wide. Thickness same as sheet metal being secured.
- .11 Fasteners: concealed.
- .12 Washers: of same material as sheet metal, 1 mm thick with rubber packings.
- .13 Flashing, Roof Curbs, and Trim: Prefinished flashing materials to match roofing materials in accordance with Section 07 62 00 - Sheet Metal Flashing and Trim.
- .14 Touch-up paint: as recommended by sheet metal roofing manufacturer.
- .15 Snow Guards: continuous type, fabricated of non-corrosive prefinished metal as directed by Consultant. Installed without penetrating metal roofing system, and complete with predrilled holes, clamps, or hooks for anchoring.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Examine substrates to ensure proper attachment to framing.
- .2 Examine roof deck to verify deck is clean and smooth, free of depressions, waves or projections and within flatness tolerances required by metal roofing system manufacturer.
- .3 Verify roof opening, curbs, pipes, sleeves, ducts or vents through roof are solidly set, cant strips and reglets in place, and nailing strips located.
- .4 Verify deck is dry and free of snow or ice.

### **3.2 DECK SHEATHING**

- .1 Mechanically fasten glass mat gypsum board to deck with plates and screws, in patterns and quantities as recommended by manufacturer for applicable wind uplift conditions.
- .2 Install sheathing with end joints staggered and fully supported.

### **3.3 PRIMING DECK**

- .1 Prime deck in accordance with manufacturers written recommendations.
- .2 Apply deck primer to deck substrate at the rate recommended by manufacturer.

- .3 Surfaces to be primed must be free of rust, dust or any residue that may hinder adherence.
- .4 Cover primed surfaces with roofing membrane within time limits recommended by roofing membrane system manufacturer.

### **3.4 VAPOUR BARRIER INSTALLATION**

- .1 Install self adhering vapour barrier membrane by unrolling 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; 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 vapour barrier to wall air barrier using compatible continuity strip to provide continuity of building envelope.

### **3.5 INSULATION**

- .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 minimum two layers with staggered joints, and in firm contact with one another.
  - .3 Cut end pieces to suit.
  - .4 Apply adhesive in continuous ribbons at 300 mm on centre.

### **3.6 UNDERLAYMENT INSTALLATION**

- .1 Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated below, wrinkle free, in shingled fashion to shed water, and with end laps minimum 6 inches (150 mm) staggered 24 inches (600 mm) between courses. Overlap side edges minimum 3-1/2 inches (90 mm). Roll laps with roller. Cover underlayment within 14 days.
  - .1 Apply over entire roof surface.
- .2 Install drip edges and metal flashings to cover underlayment to comply with requirements specified in Section 07 62 00.

### **3.7 STANDING SEAM ROOFING**

- .1 Standing seam metal roof panels: Install weathertight metal panel system including roof panels, thermally broken structural support system, insulation, and air barrier membrane in accordance with manufacturers' written instructions, accepted shop drawings, and project drawings.
- .2 Install metal roof panels in orientation, sizes, and locations indicated, free of waves, warps, buckles, fastening stresses, and distortions. Anchor panels and other components securely in place. Provide for thermal and structural movement.

- .3 Include alignment bars, brackets, clips, inserts, shims as required to securely and permanently fasten roof system to building structure.
- .4 Attach panels to supports using clips, screws, fasteners, and sealants recommended by manufacturer and indicated on accepted shop drawings.
  - .1 Install exterior prefinished roof panels on panel support clips, using manufacturer's proper construction procedure. Ensure metal roofing sheet side-lap is positively retained by clips, and proper sheet coverage is maintained.
  - .2 Seams: Form double fold standing seams with mechanical tool acceptable to roofing system manufacturer.
  - .3 Where indicated on approved shop drawings, secure end-lap of metal roofing sheets in accordance with manufacturer's specifications and details to provide weathertight seal. Exposed fasteners to match colour of roof sheet.
  - .4 Provide notched and formed closures, sealed against weather penetration, at changes in pitch, and at ridges and eaves, where required.
  - .5 Install companion flashing as shown on shop drawings. Use concealed fasteners when possible. Exposed fasteners to match colour of roof sheet.
  - .6 Provide weatherproof jacks for pipe and conduit penetrating metal panels of types recommended by manufacturer.
  - .7 Dissimilar Materials: Where elements of metal panel system contact dissimilar materials, treat faces and edges in contact with dissimilar materials as recommended by manufacturer.
- .5 Install trim, flashing, and accessories using recommended fasteners and joint sealants, with positive anchorage to building, and with weather tight mounting. Provide for thermal expansion. Coordinate installation with flashings and other components.
  - .1 Install components required for complete metal panel assembly, including trim, copings, flashings, sealants, closure strips, and similar items.
  - .2 Provide concealed fasteners except where noted on approved shop drawings.
  - .3 Set units true to line and level as indicated. Install work with permanently weather-resistant laps, joints, and seams.

### **3.8 ACCESSORY INSTALLATION**

- .1 Install accessories with positive anchorage to building and weather tight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
- .2 Install components required for a complete metal roofing system assembly including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
- .3 Provide and install metal gutters and downspouts in accordance with Section 07 62 00 – Sheet Metal Flashing and Trim.
- .4 Install flashing and trim in accordance with performance requirements, manufacturer's written installation instructions, and SMACNA recommendations; provide concealed fasteners where possible, and set units true to line and level; install work with laps, joints, and seams that will be permanently watertight and weather resistant.
- .5 Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
- .6 Install snow guards according to manufacturer's written instructions. Space rows as recommended by manufacturer. Do not use fasteners that will penetrate metal roofing, or

fastening methods that void metal roofing finish warranty. Seam-Mounted Metal Snow Guard Pads Stainless-steel clamps attached to vertical ribs of standing-seam metal roof panels.

### **3.9 CLEANING**

- .1 Remove temporary protective coverings and strippable films, if any, as metal roofing system are installed, unless otherwise indicated in manufacturer's written installation instructions.
- .2 Clean finished surfaces as recommended by metal roofing system manufacturer upon completion of metal roofing system installation; maintain in a clean condition during remainder of construction.
- .3 Replace metal roofing system components that become damaged or have deteriorated beyond successful repair by finish touch-up or similar minor repair procedures.
- .4 Remove excess materials, debris and equipment at completion.
- .5 Clean all panels clean and free of grime and dirt.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 ASTM International (ASTM)
  - .1 ASTM A606/A606M-18, Standard Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance.
  - .2 ASTM A653/A653M-20, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .3 ASTM A792/A792M-21a, Standard Specification for Steel Sheet, 55 % Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
  - .4 ASTM B32-20, Standard Specification for Solder Metal.
  - .5 ASTM B209/B209M-21, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
  - .6 ASTM F1667-21, Standard Specification for Driven Fasteners: Nails, Spikes, and Staples.
- .2 Canadian Roofing Contractors Association (CRCA)
  - .1 Roofing Specifications Manual (latest edition).
- .3 CSA Group (CSA)
  - .1 CSA A123.3-05 (R2015), Asphalt Saturated Organic Roofing Felt.
- .4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
  - .1 SMACNA 1120, Architectural Sheet Metal Manual, 7th Edition.

**1.2 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.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures:
- .2 Submit manufacturer's printed product literature, specifications, and datasheets, and include product characteristics, performance criteria, physical size(s), finish(es) and constraints.
- .3 Submit shop drawings showing proposed method of shaping, forming, jointing, fastening, and application of flashing and sheet metalwork.
- .4 Verification Samples:
  - .1 Submit duplicate 12" x 12" samples of each type of sheet metal material, colour and finish proposed to be used for the project and obtain written acceptance from Consultant before ordering materials.
- .5 Submit representative sample section of pre-painted metal flashing illustrating S-locking jointing method, minimum 24" long.
- .6 Submit warranty.



#### **1.4 QUALITY CONTROL**

- .1 General: Fabricate and install sheet metal flashing and trim in accordance with SMACNA Architectural Sheet Metal Manual, and to the CRCA Roofing Specifications Manual.
- .2 Sheet Metal and Metal Flashing: Comply with the applicable recommendations and guidelines of the CRCA Canadian Roofing Reference Manual, CRCA Specification Manual, and applicable CRCA technical bulletins.

#### **1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Stack pre-formed and pre-finished material in manner to prevent twisting bending and rubbing.
- .2 Provide protection for finished 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.

#### **1.6 WARRANTY**

- .1 Contractor agrees to correct any deficiencies of labour or material found in the work performed for a period of 5 years from the date of Substantial Performance.
- .2 Provide Warranty for sheet metal flashing and trim to include in maintenance manuals.

### **Part 2 Products**

#### **2.1 PREFINISHED STEEL FLASHING (MT 2)**

- .1 Hot dip galvanized steel sheet (pre-finished): Type A commercial quality to ASTM A653/A653M, with Z275 designation zinc coating.
  - .1 Class: F1S-Finished one side (manufacturer's standard prime finish on unexposed face).
  - .2 Thickness: minimum 0.027" base metal thickness.
  - .3 Manufacturer's Coil Coating System: silicone modified polyester (SMP) system, applied over a zinc phosphate pre-treatment, and high-performance, flexible primer.
    - .1 Acceptable Systems:
      - .1 Perspectra Series, by ArcelorMittal, or WeatherX, by Valspar.
  - .4 Colours: as selected by Consultant from manufacturer's full range; General: match colour of curtain wall system.
- .2 Formed aluminum flashing: Tension levelled, commercial quality aluminum sheet in accordance with ASTM B209 and ANSI H35.1 alloy designation 5005-H14 and as follows:
  - .1 Minimum Thicknesses:
    - .1 General Applications where indicated: minimum 0.032" thick.
  - .2 Factory Finish: powder-coated, to AAMA 2605; colour as selected by Consultant from manufacturer's full range to match colour of curtain wall system.
  - .3 Unexposed aluminum: Mill finish.
- .3 Zinc flashing: Zinc alloy sheet metal, 0.7 mm thickness.

- .1 Zinc content: 99.995%, alloyed with titanium and copper.
- .4 Form flashing, coping, and fascia to profiles indicated or as required to achieve the design intent illustrated on the Drawings.

## **2.2 CHANNEL DRAINS**

- .1 Form channel drain from 2 mm thick sheet steel, hot dipped galvanized and powder coated to PVDF Finish. Solder ½" x ½" grid heavy-duty stainless steel mesh screen to open end of channel to reduce entry of leaves and other debris.
- .2 Sized as required to suit conditions.
- .3 Finish: to match adjacent and in accordance with drawings.
- .4 Profile as indicated.
- .5 Provide all necessary fastenings and ensure watertight seal to surrounding construction.
- .6 Tie-in to structure and canopy system to ensure secure attachment to structure.

## **2.3 DOWNSPOUTS**

- .1 Custom Fabricated Downspouts: hot dipped galvanized and powder coated to PVDF Finish Tie-back to structural column, and solder downspout joint to drainage channel for watertight connection.
- .2 Finish: to match adjacent and in accordance with drawings.

## **2.4 ACCESSORIES**

- .1 Isolation coating: alkali resistant bituminous paint.
- .2 Roofing Cement: to ASTM D4586, asphalt-based, asbestos free.
- .3 Underlay for flashing: No. 15 perforated asphalt felt to CSA A123.3.
- .4 Bug Screen (**MT 3**): stainless steel, Type 304, 18 x 14 mesh, concealed mechanical attachment.
- .5 Sealants: as indicated in Section 07 92 00 – Joint Sealants.
  - .1 Mastic Sealant: 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.
- .6 Prefinished Steel 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.
- .7 Touch-up paint: as recommended by prefinished material manufacturer.

## **2.5 SLEEVE FLASHING SYSTEMS**

- .1 Aluminum flashing systems by Thaler Roofing Specialties Products or similar, with same or better warranty provisions, physical properties and performance characteristics.
- .2 Fabricate sleeve flashings square or circular and of size to suit component being flashed. Unless otherwise indicated fabricate sleeves of 0.059" thick sheet metal, minimum 18" high.
- .3 Inside of jacket base flange and all sides of protection cup shall be coated with bituminous paint.

- .4 Where possible, size sleeves to allow minimum 1" thick insulation between component and sleeve.
- .5 Provide under this Section all sleeve flashings required, except for those provided by mechanical and electrical Divisions; provide the following where required:
  - .1 Guardrail support: ARS-400/NS.
  - .2 Other types, where required suitable for purpose intended and as recommended by manufacturer.
- .6 The following or similar types are provided by mechanical and electrical Divisions respectively where required for their work (minimum 1" high):
  - .1 Stack jack: SJ-4.
  - .2 Pipe flashing: SJ-4.
  - .3 Flue pipe flashing: MEF-3A complete with 2" mineral wool insulation.
  - .4 Gas pipe flashing: MEF-9 Modcon.
  - .5 Duct support: MERS-800.
  - .6 Electrical conduit, rigid: MEF-1A.
  - .7 Electrical conduit, flexible: MEF-2C.
  - .8 Guy wire roof supports: ARS-300, HSS pipe 24" long, sleeve minimum 18" height.
  - .9 Condensing Units and Air Conditioning Units (where indicated) roof supports: MERS-900A, stack jack minimum 18" height.
  - .10 Other types where required suitable for purpose intended, as recommended by manufacturer.

## **2.6 FABRICATION**

- .1 Roofing: Fabricate flashing and other sheet metal work in accordance with applicable CRCA 'FL' series details, and as indicated.
- .2 Galvanized (zinc or aluminum-zinc as specified) sheet steel: Fabricate in accordance with SMACNA Architectural Sheet Metal Manual.
- .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 cap flashings as specified above for flashings adjacent to roofing at roof edges and area dividers, and where exposed to view from ground or an interior public area.
- .6 Make flashings for other locations of hot dip galvanized metal, Type A commercial quality to ASTM A653/A653M, with Z275 designation zinc coating, as follows:
  - .1 Use 0.027" metal core thickness except where otherwise specified.
  - .2 Use 0.033" metal core thickness for concealed fastening strips.
  - .3 Use material of thickness specified for other applications, and as indicated.
- .7 All straight run joints shall be S-Lock in roof flashings.
- .8 Make joints to allow for thermal movement, space S-Lock joints at 10 ft maximum centers.
- .9 Make flashings for building into masonry and concrete so that joints can be lapped 4" or more.
- .10 Strengthen free edges of metal flashings by folding to form a 1/2" hem.

- .11 Make flashings to curbs, walls, and parapets a minimum of 4" high, where possible.
- .12 Provide premanufactured flashing sleeves and collars for all piers, pipes and conduit extending through the roof, meeting roofing manufacturer's warranty requirements.
- .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.

### **Part 3 Execution**

#### **3.1 EXAMINATION**

- .1 Check mounting and counterflashing of mechanical items and report defects to the Consultant.
- .2 Verify that solid wood blocking or sheathing provided to back-up flashings and that nails, screws set and wood provides smooth flat plane.
- .3 Verify that reglets, provided under other Sections or built-in by other trades, properly and securely located, true and level in line.
- .4 Commencement of Work means acceptance of existing conditions.

#### **3.2 INSTALLATION**

- .1 Install sheet metal flashing and trim in accordance with applicable CRCA 'FL' series details, SMACNA's Architectural Sheet Metal Manual, and as indicated.
- .2 Verify shapes and dimensions of surfaces being covered before fabricating sheet metal.
- .3 Do not install metal flashings over flexible roof flashing and expansion joints until the flexible roof flashing and expansion joints have been inspected and approved by the Consultant. This includes curbs for roof mounted items.
- .4 Where possible, secure flashings to supporting building elements with concealed continuous cleats or locking strips. Use hot dipped galvanized steel locking strips / cleats for prefinished steel flashing.
- .5 Do not use exposed fastening unless indicated, or concealed fastening is not possible. Locations and methods shall be approved by Consultant.
- .6 Anchor units of work securely in place, providing for thermal expansion of metal units. Conceal fasteners where possible and set units true to line and level.
- .7 Install work with laps, joints, and seams that are watertight and weatherproof.
- .8 Install exposed sheet metal work that is without oil canning, buckling and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weatherproof performance.
- .9 Install surface mounted reglets true and level, and caulk top of reglet with sealant. Turn top edge of flashing into recessed reglet or mortar joint minimum of 1". Lead wedge flashing securely into joint.
- .10 Where flashing is installed around circular components and upper flashing jack is exposed, provide draw-band and around upper edge and seal top flange.
- .11 Insert metal flashing into reglets or under cap flashing as indicated to form weather tight junction.

- .12 Fasten metal base flashing to walls or upstands along top of flashing. Form lapped corner joints. Extend rolled edge of base flashing approximately 1" on to roof from toe of cant, and rest on top of roof surface.
- .13 Roof Edge Flashing: Secure metal flashing at roof edges at a maximum of 24" o.c.
- .14 Expansion Provisions:
  - .1 Provide for thermal expansion of exposed sheet metal Work.
  - .2 Space movement joints at maximum of 10 ft, with no joints allowed within 24" of a corner or intersection, or as otherwise indicated per Drawings.
  - .3 Form expansion joints of intermeshing hooked flanges, not less than 1" deep, filled with mastic sealant (concealed within joints) where lapped or bayonet type expansion provisions in the work cannot be used or are not sufficiently weatherproof and waterproof.
  - .4 Provide slip joints to allow for movement.
- .15 Sealed Joints:
  - .1 Form non-expansion, but movable, joints in metal to accommodate elastomeric sealant.
  - .2 Fill joint with sealant and form metal to conceal sealant completely.
  - .3 Use joint adhesive for non-moving joints specified.
- .16 Lock Seams:
  - .1 Fabricate non-moving seams in sheet metal with flat lock seams.
- .17 Separations:
  - .1 Separate metal from non-compatible metal or corrosive substrates by coating concealed surfaces, at locations of contact, with bituminous paint or other permanent separation as recommended by the manufacturer.
  - .2 Underlayment: Install a slip-sheet of No. 15 perforated asphalt saturated felt and a course of polyethylene underlayment where installing sheet metal directly on cementitious or wood substrates. Secure in place and lap joints minimum 4".
  - .3 Bed flanges of work in thick coat of roofing cement where required for waterproof performance.
- .18 Counter Flashing:
  - .1 Coordinate installation of counter flashing with installation of assemblies being protected by counter flashing.
  - .2 Secure in a waterproof manner.
  - .3 Lap counter flashing joints a minimum of 2" and bed with sealant.
- .19 Flashing and metal closures: where flashing and metal closures overlap at any point in a system, ensure that flashing and closures are shingled over top lower sheet(s) and not behind, so that water is directed, and drains, to the exterior.
- .20 Roof Drainage System:
  - .1 Install drainage items fabricated from sheet metal, with straps, adhesives and anchors as required, to drain the roof in the most efficient manner.
- .21 Equipment Support Flashing:
  - .1 Coordinate equipment support flashing installation with roofing and equipment installation.

**3.3            INSTALLATION: DRAINAGE CHANNELS AND DOWNSPOUTS**

- .1      Install drainage channel securely to structure and in accordance with reviewed shop drawings.
- .2      Install downpipes and solder to drainage channel to ensure watertight connection.
  - .1          Install commercial-quality metal leaf diverters at connection to downspout to ensure that leaves and other debris does not pass channel into downpipe.
  - .2          Tie-back downpipes to structural assembly and fasten securely in place, minimum 4 tie-back connections to structure.

**1.1            CLEANING**

- .1      Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning. 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. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3      Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 – Waste Management and Disposal.

**1.2            PROTECTION**

- .1      Protect installed products and components from damage during construction.
- .2      Repair damage to adjacent materials caused by Work of this Section.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 05 50 00 - Metal Fabrications.
- .2 Section 06 10 00 - Rough Carpentry.
- .3 Section 07 52 00 – Modified Bituminous Membrane Roofing.
- .4 Section 07 62 00 - Sheet Metal Flashing and Trim.
- .5 Section 07 92 00 - Joint Sealants.

**1.2 ACTION SUBMITTALS / INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data: Submit manufacturer's printed product literature, specifications and technical data sheet.
- .3 Shop Drawings: Indicate size and description of components, materials, attachment devices, description of frame and finish, and construction details.
- .4 Manufacturer's Instructions: Submit manufacturer's installation instructions.

**1.3 CLOSEOUT SUBMITTALS**

- .1 Provide maintenance data for hardware complete with pertinent details, spare parts lists and warnings against harmful maintenance materials and practices for incorporation into manual specified in 01 78 00 - Closeout Submittals.

**Part 2 Products**

**2.1 PERFORMANCE/DESIGN CRITERIA**

- .1 Cover: reinforced to support a minimum live load of 40 psf (195 kg/m<sup>2</sup>) with a maximum deflection of 1/150th of the span or 20 psf (97 kg/m<sup>2</sup>) wind uplift.

**2.2 ROOF HATCH**

- .1 Provide thermally-broken roof hatches with insulated double wall lids and insulated double wall curb frame with integral deck mounting flange and lid frame counter flashing with welded sealed corner joints, continuous weather tight perimeter gasketing and hot dip galvanized hardware, and as follows:
  - .1 Acceptable material:
    - .1 Type F-50-TB Thermally-Broken Roof Hatch-Ladder Access, by Bilco, or acceptable equivalent.
  - .2 Size: Single leaf lid, 48 x 48 inches (1220 x 1220 mm).
  - .3 Curb and Lid Material: Aluminum sheet, nominal 2.3 mm minimum thickness, insulated sandwiched construction.
    - .1 Finish: Mill finish.
  - .4 Insulation: Polyisocyanurate insulation board, 75 mm thickness, .R 20.3 (U=0.279 W/m<sup>2</sup>·K).
  - .5 Exterior Curb Liner: Manufacturer's insulated metal liner of same material and finish as metal curb.
  - .6 Hardware: Type 316 stainless steel hinges; zinc plated chromate sealed, counterbalanced spring latch with turn handles, butt or pintle type 316 stainless

steel hinge system as standard for manufacturer, interior and exterior padlock hasps.

- .7 Latching: Single point, using manufacturer's standard latching mechanism.

## **2.3 FABRICATION**

- .1 Fabricate components free of twists, bends, or visual distortion and insulated. Weld corners and joints.
- .2 Assemble roof hatch components as indicated.
- .3 Ensure continuity of weather-tight seal.
- .4 Design flashings and extrusions to collect and lead off accumulated condensation.

## **2.4 ACCESSORIES**

- .1 Screws: match metal material that the screw is to penetrate.
- .2 Securing latch: hold open operating arm with vinyl grip handle to permit one-handed release.
- .3 Resilient gasket/seal to inner face of lid in contact with hatch lid support frame.
  - .1 Gaskets: EPDM rubber.
- .4 Isolation coating: alkali resistant bituminous paint or epoxy solution.
- .5 Ladder Safety Post: Manufacturer's standard nominal 40 mm diameter galvanized steel tube ladder safety post; with post locking in place on full extension to 1070 mm above roof surface and release mechanism to return post to closed position, finished with manufacturer's standard baked enamel finish.
- .6 Safety Railing System: Manufacturer's standard safety rail system consisting of nominal 40 mm diameter rails, clamps, fasteners, safety barrier at railing opening, and all accessories required for a complete installation. Installed so that top of railing is 1070 mm above roof surface, finished with manufacturer's standard baked enamel finish, and as follows:
  - .1 Provide weep holes or another means to drain entrapped water in hollow sections of handrail and railing members.
  - .2 Fabricate joints exposed to weather in a watertight manner.
  - .3 Close exposed ends of handrail and railing members with prefabricated end fittings.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Examine substrates and structural elements to which roof hatches attach, with installer present, for compliance with requirements specified in this and other Sections that affect installation and anchorage, and other conditions affecting performance of roof hatch.
- .2 Verify related work of other trades is complete prior to installing roof hatch and coordinate installation with roof membrane and roof insulation.
- .3 Verify that an air seal has been properly installed prior to installation of roof hatch.
- .4 Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- .1 Obtain all dimensions from job site.



- .2 Ensure all structural support is aligned and condition is acceptable.
- .3 Coordination: coordinate with roofing trade as required to ensure continuity of waterproofing and compliance with the roofing warranty.
- .4 Survey substrate to assure proper elevation to align properly with roofing assembly.

### **3.3 INSTALLATION**

- .1 Install in accordance with the manufacturer's published installation instructions, datasheets, specifications, and details.
- .2 Erect components plumb, level and in proper alignment.
- .3 Ensure continuity of building envelope air barrier and vapour retarder systems.
- .4 Adjust and seal assembly with provision for expansion and contraction of components.
- .5 Secure curb assembly to structure.
- .6 Coat aluminum in contact with dissimilar materials with isolation coating.
- .7 Secure and seal frame to curb.

### **3.1 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning. 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. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3 Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 – Waste Management and Disposal.

### **3.2 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**END OF SECTION**

**Part 1 General**

**1.1 SUMMARY**

- .1 This Section includes firestopping and smoke seal systems for penetrations through fire resistance rated assemblies, including both empty openings and openings containing penetrating items.
- .2 Coordinate with electrical and mechanical Subcontractors as required to determine number, sizes, and types of penetrations to be addressed under this specification section.
- .3 This Section includes fire resistive joint systems.
- .4 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 REQUIREMENTS**

- .1 Section 04 22 00 – Unit Masonry.
- .2 Section 06 16 43 – Gypsum Sheathing.
- .3 Section 08 44 13 – Glazed Aluminum Framing Systems.
- .4 Section 09 22 16 – Gypsum Board Assemblies.
- .5 Refer to Drawings for scope of work for:
  - .1 Expansion Control System.
  - .2 Gypsum Board Assemblies.
- .6 Other Sections as indicated.

**1.3 REFERENCES**

- .1 ASTM International (ASTM)
  - .1 ASTM A653/A653M-17, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .2 ASTM A1008/A1008M-18, 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 E119-18b, Standard Test Methods for Fire Tests of Building Construction and Materials.
  - .4 ASTM E1966-15, Standard Test Method for Fire-Resistive Joint Systems.
  - .5 ASTM E2174-18, Standard Practice for On-Site Inspection of Installed Fire Stops.
  - .6 ASTM E2307-15be1, Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus
  - .7 ASTM E2393-10a(2015), Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers.
- .2 Firestop Contractors International Association (FCIA)
  - .1 FCIA Firestop Manual of Practice - 8th Edition (MOP).

- .2 FM 4991, Standard for the Approval of Firestop Contractors, 2013.
- .3 International Firestop Council (IFC)
  - .1 Recommended IFC Guidelines for Evaluating Firestop Systems in Engineering Judgments (EJs).
- .4 International Code Council (ICC) / International Building Code (IBC)
  - .1 2012 IBC, Chapter 7.
- .5 National Fire Protection Agency (NFPA)
  - .1 NFPA (Fire) 251, Standard Methods of Tests of Fire Endurance of Building Construction and Materials, 2006 Edition.
- .6 ULC Standards
  - .1 ULC Guide No. 40 U19, Firestop Systems; ULC Category Code Number XHEZC.
  - .2 CAN/ULC S101-14, Standard Methods of Fire Endurance Tests of Building Construction and Materials.
  - .3 CAN/ULC S102-18, Standard Method of Tests for Surface Burning Characteristics of Building Materials and Assemblies.
  - .4 CAN/ULC S114 (2018), Standard Method of Test for Determination of Non-Combustibility in Building Materials.
  - .5 CAN/ULC S115 (2018), Standard Method of Fire Tests of Fire stop Systems.
  - .6 CAN/ULC S702.1-2021, Standard for Mineral Fibre Thermal Insulation for Buildings, Part 1: Material Specification.
  - .7 CAN/ULC S702.2-15, Mineral Fibre Thermal Insulation for Buildings, Part 2: Application Guidelines.
- .7 Underwriters Laboratories Inc. (UL)
  - .1 UL 1479, Standard for Fire Test of Through-Penetration Firestops, 2015.

#### **1.4 REGULATORY REQUIREMENTS**

- .1 Work of this Section shall meet or exceed the requirements of the Ontario Building Code as amended (OBC).

#### **1.5 ADMINISTRATIVE REQUIREMENTS**

- .1 Pre-Installation Meetings: convene pre-installation meeting one week prior to beginning work of this Section, with contractor's representative and Consultant in accordance with Section 01 32 18 – Construction Schedule to:
  - .1 Verify project requirements.
  - .2 Review installation and substrate conditions.
  - .3 Coordination with other building trades.
  - .4 Review manufacturer's installation instructions, and warranty requirements.

#### **1.6 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
  - .1 Not later than 30 working days following Award of Contract, submit a schedule and shop drawings, including room numbers from the Contract Drawings. Indicate ULC assembly number for each condition, required temperature rise and flame rating, hose stream rating, thickness, installation methods and materials of firestopping and smoke seals, damming materials, reinforcements, anchorages

- and fastenings, size of opening, adjacent materials and number of penetrations. Include manufacturer's printed instructions for each type of penetration.
- .2 Where possible determine thickness to be applied from tests of assemblies identical to the assembly to be protected, conducted in accordance with CAN/ULC S101.
- .3 Engineering Judgements: where a UL / ULC / c-UL Design (assembly number) has not been issued, obtain an engineering judgement from the system manufacturer for a solution relevant to the job conditions involved, and obtain approval of the Authorities Having Jurisdiction.
  - .1 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.
  - .2 Obtain and submit fire stop system manufacturer's engineering judgement(s) meeting the requirements of Authorities Having Jurisdiction.
  - .3 Engineering judgements shall comply with "Recommended IFC Guidelines for Evaluating Firestop Systems in Engineering Judgments (EJs)."
- .2 Submit product data in accordance with Section 01 33 00 – Submittal Procedures:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Quality assurance submittals: submit following in accordance with Section 01 45 00 – Quality Control.
  - .1 Contractor shall obtain a training letter from the firestop system manufacturer, and submit it to Consultant prior to firestop installation.
  - .2 Submit copies of engineering judgments approved by local authorities having jurisdiction to Consultant prior to installation.
  - .3 The firestopping system manufacturer shall submit a letter of certification to the Contractor, certifying that all firestopping has been installed in compliance with the approved ULC design specifications for each type of penetration. Forward one copy to Consultant, and include one copy in each maintenance manual specified in Section 01 78 00.
    - .1 The 'Certificate of Substantial Performance' shall not be issued until Consultant has received the manufacturer's letter of certification from the Contractor indicating that all fire-stopping applications comply with the tested assemblies of the manufacturer.
  - .4 Submit manufacturer's engineering judgment identification number(s) and Shop Drawing details when no ULC or cUL system is available for an application. Engineering judgments must include the Contract name and number, and the Contractor's name.
  - .5 For those firestop applications that exist, for which no ULC or cUL tested system is available through a manufacturer, a manufacturer's engineering judgment derived from similar ULC or cUL system designs or other tests shall be submitted to local Authorities Having Jurisdiction, with a copy to Consultant, for their review prior to installation. Engineering judgment Drawings must follow the requirements set forth by the IFC.

## 1.7 QUALITY ASSURANCE

- .1 Qualifications:

- .1 Installer:
  - .1 Company or person specializing in fire stopping installations, and approved by the manufacturer with minimum 5-years' documented experience.
  - .2 Company or person shall be a member in good standing of the Firestop Contractors International Association (FCIA).
- .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 Single Source Responsibility:
  - .1 Obtain through-penetration firestop and joint systems for each kind of penetration and construction condition From a single source of manufacture and installation responsibility.
  - .2 To the extent possible, firestop and smoke seal products shall be supplied by a single manufacturer and installed by a qualified FCIA installer for entire Contract (the Work).
- .5 The manufacturer's direct technical representative (not distributor or agent) shall be on-site during the initial installation of the firestop systems to provide training to the installer's personnel in the proper product selection and installation procedures.

## **1.8 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.

## **1.9 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 Subject to compliance with requirements specified in this Section and as established by the Standard of Acceptance Materials, 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 Firestop Systems Inc.
  - .4 Hilti Canada Ltd.
  - .5 Nuco Self Seal Firestopping Products.
  - .6 Owens Corning.
  - .7 Specified Technologies Inc.
  - .8 Tremco Ltd.

### **2.2            PERFORMANCE AND DESIGN CRITERIA**

- .1 Delegated Design Requirements: Design firestopping and smoke seals required by the Contract Documents to meet fire ratings indicated, and in accordance with requirements of OBC and amendments.
- .2 Performance Requirements: Manufacturer shall design proprietary assemblies to withstand the listed ratings in accordance with OBC, 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 CAN/ULC S115, 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 CAN/ULC S115, where systems protect penetrating items exposed to potential contact with adjacent materials:
    - .1 Penetrations located outside wall cavities.
    - .2 Penetrations located outside fire resistive shaft enclosures.
    - .3 Penetrations located in construction containing fire protection rated openings.
    - .4 Penetrating items larger than 100 mm diameter nominal pipe or 100 cm<sup>2</sup> 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 SMOKE SEALS: 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 CAN/ULC S115 and listed in ULC Guide No. 40 U19.
  - .2 Service penetration firestopping and smoke seals components: certified by ULC in accordance with CAN/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/m<sup>2</sup>, 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<sub>US</sub> Number
  - .6 Date of installation
  - .7 Name of installing Trade Contractor
  - .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 CAN/ULC S115 and comprised of asbestos-free materials and systems capable of maintaining 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 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
- .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 Silicone Foams: Multi-component, silicone based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.
- .12 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/m<sup>2</sup>, 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 EXAMINATION**

- .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 air vapour barrier.
  - .4 Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.

### **3.2 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's printed installation instructions, technical datasheets, details, and specifications.

### **3.3 PREPARATION**

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

### **3.4 INSTALLATION**

- .1 Apply and install fire stopping materials to correspond with tested assemblies, or calculation procedures acceptable to authorities having jurisdiction to provide following fire resistance ratings:
  - .1 Floor assemblies shall be fire separations with a fire-resistance rating of not less than 2 hours.
  - .2 Mezzanines shall have a fire-resistance rating not less than 1 hour.
  - .3 Loadbearing walls, columns and arches shall have a fire-resistance rating not less than that required for the supported assembly.
  - .4 Other fire ratings as indicated on Drawings and OBC Compliance Report.
- .2 Install fire stopping and smoke seal material and components in accordance with manufacturer's certified tested system listing.
- .3 Provide firestopping assemblies at joints and penetrations of fire resistance rated assemblies as required to achieve and maintain minimum Sound Transmission Class (STC) of 60.
- .4 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.
- .5 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.
- .6 Tool or trowel exposed surfaces to neat finish.
- .7 Remove excess compound promptly as work progresses and upon completion.
- .8 At electrical boxes installed at gypsum board fire separations, Provide firestop back-coating on box.

### **3.5 SPECIAL REQUIREMENTS**

- .1 Location of special requirements for fire stopping and smoke seal materials at openings and penetrations in fire resistant rated assemblies are as follows:
  - .1 Designed for re-entry, removable at: electrical and communications cable penetrations through partitions.
    - .1 Use Prefabricated Firestop Sleeves or prefabricated Cable Pathways.

### **3.6 SEQUENCING**

- .1 Proceed with installation only when submittals have been reviewed by Consultant.
- .2 Install mechanical and electrical services prior to firestopping. Firestopping shall not be installed at these locations until the electrical and mechanical installations have been reviewed and accepted by Consultant.
- .3 Install floor firestopping before interior partition erections.
- .4 Metal deck bonding: firestopping to precede spray applied fireproofing to ensure required bonding.
- .5 Mechanical pipe insulation: certified firestop system component.
  - .1 Ensure pipe insulation installation precedes firestopping.

### **3.7 FIELD QUALITY CONTROL**

- .1 Inspections and reviews: notify Consultant when ready for inspections and reviews and prior to concealing or enclosing fire stopping materials and service penetration assemblies.
- .2 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of fire stop and smoke seal work, in handling, installing, applying, protecting, and cleaning of product, and submit Manufacturer's Field Reports to Consultant.
  - .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 with manufacturer to review work before work is closed in to permit review.

### **3.8 PROJECT RECORD DOCUMENTATION**

- .1 At completion of fire stopping work, update Schedule and Shop Drawings submitted in accordance with the requirements of this specification Section.
- .2 Ensure that each location that fire stopping has been applied is recorded along with all applicable fire stop information.
- .3 Ensure that each application of fire stopping is documented with location and installation details provided.
- .4 At the location of each application of fire stop, secure an identification label at both sides of penetration in a convenient, easy to read location, that documents the product used, manufacturer, installer, date of install, and the ULC assembly number involved.
- .5 Submit updated Schedule and Shop Drawings in accordance with the requirements of Section 01 78 00 - Closeout Submittals, including accurate as-built information.

### **3.9 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning. 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. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3 Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.

**3.10 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**3.11 SCHEDULE**

- .1 Fire stop and smoke seal at the following:
  - .1 Penetrations through fire-resistance rated masonry, concrete, and gypsum board partitions and walls.
  - .2 Edge of floor slabs at exterior walls.
  - .3 Top of fire-resistance rated masonry and gypsum board partitions.
  - .4 Intersection of fire-resistance rated masonry and gypsum board partitions.
  - .5 Control and sway joints in fire-resistance rated masonry and gypsum board partitions and walls.
  - .6 Penetrations through fire-resistance rated floor assemblies, ceilings and roof assemblies.
  - .7 Openings and sleeves installed for future use through fire separations.
  - .8 Around mechanical and electrical assemblies penetrating fire separations.
  - .9 Rigid ducts: greater than 129 cm<sup>2</sup>: fire stopping to consist of bead of fire stopping material between retaining angle and fire separation and between retaining angle and duct, on each side of fire separation.
  - .10 Between floor assemblies and perimeter walls.
  - .11 At gaps between edge of floor assemblies and gypsum board at perimeter walls.
  - .12 Other locations shown on Drawings and as required to achieve and maintain required fire separations.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 ASTM International
  - .1 ASTM C834-17, Standard Specification for Latex Sealants.
  - .2 ASTM C920-18, Standard Specification for Elastomeric Joint Sealants.
  - .3 ASTM C1193-16, Standard Guide for Use of Joint Sealants.
  - .4 ASTM C1330-18, Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants.
  - .5 ASTM C1521-19 (2020), Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Safety Data Sheets (SDS).

**1.2 COORDINATION**

- .1 Coordinate work of this specification section with interfacing and adjoining work for proper sequencing of each sealant installation and to provide moisture and water migration resistance, durability of the work, and protection of materials and finishes.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for joint sealants and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Manufacturer's product technical datasheets and literature to describe:
    - .1 Caulking compound.
    - .2 Primers.
    - .3 Sealing compound, each type, including compatibility when different sealants are in contact with each other.
    - .4 Submit 2 copies of WHMIS SDS.
- .3 Samples:
  - .1 Submit 2 samples of each type of material and colour.
  - .2 Cured samples of exposed sealants for each colour where required to match adjacent material.
- .4 Manufacturer's Instructions:
  - .1 Submit instructions to include installation instructions for each product used.

**1.4 CLOSEOUT SUBMITTALS**

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

## **1.5 QUALITY ASSURANCE**

- .1 Comply with the requirements of Section 01 83 00 - Building Enclosure Performance Requirements.

## **1.6 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground, protected from the elements, in dry location and in accordance with manufacturer's recommendations.
  - .2 Store and protect joint sealants from damage.
  - .3 Replace defective or damaged materials with new.

## **1.7 SITE CONDITIONS**

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

## **1.8 ENVIRONMENTAL REQUIREMENTS**

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

## **1.9 WARRANTY**

- .1 Submit manufacturer's warranty in accordance with the requirements of Section 01 78 00 - Closeout Submittals, made out in Owner's name, for each Product specified.
- .2 Contractor agrees to correct deficiencies of labour or material found in the work performed for 2-years from date of Substantial Performance.

## **Part 2 Products**

### **2.1 MANUFACTURERS**

- .1 Acceptable Materials: Use products meeting the requirements of this Section and suitable to the application to which the sealant is to be applied, selections restricted to the manufacturers listed below:
  - .1 BASF Master Builders
  - .2 Chemtron Manufacturing Ltd.
  - .3 Dow Corning Canada Inc.
  - .4 GE Silicones Limited.
  - .5 LymTal International.
  - .6 Pecora Corporation.
  - .7 PRC-DeSoto.
  - .8 Sika Chemical of Canada Ltd.
  - .9 Tremco Ltd.
- .2 Use materials as received from manufacturer without additives or adulteration. Use one manufacturer's product for each Type specified. Where sealant applications cross or contact each other, ensure compatibility, maintenance of physical properties and performance characteristics, and continuity of seal.

### **2.2 GENERAL**

- .1 Use materials as received from manufacturer without additives or adulteration.
- .2 Use one manufacturer's product for each Type specified.
- .3 Where sealant applications cross or contact each other, ensure compatibility, maintenance of physical properties and performance characteristics, and continuity of seal.
- .4 Joint sealants and caulking shall be commercial grade.

### **2.3 SEALANT MATERIALS**

- .1 Do not use caulking that emits strong odours, contains toxic chemicals or is not certified as mould resistant in air handling units.
- .2 When low toxicity caulks are not possible, confine usage to areas which off gas to exterior, are contained behind air barriers, or are applied several months before occupancy to maximize off gas time.
- .3 Where sealants require primers for suitable adhesion to substrate, use manufacturer's recommended primer.

### **2.4 SEALANT MATERIAL DESIGNATIONS**

- .1 Type S-1: Silicone Sealant; mould and mildew resistant.
  - .1 To ASTM C920; type S; grade NS; class 100/50; use NT, M, G, and A.
  - .2 Acceptable materials:
    - .1 790 Silicone, Dow Corning.
    - .2 Spectrum 1 Silicone, Tremco Inc.
    - .3 890NST, Pecora.
- .2 Type S-2: Silicone Sealant; general construction and air-seal sealant.

- .1 To ASTM C920: type S; grade NS; class 50; use NT, M, G, A, and O.
- .2 Acceptable materials:
  - .1 864NST or 895NST, Pecora Corporation.
  - .2 Dow Corning 795, Dow Corning.
  - .3 Spectrum 2, Tremco Sealant & Waterproofing.
- .3 Type S-3: Silicone Sealant; structural glazing.
  - .1 To ASTM C920: type S; grade NS; class 25; use NT, A, G, and O.
  - .2 Acceptable materials:
    - .1 995 Silicone, Dow Corning.
    - .2 Proglaze SSG, Tremco Inc.
    - .3 SSG4000, General Electric.
    - .4 895NST, Pecora.
- .4 Type S-4: Acoustical Sealant; interior, non-hardening.
  - .1 To ASTM C834 Type P, Grade -18°C.
  - .2 Acceptable materials:
    - .1 Acoustical Sealant, Tremco.
    - .2 Metaseal, Chemtron.
    - .3 QuietZone acoustic sealant, Owens Corning.
    - .4 BA-98, Pecora.
- .5 Type S-5: Multi-component polyurethane sealant; chemical curing, exterior wall sealant.
  - .1 To ASTM C920: type M; grade NS; class 50; use T, NT, M, A, and O.
  - .2 Acceptable materials:
    - .1 Dymeric, Tremco.
    - .2 Sikaflex 2c NS, Sika.
    - .3 Sonolastic NP 2, BASF Sonneborn.
    - .4 DynaTrol II, Pecora.
- .6 Type S-6: One-component polyurethane sealant; non-sag, for general construction.
  - .1 To ASTM C920: type S; grade NS; class 25; use NT, M, A, and O.
  - .2 Acceptable materials:
    - .1 Polyurethane Sealant 540, 3M Company
    - .2 Dymonic or Dymonic FC, Tremco Inc
    - .3 Multiflex, Chemtron.
    - .4 Sonolastic NP 1, BASF Sonneborn.
    - .5 Sikaflex 1a, Sika.
    - .6 DynaTrol I-XL, Pecora.
- .7 Type S-7: self-leveling, 100% solids, flexible, two component, rapid curing polyurea elastomer joint filler. Designed for 10-15% movement of installed joint width. Recommended concrete cure a minimum of 28 days prior to installing joint filler or joint sealant..
  - .1 VersaFlex SL/75, or equivalent.



- .8 Type S-8: 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.
  - .1 Acceptable materials:
    - .1 Sonolastic SL 1, BASF Sonneborn.
    - .2 Vulkem 45 SSL, Tremco Inc.
    - .3 Urexpan NR-201b, Pecora.
- .9 Type S-9: Control joint sealant: two-component, epoxy urethane, self-levelling, load bearing saw cut or preformed control joints.
  - .1 Acceptable materials:
    - .1 Loadflex, Sika.
    - .2 Dynapoxy EP-800, Pecora.
    - .3 MasterSeal CR 190, BASF Building Systems
- .10 Type S-10: Wet area applications, tub/spa rooms, showers, kitchens, exterior door thresholds, etc.: two-component, gun-grade, slump-resistant elastomeric polyurethane sealant, specially formulated for sealing joints in water-immersion conditions, and highly resistant to biodegradation by both aerobic and anaerobic bacteria; to ASTM C920, Type M, Grade NS, Class 25, use T, NT, M, G, A, O; certified to CAN/ULC S115; Canadian Food Inspection Agency acceptance.
  - .1 Acceptable Materials:
    - .1 Sikaflex 2c NS EZ Mix, by Sika Canada.
    - .2 Sikaflex 2c NS EZ Mix TG, by Sika Canada (traffic grade option).
- .11 Type S-11: for exterior wall joints at porous substrates (e.g., masonry or concrete); One-part, silicone, shore A hardness 15 B 25, conforming to CGSB 19 GP 13M, classification C 1 40 B N and C 1 25 B N and ASTM C920 11, Type S, Grade NS, Class 25. Use NT, M, G, A and O: DC 756 by Dow Corning.
- .12 Type S-12 Foam sealant: open cell polyurethane foam impregnated with an acrylic-polymer-modified, water-based asphalt emulsion. Foam to have at least 90% open cell structure. Impregnation agent to have proven non-migratory characteristics. Uncompressed impregnation density shall be at least 9 lb/ft<sup>3</sup> (144 kg/m<sup>3</sup>) but not exceed 10 lb/ft<sup>3</sup> (160 kg/m<sup>3</sup>). Expanding foam laminations to be compressed 4-times to approximately 25% of fully expanded dimension: Emseal Joint Systems, Ltd. '25V'.
- .13 Type S-13 Waterstop Sealant: for concrete penetrations: one component hydrophilic polyurethane-based extrudable swelling profile: Sika 'SikaSwell S'.
- .14 Type S-14 Interior silicone sealant, paintable: Dow Corning 'Trade Mate' Silicone Sealant.

## 2.5 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: 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/m<sup>3</sup> density, or neoprene foam backer, size as recommended by manufacturer.
- .3 Bond Breaker Tape.
  - .1 Polyethylene bond breaker tape which will not bond to sealant.
- .2 Primer: Non-staining type as recommended by sealant manufacturer.
- .3 Joint Cleaner: Non-corrosive solvent type recommended by sealant manufacturer for applicable substrate materials.

## **2.6 COLOURS**

- .1 Sealant colour: confirm sealant selections with Consultant prior to ordering materials. Colours shall be selected by Consultant from manufacture's full range, and as follows:
  - .1 Sealants at masonry control joints to match mortar colour.
  - .2 Sealants at other locations to match colour of adjacent exposed material.
  - .3 Where colour match choice is unclear, Consultant will decide.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions are acceptable for product installation in accordance with manufacturer's written instructions.
  - .1 Check and verify that no irregularities exist that would affect quality of execution of work specified.
  - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

### **3.2 SURFACE PREPARATION**

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

### **3.3 PRIMING**

- .1 Unless explicitly prohibited by manufacturer, prime all joint bonding surfaces.

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

### **3.4 BACKUP MATERIAL**

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

### **3.5 MIXING**

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

### **3.6 APPLICATION**

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

### **3.7 FIELD ADHESION TESTING**

- .1 Field test joint sealant adhesion to substrates in the presence of Consultant as follows:
  - .1 Extent of Testing: test completed and cured sealant joints as follows:
    - .1 Perform 10 tests for the first 300 m of joint length for each kind of sealant and joint substrate.
    - .2 Perform 1 test for each 300 m of joint thereafter or 1 test per each floor per elevation.
  - .2 Test Method: test joint sealants according to method A, Field-Applied Sealant Joint Hand Pull Tab, Appendix X1, ASTM C1193 or Method A, Tail Procedure, ASTM C1521.
    - .1 For joints with dissimilar substrates, verify adhesion to each substrate separately. Extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
  - .3 Inspect tested joints and report on finding for the following requirements:
    - .1 Joint cavities filled and free of voids.
    - .2 Sealant dimensions and configurations comply with sealant manufacturer's data sheet and printed installation requirements.

- .3 No adhesive or cohesive failure noted during pull tests per ASTM criteria. Include data on pull distance used to test each kind of product and joint substrate.
- .4 Record tests results in a field-adhesion test log. Include dates when sealants were installed, name of worker responsible in each instance, test dates, test locations, whether joints were primed or not, adhesion results and percent elongations, sealant fill, sealant configuration and dimensions.
- .5 Repair sealant test locations by applying new sealants following approved preparation and application procedures.
- .2 Evaluation of Field Adhesion Test results:
  - .1 Sealants passing ASTM pull-tests and compliant with specifications will be considered satisfactory.
  - .2 Remove sealants that fail adhesion tests or do not meet specifications, and apply in accordance with approved preparation and application requirements.
  - .3 Retest re-applied sealants until test results are satisfactory and sealant application is compliant.

### **3.8 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning. 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. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3 Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 – Waste Management and Disposal.

### **3.9 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

### **3.10 SCHEDULES**

- .1 General Provisions:
  - .1 Examine the Contract Drawings and determine entire extent of Work of this Section. Seal joints at terminations, perimeters, transitions and penetrations.
  - .2 Where no specified type of sealant is shown or specified, choose one of the sealants specified in this Section appropriate for its location and conditions as recommended by the sealant manufacturer in accordance with its warranty provisions and datasheet.
  - .3 Make sealant selections consistent with manufacturer's recommendations.
- .2 Materials Schedule:
  - .1 Clean and prime bonding surfaces prior to applying sealants, and install sealants in accordance with the following requirements:
    - .1 Use mould & mildew resistant silicone sealant Type S-1 for non-moving joints in washrooms and kitchens. Do not use on floors.
    - .2 Use silicone general construction sealant Type S-2 for metal-to-metal joints where no other specific sealant type specified.

- .3 Use structural glazing silicone Type S-3 for sealing glass, interior and exterior.
  - .4 Use acoustical sealant Type S-4 at acoustic-purposed joints, only where it will be fully concealed, and only where no constant or consistent air pressure difference will exist across the joint.
  - .5 Use multi component sealant type S-5 at masonry and concrete joints.
  - .6 Use one-component polyurethane general construction sealant Type S-6 at joints other than metal-to-metal where no other specific sealant type specified.
  - .7 Use multi component sealant Type S-7 for horizontal joint sealant of plaza, floors and decks, exterior areas only, subject to pedestrian and vehicular traffic.
  - .8 Use one-part sealant Type S-8 for horizontal joint sealant of plaza, floors and decks, exterior areas only, not subject to pedestrian and vehicular traffic.
  - .9 Use control joint sealant S-9 as filler for interior, horizontal saw cut or preformed control joints where joints are subject to load bearing conditions.
  - .10 Use wet area sealant S-10 for horizontal and vertical joints, and perimeter joints, at showers, exterior door threshold plates, and other wet area applications. Use traffic grade (TG) at horizontal floor locations.
  - .11 Use sealant Types S-11, S-12, S-13, and S-14 at locations suitable to substrates, conditions, and purposes to be served as recommended by sealant manufacturer.
  - .12 Use other Types as required to suit conditions and function/use.
- .3 Exterior Sealant Schedule:
- .1 The following list is provided for general guidance and is not intended to exhaust all locations where sealant is required. Refer to General Provisions of this Section.
  - .2 Exterior sealant work is part of the work of this section. Install exterior sealant to:
    - .1 General: seal open joints in surfaces exposed to view and as required to make the building weather-tight and airtight.
    - .2 Exterior joints between dissimilar materials.
    - .3 Perimeters of exterior openings where frames meet exterior façade of building.
    - .4 Movement and control joints in exterior surfaces of in-place concrete and masonry.
    - .5 Exterior joints between masonry and in-place concrete.
    - .6 Exterior joints in horizontal wearing surfaces.
    - .7 Exterior intake and exhaust louvers. Provide space in sealant at bottom for drainage.
    - .8 Below door thresholds (2 beads).
    - .9 Penetrations through exterior building elements.
    - .10 Where indicated on drawings.
  - .3 Foam sealant installation: Compression when expanded in joint, shall be 25% or uncompressed thickness. Depth shall be in accordance with manufacturer's sizing table.

- .4 Interior Sealant Schedule:
  - .1 The following list is provided for general guidance and is not intended to exhaust all locations where sealant is required. Refer to General Provisions of this Section.
  - .2 Install interior sealant to:
    - .1 Movement and control joints on exposed in-place concrete walls.
    - .2 Interior control and expansion joints in floor and wall surfaces.
    - .3 Raked out joints at junctions of masonry with concrete walls and columns, and at intersection of masonry walls and partitions.
    - .4 Perimeters of exterior door, curtain wall and window frames.
    - .5 Joints at tops of non-load bearing masonry walls at the underside of metal deck or in-place concrete, except where fire sealant and smoke sealant required.
    - .6 Perimeter and perimeter joints of plumbing fixtures, with mildew resistant sealant.

**END OF SECTION**

**Part 1 General**

**1.1 SUMMARY**

- .1 This section includes hollow metal products, including doors, panels, frames, sidelight and window assemblies as indicated.

**1.2 RELATED REQUIREMENTS**

- .1 Section 08 14 16 – Flush Wood Doors.
- .2 Section 08 71 00 – Door Hardware.
- .3 Section 08 80 50 – Glazing.
- .4 Division 26: wiring and hookup for electronic hardware.
- .5 Schedule F – Doors.

**1.3 REFERENCES**

- .1 American National Standards Organization (ANSI) / Steel Door Institute (SDI)
  - .1 ANSI/SDI A250.3-2007 (R2011), Test Procedure and Acceptance Criteria for Factory Applied Finish Coatings for Steel Doors and Frames.
  - .2 ANSI/SDI A250.8-2003 (R2008), Recommended Specifications for Standard Steel Doors and Frames.
  - .3 ANSI/SDI A250.10-R2011, Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
- .2 ASTM International (ASTM)
  - .1 ASTM A653/A653M-20, Standard 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-19, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
  - .5 ASTM C553-13(2019), Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
  - .6 ASTM C578-19, Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
  - .7 ASTM C591-20, Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
  - .8 ASTM C592-16, Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type).
  - .9 ASTM C1289-19, Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
  - .10 ASTM D1622-20, Standard Test Method for Apparent Density of Rigid Cellular Plastics.
  - .11 ASTM D4726-18, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Exterior-Profile Extrusions Used for Assembled Windows and Doors.
  - .12 ASTM D6386-16a, Standard Practice for Preparation of Zinc (Hot Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting.

- .13 ASTM D7396-14(2020), Standard Guide for Preparation of New, Continuous Zinc-Coated (Galvanized) Steel Surfaces for Painting.
- .3 Builders Hardware Manufacturers Association (BHMA)
  - .1 BHMA A156.16-2018, Auxiliary Hardware.
- .4 CSA Group (CSA)
  - .1 CSA G40.20-13/G40.21-13 (R2018), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel, Includes Update No. 1 (2014).
  - .2 CSA W47.1:19, Certification of companies for fusion welding of steel.
  - .3 CSA W59-18, Welded Steel Construction.
- .5 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, 2009.
  - .3 CSDMA, Selection and Usage Guide for Commercial Steel Doors, 2009.
- .6 National Fire Protection Association (NFPA)
  - .1 NFPA (Fire) 80, Standard for Fire Doors and Other Opening Protectives, 2019 Edition.
  - .2 NFPA (Fire) 252, Fire Tests of Door Assemblies, 2017 Edition.
- .7 The Society for Protective Coatings (SSPC)
  - .1 SSPC-PS 12.01, One Coat Zinc-Rich Painting System.
  - .2 SSPC-PS Guide 12.00, Guide to Zinc-Rich Coating Systems.
- .8 ULC Standards
  - .1 CAN/ULC S104-15, Standard Method for Fire Tests of Door Assemblies.
  - .2 CAN/ULC S105:2016, Standard Specification for Fire Door Frames Meeting the Performance Required by CAN/ULC S104.
  - .3 CAN/ULC-S106-15, Standard Method for Fire Tests of Window and Glass Block Assemblies.
  - .4 CAN/ULC S701.1-17, Standard for Thermal Insulation, Polystyrene, Boards.
  - .5 CAN/ULC S702.1-14 (R2019), Standard for Mineral Fibre Thermal Insulation for Buildings, Part 1: Material Specification.
  - .6 CAN/ULC S702.2, Mineral Fibre Thermal Insulation for Buildings, Part 2: Application Guidelines.
  - .7 CAN/ULC S704.1:2017, Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.

#### **1.4 ACTION AND INFORMATIONAL 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 for each type of door and frame specified.
- .2 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures:
  - .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, finishes, and special features.



- .2 Reference door and frame types to Door Schedules found on Drawings. Indicate door numbers where applicable.
- .3 Manufacturer/Fabricator: member in good standing of the Canadian Steel Door and Frame Manufacturer's Association.
- .4 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.
- .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 Fabricate all rated doors and frames to labelling authority standard.
- .6 Manufacture door and frame assemblies to ANSI/SDI A250.8.

## **1.5 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.

## **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°C to 35°C.
- .3 Maximum deflection for exterior steel entrance doors 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 CAN/ULC S104 and CAN/ULC 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 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:

	<b>Hardware Reinforcement</b>	<b>Door (mm)</b>	<b>Frame (mm)</b>
	Pivot Hinge:	4.20 (0.16")	4.20 (0.16")
	Mortise Hinge:	3.51 (0.14")	3.51 (0.14")
	Mortise or Bored Lock or Deadbolt:	1.98 (0.08")	1.98 (0.08")
	Flush or Surface Bolt Front:	1.98 (0.08")	1.98 (0.08")
	Surface or Concealed Closer:	2.74 (0.11")	2.74 (0.11")
	Strike Reinforcements:	1.98 (0.08")	1.98 (0.08")
	Hold Open Arm:	1.98 (0.08")	1.98 (0.08")
	Electronic Hardware Reinforcements:	1.98 (0.08")	1.98 (0.08")
	Pull Plates and Bars:	1.30 (0.05")	1.30 (0.05")
	Mortar Box:	--	0.84 (0.03")
	Surface Exit Devices:	1.98 (0.08")	1.98 (0.08")
	Door Surface Hardware Reinforcements:	1.30 (0.05")	1.30 (0.05")
	Frame surface hardware reinforcements:	2.74 (0.11")	2.74 (0.11")
.3	Door Core Materials:		
.1	Honeycomb: Structural small cell 25 mm (1 inch) maximum. kraft paper:		
.1	Weight: 36.3 kg/ream minimum.		
.2	Density: 16.5 kg/m <sup>3</sup> minimum.		
.3	Sanded to required thickness.		
.2	Polystyrene: Rigid extruded, closed cell insulation, fire retardant treated, to ULC S701.1, Type 4, minimum thermal resistance RSI 0.8/25 mm thickness.		
.3	Temperature Rise Rated (TRR): core composition shall provide fire-protection rating and limit temperature rise on unexposed side of door at 250°C for 30 or 60 minutes as determined by Ontario Building Code. Core shall be tested as part of complete door assembly in accordance with CAN/ULC S104 and listed by a nationally recognized testing agency with factory inspection service.		

## 2.3 ADHESIVES

- .1 Honeycomb cores and steel components: heat resistant, spray grade, resin reinforced neoprene/rubber (polychloroprene) based, low viscosity, contact cement.
- .2 Polystyrene 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 ACCESSORIES

- .1 Door silencers (bumpers): Black neoprene, 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 Exterior top and bottom caps: steel.
- .3 Interior top caps: rigid polyvinylchloride extrusion, to ASTM D4726.
- .4 Fabricate glazing stops as formed channel, minimum 16 mm (0.63") 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.
  - .2 Design exterior glazing stops to be tamperproof.
- .6 Metallic paste filler: to manufacturer's standard.

- .7 Fasteners: 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.
- .10 Glazing: Section 08 80 50 – Glazing.

## **2.5 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 continuous unless specified otherwise. Welding shall be undertaken only by fabricator fully approved by Canadian Welding Bureau to requirements of CSA W47.1.
- .2 Permit access by approved inspection and testing company for 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 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.

## **2.6 FABRICATION - FRAMES (PRESSED STEEL DOOR AND SCREEN FRAMES)**

- .1 Supply frames to suit construction conditions and indicated dimensions.
- .2 Fabricate frames of ZF120 wipe zinc coat steel unless otherwise indicated.
- .3 Provide welded type pressed steel door frame and screen components in minimum thickness 1.5 mm (16 gauge).
- .4 Assemble components with accurately cut joints. Mitre outside corner joints of frames. Continuously weld joints on inside of profile and grind welds, flush and sand to smooth uniform surface; tabbed and spot-welded connections are not acceptable.
- .5 Provide recessed sheet steel panels, bases, and covers, where indicated, minimum 2 mm thick. At fire rated screens, construct panels, bases, and covers in accordance with fire test requirements. Weld panels, bases, and covers to perimeter framing in concealed manner where possible; where welds are exposed, provide continuous welds. Reinforce or laminate panels, bases, and covers as required to provide a flat uniform surface.
- .6 Fill concealed void at exterior frames, between frame and rough opening, with mineral fibre insulation.
- .7 On factory-assembles frame product, provide two removable steel jamb spreaders welded to base of jambs or mullions to maintain alignment during shipping and handling. Remove spreaders prior to anchoring frames to floor.
- .8 Brace frame units to prevent distortion and protect finish during shipment.
- .9 Install three bumpers in interior frames at single opening latch jambs, and two at double door frame heads.
- .10 Provide mullions and rails of closed construction type. For fixed condition, attach members to frame with butt-welded joints. For removable condition, attach members with removable mullion anchors.
- .11 Conceal fastenings unless otherwise indicated.

- .12 Fasten removable stops by counter-sunk Philips head screws at approximately 225 mm (9 inches) on centre symmetrically space on stop length.
- .13 Form door stops and glass stops integrally with frame and not added as a separate profile.
- .14 Anchor frames to floor by 1.6 mm (0.063") thick adjustable base clips, welded to frame and Provide with 2 holes for floor anchorage.
- .15 Provide minimum 3 mm (1/8") anchors for connection to adjacent floor and wall construction. Each wall anchor shall be located immediately above or below each hinge reinforcement on the hinge jamb and directly opposite the strike jamb. On each jamb, install 2 anchors for openings up to and including 1525 mm (60") high and install 1 anchor for each additional height of 610 mm (24") of height or fraction thereof, except as indicated below. Frames placed in previously placed concrete, masonry or structural steel shall be Provided with anchors located not more than 150 mm (6") from top and bottom of each jamb, and intermediate anchors at 660 mm (26") on centre maximum. Fasteners for such anchors shall be provided by Section 06 20 00. Anchors for stainless steel frames shall be Type 316L stainless steel.
- .16 Secure frames set in previously constructed concrete or masonry openings by countersunk expansion bolts at same centres as for adjustable Tee wall anchors. Reinforce frame at fastening location to prevent indentation of frame by fastening device. Provide steel sleeves between frame and wall.
- .17 Protect strike and hinge reinforcements using guard boxes welded to frames at masonry construction. Provide guard boxes welded to frame at hinges, strikes, door alarm contacts, switches, and other hardware items recessed into frames.
- .18 Reinforce head of frames wider than 1220 mm (48") with steel angles or channels.
- .19 Prepare door frames for security system contacts. Coordinate with Division 16.
- .20 Provide welded-on drip at head of exterior door frames.
- .21 Hardware reinforcements shall be minimum thicknesses as specified herein, not including frame thickness. Provide reinforcement at hardware fastening points. Provide high frequency (angle type) reinforcement at hinges. Provide full height reinforcement of thicknesses at hinge side of frames with continuous hinges.
- .22 Where indicated at interior screen frames, provide 38 mm (1-1/2") square hollow steel railings between mullions, with concealed fastening to mullions. Design railings to comply with OBC load requirements for handrails. Provide hollow steel railings in accordance with Section 05 50 00.

## **2.7 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 (2") 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 (7'-6"). Add one anchor per jamb for each additional 760 mm (30") or fraction thereof in frame height.
- .4 Locate anchors for frames in existing openings not more than 150 mm (6") from top and bottom of each jambs and intermediate at 660 mm (26") on centre maximum.

## **2.8 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 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 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.
- .7 Insulate exterior frame components with polyurethane insulation.

## **2.9 DOOR FABRICATION: GENERAL**

- .1 Doors: swing type, flush, with provision for openings as indicated.
- .2 Fabricate doors with longitudinal edges locked seamed with adhesive and spot-welded for larger doors. Seams: not visible, grind welded joints to flat plane, fill with metallic paste filler and sand to uniform smooth finish. Bevel both stiles of single doors 1 in 16.
- .3 Top and bottom of doors shall be provided with inverted, recessed, nominal 1.60 mm (0.063") steel end channels; nominal 2.74 mm (0.1") steel end channels for acoustic doors, welded to each face sheet at 150 mm (6") O/C.
- .4 Equip top and bottom of acoustic doors with nominal 1.60 mm (0.063") continuous flush steel non-removable end caps welded securely in place.
- .5 Provide fixed transoms, side panels and base panels where indicated or scheduled, of same materials, gauge, thickness, construction and finish as door. Reinforce transoms and panels to prevent oil canning. Install transoms and panels with concealed fastenings, and reinforce to accommodate hardware as required. Seal joint between transom or panel airtight. Provide accurately formed ship lap joint between door and transom panel where no transom rail occurs.
- .6 Mortise, reinforce, drill, and tap doors to receive templated hardware, security, and electrical devices.
- .7 Reinforce doors where required, for surface mounted hardware. Provide flush steel top and bottom caps to exterior doors. Provide inverted, recessed, spot welded channels to top and bottom of interior doors.
- .8 Factory prepare holes 12.7 mm (1/2") diameter and larger except mounting and through-bolt holes, on site, at time of hardware installation.
- .9 Cut-outs: Where openings are required, provide integrally formed cut-outs with steel framing, and closely fitted steel glass and grille stops, as required. Mitre corners of stops. Drill and countersink fasteners symmetrically at 150 mm (6") o.c. Supply and install coated steel stops, with same coating type and thickness as doors. Screw stops in place.
- .10 Supply and install steel vent grilles in doors where indicated.
- .11 Fabricate doors with clearance of 3 mm (1/8") to frame and 6 mm (1/4") to completed floor finish or threshold, except at openings in non-fire rated separations where undercuts are indicated.
- .12 Provide flush top and bottom steel edge on exterior doors and doors to stair shafts. Equip exterior doors with factory installed flush PVC top caps. Equip fire labelled exterior doors with factory installed flush steel top caps.
- .13 Provide touch-up primer at areas where zinc coating has been removed or damaged during fabrication.

- .14 Provide fire labelled doors for openings requiring fire protection ratings, as scheduled. Test such products in conformance with CAN/ULC S104 and list by nationally recognized agency having factory inspection service and construct as detailed in Follow-Up Service Procedures/Factory Inspection Manuals issued by listing agency to individual manufacturers.

- .15 Manufacturer's nameplates on doors are not permitted.

## **2.10 FABRICATION: EXTERIOR DOORS**

- .1 Face sheets: Minimum 1.6 mm (0.063") base steel sheet thickness.
- .2 Stiffened, insulated and sound deadened with polystyrene core laminated under pressure to each face sheet.
- .3 Longitudinal edges mechanically interlocked, adhesive assisted with edge seams continuous welded, filled, and sanded flush with no visible seam.

## **2.11 FABRICATION: INTERIOR DOORS**

- .1 Face sheets: Minimum 1.2 mm (0.05") base steel sheet thickness.
- .2 Stiffened and sound deadened with honeycomb core laminated under pressure to each face sheet.
- .3 Longitudinal edges mechanically interlocked, adhesive assisted with edge seams continuous welded, sanded flush with no visible seam.

## **2.12 FABRICATION: ACOUSTIC DOORS**

- .1 Face sheets: Minimum nominal 1.60 mm (0.063") base steel sheet thickness.
- .2 Internally steel stiffened having voids filled with manufacturer's proprietary sound attenuating core tested as part of a fully operable assembly in accordance with ASTM E90 and ASTM E413 to provide STC 51; equipped with perimeter sound seals, drop door bottom, secondary acoustic jamb seals, and acoustic threshold and frames.

## **2.13 FABRICATION: FIRE RATED DOORS**

- .1 Face sheets: Minimum 1.6 mm (0.063") base steel sheet thickness.
- .2 Stiffened and sound deadened with honeycomb core laminated under pressure to each face sheet.
- .3 Longitudinal edges mechanically interlocked, adhesive assisted with edge seams continuous welded, sanded flush with no visible seam.
- .4 Equip pairs of fire labelled doors with minimum 2.7 mm (0.105") steel surface mounted flat bar astragal, shipped loose for application on site.

## **2.14 LAMINATED CORE CONSTRUCTION**

- .1 Form face sheets for exterior doors from 1.6 mm (0.063") sheet steel with polystyrene core laminated under pressure to face sheets.
- .2 Form face sheets for interior doors from 1.6 mm (0.063") sheet steel with honeycomb core, or fire-resistance rated or temperature rise core as required by OBC, laminated under pressure to face sheets.

## **2.15 EXTERIOR FRAMES**

- .1 Insulate exterior frame components with polyurethane foamed-in-place insulation.
- .2 Insulate fire rated exterior frame components with fire stop fill material in accordance with requirements of authority having jurisdiction.

**2.16 PRIMER**

- .1 Touch-up primer: Commercial rust inhibitive primer, shop prime coat doors and frames before delivery; grey or red coloured primer. Clear primer not acceptable; provide primer for field touch-up.

**2.17 PAINT**

- .1 Field paint steel doors and frames. Protect weatherstrips from paint. Provide final finish free of scratches or other blemishes.

**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 Consultant. 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 and frames to, CSDMA Guide Specification for Installation and Storage of Hollow Metal Doors and Frames.

**3.4 FRAME INSTALLATION**

- .1 Set frames plumb, square, level and at correct elevation.
- .2 Secure anchorages and connections to adjacent construction.
- .3 Brace frames rigidly in position while building-in. Install temporary horizontal wood spreader at third points of door opening to maintain frame width. Provide vertical support at centre of heads for openings over 1200 mm (4') wide. Remove temporary spreaders after frames are built-in.
- .4 Make allowances for deflection of structure to ensure structural loads are not transmitted to frames.
- .5 Install hollow metal window frames at interior locations as indicated.
- .6 Install door silencers.
- .7 Caulk perimeter of frames between frame and adjacent material.
- .8 Maintain continuity of air barrier and vapour retarder.

**3.5 DOOR INSTALLATION**

- .1 Install doors and hardware in accordance with hardware templates and manufacturer's instructions and Section 08 71 00 - Door Hardware.
- .2 Provide even margins between doors and jambs and doors and finished floor and thresholds as follows.
  - .1 Hinge side: 1.0 mm (0.04").

- .2 Latchside and head: 1.5 mm (0.06").
- .3 Finished floor, top of carpet, non-combustible sill, or thresholds: 6 mm.
- .3 Adjust operable parts for correct function.

### **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**

- .1 Adjust doors for smooth and balanced door movement.

### **3.9 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning. 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. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3 Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.

### **3.10 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 06 20 00 – Finish Carpentry.
- .2 Section 06 40 00 – Architectural Woodwork.
- .3 Section 08 11 14 – Metal Doors and Frames.
- .4 Section 08 71 00 – Door Hardware.
- .5 Section 09 91 00 – Painting.
- .6 Door Schedule and Finish Schedule.

**1.2 REFERENCES**

- .1 American National Standards Institute (ANSI)
  - .1 ANSI A208.1-2016, Particleboard.
- .2 Architectural Woodwork Manufacturers Association of Canada and Woodwork Institute
  - .1 North American Architectural Woodwork Standards, v 4.0, 2021, including Errata.
- .3 CSA Group
  - .1 CSA B651-18, Accessible Design for the Built Environment.
  - .2 CAN/CSA O132.2 Series-90 (R1998), Wood Flush Doors.
- .4 National Fire Protection Association (NFPA)
  - .1 NFPA (FIRE) 80, Standard for Fire Doors and Other Opening Protectives, 2019 Edition.
- .5 National Lumber Grades Authority (NLGA)
  - .1 Standard Grading Rules for Canadian Lumber 2019.
- .6 ULC Standards
  - .1 CAN/ULC S104-15, Standard Method for Fire Tests of Door Assemblies.
- .7 Window and Door Manufacturers Association (WDMA)
  - .1 ANSI/WDMA I.S. 1A-13 Interior Architectural Wood Flush Doors.

**1.3 ADMINISTRATIVE REQUIREMENTS**

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

**1.4 ACTION AND INFORMATIONAL SUBMITTALS**

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

- .2 Product Data: Submit sufficient manufacturer's data to indicate compliance with these specifications, including:
  - .1 Preparation instructions and recommendations.
  - .2 Storage and handling requirements and recommendations.
  - .3 Installation methods.
- .3 Shop Drawings: Submit shop drawings coordinated with door frame and hardware requirements.
  - .1 Indicate door core materials and NAAWS construction type and high pressure decorative laminate selection.
  - .2 Indicate door opening elevations, sizes, types, swings, undercuts required, special bevels, special blocking for hardware, and cut outs for glazing.
  - .3 Indicate plans and elevations, materials, profiles, assembly methods, accessories, hardware, and schedule of finishes.
- .4 Samples:
  - .1 Submit three 300 x 300 mm samples of each type of wood door finish for verification.

## **1.5 QUALITY ASSURANCE**

- .1 Fabricate doors in accordance with NAAWS Premium grade.
- .2 Manufacturer Qualification: Manufacturer specializing in products in this section with minimum five years of documented experience and member in good standing of the Architectural Woodwork Manufacturers Association of Canada.
- .3 Regulatory Requirements:
  - .1 Wood fire rated doors: labelled and listed by an organization accredited by Standards Council of Canada.
  - .2 Installed Fire-rated Door Assemblies to conform to NFPA 80 for fire-rated class as indicated.
- .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.

## **1.6 DELIVERY, STORAGE, AND HANDLING**

- .1 Doors: Deliver packaged individually in plastic bags and/or cardboard cartons.
  - .1 Mark each door on top and bottom rail with opening number used on Shop Drawings.
  - .2 Mark packages with size, swing, and door tag or opening number.
- .2 Frames: Deliver in individual cartons of heavy corrugated packaging material.
  - .1 Mark cartons with size, swing, and opening number.
- .3 Store products in manufacturer's unopened packaging until ready for installation.
  - .1 Maintain plastic bags in place during on site handling and erection.
  - .2 Upon delivery open cartons and carefully inspect doors for humidity damage.
  - .3 Contact manufacturer if there are questions or problems.

## **1.7 PROJECT CONDITIONS**

- .1 Do not use products in high-humidity areas.
- .2 Environmental Limitations:
  - .1 Do not deliver or install doors until building is enclosed, wet work is complete, and HVAC system is operating.
  - .2 To ensure product performance, maintain temperature range of 60°-80°F and humidity range of 35-55% during storage, and installation.

## **1.8 COORDINATION**

- .1 Coordinate Work with door frame and door submittals, hardware fabrication and installation.

## **1.9 WARRANTY**

- .1 Standard Warranty: products shall be warranted to be free from defects for life of installation under normal use. Adhere to manufacturer's requirements to avoid voiding warranty.

## **Part 2 Products**

### **2.1 ACCEPTABLE MANUFACTURERS**

- .1 Baillargeon Doors.
- .2 Lambton Doors.
- .3 Masonite Architectural.
- .4 RK Doors Inc.

### **2.2 FIRE RATED WOOD DOORS**

- .1 Wood doors: tested in accordance with CAN/ULC S104 to achieve ratings as scheduled.
  - .1 Face panels: match non-rated doors.

### **2.3 FLUSH WOOD DOORS**

- .1 Flush wood doors: to NAAWS Premium grade.
- .2 Solid Core Wood Doors: to CAN/CSA O132.2.1 and ANSI/WDMA I.S. 1A-13.
  - .1 Particleboard Core: Average 30 pcf (480 kg/m<sup>3</sup>) density core complying with ANSI A208.1 Grade LD-1.
  - .2 Stiles and Rails: structural composite lumber or solid hardwood:
    - .1 Stile and Top and Bottom Rail Widths: 1-3/8 inches (35 mm) before trimming.
  - .3 Adhesives: Type I waterproof.
  - .4 Provide factory cut-outs for lights where required and wood stops.
    - .1 Edge Banding: matching facing laminate.
  - .5 Faces for opaque paint finish: hardboard panel.
- .3 Frames: as noted on Drawings.

## **2.4            **HARDWARE - GENERAL****

- .1       Hardware: to Section 08 71 00 – Door Hardware, and as recommended by manufacturer, and required for a complete installation. Provide barn door and swing door hardware as required.
  - .1           Pull and lever handle hardware mounting heights: to CSA B651.

## **2.5            **FINISHING****

- .1       Painted Doors: factory-prime and field finish paint doors for those doors scheduled for paint finish: paint to the requirements of Section 09 91 00 – Painting.
  - .1           Factory-seal top and bottom of door edges and finish paint to match face panels. Field-seal all cut-outs and cut ends.
- .2       Provide materials for touch-up of finishes.

## **2.6            **FABRICATION****

- .1       Fabricate doors in accordance with NAAWS Premium grade.
- .2       Vertical edge strips to match face.
- .3       Prepare doors for glazing where indicated. Provide species to match face veneer; hardwood glazing stops with mitred corners.
- .4       Doors shall be pre-fitted, bevelled and machined at the factory for all mortise hardware items as per templates and approved hardware schedules provided.
- .5       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.
- .6       Radius vertical edges of double acting doors to 60 mm radius.

## **2.7            **SOURCE QUALITY CONTROL****

- .1       Allowable Face Plane Tolerance (Telegraphing): Variation in surface of face not more than 1/100 inch (0.25mm) from true plane in any 3 inch (75mm) span.
- .2       Allowable Warp Tolerance: Bow, cup, and twist not more than 1/4 inch (6 mm) in any 42 inches (1067 mm) wide by 84 inches (2133 mm) high area, or less, if door dimensions are smaller; excluding doors less than 1-3/4 inch (44 mm) thick that are over 36 inches (914 mm) wide or 84 inches (2133 mm) high and doors with cut-outs exceeding manufacturer's specified limits.

## **Part 3           **Execution****

### **3.1            **EXAMINATION****

- .1       Verification of Conditions: verify that conditions are acceptable for product installation in accordance with manufacturer's written instructions.
  - .1           Check and verify that no irregularities exist that would affect quality of execution of work specified.
  - .2           Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
  - .3           Verify wall thickness does not exceed manufacturer's recommended tolerances of specified throat size.
  - .4           Inform Consultant of unacceptable conditions immediately upon discovery.

- .5 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

### **3.2 INSTALLATION**

- .1 Unwrap and protect doors in accordance with CAN/CSA O132.2 Series, Appendix A.
- .2 Install labelled fire rated doors to NFPA 80.
- .3 Install doors and hardware in accordance with manufacturer's published instructions and CAN/CSA O132.2 Series, Appendix A.
- .4 Install all materials in accordance with the manufacturer's installation instructions with doors in frames plumb and true, without rack, and so doors do not fall open or closed due to gravity.
  - .1 Securely anchor door frames in straight, plumb, and level condition without distortion of frames in accordance with final shop drawings. Final adjustments shall be made for proper door operation. Brace frames in position securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders leaving surfaces smooth and undamaged.
  - .2 Install doors with all hardware specified.
  - .3 Adjust hardware for correct function.
- .5 Installation Tolerances: Install non-fire-rated doors with not more than 1/8" clearance at top and sides, 1/4" at bottom.

### **3.3 COMMISSIONING**

- .1 Test door assemblies specified in this Section to verify proper operation; make necessary adjustments.
- .2 Verify that hardware required has been furnished and installed.
- .3 Adjust door and frame for free operation without binding, rack, or warp. Re-hang or replace doors that do not swing or operate freely.
- .4 Remove packing material from assemblies and leave in clean condition ready for operation.

### **3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning. 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. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3 Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.

### **3.5 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**END OF SECTION**

**Part 1 General**

**1.1 SUMMARY**

- .1 This Section includes requirements for supply and installation of the following:
  - .1 Non-rated wall access doors and frames.
  - .2 Fire rated wall access doors and frames.
  - .3 Non-rated ceiling access doors and frames.
  - .4 Fire rated ceiling access doors and frames.

**1.2 RELATED REQUIREMENTS**

- .1 Section 05 50 00 – Metal Fabrications
- .2 Section 07 92 00 – Sealants
- .3 Section 09 21 16 – Gypsum Board Assemblies
- .4 Section 09 91 00 – Painting
- .5 Division 22 – Plumbing: Shut-off and control valves for heating and plumbing systems; clean-outs for drainage systems.
- .6 Division 23 – Heating, Ventilating and Air Conditioning: Duct accessories for heating and air-conditioning duct access doors.
- .7 Division 26 – Electrical: Transformers and access doors for points and other electrical accessories.

**1.3 REFERENCES**

- .1 ASTM International (ASTM)
  - .1 ASTM A568/A568M-19a, Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for.
  - .2 ASTM A780/A780M-20, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
  - .3 ASTM A653/653M-19a, Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process, General Requirements.
  - .4 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 Hardenable.
  - .5 ASTM B221-20, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
  - .6 ASTM B633-19, Standard Specification for Electrodeposited Coatings of Zinc or Iron and Steel.
  - .7 ASTM C1396/C1396M-17, Standard Specification for Gypsum Board.
- .2 National Fire Protection Agency (NFPA)
  - .1 NFPA (Fire) 80, Standard for Fire Doors and Other Opening Protectives, 2019 Edition.
- .3 ULC Standards
  - .1 CAN/ULC S104-15, Standard Method for Fire Tests of Door Assemblies.

- .4 Underwriters' Laboratories (UL), Standards for Safety acceptable to the Standards Council of Canada (SCC).

#### **1.4 ADMINISTRATIVE REQUIREMENTS**

- .1 Coordination: Determine specific locations and sizes for access doors needed to gain access to concealed equipment, and indicate on schedule specified and as follows:
  - .1 Coordinate locations of all access panels in gypsum board ceilings with Consultant for size and location prior to installation, making every effort to locate outside of gypsum board ceilings.
  - .2 Coordinate acceptable locations and sizes with Architectural Reflected Ceiling Plans; no access panels are allowed in public corridors or feature ceilings.
  - .3 Coordinate closely with mechanical and electrical sections for size and locations of access panels in walls and ceilings; provide access doors and panels required for project.
- .2 Pre-installation meeting: one week prior to beginning work of this Section, with Contractor, Consultant, 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.

#### **1.5 ACTION SUBMITTALS / INFORMATIONAL SUBMITTALS**

- .1 Submit product data in accordance with Section 01 33 00 – Submittal Procedures.
  - .1 Provide product data for each type of door and frame indicated, including construction details relative to materials, individual components and profiles, finishes, and fire ratings (if required) for access doors and frames.
- .2 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.
  - .1 Provide coordination drawings and reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items with concealed framing, suspension systems, piping, ductwork, and other construction. Show the following:
    - .1 Method of attaching door frames to surrounding construction.
    - .2 Ceiling mounted items including access doors and frames, lighting fixtures, diffusers, grilles, speakers, sprinklers, and special trim.
- .3 Manufacturer's Instructions:
  - .1 Submit manufacturer's installation instructions.

#### **1.6 QUALITY ASSURANCE**

- .1 Regulatory Requirements: Provide fire rated access doors and frames in accordance with NFPA 80 or CAN/ULC S104, and labelled and listed by UL, ULC or ITS/Warnock Hersey, or another testing and inspecting agency acceptable to Authority Having Jurisdiction.

#### **1.7 DELIVERY, STORAGE, AND HANDLING**

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

## **Part 2            Products**

### **2.1            NON-RATED ARCHITECTURAL ACCESS PANELS**

- .1 Flush doors and trimless frames, fabricated as follows:
  - .1 Aluminum Extrusions: ASTM B221/B221M, alloy 6063-T6.
  - .2 Door: Extruded aluminum frame with concealed hardware; gypsum board inlay for flush installation.
    - .1 Size: Square sized to suit access requirements if not indicated on Drawings.
  - .3 Latch: Flush cam latch operated by tamper-resistant torx drive.
  - .4 Hinge: Concealed, two point pin hinge, non corroding, allowing door to open 120° and allowing door to be removed.
  - .5 Safety cable: rated to 61 kg (135 lb), nylon coated, with crimp connections and spring snap aluminum carabiner.
  - .6 Edge Bead: Recessed extruded aluminum frame edge bead providing surface that can be finished to adjacent gypsum board.
  - .7 Accessories: Fibreglass reinforced nylon, zinc plated screws, stainless steel springs and retaining wire to manufacturer's standard.
  - .8 Finish: Aluminum frames, gypsum board, nylon and aluminum cam latch to receive the same finish and paint as the surrounding surface.
  - .9 Basis of Design Materials:
    - .1 Access Panel Solutions, BaucoPlus II Architectural Access Panel.

### **2.2            FIRE RATED ACCESS PANELS**

- .1 Flush, fire rated access doors and trimless frames, fabricated from zinc coated steel sheet, and as follows:
  - .1 Cold-Rolled Steel Sheets: ASTM A1008/A1008M, Commercial Steel (CS), or ASTM A1008/A1008M, Drawing Steel (DS), Type B; stretcher-levelled standard of flatness; with minimum thickness indicated representing specified nominal thickness according to ASTM A568/A568M.
  - .2 Galvanizing: Electrolytic zinc-coated steel sheet, complying with ASTM B633, Class C coating or ASTM A653/A653M Z180 (G60) mill phosphatized zinc coating, at fabricator's option.
  - .3 Door: Flush panel, minimum thickness of 0.95 mm.
  - .4 Latch: Self-latching bolt operated by tamper-resistant torx drive with interior release.
  - .5 Hinge: Concealed, two point pin hinge, non-corroding, allowing door to open 120° and allowing door to be removed.
  - .6 Automatic Closer: Spring type.
- .2 Edge Beads: Edge trim formed from 0.80 mm nominal thickness zinc coated steel sheet formed to receive joint compound and in size to suit thickness of gypsum board.
- .3 Door Frame: Minimum 1.6 mm thick sheet metal with gypsum board bead.
  - .1 Acceptable Materials: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - .1 Acudor Products, Inc.
    - .2 Cendrex.
    - .3 Nystrom.



## **2.3 FIRE RATED ACCESS PANELS IN MASONRY OR CONCRETE**

- .1 Flush, fire rated access doors and trimless frames, fabricated from zinc coated steel sheet, and as follows:
  - .1 Cold-Rolled Steel Sheets: ASTM A1008/A1008M, Commercial Steel (CS), or ASTM A1008/A1008M, Drawing Steel (DS), Type B; stretcher-levelled standard of flatness; with minimum thickness indicated representing specified nominal thickness according to ASTM A568/A568M.
  - .2 Galvanizing: Electrolytic zinc-coated steel sheet, complying with ASTM B633, Class C coating or ASTM A653/A653M Z180 (G60) mill phosphatized zinc coating, at fabricator's option.
  - .3 Door: Flush panel, minimum thickness of 0.95 mm.
  - .4 Latch: Self-latching bolt operated by tamper-resistant torx drive with interior release.
  - .5 Hinge: Concealed, two point pin hinge, non-corroding, allowing door to open 120° and allowing door to be removed.
  - .6 Automatic Closer: Spring type.
  - .7 Edge Trim: All purpose exposed flange formed from 1.98 mm nominal thickness zinc coated steel sheet.
  - .8 Door Frame: Minimum 1.6 mm thick sheet metal with gypsum board bead.
  - .9 Acceptable Materials: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - .1 Acudor Products, Inc.
    - .2 Cendrex.
    - .3 Nystrom.

## **2.4 FABRICATION**

- .1 Provide access door assemblies manufactured as integral units ready for installation.
- .2 Provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness for metal surfaces exposed to view in the completed Work.
- .3 Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.
- .4 Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed based on size of door or panel opening.
- .5 Apply manufacturer's standard protective coating on aluminum that will come in contact with concrete after fabrication.

## **2.5 FINISHES**

- .1 Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- .2 Finish metal fabrications after assembly.
- .3 Aluminum Finishes:
  - .1 Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
  - .2 As-Fabricated Finish: AA-M10 Mechanical Finish: as fabricated, unspecified (mill finish).

- .4 Steel Finishes:
  - .1 Surface Preparation: Clean surfaces with non-petroleum solvent so surfaces are free of oil and other contaminants. For galvanized surfaces, apply, after cleaning, a conversion coating suited to the organic coating to be applied over it. For zinc coated surfaces, clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A780.
  - .2 Factory Priming for Field-Painted Finish: Apply shop primer immediately after cleaning and pre-treating, as follows:
    - .1 Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate free, universal modified alkyd primer selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.
    - .2 Shop Primer for Zinc Coated Steel: Organic zinc-rich primer complying with SSPC-Paint 20 and compatible with topcoat.
    - .3 Galvanizing Repair Paint: High zinc dust content paint for reglazing welds in steel, complying with SSPC-Paint 20.

### **Part 3 Execution**

#### **3.1 PREPARATION**

- .1 Advise installers of other work about specific requirements relating to access door installation, including sizes of openings to receive access door and frame, as well as locations of supports, inserts, and anchoring devices.

#### **3.2 INSTALLATION**

- .1 Installation shall be completed by Section 09 21 16 - Gypsum Board Assemblies.
- .2 Comply with manufacturer's written instructions for installing access doors and frames.
- .3 Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.
- .4 Install access doors with trimless frames flush with adjacent finish surfaces or recessed to receive finish material.

#### **3.3 ADJUSTING**

- .1 Adjust doors and hardware after installation for proper operation.

#### **3.4 CLEANING**

- .1 Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 08 80 50 – Glazing.
- .2 Door hardware schedule and group S.

**1.2 REFERENCES**

- .1 Aluminum Association (AA)
  - .1 AA DAF 45-03(R2009), Designation System for Aluminum Finishes.
- .2 ASTM International (ASTM)
  - .1 ASTM B209-10, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
  - .2 ASTM B221-12, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
  - .3 ASTM B308/B308M-10, Standard Specification for Aluminum-Alloy 6061 T6 Standard Structural Profiles.
  - .4 ASTM B429/B429M-10e1, Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
  - .5 ASTM B632/B632M-08, Standard Specification for Aluminum-Alloy Rolled Tread Plate.
  - .6 ASTM C920-18, Standard Specification for Elastomeric Joint Sealants.
  - .7 ASTM D1187/D1187M-97(2011)e1, Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal.
  - .8 ASTM E488/E488M-10, Standard Test Methods for Strength of Anchors in Concrete Elements.
  - .9 ASTM F468-12, Standard Specification for Nonferrous Bolts, Hex Cap Screws, Socket Head Cap Screws, and Studs for General Use.
  - .10 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.
- .3 American Welding Society (AWS)
  - .1 AWS C3.7M/C3.7:2011, Specification for Aluminum Brazing.
  - .2 AWS D1.2/D1.2M:2014, Structural Welding Code - Aluminum - includes 2014 Errata.
- .4 CSA Group (CSA)
  - .1 CSA G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel, Includes Update No. 1 (2014).
  - .2 CSA W47.1-09, Certification of companies for fusion welding of steel, Includes Update No. 3 (2011), Update No. 5 (2012).
  - .3 CSA W47.2-11 (R2015), Certification of companies for fusion welding of aluminum, Includes Update No. 1 (2011), Update No. 2 (2012).
  - .4 CSA W48-18, Filler metals and allied materials for metal arc welding.
  - .5 CSA W55.3-08(R2013), Certification of companies for resistance welding of steel and aluminum.
  - .6 CSA W59-13, Welded Steel Construction (Metal Arc Welding), Includes Update No. 1 (2014), Update No. 3 (2015).
  - .7 CSA W178.2-18, Certification of Welding Inspectors.

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with the requirements of Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and technical data sheet including construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- .3 Shop Drawings:
  - .1 Submit shop drawings indicating fabrication and installation details including, but not limited to, the following:
    - .1 Plans, elevations, and sections
    - .2 Details of fittings and glazing
    - .3 Hardware quantities, locations, and installation requirements
    - .4 Structural analysis data signed and sealed by the qualified professional engineer responsible for preparation for products indicated to comply with design loads.
- .4 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

### **1.4 QUALITY ASSURANCE**

- .1 Installer qualifications: Engage an experienced installer who has completed installations of specified doors and framing of similar design and extent to those required and who has a record of successful performance.
- .2 Obtain all glass fronts from a single manufacturer to ensure full compatibility and warranty of materials.
- .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 Detail and fabricate metal fabrications in accordance with the NAAMM AMP 555.
- .6 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.
- .7 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.
- .8 Welding:
  - .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 or CSA W47.2 as required.
  - .3 Welding inspection: to CSA W178.
  - .4 Resistance welding: to CSA W55.3.
  - .5 Fusion / Metal Arc welding: to CSA W59.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver, store and handle materials in accordance with manufacturer's recommendations.
- .2 Receive and store materials as recommended by materials manufacturer.
- .3 Adequately protect surfaces from damage during moving, handling and storage.

**1.6 SITE CONDITIONS**

- .1 Site Measurements: Verify actual locations of structural supports for all glass entrances systems by site measurements before fabrication and indicate measurements on Shop Drawings.
- .2 Established Dimensions: Establish dimensions and proceed with fabricating all glass entrances and storefront systems where site measurements cannot be made without delaying the Work; coordinate construction to ensure that actual dimensions correspond to established dimensions.

**1.7 WARRANTIES**

- .1 Contractor agrees to correct any deficiencies of labour or material found in the work performed for a period of 5-years commencing from date of publication of Substantial Performance.
- .2 Submit manufacturer's 7-year defective materials and workmanship warranty commencing from date of publication of Substantial Performance.
- .3 Warranties shall be made out in name of Owner.

**Part 2 Products**

**2.1 MATERIALS**

- .1 Glass:
  - .1 Clear tempered safety glass: Safety Glass to Section 08 80 50, and as follows: 10 mm thick, minimum, and as required to meet or exceed the requirements of the OBC and amendments, but not less than 10 mm thick.
  - .2 Glazing gaskets: system manufacturer's rubber or neoprene, purpose-made gaskets for dry glazing.
- .2 Aluminum:
  - .1 All sections shall be comprised of Aluminum extrusions of 6063 alloy with a T5 heat treatment.
  - .2 Framing wall thicknesses shall be 3.2 mm (0.125") on exposed surfaces and 4.7 mm (0.187") on internal webs.
  - .3 Steel members to be galvanized.
  - .4 Provide framing with the following characteristics:
    - .1 Aluminum framed doorframe for swing doors with stationary sidelight system to fit manufacturer's standard 3-1/2" wall thicknesses.
  - .5 Trackless threshold: System is surface-mounted to finished or unfinished floor.
  - .6 Aluminum Glazed Doors shall be 1-3/4", heights as indicated.

## **2.2 ALUMINUM FRAMED SYSTEM COMPONENTS**

- .1 PC350 Elite Door Frame System: Provide frames with the following characteristics:
  - .1 Rectilinear design.
  - .2 0.070 inch rabbet wall thickness.
  - .3 Throat sizes as required to accommodate glass thickness.
  - .4 Provide seamless SSG glass installations between partition perimeter framing.
  - .5 Door Hardware:
    - .1 Provide manufacturer's standard system hardware.
  - .6 Standard of Acceptance:
    - .1 PC350, 130 Nolan Court, Markham, ON L3R 2V7, (905) 475 6022  
www.PC350.com
  - .7 Aluminum: Controlled alloy billets of 6063-T5 to assure compliance with tight dimensional tolerances and maintain color uniformity.
  - .8 Provide System Manufacturer's Elite Swing Doors, complete with trackless threshold and all door hardware, as follows:
    - .1 Hinges, offset ladder pulls, auto door drop seals, swing door locksets with cylinder on the exterior and thumb turn on the interior, strike plates; exposed surfaces colour-matched to frame.

## **2.3 ACCESSORIES**

- .1 Provide all fasteners, anchors, fittings, and accessories as required for a complete installation connected to structure securely and operating smoothly.

## **2.4 ALUMINUM FINISHES**

- .1 Factory finish extruded frame components so that any part exposed to view upon completion of installation will be uniform in finish and colour.
- .2 Factory-Applied Powder-Coat Finish; colour: as selected by Consultant from manufacturer's full range.

## **2.5 FABRICATION**

- .1 Cut glass to required size, polish all exposed edges, include cutouts for hardware and other attachments before heat treatment.
- .2 Attach fittings and components before shipping to site as recommended by manufacturer.

## **Part 3 Execution**

### **3.1 COMPLIANCE**

- .1 Comply with manufacturer's published technical datasheets, assembly and installation instructions, guide specifications and shop drawings.

### **3.2 CONDITIONS**

- .1 Deliver all aluminum door frames and glazing screen material and related components in the manufacturer's provided protective packaging. Do not deliver until ready for installation.
- .2 Inspect all components for damage upon delivery.
- .3 Deliver, store and handle materials in accordance with manufacturer's published instructions.

- .4 Store all materials indoors in dry locations. Ensure that materials do not come into direct contact with ground or damp substrates.

### **3.3 INSTALLATION**

- .1 Install assemblies square, plumb and true to line, securely anchored to structure.
- .2 Field measure each wall area that is receiving panels in order to establish the exact layout. Chip recess in concrete slab where required for concealed hardware. Grout solid after installation, smooth and level with adjacent slab finish.
- .3 Install tempered glass partitions and doors as indicated complete with all fittings and components.
- .4 Coordinate with work of this section.
- .5 Adjust operable parts for correct function and smooth operation.

### **3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
  - .2 Clean aluminum with damp rag and approved non-abrasive cleaner in accordance with manufacturer's instructions.
  - .3 Remove traces of primer, caulking; clean doors and partitions.
  - .4 Clean glass and glazing materials with approved non-abrasive cleaner.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Dispose of all waste materials in accordance with the requirements of Section 0 74 19 Waste Management and Disposal.

### **3.5 PROTECTION**

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

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 05 50 00 – Metal Fabrications.
- .2 Section 07 21 19 – Foam-In-Place Insulation
- .3 Section 07 27 14 – Air Barriers.
- .4 Section 07 62 00 – Sheet Metal Flashing and Trim.
- .5 Section 07 92 00 – Joint Sealants.
- .6 Section 08 71 00 – Door Hardware.
- .7 Section 08 80 50 – Glazing.
- .8 Refer to Drawings.

**1.2 REFERENCES**

- .1 American Architectural Manufacturers Association (AAMA)
  - .1 AAMA CW-10-15, Care and Handling of Architectural Aluminum from Shop to Site.
  - .2 AAMA CWG-1-89, Installation of Aluminum Curtain Walls.
  - .3 AAMA 503-14, Voluntary Specification for Field Testing of Metal Storefronts, Curtain Wall and Sloped Glazing Systems.
  - .4 AAMA 609 & 610-15, Cleaning and Maintenance Guide for Architecturally Finished Aluminum.
  - .5 AAMA 701/702-11, Voluntary Specification for Pile Weatherstripping and Replaceable Fenestration Weatherseals.
- .2 ASTM International (ASTM)
  - .1 ASTM A123/A123M-17, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - .2 ASTM A666-15, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
  - .3 ASTM A653/A653M-18, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process.
  - .4 ASTM B209-14, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
  - .5 ASTM B221-14, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
  - .6 ASTM C864 - 05(2019), Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.
  - .7 ASTM E783 - 02(2018), Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors.
  - .8 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.
  - .9 ASTM E2112 – 19b, Standard Practice for Installation of Exterior Windows, Doors and Skylights.



- .3 CSA Group (CSA)
  - .1 CAN/CSA G40.20-13/G40.21-13 (R2018), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel, Includes Update No. 1 (2014).
  - .2 CAN/CSA G164-18, Hot Dip Galvanizing of Irregularly Shaped Articles.
  - .3 CSA W59.2-18, Welded Aluminum Construction.
- .4 Society for Protective Coatings (SSPC)
  - .1 Surface Preparation Guidelines:
    - .1 SSPC-SP COM Surface Preparation Commentary for Steel and Concrete Substrates.
    - .2 SSPC-PS Guide 12.00, Guide to Zinc-Rich Coating Systems.
  - .2 SSPC - Paint 20 Zinc Rich Coating.
  - .3 SSPC - Paint 25 Alkyd, Zinc Oxide Linseed Oil and Primer for Use Over Hand Cleaned Steel Type 1 and Type 2.

### 1.3 DESIGN RESPONSIBILITY

- .1 Drawings and details are diagrammatic and are intended to show design concept, configuration, components and arrangements; they are not intended to identify nor solve completely the problems of thermal and structural movements, air pressure equalization, air and vapour barriers, assembly framing, fixings and anchorages, moisture disposal, water penetration, orientation of walls, shading factors, size and shape of glazing, location of convectors, location of blinds, and problems at the glass line associated with glazing installation, movements, pressure fracture or thermal shock and weather seal.
- .2 The design, engineering, procurement, fabrication and erection of the aluminum framing assemblies, as required to meet these performance specifications shall be the complete responsibility of the Contractor.

### 1.4 PERFORMANCE CRITERIA

- .1 Glazed aluminum framing systems 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 Meet the requirements of the Ontario Building Code plus amendments and the National Energy Code of Canada for Buildings (NECB), current editions.
- .3 Minimum Erection Tolerances:
  - .1 Design and install aluminum framing 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 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.

## **1.5 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, Consultant, installer, and manufacturer's representative in accordance with Section 01 31 19 – 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 aluminum framing system structural connections at floor slabs to vertical members.

## **1.6 ACTION AND INFORMATION SUBMITTALS**

- .1 Submit product data in accordance with Section 01 33 00 – Submittal Procedures:
  - .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.
- .2 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures:
  - .1 Submit shop drawings, signed and sealed by manufacturer's engineer, detailing fabrication and assembly of glazed aluminum framing 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 Fully dimensioned layouts for positioning of brackets and anchorage devices to structures.
    - .4 Dimensions, gauges, thicknesses.
    - .5 Type, size and spacing of fastening devices.
    - .6 Glazing details.

- .7 Air/vapour barrier details, acoustic control details, aluminum alloy and temper designations, metal finishing specifications and other pertinent data and information.
- .8 Internal drainage.
- .9 Show details of connecting work of this section with work of adjacent sections.
- .3 Submit samples in accordance with Section 01 33 00 – Submittal Procedures:
  - .1 Submit samples of materials for Consultant'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 a sample of each finish hardware item that is to be supplied under this section.
  - .3 Submit two samples 610 x 610 mm in size illustrating window frame section, insulation, vapour barrier, glass, spandrel panels, vents and sealant.
- .4 Closeout Submittals: Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - 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).

## **1.7 QUALITY ASSURANCE**

- .1 Sole Source for Aluminum Products:
  - .1 Use same manufacturer for exterior aluminum framing and entrances.
- .2 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.

## **1.8 MOCK-UP**

- .1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control.
- .2 Mock-up: Construct full size 3 x 3 m (10 x 10 ft) mock-up of vertical glazed aluminum framing using proposed procedures, materials and quality of work where directed by Consultant and in accordance with Section 01 45 00 - Quality Control.
- .3 Include framing components, glass, and insulated infill panel.
- .4 Assemble to illustrate component assembly including glazing materials, weep drainage system, attachments, anchors, and perimeter sealant.
- .5 Purpose: To judge quality of work and material installation.
- .6 Allow Consultant minimum 24 hours prior to review of mock-up.
- .7 Do not proceed with work prior to receipt of written acceptance of mock-up by Consultant.

- .8 When accepted, mock-up will demonstrate minimum standard of quality required for work of this Section.
- .9 Approved mock-up may remain as part of finished work.

## **1.9 DELIVERY, STORAGE, AND HANDLING**

- .1 Comply with AAMA CW-10 for care and handling of 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.

## **1.10 SITE CONDITIONS**

- .1 Site Measurements: Verify dimensions of other construction by site measurements before fabrication and indicate measurements on shop drawings where aluminum framing systems are indicated to fit to other construction.
- .2 Established Dimensions: Establish dimensions and proceed with fabricating aluminum framing 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.

## **1.11 WARRANTY**

- .1 Provide manufacturers written guarantee, signed and issued in the name of Owner, to replace the following items for defective material and workmanship for the time stated from date of Substantial Performance:
  - .1 Aluminum finish: 10 years.
  - .2 Framing, panels and glazing: failure of performance requirements specified in Contract Documents; 2 years.
  - .3 Sealants, caulking: failure to maintain seal; 2 years.
  - .4 Structural silicone glazing; 20 years.
  - .5 Aluminum brake shapes: oil-canning and delamination; 2 years.
- .2 Provide Warranty for aluminum framing systems to include in maintenance manuals as specified in Section 01 78 00 – Closeout Submittals.

## **Part 2 Products**

### **2.1 DESCRIPTION OF BASIS-OF-DESIGN SYSTEMS**

- .1 Refer to Section 01 62 00 - Product Options; where specific products are named, supply that system or equivalent with same or better physical properties and performance

characteristics that suites the design concept of the project and meets or exceeds the requirements of this specification Section.

- .2 Thermally-Broken Aluminum Framing:
  - .1 Basis-of-Design:
    - .1 Alumicor ThermaWall 2600, capped, equivalent by BVGlazing Systems., or other approved equivalent, designed to accommodate Tremco Proglaze ETA Engineered Transition Assembly, or approved equivalent.
      - .1 Mullion colour:
        - .1 Champagne 76 - Alumicor.
        - .2 Champagne Bronze 52 – BVGlazing Systems.
  - .2 Infill panels, as indicated:
    - .1 Miscellaneous infill locations and building corner transitions: anodized aluminum fascia or break shapes to suit; metal closures and corner guards where indicated; colour to match adjacent aluminum framing.
    - .3 Glass spandrel panels with insulated back pans; glass to Section 08 80 50 – Glazing.
- .3 Exterior Thermally-Broken Aluminum Swing Doors (door hardware per Section 08 71 00 – Door Hardware).
  - .1 Aluminum swing doors: aluminum framing with integrated door adaptors, manufacturer's heavy duty commercial accessories and hardware; door hardware per Section 08 71 00 - Door Hardware.
- .4 Include hardware packages, sills, thresholds, frames, connections, anchors, fasteners, flashings, transition membranes, and accessories as required for a complete installation.

## 2.2 MATERIALS

- .1 Aluminum materials:
  - .1 Extruded aluminum: to ASTM B221 6063 alloy, T5 or T6 temper, free from perceptible distortions, waves, twists, buckling or other deficiencies of appearance or performance.
  - .2 Sheet, exposed: to ASTM B209/B209M, anodizing quality to AA-1100 series.
  - .3 Reinforcing Members: Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B633 for SC 3 severe service conditions or other suitable zinc coating; provide sufficient strength to withstand design pressure indicated.
  - .4 Sheet and plate: to ASTM B209/B209M, anodizing quality, alloy and temper suitable for purpose and finish required, special hardness for flat panel application, re-squared saw cut edges, free from perceptible distortions, waves, twists, buckling or other deficiencies in appearance or performance.
    - .1 Panels, copings, soffits, sills, trims, closures and other such components shall be minimum 3 mm thick; 1.5 mm thickness may be used for flashings. Finish to match exterior aluminum framing finish.
  - .5 Extruded bars, rods, profiles, and tubes: In accordance with ASTM B221/B221M, and AA-6063-T5 or T6 temper, anodizing quality.
  - .6 Aluminum extruded structural pipe and tubes: In accordance with ASTM B429, and AA6063-T6 temper, anodizing quality.
  - .7 Structural Profiles: In accordance with ASTM B308/B308M, anodizing quality.
  - .8 Aluminum welding: to CSA W59.2.

- .2 Steel: to CSA G40.20/G40.21, 300W hot dipped galvanized after fabrication to ASTM A123/A123M, minimum coating of 600 g/m<sup>2</sup> shapes to suit mullion sections.
- .3 Galvanizing, unless otherwise specified: hot dipped galvanizing, with minimum zinc coating of 600 g/m<sup>2</sup> to ASTM A123/A123M.
- .4 Stainless steel: to ASTM A167, Type 304 or 316; of one type throughout.
- .5 Anchors: 3-way adjustable hot-dip galvanized cast iron.
- .6 Fasteners: to ASTM A167, stainless steel, type 304 as recommended by aluminum framing manufacturer selected to prevent galvanic action with the components fastened, of suitable size to withstand imposed loads.
- .7 Anti-rotation spacers: manufacturer's extruded aluminum spacers with integral gaskets as required at frame transitions and termination points, including at dual-glazed framing to single-pane spandrel panel transitions.
- .8 Grout fill for anchor pockets: non-shrink Masterflow 713 Plus, by BASF, or SikaGrout 212, by Sika Canada.
- .9 Primers and Adhesives: as recommended by aluminum framing manufacturer.
- .10 Thermal barrier: 1" (25 mm) separation between interior and exterior metal members in a typical condition, while maintaining continuous watertight seal. Thermal barrier assembly shall be tested to thermal cycling requirements of ASTM E2692 and show no sign of degradation following the test.
  - .1 Thermal separators (thermal break): Thermal separator shall be extruded of a silicone compatible elastomer that provides for silicone adhesion, of size to conform to the extruded aluminum members or other locations where required, and having a minimum tensile strength of 14 MPa (2000 psi) and Durometer A Hardness of 60, +/- 5.
- .11 Concealed flashing: manufacturer's standard corrosion-resistant, non-staining, non-bleeding flashing compatible with adjacent materials.
- .12 Transition membranes: Tremco Proglaze® ETA Connections, or approved equivalent.
- .13 Gaskets: glazing gaskets shall be silicone-compatible EPDM to ASTM C864, 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, and provides for silicone adhesion; heat-resistant where required due to proximity of heating units.
- .14 Isolation coating: alkali resistant bituminous paint.
  - .1 CRL Black Bituminous Paint – aerosol or paint, by C.R. Laurence of Canada, or equivalent.
- .15 Primer for ferrous metals: CISC/CPMA 2-75.
- .16 Zinc chromate primer, by PPG Industries, Inc. or equivalent.
- .17 Touch up primer for galvanized steel: organic zinc rich primer, by Sherwin Williams Company of Canada Ltd. or equivalent.
- .18 Insulated Spandrel Panels
  - .1 Spandrel Glass: to Section 08 80 50.
  - .2 Back pan: Galvanized steel in accordance with ASTM A653, 0.91 mm base metal thickness, formed into a pan shape to fit into glazing throat with back of pan flush with inside face of back section.
  - .3 Insulation for back pans: CurtainRock ® 80 by Rockwool, or Fibrex Safing, held in place with manufacturer's standard fixing system to back face of back pan.

- .19 Insulation for miscellaneous voids and cavities: CurtainRock® 80 by Rockwool, or Fibrex Safing, friction fit, or held in place by miscellaneous metal angle or sheet metal flashing, as required.
- .20 Flexible flashing, flexible air/vapour retarder:
  - .1 Flashing as recommended by aluminum framing manufacturer, compatible with adjacent materials and systems.
  - .2 Adhesive, tapes, primers and sealant: as recommended by the flexible flashing manufacturer.
- .21 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 / A853M, minimum 1 mm sheet steel, galvanized, stretcher-levelled, minimum coating weight 380 g/m<sup>2</sup>.
- .22 Sealants, including primer, joint filler: as specified in section 07 92 00, augmented as follows:
  - .1 Sealants used in structural joints shall have adequate strength to retain insulating units to the metal framing or each other 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.
- .23 Glass and Glazing: to Section 08 80 50 – Glazing.
- .24 Fire Safety Materials: to Section 07 84 00 – Firestopping and Smoke Seals.
- .25 Flashing: matching aluminum flashing as recommended by manufacturer, and as follows:
  - .1 Flashing: roll formed aluminum, 0.019" thick, mill finish.
  - .2 Aluminum sheet to conform to Federal Specification QQ-A-359, Alloy 3003.

## **2.3 ALUMINUM SWING ENTRANCES**

- .1 Aluminum Extrusions: Alloy and temper recommended by sliding aluminum-framed glass door manufacturer for strength, corrosion resistance, and application of required finish and not less than 2.3 mm wall thickness at any location for the main frame and sash members.
- .2 Fasteners: Aluminum, nonmagnetic stainless steel or other materials to be non-corrosive and compatible with sliding aluminum-framed glass door members, trim hardware, anchors, and other components.
- .3 Anchors, Clips, and Accessories: Aluminum or nonmagnetic stainless steel; provide sufficient strength to withstand design pressure indicated.
- .4 Reinforcing Members: Aluminum or nonmagnetic stainless steel; provide sufficient strength to withstand design pressure indicated.
- .5 Weather Seals: Provide weather stripping with integral barrier fin or fins of semi rigid, polypropylene sheet or polypropylene-coated material. Comply with AAMA 701/702.
- .6 Door stile and rail face dimensions of entrances shall be as indicated. Provide manufacturer's heavy-duty commercial door adaptors.
- .7 Major portions of the door members to be 3.2 mm nominal in thickness and glazing molding to be 1.3 mm thick.

- .8 Glazing gaskets shall be either EPDM elastomeric extrusions or a thermoplastic elastomer.
- .9 Provide adjustable glass jacks to help center the glass in the door opening.

## **2.4 FABRICATION – GENERAL**

- .1 Do not start fabrication until samples, shop and erection drawings have been reviewed.
- .2 Insofar as practical, execute fitting and assembly in the shop 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 If aluminum 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 Equip perimeter framing with factory installed air and vapour barrier material as required for sealing to building air and vapour barrier, and as follows:
  - .1 Material: identical to, or compatible with, building air barrier and vapour retarder materials to provide required air tightness and vapour diffusion control throughout exterior envelope assembly.
  - .2 Material width: adequate to provide required air tightness and vapour diffusion control to building air barrier and vapour retarder from interior.

## **2.5 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 watertight 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 Consultant.
- .3 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.



- .4 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 that is forced onto face of frame assembly.
- .5 Location of joints and pressure equalizing drain vents to be subject to consultant's acceptance.
- .6 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.
- .7 Develop drainage holes with moisture path to exterior.
- .8 Prepare components to receive anchor devices. Fabricate anchorage items.
- .9 Arrange fasteners, attachments, and jointing to ensure concealment from view.
- .10 Cope, notch and drill to provide minimum tolerance throughout system and to fit with hairline joints.
- .11 Conceal interconnecting members and fastenings in completed assembly. Provide pressure-equalizing holes in members and condensation drains.
- .12 Framing members and associated sealing shall combine to form airtight vapour barrier for entire interior skin of aluminum framing system. Cooperate and coordinate with other sections to ensure continuous thermal and air barrier seal at interfaces with adjacent materials.
- .13 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.
- .14 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.
- .15 Fabricate expansion joints between mullion sections with formed extruded aluminum internal sleeve sections, secure to permit joint function and maintain true alignment of sections.
- .16 Fabricate sections to accommodate and interface with work of other trades by means of rabbets, interlocks, miscellaneous angles, trim and filler sections as required.
- .17 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.
- .18 Brake form parapet caps and sills out of 3 mm thick aluminum sheet.
- .19 Reinforce mullions with structural steel sections where required with adequate anchorage to structure.
- .20 Provide internal reinforcement in horizontal window mullions to satisfy wind loads and to maintain rigidity.
- .21 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.
- .22 Isolate aluminum in contact with other metals, masonry, concrete, plaster or mortar to prevent corrosion.

- .23 Verify wall openings and adjoining air and vapour seal materials are ready to receive work of this section.
- .24 Beginning installation means acceptance of site conditions.
- .25 Provide airtight vapour seals in aluminum framing.

## **2.6 FABRICATION – SPANDREL PANELS**

- .1 Refer to Drawings for size, type and location of glass spandrel panels.
- .2 Spandrels to have insulated backup panels, complete with 75 mm thick insulation consisting of two layers. Secure insulation to metal liner with adhesive and "spindle" clips with black retainer discs, minimum two per board.
- .3 First layer of insulation to be 50 mm thick impaled on clips and secured with retainer discs. Second layer to be black-faced, secured to first with adhesive, uniformly spread over opposing faces. Align panels symmetrically with joints in line and tight together. Cut off ends of spindles just above discs. It is imperative that joints are tight so that edges do not show, if misaligned, caulk with black sealant. Similarly caulk perimeter edges. Appearance from outside shall be a consistent black colour.
- .4 Fabricate liner panel from not less than 22-gauge galvanized sheet steel with airtight seams, brake formed at the edges. Isolate dissimilar metal surfaces using isolation coating. Reinforce with galvanized steel sections as required for rigidity and to meet design criteria, and to eliminate noises due to thermal and air pressure changes.
- .5 Seal perimeter of liner panels with non-permeable sealant to maintain vapour barrier. Install weatherseal, rain deterrent and vent where detailed and required.
- .6 Reinforce liner panels where necessary to prevent undue deflection.
- .7 Provide sloping sills with high backs, to terminate aluminum framing system at bottom. Brake form to detailed profiles.
- .8 Fabricate panels in manner to maintain complete thermal and vapour barrier seal at inner panel, yet to ensure moisture is drained to exterior.
- .9 Form aluminum flashing, parapet coping and cap flashing as detailed and to locations indicated. Prevent damage by window washing equipment, ladders, etc., by reinforcing edges of copings and caps.
- .10 Provide sound baffles within spandrels to reduce noise transmission vertically between floors.

## **2.7 FABRICATION – SWING ENTRANCES**

- .1 Fabricate aluminum-framed glass entrance doors in sizes indicated. Include a complete system for assembling components and anchoring doors. Comply with OBC criteria.
- .2 Door hardware and keying: in accordance with Door Hardware Schedule. Additional miscellaneous hardware shall be manufacturer's heavy-duty commercial quality accessories and hardware as required for a complete installation.
- .3 Fabricate aluminum-framed glass doors that are re-glazeable without dismantling perimeter framing.
- .4 Door corner construction shall consist of mechanical clip fastening, SIGMA deep penetration plug welds and 1-1/8" (29 mm) long fillet welds inside and outside of all four corners. Glazing stops shall be hook-in type with EPDM glazing gaskets reinforced with non-stretchable cord.
- .5 Accurately fit and secure joints and corners. Make joints hairline in appearance.
- .6 Prepare components with internal reinforcement for door hardware.

- .7 Arrange fasteners and attachments to conceal from view.
- .8 Door hardware to be supplied by door hardware contractor under the door hardware Section, to be installed by aluminum framing contractor. Prepare aluminum framing framing for installation of all door hardware and accessories, including but not necessarily limited to the following criteria:
  - .1 Exterior Doors, Semi-Automatic Swing:
    - .1 Concealed overhead automatic door operator.
    - .2 Concealed overhead door stop and holder.
    - .3 Pull hardware.
    - .4 Panic Hardware and cylinders.
    - .5 Continuous Hinge.
    - .6 Automatic retractable door sweep.
    - .7 Weather stripping and threshold.
    - .8 Flush bolts (top and bottom) - inactive leaf of pairs of doors only.
  - .2 Exterior Doors, Manual Swing:
    - .1 Concealed overhead automatic door operator.
    - .2 Concealed overhead door stop and holder.
    - .3 Pull hardware.
    - .4 Panic Hardware and cylinders.
    - .5 Continuous Hinge.
    - .6 Automatic retractable door sweep.
    - .7 Weather stripping and threshold.
    - .8 Flush bolts (top and bottom) - inactive leaf of pairs of doors only.
  - .3 Interior Doors Manual Swing Non-Exit:
    - .1 2 pairs of stainless steel butt hinges.
    - .2 Push/Pull hardware.
    - .3 Concealed overhead automatic door operator.
    - .4 Concealed overhead door stop and holder.
    - .5 Flush bolts (top and bottom) - inactive leaf of pairs of doors only.
    - .6 Cylinder lock.
  - .4 Interior Doors Manual Swing Exit:
    - .1 Pull hardware.
    - .2 Concealed overhead automatic door operator.
    - .3 Concealed overhead door stop and holder.
    - .4 Panic Hardware and cylinders.
    - .5 Continuous hinge.
    - .6 Automatic retractable door sweep.
    - .7 Weather stripping and threshold.
  - .5 Interior Doors - Automatic Swing:
    - .1 Concealed overhead automatic door operator.
    - .2 2 pairs of stainless steel butt hinges.
    - .3 Activation switches.
    - .4 Concealed overhead door stop and holder.
    - .5 Panic Hardware and cylinders at non-rated fire separations with electric strike. Push/Pull hardware at other locations.

- .9 Provide all hardware of each type from one manufacturer.
- .10 Keying: in accordance with Door Hardware Schedule; provide removable / exchangeable construction cores and 20 extra keys for each lock for construction cores.

## **2.8 FABRICATION – FLASHING AND ACCESSORIES**

- .1 Provide sloping sills with high backs, to terminate aluminum framing system at bottom. Brake form to detailed profiles.
- .2 Aluminum flashing: tension-levelled, commercial quality aluminum sheet in accordance with ASTM B209 and ANSI H35.1 alloy designation 5005 H14 or 3003 H14 as required, finished to match adjacent framing.
  - .1 Form sheet materials to profiles required.
  - .2 Form aluminum flashing, parapet coping and cap flashing as detailed and to locations indicated. Prevent damage by window washing equipment, ladders, etc., by reinforcing edges of copings and caps.
  - .3 Fabricate in accordance with AAI Aluminum Sheet Metal Work in Building Construction. Back-paint aluminum flashing in contact with concrete or masonry, or dissimilar metal, with bituminous paint prior to installation.
  - .4 Form sections square, true, and accurate to size, free from distortion and other defects detrimental to appearance or performance.
  - .5 Strengthen free edges of flashings by folding to form a 13-mm hem.
  - .6 All bends machine made. Form sections square, true, and accurate to size, free from distortion and other defects detrimental to appearance or performance.

## **2.9 FINISHES**

- .1 Aluminum Finishes:
  - .1 Exposed Aluminum:
    - .1 Exposed surfaces of aluminum components in accordance with Aluminum Association AA-A41 Class I, 0.018 mm minimum thickness.
  - .2 Unexposed aluminum: Mill finish.
- .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/m<sup>2</sup>. 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 Colour appearance to be uniform with no variations detectable by the naked eye at a distance of 1525 mm under natural lighting.
- .5 Shop and touch-up primer for steel components: SSPC 25 Paint red oxide.
- .6 Touch-up primer for galvanized steel surfaces: SSPC 20 Paint zinc rich.
- .7 Concealed steel items: galvanized in accordance with ASTM A123 to 600 gm/m<sup>2</sup>.
- .8 Apply one coat of bituminous paint to concealed aluminum and steel surfaces in contact with cementitious or dissimilar materials.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Inspect Work and conditions affecting the Work of this Section. Proceed only after deficiencies have been corrected.
- .2 Ensure that flashings built in or provided by others integrate with system to divert moisture to exterior.
- .3 Ensure that anchor blocks or inserts required to receive system are correctly located and installed.
- .4 Ensure that 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 – Foam-In-Place Insulation and Section 07 27 14 – Air Barriers.

### **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**

- .1 Compliance: comply with AAMA CW-10-15 recommendations, and manufacturer's printed installation instructions, standard details as applicable, and data sheets.
- .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, 6" 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 silicone sealant and foam rubber joint plugs (end dams) as required at frame corners to fill and seal the joinery.
- .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 airtight 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 Adhere stick clips to metal air/vapour barriers at 300 mm o.c. both ways. As an alternative, gun weld pins to metal substrates in lieu of stick clips, provided clips do not easily break off and weld burn-through does not occur.
- .16 Support adhesive-applied clips in place until adhesive has set.
- .17 Isolate metal air/vapour barriers with thermal breaks and spacers.
- .18 Locate vapour barrier on the warm-in-winter side of the insulation.
- .19 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.
- .20 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.
- .21 Install insulation to thicknesses shown on the Drawings, or as required to achieve continuity of thermal insulation performance.
- .22 Press insulation boards firmly to barrier or substrate impaling them on clips without bending clips. Butt insulation boards tightly. Install retainers to clips.
- .23 Fill irregular shaped voids within assemblies with fibrous packing insulation to maintain continuity of thermal barrier.
- .24 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 Consultant.
- .25 Install operable windows and related hardware, at locations indicated and ensure watertight, rattle-free closure when units are in the closed and locked position. Perform drilling required to install stops and other hardware items fixed to adjacent construction.
- .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 Supply and install sheet waterproofing membrane at copings and parapets as indicated. Lap, adhere, and seal joints in membrane in accordance with recommendations of the membrane manufacturer to provide a watertight, continuous membrane.
- .29 Gun-apply three continuous beads of sealant under extruded aluminum thresholds. Make bead diameter sufficient to ensure a full width seal. Remove excess sealant.

- .30 Louvers and plenum boxes: install louvers and plenum boxes fully integrated with aluminum framing assembly. Coordinate with other trades as required.
- .31 Swing Doors and Frames:
  - .1 Comply with Drawings and manufacturer's printed installation instructions for installing aluminum swing entrance doors, hardware, accessories, and other components.
  - .2 Provide 20 mm wide x 115 mm deep aluminum sub-frame at door jambs within aluminum framing at interior and exterior door openings.
  - .3 Coordinate with electrical for power connection and wiring to automatic door operator and controls, security devices and other work to be incorporated.
  - .4 Install aluminum swing entrance doors level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.
  - .5 Set sill threshold in bed of sealant, as indicated, for weather tight construction.
  - .6 Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

### **3.4 FOAMED-IN-PLACE INSULATION**

- .1 Install between aluminum framing and rough openings at exterior walls, at perimeter joints and penetrations and where indicated: to Section 07 21 19 - Foamed-in-Place Insulation.

### **3.5 COVERS, CLOSURES, TRIM AND HANDRAILS**

- .1 Provide copings, covers, closures, trim and handrails as indicated and as required to provide complete and finished installation to OBC requirements.
- .2 Use concealed fastenings.
- .3 Fabricate aluminum components in largest practical lengths. Where joints are required, provide flush slip joints at exterior components and flush hairline joints at interior components. Unless otherwise indicated, locate joints to align with adjacent mullions and as directed by Consultant. All exterior joints to have suitable backplates and be sealed watertight.

### **3.6 FIELD GLAZING**

- .1 Install glass and insulating glass units to Section 08 50 00 – Glazing.

### **3.7 SEALANTS**

- .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 water 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 Install SSG structural silicone in accordance with manufacturer's installation instructions and data sheet.
  - .2 Obtain approval from the sealant manufacturer for the priming, cleaning and application techniques at commencement of the sealant installation.
  - .3 Before sealant installation is commenced, test the sealant for adhesion to substrates.
  - .4 Install materials in compliance with the recommendations of their manufacturers.
  - .5 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.
  - .6 Be familiar with the work life of the sealant to be used. Do not mix multiple component materials until required for use.
  - .7 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.
  - .8 Before any sealing is commenced, test the materials for indications of staining or poor adhesion.
  - .9 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.
  - .10 Install sealant with pressure operated guns.
  - .11 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.
  - .12 Ensure that the correct sealant depth is maintained. Superficial painting with a skin bead will not be accepted.
  - .13 Sealant installations shall be a full bead free from air pockets and embedded impurities and having smooth surfaces, free from ridges, wrinkles and sags.
  - .14 After joints have been completely filled, tool them neatly to a slightly concave surface.
  - .15 If joints are masked, remove masking immediately after tooling and before sealants begin to cure.
  - .16 Install exposed structural silicone sealants at glazing so that top surfaces of the beads are formed to drain water away from the glass.



- .17 Clean excess sealants from glass and framing surfaces immediately after installation.
- .18 Cover all fasteners penetrating the air/vapour barriers with sealant.
- .19 Immediately clean adjacent surfaces that have been soiled and leave work in a neat, clean condition. Remove excess materials and droppings using recommended cleaners and solvents.

### **3.8 FIELD QUALITY CONTROL**

- .1 Field Tests: to Section 01 29 83 - Testing and Inspection Services, conducted by Owner's third-party testing agency if elected. Consultant may, at its sole discretion, select portions of the installation to be tested as soon as a representative portion of the project has been installed, glazed, perimeter caulked and cured. If elected, conduct tests for air infiltration and water penetration with manufacturer's representative present. Tests not meeting specified performance requirements and units having deficiencies shall be corrected as part of the contract amount.
  - .1 Testing: Testing shall be performed per AAMA 503 by a qualified independent testing agency.
  - .2 Air Infiltration Tests: Conduct tests in accordance with ASTM E783. Allowable air infiltration shall not exceed 1.5 times the amount indicated in the performance requirements or 0.09 cfm/ft<sup>2</sup>, whichever is greater.
  - .3 Water Infiltration Tests: Conduct tests in accordance with ASTM E1105. No uncontrolled water leakage is permitted when tested at a static test pressure of two-thirds the specified water penetration pressure but not less than 10 psf (479 Pa).
- .2 Manufacturer's Field Services: Provide periodic site visit by manufacturer's field service representative.
  - .1 Schedule site visits to review work at stages listed:
  - .2 After delivery and storage of vapour retarder and components, and when preparatory work on which work of this Section depends is complete, but before installation begins.
  - .3 Once during progress of work.
  - .4 Upon completion of work of this section and prior to pouring of concrete.
  - .5 Obtain reports within three days of review and submit immediately to Consultant.

### **3.9 COMMISSIONING**

- .1 Adjust operating entrances, hardware and accessories for a tight fit at contact points and weather stripping for smooth operation and weather tight closure. Lubricate hardware and moving parts.
- .2 Replace defective materials and materials damaged due to faulty installation, careless handling or other causes resulting from work of this section.
- .3 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.
- .4 Test and adjust hardware and replace or repair faulty items.
- .5 Adjust weather-stripping to leave each opening unit in its most watertight position.
- .6 Test operable elements and ensure easy and smooth operation.
- .7 Test airtightness and weather resistance for compliance with the requirements of Section 01 83 00 - Building Enclosure Performance Requirements.

**3.10 CLEANING**

- .1 Cleaning of aluminum components shall be to AAMA 609.
- .2 Remove protective material from pre-finished aluminum surfaces, interior and exterior.
- .3 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.
- .4 Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
- .5 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.
- .6 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.
- .7 Perform final cleaning after completion of entire installation when approved by the Consultant. Remove dirt and stains where such does not respond to the washing or cleaning specified in Section 01 74 11 – Cleaning, refer the condition to the Consultant, with recommendations as to the remedial action required; but do not undertake any cleaning procedure of a more severe nature without the written approval.
- .8 Cleaning shall include the interior/exterior surfaces of materials installed under this section.
- .9 Remove excess sealant by moderate use of mineral spirits or other solvent acceptable to sealant manufacturer.
- .10 Final cleaning shall be performed under work of Section 01 74 11 – Cleaning.
- .11 Upon completion of the work of this section, remove debris, equipment and excess material resulting from the work of this section from the site.
- .12 Provide the Owner with instructions for proper method and materials to be used in maintenance cleaning of finished surfaces.
- .13 Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 – Waste Management and Disposal.

**3.11 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 08 11 14 – Metal Doors and Frames.
- .2 Section 08 44 13 – Glazed Aluminum Framing Systems.

**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 ASTM International (ASTM)
  - .1 ASTM C542-05(2017) Standard Specification for Lock-Strip Gaskets.
  - .2 ASTM C716-06(2015), Standard Specification for Installing Lock-Strip Gaskets and Infill Glazing Materials.
  - .3 ASTM C920-18, Standard Specification for Elastomeric Joint Sealants.
  - .4 ASTM C964-07(2012), Standard Guide for Lock-Strip Gasket Glazing.
  - .5 ASTM C1048-18, Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass.
  - .6 ASTM C1172-19, Standard Specification for Laminated Architectural Flat Glass.
  - .7 ASTM C1349-17, Standard Specification for Architectural Flat Glass Clad Polycarbonate.
  - .8 ASTM C1503-18, Standard Specification for Silvered Flat Glass Mirror.
  - .9 ASTM D2240-15e1, Standard Test Method for Rubber Property—Durometer Hardness.
  - .10 ASTM E119-18ce1, Standard Test Methods for Fire Tests of Building Construction and Materials.
  - .11 ASTM E330/E330M-14, Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference
  - .12 ASTM E1300-16, Standard Practice for Determining Load Resistance of Glass in Buildings.
  - .13 ASTM E2190-19 Standard Specification for Insulating Glass Unit Performance and Evaluation.
- .3 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-12.1-2017, Safety Glazing.
  - .2 CAN/CGSB-12.3-M91(R2017), Flat, Clear Float Glass.
  - .3 CAN/CGSB-12.4-M91(R2017), Heat Absorbing Glass.
  - .4 CAN/CGSB-12.8-2017, Insulating Glass Units.
  - .5 CAN/CGSB-12.9-M91, Spandrel Glass.
- .4 CSA Group (CSA)
  - .1 CSA A440-17, North American Fenestration Standard / Specification for windows, doors, and skylights, Includes Errata (2018).
  - .2 CSA A440.2-19/A440.3-19, Fenestration energy performance/User guide to CSA A440.2-19, Fenestration energy performance.
  - .3 CSA A440.4-19, Window, Door, and Skylight Installation.

- .4 CSA A460:19, Bird-friendly building design, Includes Errata No. 1 (2019).
- .5 CSA A500-16, Building Guards.
- .6 CSA Certification Program for Windows and Doors.
- .5 British-Adopted European Standard (BS EN)
  - .1 BS EN 1096-4:2018, Glass in building. Coated glass. Product standard.
  - .2 BS EN 14179-1:2016, Glass in building. Heat-soaked thermally-toughened soda lime silicate safety glass. Definition and description.
  - .3 BS EN 14179-2:2005, Glass in building. Heat-soaked thermally-toughened soda lime silicate safety glass. Evaluation of conformity/Product standard.
- .6 Glass Association of North American (GANA)
  - .1 GANA Glazing Manual (50th Anniversary Edition).
  - .2 GANA Laminated Glazing Reference Manual (latest published edition).
- .7 Underwriters Laboratories (UL)
  - .1 UL 2761, Sealants and Caulking Compounds, 10/03/2011.
- .8 National Fire Protection Association (NFPA):
  - .1 NFPA (FIRE) 80, Standard for Fire Doors and Other Opening Protectives, 2019 Edition.
  - .2 NFPA (FIRE) 252, Fire Tests of Door Assemblies, 2017 Edition.
  - .3 NFPA 257, Fire Test for Window and Glass Block Assemblies, 2017 Edition.
- .9 ULC Standards
  - .1 ULC 101-14, Standard Methods of Fire Endurance Tests of Building Construction and Materials (CAN/ULC S101-14).
  - .2 ULC 104-15, Standard Method for Fire Tests of Door Assemblies (CAN/ULC S104-15).
  - .3 ULC 106-15, Standard Method for Fire Tests of Window and Glass Block Assemblies (CAN/ULC S106-15).

### **1.3 ADMINISTRATIVE REQUIREMENTS**

- .1 Pre-Installation Meeting:
  - .1 Convene pre-installation meeting 2 weeks prior to beginning work of this Section and on-site installation, with Contractor's Representative and Consultant in accordance with Section 01 31 19 - Project Meetings to:
    - .1 Verify project requirements.
    - .2 Review installation and substrate conditions.
    - .3 Coordination with other trades.
    - .4 Review manufacturer's written installation instructions and warranty requirements.

#### **1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Coordinate with other trades as required to maintain schedule.
- .2 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .3 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for glass, sealants, and glazing accessories, and include product characteristics, performance criteria, physical size, finishes, and limitations.
- .4 Samples:
  - .1 Submit for review and acceptance of each unit.
  - .2 Samples will be returned for inclusion into work.
  - .3 Submit duplicate 300 mm x 300 mm size samples of glass products and insulating glass units.
- .5 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .6 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
  - .1 Submit testing and analysis of glass under provisions of Section 01 45 00 - Quality Control.
  - .2 Submit shop inspection and testing for glass.
- .7 Submit in accordance with Section 01 78 00 - Closeout Submittals.
  - .1 Operation and Maintenance Data: submit operation and maintenance data for glazing for incorporation into manual.

#### **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.
  - .4 Provide shop inspection for glass.
- .2 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.
- .3 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

#### **1.6 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

- .3 Storage and Handling Requirements:
  - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect glazing and frames from damage.
  - .3 Protect prefinished aluminum surfaces with wrapping or strippable coating.
  - .4 Replace defective or damaged materials with new.

## 1.7 SITE CONDITIONS

- .1 Environmental Requirements:
  - .1 Install glazing when ambient temperature is 10 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 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: 20 Years.
  - .2 Mirrors: 10-year warranty that silvering will remain as initially installed.
  - .3 Provide warranty for glazing to include in maintenance manuals as specified in Section 01 78 00 – Closeout Submittals.

## Part 2 Products

### 2.1 MATERIALS

- .1 Design Requirements:
  - .1 Meet or exceed the requirements of the Ontario Building Code and amendments.
  - .2 Guards: to CSA A500.
  - .3 Size glass to withstand dead loads and positive and negative live loads as measured in accordance with ANSI/ASTM E330.
  - .4 Glass that is used or functions as a guard as defined by Ontario Building Code shall meet or exceed the standards and recommendations of CSA A500.
  - .5 Safety Glass: shall meet or exceed criteria and standards established by CGSB 12.1 and ANSI Z97.1 Class A.
  - .6 Glazing installation shall meet or exceed requirements of Ontario Building Code, with deflection less than 1/175.
  - .7 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.
- .2 Edge Treatments:
  - .1 Concealed edges: flat belt ground and seamed.
  - .2 Structural Silicone Glazed (SSG) edges: flat belt ground and seamed.
  - .3 Butt joined edges with silicone seal: flat ground with arris.

- .4 Exposed edges: flat polish with arris.
- .5 At structural glass, all exposed edges shall be polished and eased with exposed corners slightly rounded.
- .6 Joints at structural glass screens and smoke baffles shall be sealed using clear structural silicone sealant.
- .7 Joints at guards shall be open unless otherwise noted.
- .3 **Type GL-1;** Clear Float Glass: to CAN/CGSB-12.3, glazing quality, thickness not less than 6 mm.
- .4 **Type GL- 2;** Heat-Strengthened Glass: to ASTM C1048, transparent, glazing quality, thickness not less than 6 mm.
- .5 **Type GL-3;** Safety Glass: tempered glass to CAN/CGSB-12.1, transparent, glazing quality, thickness as required to meet ANSI Z97.1 Class A but not less than 6 mm thick. At locations where full-height glass panes are used (e.g., panes  $\geq$  2200 mm in height), minimum thickness 10 mm.
  - .1 Type: 2 tempered; Class: B float.
  - .2 Category: ANSI Z97.1 Class A.
- .6 **Type GL-4:** Heat-Soaked Tempered Glass; heat-soaked tempered glass to CAN/CGSB-12.1, transparent, glazing quality, thickness as required to meet ANSI Z97.1 Class A but not less than 6 mm thick.
  - .1 At locations where full-height glass panes are used (e.g., panes  $\geq$  2200 mm in height), minimum thickness 10 mm.
  - .2 Type: 2 tempered; Class: B float.
  - .3 Category: ANSI Z97.1 Class A.
  - .4 Heat-soaked, to BS EN 14179-1.
  - .5 Locations of use: glazed partitions, storefront glazed panels.
- .7 **Type GL-5:** laminated tempered safety glass, glazing quality, clear, and as follows:
  - .1 Laminating, to ASTM C1172.
  - .2 Tempered safety glass, to CAN/CGSB-12.1.

## 2.2 SEALED INSULATING GLASS UNITS (IGU)

- .1 Insulating Glass Units (IGU): 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 Application Locations: aluminum exterior framing, storefront framing.
  - .2 Spacer: Technoform Spacer M wire; by Technoform.
  - .3 Primary Seal: PIB, by Fenzi.
  - .4 Secondary Seal: Kodimelt, by Kommerling.
  - .5 Outboard pane: **Type GL-3**, 6 mm thick, with Low-E coating on No. 2 surface.
    - .1 Standard of Acceptance:
      - .1 Vitro Architectural Glass, Solarban® 60 Solar Control Low-E Coating.
  - .6 Inter cavity space: 13 mm spacer.
  - .7 Inert gas fill:  $\geq$  95% argon filled.
  - .8 Inboard pane: **Type GL-3**, 6 mm thick.

- .9 At exterior glazing locations, incorporate bird deterrent treatment in accordance with CSA A460, provide glass with bird deterrent patterns of ceramic frit on full area of No. 1 surface.
  - .1 Visual pattern size: minimum of 4 mm diameter for individual elements/dots.
  - .2 Spacing: no more than 50 mm vertically and horizontally between visual markers or other patterns.
  - .3 Contrast: dots are to be high contrast to colour/tint of glazing material.

## **2.3 SILVERED MIRROR GLASS**

- .1 Silvered mirror glass: to ASTM C1503, 6 mm thick.
  - .1 Type: 3A- Tempered mirror glass.
  - .2 Tint: Clear.
  - .3 Edges: ground and polished with arris.
  - .4 Size: custom, as indicated.
  - .5 Thickness: 6 mm.

## **2.4 ACCESSORIES**

- .1 Sealant: in accordance with Section 07 92 00 – Joint Sealants.
- .2 Glazing sealant: Type as recommended by glazing manufacturer as required to meet or exceed performance requirements. Verify compatibility with insulating glass unit secondary sealant.
- .3 Sealant for glazing between edges of glass units: one component silicone base, non-acidic, non-corrosive qualifying to ASTM C920. DC 795 by Dow Corp, Silpruf SCS 2000 Series by G.E Silicones, or similar as required to meet performance requirements.
- .4 Heel bead: DC 795 by Dow Corp or Silpruf SCS 2000 Series by G.E Silicones, or similar as required to meet performance requirements.
- .5 Setting blocks: Neoprene, 80-90 Shore A durometer hardness to ASTM D2240, to suit glazing method, glass light weight and area.
- .6 Spacer shims: Neoprene, 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.
- .7 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.
- .8 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.
- .9 Glazing splines: resilient polyvinyl chloride, extruded shape to suit glazing channel retaining slot, black colour.
- .10 Glazing clips: manufacturer's standard type.
- .11 Lock-strip gaskets: to ASTM C542.
- .12 Mirror attachment accessories:
  - .1 Stainless steel edge clips, with fastening concealed behind mirror.
- .13 Other Glazing Accessories: to CAN/CSA-A440.
- .14 Screws, bolts and fasteners: ASTM F738M; Type 304 stainless steel.
- .15 Glass presence markers: easily removable, non-residue depositing.

## 2.5 FABRICATION

- .1 Verify glazing dimensions on Site.
  - .2 Clearly label each glass light with maker's name, weight, quality, type and certification number. Do not remove labels until after work has been reviewed by Consultant.
  - .3 Accurately size glass to fit openings allowing the clearances shown on the following tables:
    - .1 Minimum glass clearances:
 

<b>Thickness</b>	<b>Edge Clearance</b>	<b>Face Clearance</b>
6 mm	6 mm	3 mm
over 6 mm	6 mm or 3/4 times the glass thickness, whichever is greater	
- \* = where any dimension of glass exceeds 760 mm increase minimum edge clearance by 1.5 mm.
- .4 Bite of glass edge on stop:
    - .1 Up to 1270 mm united size: 6 mm minimum.
    - .2 1270 mm to 2540 mm united size: 10 mm minimum.
    - .3 Over 2540 mm united size: 13 mm minimum.

## Part 3 Execution

### 3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions are acceptable for product installation in accordance with manufacturer's written instructions.
  - .1 Check and verify that no irregularities exist that would affect quality of execution of work specified.

- .2 Inform Consultant of unacceptable conditions immediately upon discovery.
- .2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

### **3.2 COMPLIANCE**

- .1 Size glass to Ontario Building Code requirements and verify glass for openings are correctly sized and are within allowable tolerances. Install glass with full contact and adhesion at perimeter. Maintain edge clearance recommended by glass manufacturer.
- .2 Work shall meet or exceed requirements of CAN/CSA A440.4, GANA Glazing Manual, and GANA Laminated Glazing Reference Manual.

### **3.3 PREPARATION**

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

### **3.4 EXTERIOR**

- .1 Manufacturer's Instructions: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.
- .2 Perform work in accordance with GANA Glazing Manual for glazing installation methods.
- .3 Cut glazing tape to length and set against permanent stops, 6 mm below sight line. Seal corners by butting tape and dabbing with sealant.
- .4 Apply heel bead of sealant along intersection of permanent stop with frame ensuring full perimeter seal between glass and frame to complete continuity of air and vapour seal.
- .5 Place setting blocks at ¼ points, with edge block maximum 150]mm from corners.
- .6 Rest glazing on setting blocks and push against tape [and heel head of sealant] with sufficient pressure to attain full contact at perimeter of light or glass unit.
- .7 Install removable stops with spacer strips inserted between glazing and applied stops 6 mm below sight line.
- .8 Fill gap between glazing and stop with sealant to depth equal to bite of frame on glazing, to maximum 9 mm below sight line.
- .9 Apply cap bead of sealant along void between stop and glazing, to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

### **3.5 INTERIOR**

- .1 Use method best suited to glass size, location and site conditions as recommended by GANA Glazing Manual.
- .2 Wet/Dry (Tape and Sealant) Method:
  - .1 Perform work in accordance with GANA Glazing Manual for glazing installation methods.
  - .2 Cut glazing tape to length and install 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 to ensure full contact at perimeter of light or unit.
- .5 Install removable stops, with spacer shims inserted between glazing and applied stops at 600 mm intervals, 6 mm below sight line.
- .6 Fill gaps between light and applied stop with sealant to depth equal to bite on glazing, to uniform and level line.
- .7 Trim protruding tape edge.
- .3 Dry/Dry (Tape and Tape) Method:
  - .1 Perform work in accordance with GANA Glazing Manual for glazing installation methods.
  - .2 Cut glazing tape to length and set against permanent stops, projecting 1.6 mm above sight line.
  - .3 Place setting blocks at 1/3 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 INSTALLATION: MIRRORS**

- .1 Set mirrors with adhesive, applied in accordance with adhesive manufacturer's instructions.
- .2 Set mirrors with clips. Anchor rigidly to wall construction.
- .3 Secure mirrors with a minimum of 4 clips per piece. Provide pads to prevent direct metal-to-glass contact of clips or screws.
- .4 Set on wood backing, offset to conceal backing, and painted to match adjacent wall.
- .5 Align mirrors (in multiple application) to a parallel and true plane surface to produce a true reflection across all sections.
- .6 Install plumb and level.

### **3.7 FIELD QUALITY CONTROL**

- .1 Manufacturer's Field Services: Upon Consultant's written request provide periodic site visit by manufacturer's field service representative.

### **3.8 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning. 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. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3 Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 – Waste Management and Disposal.

### **3.9 PROTECTION**

- .1 After installation, mark light with an "X" by using removable plastic tape or paste. Do not mark heat absorbing or reflective glass units.
- .2 Protect installed products and components from damage during construction.
- .3 Repair damage to adjacent materials caused by Work of this Section.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 08 80 50 – Glazing.

**1.2 REFERENCES**

- .1 International Window Film Association (IWFA)
  - .1 Architectural Visual Inspection Guideline for Applied Window Film 2020.

**1.3 ADMINISTRATIVE REQUIREMENTS**

- .1 Pre-Installation Meetings:
  - .1 Convene pre-installation meeting one week prior to beginning work of this Section and on-site installation, with Contractor's Representative and Consultant in accordance with Section 01 31 19 - Project Meetings to:
    - .1 Verify project requirements, including locations of glazing film installation.
    - .2 Review methods of installation and protection.
    - .3 Coordination with other trades.
    - .4 Review manufacturer's written installation instructions and warranty requirements.

**1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data: Submit glazing film manufacturer's printed installation instructions, technical datasheets, details, and specifications.
- .3 Submit shop drawings showing methods and locations of installation.
- .4 Samples:
  - .1 Samples for Initial Selection: Submit samples for initial selection of frosted translucent film from manufacturer's standard range.
  - .2 Samples for Verification: Submit triplicate 150 x 150 mm samples of selected film installed on 6 mm thick clear plate glass for verification.
- .5 Test Reports:
  - .1 Submit test reports from approved independent testing laboratory, certifying film's compliance with specified requirements.
- .6 Submit closeout submittals in accordance with Section 01 78 00 - Closeout Submittals.
  - .1 Provide operation and maintenance data for window film for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
  - .2 Follow manufacturers written instructions for care and maintenance of security and safety film.
  - .3 Use only cleaning solution recommended by manufacturer for regularly scheduled cleaning of security film.

**1.5 QUALITY ASSURANCE**

- .1 Comply with International Window Film Association (IWFA) guidelines.

## **1.6 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with section 01 61 00 - Common Product Requirements.
- .2 Store products indoors in conditioned space, with ambient temperature at approximately 20°C.
- .3 Store rolls of film flat on cross supports. Do not stand rolls of film on end.
- .4 Remove from storage in quantities required for same day use.
- .5 Store materials in accordance with manufacturers written instructions.

## **1.7 WARRANTY**

- .1 Submit manufacturer's product warranty.
- .2 Contractor hereby warrants that glazing films will stay in place without delaminating, peeling, or blistering for 5-years from date of Substantial Performance.
  - .1 Ensure warranty includes items as follows:
    - .1 Maintaining adhesion properties without blistering, bubbling, or delaminating from glass surface.
    - .2 Maintaining appearance without discolouration.
    - .3 Removing, replacing, and reapplying defective materials.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 **FLM-1:** Optically Frosted Privacy Window Film: polyester film adhered to face of glass:
  - .1 Thickness (film): 50 microns.
  - .2 Adhesive Type: Pressure-sensitive acrylic, clear.
  - .3 Opacity: Translucent, white.
  - .4 Surface Finish: Matte.
  - .5 Design Pattern: as determined by Consultant.
  - .6 Acceptable Materials:
    - .1 Fasara Cloud by 3M Company.
    - .2 Llumar.

### **2.2 GLAZING FILM ACCESSORIES**

- .1 Cleaners, primers and sealers: types as recommended by glazing film manufacturer.

### **2.3 FABRICATION**

- .1 To the extent practicable, shop-install glazing film:
  - .1 Ensure dust, grease, and chemical residue are removed from surface of glass before installation of film.
  - .2 Examine glass under natural daylight and identify cracks, blisters, bubbles, discolouration, edge defects or other anomalies that may cause film to delaminate, or cause vision transparency or distortion problems.
  - .3 View glass from 2.0 m minimum. Report findings to Consultant.
    - .1 Proceed with Work only after receipt of written approval from Consultant.
    - .2 Install film to panels ensuring no blisters, bubbles, scratches, edge defects or distortions. At interior windows and doors, film shall be

installed on either corridor or room side as recommended by film manufacturer to suit purpose and type, or as otherwise directed by Consultant (confirm orientation with Consultant prior to installing). Cut film edges straight and square to within 3 mm of edge of panel.

- .3 Deliver panels complete with film installed, with labels intact and legible, to site in accordance with Section 01 61 00 - Common Product Requirements.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions are acceptable for product installation in accordance with manufacturer's written instructions.
  - .1 Check and verify that no irregularities exist that would affect quality of execution of work specified.
  - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

### **3.2 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's printed preparation and installation instructions, technical datasheets, and specifications.

### **3.3 INSTALLATION - FIELD APPLICATIONS**

- .1 Comply with glazing film manufacturer's written installation instructions.
- .2 Cut film edges straight and square.
- .3 Cut edges 3 mm maximum from edge of glass sealing device in accordance with manufacturer's written instructions.
- .4 Apply and attach film to glass in accordance with manufacturer's written instructions.
- .5 Splicing:
  - .1 Splice film only when glass is greater in width than film.
  - .2 Splice film only after receipt of written acceptance from Consultant.
  - .3 Use butt factory edges only.
  - .4 Install with no gaps or overlaps.
- .6 Use only water and film slip solution on glass to facilitate positioning of film.
- .7 Ensure removal of excess water from between film and glass.
- .8 Remove left over material from work area and return work area to original condition.

### **3.4 FIELD QUALITY CONTROL**

- .1 Contractor and Consultant shall review the glazing film installations jointly in accordance with IWFA Architectural Visual Inspection Guideline for Applied Window Film.
- .2 Return glass with non-compliant film application to manufacturer for correction of deficiencies.
- .3 Remove and replace film that shows blisters, bubbles, tears, scratches, edge defects or vision distortion in film when viewed under natural daylight from 2 m minimum after 30-day period.

### **3.5 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning. Leave Work area clean at end of each day.
- .2 Follow glazing film manufacturer's recommendations and instructions for cleaning procedures.
- .3 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning. Perform cleaning after installation to remove construction and accumulated environmental dirt.
  - .1 Wash interior and exterior of each window, glass panel and film using cleaning solution recommended by glazing film manufacturer.
- .4 Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.

### **3.6 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

### **3.7 SCHEDULE**

- .1 Refer to Drawings for locations.

**END OF SECTION**



**Part 1 General**

**1.1 SUMMARY**

- .1 This Section includes requirements for supply of equipment and services necessary for mechanical preparation of existing substrates to receive new flooring finishes.

**1.2 RELATED REQUIREMENTS**

- .1 Section 03 35 00 – Concrete Finishing.
- .2 Section 09 05 23 – Common Work Results for Flooring Preparation: Floor levelling and toppings required for improved floor flatness tolerances relating to applied finishes.
- .3 Interior design Drawings.

**1.3 REFERENCES**

- .1 ASTM International (ASTM)
  - .1 ASTM D4258-05 (2017), Standard Practice for Surface Cleaning Concrete for Coating.
  - .2 ASTM D4259-18, Standard Practice for Abrading Concrete.
- .2 International Concrete Repair Institute (ICRI)
  - .1 ICRI Technical Guideline No. 310.2R-2013, Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair.

**1.4 ADMINISTRATIVE REQUIREMENTS**

- .1 Coordination: Coordinate work of this Section with requirements of floor levelling and topping materials specified in Section 09 05 23 – Common Work Results for Flooring Preparation for surface profile.
- .2 Pre-Construction Meetings: Conduct a pre-construction meeting to discuss existing concrete slab condition, procedures proposed for substrate preparation, location of required on-site mock-ups and surface profile requirements for installation of levelling products in accordance with Section 01 31 19 – Project Meetings, attended by Consultant, Construction Manager, Subcontractor and other Subcontractors or Suppliers affected by work of this Section.
- .3 Scheduling: Schedule work of this Section to occur during non-work hours in occupied buildings to minimize disturbance to adjacent spaces.

**1.5 ACTION SUBMITTALS / INFORMATIONAL SUBMITTALS**

- .1 Submit product data in accordance with Section 01 33 00 – Submittal Procedures:
- .2 Action Submittals: Provide the following submittals before starting any work of this Section:
  - .1 Product Data: Submit product data sheets describing mechanical preparation methods and cleaning methods and equipment proposed for use on project.
- .3 Informational Submittals: Provide the following submittals before starting any work of this Section:
  - .1 Dust and Water Control Plan: Submit written description of materials and procedures used to control and remove dust and water from work area, methods to prevent spread of dust and water to adjacent occupied spaces and to prevent contamination of HVAC systems.

## **1.6 QUALITY ASSURANCE**

- .1 Qualifications: Provide proof of qualifications when requested by Consultant:
  - .1 Installer: Use installer having experience in preparation of flooring substrates of similar extent and complexity as required for this Project, using equipment and methods to reduce risk of damage to substrates.

## **Part 2 Products**

### **2.1 EQUIPMENT**

- .1 Surface Preparation Equipment: Use equipment of type recommended by Subcontractor that minimizes dust and water generation, and that provides surface profiles required by subsequent floor levelling, and as follows:
  - .1 CSP 2 through CSP 4 Surface Profiling: Abrasive blast or grinding type equipment with vacuum recovery systems to control dust and collect surface aggregate.
  - .2 CSP 3 through CSP 8 Surface Profiling: Dry shot blast type equipment with vacuum recovery systems to contained blast materials and collect surface aggregate.
  - .3 CSP 2 through CSP 10 Surface Profiling: Mechanical impact or high or ultra-high pressure water jet type equipment with aggregate and effluent recovery system.
- .2 Limitations: Notify and obtain acceptance from Consultant where surface profiling required by floor levelling use of high or ultra-high pressure water jet, or mechanical impact methods that have moderate to high potential to cause microcracking before starting work of this Section:
  - .1 Consultant may consider alternate methods of floor preparation when less damaging methods are not practical based on site conditions or timing of work required by this Section.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Verify that work of others affected by this Section, or work required by this Section is complete before starting mechanical preparation and surface profiling and as follows:
  - .1 Confirm degree of floor profile require for installation of floor levelling specified in other Sections before starting work of this Section.
  - .2 Starting work of this Section denotes acceptance of site conditions and implementation of surface profile required of floor levelling required by other Sections.

### **3.2 PREPARATION**

- .1 Use methods that reduce potential for microcracking of concrete substrates, and that minimize the amount of water or residue clean-up.
- .2 Prepare concrete substrate and create surface profile in accordance with ASTM D4259; clean concrete in accordance with ASTM D4258 using methods compatible with levelling, and as follows:
  - .1 Prepare surface profiles required by levelling in accordance with ICRI Technical Guideline No. 310.2.

- .2 Acceptable substrate surfaces will be free of laitance, oil, grease, flooring adhesive, paint, and other surface contaminants capable of affecting bond of specified floor finishes to concrete substrate.
- .3 Prepare surfaces to receive Self-Levelling Underlayment as specified in Section 09 05 23 - Common Work Results for Flooring Preparation to minimum CSP 3 or as otherwise required by Self-Levelling Underlayment manufacturer.

### **3.3 SITE QUALITY CONTROL**

- .1 Testing and Inspection Agency: Owner will appoint inspection and testing agency in accordance with Section 01 45 00 – Quality Control, and as follows:
  - .1 Notify Consultant, and inspection and testing agency with sufficient timing to allow reasonable opportunity for review; provide assistance and access to the Work.
  - .2 Inspection and testing will include visual inspection of completed substrate preparation to verify that contamination is removed and specified ICRI surface profile are achieved using ICRI standard rubber mold for visual comparison.
- .2 Non-Conforming Work: Repair work that does not meet specified ICRI surface profile at no additional expense to the Owner.

### **3.4 PROTECTION**

- .1 Protect prepared substrates from contamination; re-clean substrates that are contaminated by construction operations prior to installation of specified floor levelling.

**END OF SECTION**

**Part 1 General**

**1.1 SUMMARY**

- .1 This Section includes requirements for preparation of new concrete slabs and existing slabs to receive applied flooring for installation required flatness, and levelness. This Section applies as follows:
  - .1 New concrete slabs that meet requirements specified in Section 03 35 00 - Concrete Finishing but require further preparation to meet substrate requirements for flooring finishes specified on the interior design Drawings.

**1.2 RELATED REQUIREMENTS**

- .1 Section 03 35 00 – Concrete Finishing: Coordination with minimum requirements for flatness and levelness for acceptance before additional finishing required for specific flooring installations.
- .2 Division 21 – Fire Suppression: Coordination of pipes and pipe fittings and other materials penetrating floor assemblies.
- .3 Division 22 – Plumbing: Coordination of pipes and pipe fittings and other materials penetrating floor assemblies.
- .4 Division 23 – Heating, Ventilation and Air Conditioning: Coordination of ductwork and other materials penetrating floor assemblies.
- .5 Division 25 – Integrated Automation: Coordination conduit and other materials penetrating floor assemblies.
- .6 Division 26 – Electrical: Coordination conduit and other materials penetrating floor assemblies.
- .7 Division 27 – Communications: Coordination conduit and other materials penetrating floor assemblies.
- .8 Division 28 – Electronic Safety and Security: Coordination conduit and other materials penetrating floor assemblies.
- .9 Interior design Drawings.

**1.3 ADMINISTRATIVE REQUIREMENTS**

- .1 Coordination: Coordinate compatibility of products specified in this Section with adhesive products specified in Division 09 floor finishes; submit Compliance Certification in accordance with items below.
- .2 Pre-Construction Meetings: Arrange for Pre-Construction Meeting in accordance with Section 01 31 19 – Project Meetings, Standard Documents Package, with Construction Manager, Subcontractor, Subcontractors or suppliers affected by the Work of this Section, and Consultant to discuss installation requirements and site reviews required by the Consultant.
- .3 Provide minimum 72 hours of notice to Consultant before starting Work of this Section; increase notice period where time period spans weekends or statutory holidays.

**1.4 ACTION SUBMITTALS / INFORMATIONAL SUBMITTALS**

- .1 Provide required information in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Action Submittals: Provide the following submittals before starting any Work of this Section:

- .3 Product Data: Submit product data for products specified indicating physical properties, performance characteristics, acceptability of substrates, application limitations and test results.

## **1.5 QUALITY CONTROL**

- .1 Qualifications: Provide proof of qualifications during the course of the Work of this Section:
  - .1 Manufacturer: Obtain specified products through one source from a single manufacturer or using materials from a secondary source that are acceptable to the manufacturer.
  - .2 Installer: Install using personnel experienced in installation of flooring preparation products specified in this Section who are trained, licensed or otherwise approved by the manufacturer.
- .2 Certifications: Provide proof of the following during the course of the Work:
  - .1 Compliance Certification: Provide letter from flooring adhesive manufacturers stating that product selected from Acceptable Products specified in this Section is compatible with flooring adhesives specified in Sections listed in Related Requirements.

## **1.6 SITE CONDITIONS**

- .1 Ambient Conditions: Maintain air temperature and substrate temperature in accordance with manufacturer's printed installation instructions.

## **Part 2 Products**

### **2.1 MANUFACTURERS**

- .1 Acceptable Products Manufacturers: Subject to compliance with requirements specified in this Section; where multiple listings of manufacturers occur, use any of the following listed manufacturers' Products in accordance with Section 01 62 00 – Product Options and Substitutions:
  - .1 Ardex Engineered Cements.
  - .2 Custom Building Products,
  - .3 MAPEI Canada Inc.
  - .4 Sika Canada Ltd.
  - .5 W.R. Meadows of Canada.
- .2 Unsolicited Substitutions: Consultant may consider additional manufacturers having similar products to Acceptable Products Manufacturers listed above during the construction period, provided they meet the performance requirements established by the named Products and provided they submit requests for substitution in accordance with Section 01 62 00 - Product Options and Substitutions, Standard Documents Package, before starting any work of this Section:
  - .1 Do not use substitute materials to establish Bid Price.
  - .2 Apparent Substitutions that appear as a part of the Project without review and acceptance by the Consultant will be rejected and replaced with one of the specified Products.

### **2.2 PERFORMANCE REQUIREMENTS**

- .1 Substrate Surface Flatness Tolerances for Tiling: Section 03 35 00 - Concrete Finishing establishes a flatness requirement for FF25 for slabs on grade and FF20 for structural slabs for in place concrete and is considered as the starting flatness for work of this

Section; final measurement for flatness and level using patching or self-levelling screed Products provided by this Section will be measured in same manner as specified in Section 03 35 00 - Concrete Finishing to achieve the following:

- .1 Small Format Floor Tile: Tiles having dimensions less than 100 mm x 100 mm require floor flatness as specified in Section 03 35 00 - Concrete Finishing.
  - .2 Large Format Floor Tile: Tiles having dimensions 400 mm x 400 mm and larger require floor flatness measured to a minimum of FF50; equivalent to 3 mm with no more than two gaps under 3000 mm straightedge measurement.
  - .3 Other Flooring Types: provide floor flatness as specified by the flooring manufacturer for each flooring type to be installed.
- .2 Volatile Organic Compound (VOC) Limitations: Provide products for each site applied coating used within the building envelope (interior side of weatherproofing system) complying with the VOC Limits established by South Coast Air Quality Management District Rule #1113, Architectural Coatings.

## **2.3 PATCHING AND LEVELLING MATERIALS**

- .1 Underlayment / Topping for Sloping to Floor Drain Locations: rapid setting, rapid hardening, polymer modified, pre-blended, cement based mortar bed and sloping mortar for leveling and ramping up to 75 mm on horizontal substrates; up to 125 mm thick in confined areas such as trenches. Product shall be designed to set to walkable hardness within 1 to 2 hours after application.
  - .1 Standard of Acceptance:
    - .1 CUSTOM® SpeedSlope® - Rapid Setting Sloping Mortar, by Custom® Building Products, or approved equivalent sloping cementitious underlayment.
- .2 Underlayment: Cementitious, self-levelling, single component, polymer modified underlayment with manufacturer's recommended primer and crack repair materials; for application thicknesses to minimum feather edge to 13 mm; interior grade and as follows:
  - .1 Standard of Acceptance:
    - .1 K 15 Premium Self Levelling Underlayment, Ardex.
    - .2 CustomTech TechLevel 150, Custom Building Products
    - .3 Novoplan® 2 Plus, MAPEI.
    - .4 Sikafloor Level 125, Sika.
    - .5 Sure-Flo ST, W.R. Meadows.
- .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 from 4 mm to 25 mm, and as follows:
  - .1 Standard of Acceptance:
    - .1 SD-P, Ardex.
    - .2 CustomTech TechPatch MP, Custom Building Products
    - .3 Mapecem 101, MAPEI.
    - .4 SikaQuick 1000, Sika.
    - .5 Sealtight Meadow-Crete H, W.R. Meadows.
- .4 Fine Finish Flash Patching Materials: Cementitious based, polymer modified, fine aggregate, single component, ultra-fast drying, early strength floor patching compounds having high adhesion with manufacturer's recommended primer and surface profile; for application in thicknesses from 0 mm to 6 mm, and as follows:

- .1 Standard of Acceptance:
  - .1 SD-F Feather Finish®, Ardex.
  - .2 CustomTech Silk Patch, Custom Building Products
  - .3 Planipatch®, MAPEI.
  - .4 Sika® Level SkimCoat CA, Sika.
  - .5 Sealtight Meadow-Patch® T1, W.R. Meadows.

## **2.4 ACCESSORIES**

- .1 Primer: Product compatible with and as recommended by patching and levelling product manufacturer.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: Verify concrete substrates before beginning of installation of Products specified in this Section.
  - .1 Ensure concrete floors are dry by using test methods recommended by flooring manufacturer, and exhibit negative alkalinity, carbonization or dusting.
  - .2 Installation of products specified in this Section will denote acceptance of site conditions.

### **3.2 PREPARATION**

- .1 Surface Preparation – General:
  - .1 All substrates must be structurally sound, dry, solid and stable.
  - .2 Substrate must be clean and free of dust, dirt, oil, grease, paint, curing agents, concrete sealers, latex compounds, loosely bonded toppings, loose particles, laitance, adhesive residue, and any other substance or condition that may prevent or reduce adhesion.
  - .3 Ensure substrates are sound, level, free of cracks greater than 3 mm in width, and changes in elevation that may adversely affect installation.
  - .4 Ensure concrete is free of any negative hydrostatic pressure and excessive moisture.
- .2 Surface Preparation – Underlayments and Overlayments:
  - .1 Prepare and mechanically profile concrete slabs in accordance with Section 09 05 13 - Mechanical Preparation of Flooring Substrates.
    - .1 Ensure substrate and ambient room temperatures are between 10°C and 35°C before application and for 72 hours after application.

### **3.3 INSTALLATION – UNDERLAYMENTS**

- .1 Mixing:
  - .1 Mix in clean mixer in accordance with manufacturer's written instructions. Use appropriate mixing and delivery method in accordance with area to receive underlayment.
- .2 If pump mixing is being used, periodically clean pump in accordance with manufacturer's written instructions.
  - .1 Do not overwater.

- .2 Thoroughly mix with high-speed mixer (at about 1100 rpm) to homogenous, smooth, lump-free consistency.
- .3 Do not overmix; which could cause air to become trapped, shortening pot life or causing pin holing during application and curing.
- .3 Application:
  - .1 Place Product in ribbon pattern to achieve continuous flow of wet material to avoid trapping air or creating cold joint.
  - .2 Set width of pour that is ideal for maintaining wet edge throughout placement; adjust width of pour to maintain wet edge.
  - .3 Immediately after placing Product, spread with gauge rake; smooth surface after achieving required thickness.

### **3.4 INSTALLATION – PATCHING AND FLASH PATCHING PRODUCTS**

- .1 Mixing:
  - .1 Mix in clean container in accordance with manufacturer's written instructions.
  - .2 Do not overwater.
  - .3 Thoroughly mix with low-speed mixer (at about 300 rpm) to smooth, lump-free consistency.
  - .4 Do not mix more material than can be applied within eight to ten minutes.
  - .5 Avoid air entrapment and prolonged mixing, which will shorten pot life.
- .2 Application:
  - .1 Select an appropriate flat-edge steel trowel.
  - .2 Immediately apply mixed patching and levelling products to substrate, according to the desired thickness. Do not exceed manufacturer's maximum single-coat thickness.
  - .3 Blend into surrounding area and finish to required smoothness.

### **3.5 PROTECTION**

- .1 Protect from traffic dirt or dust from other trades until final installation of floor covering.
- .2 Allow for extended periods of cure and protection when temperatures drop below 16°C and/or when relative humidity is higher than 70%.

### **3.6 SCHEDULE**

- .1 Refer to interior design Drawings for locations, product selections and other flooring-related requirements.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 05 41 00 - Structural Metal Stud Framing.
- .2 Section 05 50 00 - Metal Fabrications.
- .3 Section 06 10 00 - Rough Carpentry.
- .4 Section 07 21 16 - Blanket Insulation.
- .5 Section 07 21 19 - Foamed-in-Place Insulation.
- .6 Section 07 26 00 - Vapour Retarders.
- .7 Section 07 27 00 - Air Barriers.
- .8 Section 07 84 00 - Firestopping and Smoke Seals.
- .9 Section 07 92 00 - Joint Sealants.
- .10 Section 08 31 00 - Access Doors and Panels.
- .11 Section 09 22 00 - Non Structural Metal Framing.
- .12 Section 09 30 13 - Tiling.
- .13 Section 09 91 00 - Painting.
- .14 Section 10 28 10 - Toilet and Bath Accessories.
- .15 Other technical Sections as indicated.
- .16 Schedule A – Finishes.

**1.2 REFERENCES**

- .1 Aluminum Association (AA)
  - .1 AA DAF-45, Designation System for Aluminum Finishes.
- .2 ASTM International (ASTM)
  - .1 ASTM C475/C475M-17, 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 C840-18a, Specification for Application and Finishing of Gypsum Board.
  - .5 ASTM C954-18, 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 C1002-18, 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 C1177/C1177M-17, Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
  - .9 ASTM C1178/C1178M-18, Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel.

- .10 ASTM C1278/C1278M-17, Standard Specification for Fiber-Reinforced Gypsum Panel.
- .11 ASTM C1280-13a, Specification for Application of Exterior Gypsum Panel Products for Use as Sheathing.
- .12 ASTM C1396/C1396M-17, Standard Specification for Gypsum Board.
- .13 ASTM C1658/C1658M-18, Standard Specification for Glass Mat Gypsum Panels.
- .3 Gypsum Association (GA)
  - .1 GA-214-17, Recommended Levels of Gypsum Board Finish.
  - .2 GA-216-16, Application and Finishing of Gypsum Panel Products.
- .4 ULC Standards
  - .1 CAN/ULC S102 (2018), Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

### **1.3 ACTION AND INFORMATIONAL 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 Shop Drawings:
  - .1 Submit shop drawings showing elevations, sections and details of construction in accordance with Section 01 33 00 - Submittal Procedures and Section 01 45 00 - Quality Control.
  - .2 Delegated Design Requirements:
    - .1 For suspended ceiling applications, fire resistive rated walls, and for walls exceeding 3050 mm in height, exterior soffits, locations with two or more thicknesses of gypsum board, and acoustical ceilings (with 2 layers of gypsum board and insulation), submit shop drawings designed and sealed by a Professional Engineer (P.Eng.) licenced to practice in the Province of Ontario, showing elevations, plans, sections and details, including engineering calculations.
    - .2 Submit confirmation of stud thicknesses and spacings to suit spans and conditions as required to satisfy OBC and L/240 maximum deflection.

### **1.4 QUALITY ASSURANCE**

- .1 Delegated Design: Contractor shall engage the services of a Professional Engineer (P.Eng.) licenced to practice in Ontario to design and seal shop drawings.
- .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.
- .4 Fire-Test-Response Characteristics: For fire resistance-rated assemblies that incorporate non-loadbearing interior steel framing, provide materials and construction identical to those tested in assembly indicated according to CAN/ULC S101.

### **1.5 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.

## **1.6 SITE ENVIRONMENTAL REQUIREMENTS**

- .1 Maintain temperature minimum 10°C, maximum 21°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.

## **Part 2 Products**

### **2.1 GYPSUM MATERIALS**

- .1 Standard Board: to ASTM C1396/C1396M and as follows:
  - .1 Type: regular and fire resistant.
  - .2 Size: 48" x maximum practical length.
  - .3 Thickness: as indicated on Drawings.
  - .4 Ends: square cut.
  - .5 Edges: tapered.
  - .6 Acceptable materials:
    - .1 ProRoc Wallboard (Type X), CertainTeed.
    - .2 Sheetrock (Firecode), CGC Inc.
    - .3 Toughrock Gypsum Wallboard (Fireguard), Georgia-Pacific Canada, Inc.
    - .4 Cabot Regular Board and Cabot Type X Light.
- .2 Mould-Resistant Board: to ASTM C1396/C1396M, mould resistance to ASTM D3273, and as follows:
  - .1 Type: regular and fire resistant.
  - .2 Size: 1200 mm x maximum practical length.
  - .3 Thickness: as indicated on Drawings.
  - .4 Acceptable materials:
    - .1 CGC Inc., Fiberock Aqua-Tough Interior Panels
    - .2 Georgia Pacific Canada, Inc., DensArmor Plus Interior Panels
    - .3 Cabot Protect M + M
- .3 Water-Resistant Gypsum Backing Board: to ASTM C1178 and as follows:
  - .1 Type: regular and fire resistant.
  - .2 Size: 1200 mm x maximum practical length.
  - .3 Thickness: as indicated on Drawings.
  - .4 Acceptable materials:
    - .1 Diamondback (Type X), CertainTeed.
    - .2 DensShield (Fireguard) Tile Backer, Georgia Pacific
    - .3 Fiberock Aqua-Tough Interior Panel Abuse Resistant (Type FRX), CGC Inc.
- .4 Cementitious Backer Board: to ASTM C1325 and as follows:
  - .1 Size: 48" x maximum practical length.

- .2 Thickness: as indicated on Drawings.
- .3 Acceptable materials:
  - .1 Durock, CGC Inc.
  - .2 Wonderboard, Custom Building Products Ltd.
  - .3 National Gypsum / CertainTeed Canada Permapase Cement Panel.

## **2.2 FRAMING MATERIALS**

- .1 Studs and Tracks: as indicated in Section 09 22 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 clips: 0.5 mm base steel thickness galvanized steel for resilient attachment of gypsum board.

## **2.3 INSULATION MATERIALS**

- .1 Blanket insulation: refer to Section 07 21 16 – Blanket Insulation.
- .2 Foamed-in-place air seal: refer to Section 07 21 19 – Foamed-in-Place Insulation.

## **2.4 INSULATION MATERIALS – INTERIOR WALLS AND CEILINGS**

- .1 Blanket insulation: refer to Section 07 21 16 – Blanket Insulation.
- .2 Foamed-in-place air seal: refer to Section 07 21 19 – Foamed-in-Place Insulation.

## **2.5 ACCESSORIES**

- .1 Sheathing board for roof assemblies: specified in roofing Sections.
- .2 Access doors: to Section 08 31 00 - Access Panels, and mechanical and electrical specifications.
- .3 Firestopping and smoke seals: to Section 07 84 00 – Firestopping and Smoke Seals.
- .4 Joint Sealants: to Section 07 92 00 - Joint Sealants.
- .5 Metal support systems: to Section 05 50 00 - Metal Fabrications and Section 09 22 00 - Non-Structural Metal Framing.
- .6 Blocking: to Section 06 10 00 - Rough Carpentry and Section 09 22 00 - Non-Structural Metal Framing.
- .7 Tile setting materials: to Section 09 30 13 - Tiling.
- .8 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.
- .9 Casing beads, corner beads, control joints and edge trim: to ASTM C1047, metal, zinc-coated by hot-dip process, .02" base thickness, perforated flanges, one-piece length per location. Provide transition caps at the base and head, by Trim-Tex or similar.
- .10 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.
- .11 Insulating Strip: rubberized, moisture-resistant, 1/8" thick closed cell neoprene or EPDM, full width of stud, with self-sticking permanent adhesive on one face, lengths as required.

- .12 Control Joints: No. 93 zinc Control Joint, by CGC Inc., or similar to same effect, with same or better physical properties and appearance, metal bellows shaped section with perforated flanges.
- .13 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 Exterior Gypsum Soffit Board: Fibreglass mesh tape.
    - .3 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 Cementitious Backer Board:
    - .1 Use setting type taping and setting type, sandable topping compounds, as recommended by board manufacturer for application and conditions.
  - .4 Joint Compound for interior Mould-Resistant Board and Water-Resistant Gypsum Backing Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
    - .1 Pre-filling: Setting type joint compound.
    - .2 Embedding and First Coat: Setting type joint compound.
    - .3 Fill Coat: Setting type, sandable topping compound.
    - .4 Skim Coat: Setting type joint compound, sandable topping compound.

## **2.6 FINISHES**

- .1 Paint: in accordance with Section 09 91 00 – Painting.
- .2 Other finishes as indicated.

## **Part 3 Execution**

### **3.1 COMPLIANCE AND GENERAL PROVISIONS**

- .1 Comply with manufacturer's printed installation instructions and illustrations, technical datasheets and specifications.
- .2 Install and finish gypsum board in accordance with ASTM C840 and GA-216, except where specified otherwise.
- .3 Install gypsum sheathing assemblies in accordance with ASTM C1280, except where specified otherwise.
- .4 Install hangers and runner channels for suspended gypsum board ceilings in accordance with ASTM C840, except where specified otherwise.

- .5 Work shall meet or exceed Ontario Building Code requirements.

### **3.2 ERECTION**

- .1 Support light fixtures by providing additional ceiling suspension hangers within 6" of each corner and at maximum 24" around perimeter of fixture.
- .2 Install work level to tolerance of 1:1200.
- .3 Frame with furring channels, perimeter of openings for access panels, light fixtures, diffusers, grilles.
- .4 Install 3/4" x 2-1/2" furring channels parallel to, and at exact locations of steel stud partition header track.
- .5 Furr gypsum board faced vertical bulkheads within and at termination of ceilings.
- .6 Furr above suspended ceilings for gypsum board fire and sound stops and to form plenum areas as indicated.
- .7 Install wall furring for gypsum board wall finishes in accordance with ASTM C840, except where specified otherwise.
- .8 Furr openings and around built-in equipment, cabinets, access panels, on four sides. Extend furring into reveals. Check clearances with equipment suppliers.
- .9 Furr duct shafts, beams, columns, pipes and exposed services where indicated.
- .10 Erect drywall resilient furring transversely across studs and joists spaced maximum 24" on centre and not more than 6" from ceiling/wall juncture. Secure to each support with 1" drywall screw.
- .11 Install 6" continuous strip of 1/2" gypsum board along base of partitions where resilient furring installed.

### **3.3 APPLICATION**

- .1 Do not apply gypsum board until bucks, anchors, blocking, sound attenuation, electrical and mechanical work are approved.
- .2 Before application of gypsum board commences, ensure that internal services have been installed, tested, and approved; that conduits, pipes, cables, and outlets are plugged, capped, or covered; and that fasteners and supports installed by others are in place.
- .3 Unless otherwise specified, erect gypsum board vertically or horizontally, whichever results in the fewest end joints.
- .4 Apply single or double layer gypsum board as indicated to metal furring or framing using screw fasteners. Maximum spacing of screws 12" 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 10".
    - .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 10" with base layer joints.
- .5 Apply moisture and mould resistant gypsum board adjacent to slop sinks and janitor's closets, in kitchen areas and washrooms (except where tile backer boards are used at tile locations). Apply mould-resistant sealant to edges, ends, cut-outs which expose gypsum core and to fastener heads. Do not apply joint treatment on areas to receive tile finish.
- .6 Apply 1/2" 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.
- .7 Install ceiling boards in direction that will minimize number of end-butt joints. Stagger end joints at least 10".
- .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.

### **3.4 ACCESSORIES**

- .1 At external corners install corner bead trim secured to framing at 9" on centre on both flanges using screw fasteners.
- .2 Secure casing trim at board edges where exposed to view, where board abuts against other materials that have no trim to conceal junction, and where indicated. Secure metal reveal trim where gypsum board abuts dissimilar materials at walls and ceilings. Fasten at maximum 9" on centre using screw fasteners.
- .3 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 6" on centre.

### **3.5 INSTALLATION**

- .1 Install casing beads around perimeter of suspended ceilings.
- .2 Install casing beads where gypsum board butts against surfaces having no trim concealing junction and where indicated. Seal joints with sealant.
- .3 Install insulating strips continuously at edges of gypsum board and casing beads abutting metal window and exterior door frames, to provide thermal break.
- .4 Install shadow mould at gypsum board/ceiling juncture as indicated. Minimize joints; use corner pieces and splicers.
- .5 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.
- .6 Provide continuous polyethylene dust barrier behind and across control joints.
- .7 Locate control joints where indicated and at changes in substrate construction at approximate 30 ft spacing on long corridor runs at approximate 50 ft spacing on ceilings.
- .8 Install control joints straight and true.

- .9 Extend board into door, window, and other openings, reveals, behind fitments, and other applied items and on metal stud partitions to structure above unless indicated otherwise.
- .10 Locate joints on opposite sides of partitions on different studs, and at least 12" from opening jambs.
- .11 Install board to minimize joints and align end joints to be the least objectionable (where they are unavoidable), according to the indicated lighting design. Locate joints in ceilings where least prominently discerned, and never line them up with opening edges.
- .12 Form smooth joints at ends and at field cut edges of board panels.
- .13 Fasten board to metal support members by metal gypsum board screws, 0.374" minimum to, and 1/2" maximum from, center of joints. Space screws:
  - .1 At fire rated board as per fire-rated assembly.
  - .2 At typical board walls at 12" on centre at edges and field unless otherwise required.
  - .3 At typical board ceilings at 12" on centre at edges and field unless otherwise required.
- .14 Offset gypsum board seams from corners of openings.
- .15 Unless otherwise shown or specified, extend gypsum board on both side of partitions to underside of structural slab above. Fasten gypsum board to studs, not to top channel. Allow for minimum 0.79" deflection.
- .16 Extend gypsum board close to floor with gap between board and floor not exceeding 0.2" and with bottom edge of board straight and unbroken.
- .17 Provide metal mouldings and trim at corners and terminations. Fastened with drywall screws. Provide corner beads at external corners. Provide casing beads around openings and reveal trim where gypsum board abuts dissimilar materials and construction.
- .18 Adhesive bonded gypsum board; apply 1/2" x 1/2" ribbons of laminating adhesive to back side of board, parallel to long dimension; space adhesive ribbons at maximum 6" on centre. Temporarily brace boards until complete adhesive bond develops.
- .19 Where double layer gypsum board is required, screw fasten second layer through first, into framing, offset joints.
- .20 Provide gypsum backing board for ceramic tile with coated side facing away from framing.
- .21 Install self-sticking resilient sponge isolation tape at edges of wall board in contact with aluminum curtainwall, aluminum windows and exterior door frames to provide thermal break. Adhere isolation tape to casing bead and compress during installation.
- .22 Provide tile backer board behind ceramic wall tile.

### 3.6

#### **CEMENTITIOUS BACKER BOARD**

- .1 Install in accordance with manufacturer's specifications and as indicated.
- .2 Apply cement board with rough side towards interior, as and with ends applicable, and edges over supports. Fit ends and edges closely, but not forced together. Stagger end joints in successive courses.
- .3 Fasten cement board to framing with specified fasteners. Drive fasteners in field of cement board first, working toward ends and edges. Hold cement board in firm contact with framing while driving fasteners. Space fasteners along framing with perimeter fasteners at least 0.374" and less than 5/8" from ends and edges. Drive fasteners so bottom of heads are flush with surface of cement board to provide firm board contact with framing. Do not drive fastener heads below panel surface.



- .4 Maximum fastener spacing as follows:
  - .1 Walls: 8".
  - .2 Ceiling: 6".
- .5 Perimeters: minimum 3/8" and maximum 5/8" from ends and edges.

### **3.7 ACOUSTICAL ASSEMBLIES**

- .1 Seal perimeters with acoustical sealant both side of partitions.
- .2 Seal penetrations through non-fire-rated assemblies per Section 07 92 00 – Joint Sealants: Type S-4. Seal penetrations through fire rated assemblies per Section 07 84 00.
- .3 Install fibrous acoustical insulation as required to fill spaces between studs.
- .4 Acoustical sealant and plaster:
  - .1 Apply two bead caulking system around horizontal and vertical perimeters of partitions. Apply continuous sealant beads at each side of horizontal top and bottom plates and vertical end studs, between gypsum board and adjacent construction.
  - .2 Apply bead of acoustic sealant to seal joint between penetrations and gypsum board at concealed and non-rated installations only. Where exposed, use interior sealant in accordance with Section 07 92 00.
  - .3 Completely seal objects at wall and gypsum board penetration (such as electrical boxes) with heavy coating of premixed perlite plaster.
  - .4 Apply sealant to clean, dry surfaces.
- .5 Ceilings:
  - .1 Install acoustic insulation on top of gypsum board, at perimeter of ceilings and at penetrations through ceilings. Accurately fit insulation at joints; leave no voids or gaps.
- .6 Sound attenuation insulation:
  - .1 Install sound attenuation insulation in the partition walls of the following walls:
    - .1 Common walls separating apartments.
  - .2 Install sound attenuation insulation in partition by filling voids with batts.
  - .3 Maintain air space between backs of sound attenuation insulation and back of opposite face layer.
  - .4 Pack sound attenuation insulation against ducts, conduits and services passing through wall assemblies.
  - .5 Extend acoustic wall assemblies to underside of structure. Incorporate approved provision to prevent transmittance of structural deflection to partition assembly.
  - .6 Install insulation by friction fit.
  - .7 Where studs are not faced with gypsum board on both sides, mechanically fasten wire mesh to non-faced side of stud to retain insulation.
  - .8 Mechanically attach sound attenuation insulation in wall assemblies where cavity of wall assembly is greater than 150 mm.
  - .9 Secure insulation in such a manner that it will not sag.
- .7 Sound Flanking Paths:
  - .1 Where partition walls intersect non-rated gypsum board partition walls, extend construction to completely close sound flanking paths through non-rated construction.

- .2 Seal joints between face layers at vertical interior angles of intersecting partitions.

### **3.8 TRIM**

- .1 Use same fasteners to anchor trim accessory flanges as required to fasten gypsum board to supports, unless otherwise recommended by trim manufacturer.
- .2 Install metal corner beads at external corners.
- .3 Install metal casing bead trim whenever edge of gypsum base would otherwise be exposed or semi exposed, and where gypsum base terminates against window, door, and curtainwall frames.
- .4 Erect beads plum or level, with minimum joints.
- .5 Provide metal reveal trim where gypsum board wall or ceiling abuts dissimilar materials and where indicated.
- .6 Provide aluminum reveal trim at perimeter of aluminum screens and where indicated.

### **3.9 CONTROL, EXPANSION AND RELIEF JOINTS**

- .1 Control joints:
  - .1 Provide continuous polyethylene dust barrier behind and across control joints.
  - .2 Provide control joints set in gypsum board facing. Support control joints with studs or furring channels on both sides of joint.
  - .3 Provide control joints where indicated, where directed by Consultant, and as follows:
    - .1 Partitions: 24 ft on centre, maximum
    - .2 Ceilings: 30 ft on centre, maximum.
  - .4 In addition, provide control joints in locations, in consultation with Consultant, where:
    - .1 Partition or furring abuts a structural element (except floor) or dissimilar wall or ceiling;
    - .2 Ceiling abuts a structural element, dissimilar wall or partition or other vertical penetration;
    - .3 Construction changes within the plane of the partition or ceiling;
    - .4 Partition or furring run exceeds 30ft;
    - .5 Ceiling dimensions exceed 50 ft in either direction with perimeter relief, 30 ft in either direction without.
    - .6 Wings of "L", "U", and "T" shaped ceiling areas are joined;
    - .7 Expansion or control joints occur in the base exterior wall.
  - .5 Line up control joints with joints in other construction or with center lines of mullions, columns, piers, or similar building elements, and where accepted by Consultant.
  - .6 Install control joints straight and true.
  - .7 Ceiling height door frames may be used as control joints. Less than ceiling height frames should have control joints extending to the ceiling from both corners. If control joints are not used, additional reinforcement is required at corners to distribute concentrated stresses.
  - .8 Construct through wall control joints at fire-rated assemblies in accordance with fire-rated assemblies in accordance with assembly listing requirements.

- .2 Expansion joints:
  - .1 Provide expansion joints in gypsum board elements located at building expansion joints.
  - .2 Unless otherwise shown, form expansion joint by terminating gypsum board edged with casing bead on both sides of joint and backed by minimum 1" thick aluminum plate fastened on one side only. Fabricate to align with adjacent floor expansion joint cover.
- .3 Relief joints:
  - .1 Provide relief joints where indicated and where gypsum board assemblies abut dissimilar construction.
  - .2 Where indicated, provide other mouldings, reveals, and feature strips. Install in accordance with manufacturer's directions, plumb, level, accurately aligned at joints, and securely fastened to supporting work.
  - .3 At exterior wall, where gypsum board abuts curtainwall, window, and door frames, provide isolation tape between casing bead and frame.

### **3.10 FIRE SEPARATIONS**

- .1 Install fire-rated assemblies in accordance with assembly listing requirements in order to obtain fire ratings indicated and as required by authorities having jurisdiction.
- .2 Vertical bulkheads in ceiling spaces over fire rated partitions, doors and the like shall have same fire rating as the partition over which they occur. Such bulkheads shall be of gypsum board construction unless otherwise indicated.
- .3 Use fire rated gypsum wallboard as specified.
- .4 Where lighting fixtures, diffusers, and the like are recessed into fire rated ceilings or bulkheads, provide enclosure to maintain required fire rating. Form removable panel to give access to fixture outlet box.
- .5 Where fire hose cabinets or other fixtures or equipment are recessed in fire rated walls or partitions, provide gypsum board enclosure or backing to maintain required fire rating, unless otherwise detailed.
- .6 Construct non-rated fire separations to same requirements as rated assembly but use standard gypsum board.

### **3.11 ACCESS DOORS**

- .1 Install access doors as specified in Section 08 31 00 in locations determined by coordination with trades installing mechanical, electrical, and other building services and consultation with Consultant.
- .2 Rigidly secure frames to furring or framing systems.
- .3 Some access panels require gypsum board infill, coordinate with electrical and mechanical for type and location.

### **3.12 FINISHING**

- .1 Gypsum Board Finish: finish gypsum board walls and ceilings to following levels in accordance with Gypsum Association GA-214, Recommended Levels of Gypsum Board Finish:
  - .1 Levels of finish:
    - .1 Level 1 for non-exposed areas: 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.
    - .2 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.
    - .3 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.
    - .4 Level 4 for exposed areas: 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.
    - .5 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 manufacturer's recommended compound to entire surface; surfaces smooth and free of tool marks and ridges.
      - .1 Use this level of finish to minimize joint photographing at long corridors and high walls as directed by Consultant.
      - .2 Use at Mould-Resistant Board and Water-Resistant Gypsum Backing Board locations.

### **3.13 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning. 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. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3 Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 - Construction Waste Management.

### **3.14 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

### **3.15 BOARD SCHEDULE**

- .1 Refer to Drawings for general requirements for partitions and walls; the additional requirements noted below are part of Contract and are required:

- .1 Use fire rated Type C and Type X board as required at fire rated wall and ceiling assemblies, meeting OBC requirements.
  - .1 Standard Board: general use, unless otherwise specified.
  - .2 High-Impact Gypsum Board: at locations where indicated.
  - .3 Mould-Resistant Board: at inside face of exterior walls except where cementitious backer board, water-resistant gypsum backing board.
  - .4 Water-Resistant Gypsum Backing Board: install at kitchen walls, laundry, wet rooms, and plumbing walls except where cementitious backer board is specified.
  - .5 Cementitious Backer Board (tile backer board): all tile locations.
  - .6 Refer to and coordinate requirements with Schedule A – Finishes.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 05 50 00 – Metal Fabrications.
- .2 Section 09 21 16 – Gypsum Board Assemblies.
- .3 Refer to and coordinate with other Sections as required for in-wall blocking and support structures.

**1.2 REFERENCES**

- .1 ASTM International (ASTM)
  - .1 ASTM C645-18, Standard Specification for Nonstructural Steel Framing Members.
  - .2 ASTM C754-20, Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
- .2 CSA Group (CSA)
  - .1 CSA S136-16 (R2021), North American Specification for the Design of Cold Formed Steel Structural Members.

**1.3 ADMINISTRATIVE REQUIREMENTS**

- .1 Convene pre-installation meetings one week prior to beginning work of this Section in accordance with Section 01 32 16 – Construction Schedule to:
  - .1 Verify project requirements.
  - .2 Review installation conditions.
  - .3 Coordinate with other building trades.
  - .4 Review manufacturer's instructions.

**1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications, and technical datasheets for each type of product indicated.
- .3 Shop Drawings:
  - .1 Submit shop drawings showing elevations, sections, and details of construction in accordance with Section 01 33 00 - Submittal Procedures and Section 01 45 00 - Quality Control.
  - .2 Delegated Design Requirements:
    - .1 For suspended ceiling applications, fire resistive rated walls, and for walls exceeding 3050 mm in height, exterior soffits, locations with two or more thicknesses of gypsum board, and acoustical ceilings (with 2 layers of gypsum board and insulation), submit shop drawings designed and sealed by a Professional Engineer (P.Eng.) licenced to practice in the Province of Ontario, showing elevations, plans, sections and details, including engineering calculations.
    - .2 Submit confirmation of stud thicknesses and spacings to suit spans and conditions as required to satisfy OBC and L/240 maximum deflection.

## **1.5 QUALITY ASSURANCE**

- .1 Delegated Design: Contractor shall engage the services of a Professional Engineer (P.Eng.) licenced to practice in Ontario to design and seal shop drawings specified in this Section in accordance with the requirements of Section 01 35 01 - Delegated Design.
- .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.

## **Part 2 Products**

### **2.1 CEILING SUPPORT MATERIALS AND SYSTEMS**

- .1 General: Size ceiling support components to comply with ASTM C754 and OBC unless otherwise indicated.
- .2 Protective Coating: to ASTM A653/A653M, G60 hot dipped galvanized.
- .3 Main Runners: steel channels, galvanized Z180, hot or cold rolled; Z275 hot dipped galvanized where used in high-humidity environments (e.g. shower rooms, other wet areas and outdoors).
- .4 Hanger Wire: to ASTM A641, soft, Class 1 galvanized generally, stainless steel in high-humidity environments (e.g. shower rooms, other wet areas and outdoors); minimum 4.064 mm (8 IWG).
- .5 Hanger Rods and Flats: mild steel with zinc coating.
- .6 Hanger anchoring devices:
  - .1 Screws, clips, bolts, concrete inserts or other devices applicable to the indicated method of structural anchorage for ceiling hangers and whose suitability for use intended has been proven through field-tested and conventional construction practices or by certified tests data. Size devices for 4X calculated load supported except size direct pull-out concrete inserts for 5X calculated loads.
  - .2 Interior concrete ceiling applications:
    - .1 Duynabolt Sleeve Anchor TW-1614 or Rendi-Tie-Drive TD4-112 tie-wire anchor by ITW Ramset/Red Head.
    - .2 Trubolt or Dynabolt anchors by ITW Ramset/Red Head.
    - .3 Kwik-Bolt II HCKB ¼ tie-wire anchor by Hilti Corporation.
    - .4 Kwik-Bolt II anchors by Hilti Corporation.
  - .3 Fasteners exposed or concealed in ceiling assemblies in high-humidity environments (e.g. shower rooms, other wet areas and outdoors):
    - .1 Wood ceiling anchor substrate: ITW Buildex Climaseal coated steel in applicable product lines specified in preceding paragraphs.
    - .2 Concrete ceiling anchor substrate: ITW Readhead Dynabolt 304 Stainless Steel with minimum 1.22 mm Z275 galvanized clip angles.
  - .4 Powder actuated fastening systems not permitted.
  - .5 Fasteners exposed to weather, condensation, corrosive conditions (e.g., exposed to de-icing salts or air-borne de-icing salt overspray from passing vehicles), high-humidity environments (e.g. shower rooms, other wet areas and outdoors): Z275 hot dipped galvanized or type 316 stainless steel fasteners in applicable product lines specified in preceding paragraphs.
- .7 Tie-Wire: 1.65 mm (16 IWG) zinc-coated annealed wire.

- .8 Furring anchorages: 16-gauge galvanized tie-wires, manufacturer's standard wire type clips, bolts, nails or screws as recommended by furring manufacturer and complying with ASTM C754.
- .9 Runner (Carry) Channels: 1.6 mm thick cold rolled steel, zinc coated for interior locations, Z275 coated where exposed to weather, condensation, corrosive conditions (e.g., exposed to de-icing salts or air-borne de-icing salt overspray from passing vehicles), or high-humidity environments (e.g. shower rooms, other wet areas and outdoors):
  - .1 38 mm x 13 mm where supported at centres of 914 mm maximum spacing.
  - .2 38 mm x 19 mm where supported at centres of 1220 mm maximum spacing.

## 2.2 METAL STUD ASSEMBLY MATERIALS - GENERAL

- .1 Maximum permitted deflection: L/240.
- .2 Coordinate with other trades as required.
- .3 Design Thickness, to CSA S136, and Stud Spacing:
  - .1 Submit Professional Engineer's (P.Eng.) confirmation of stud thicknesses and spacings to suit spans and conditions as required to satisfy OBC and L/240 maximum deflection.
  - .2 Non-rated Partitions: fabricated from minimum 0.478 mm thick material (Design Thickness). (Steel framing gauge no. for reference only: 25 ga.);
    - .1 High Span Requirements: Provide 0.84 mm thick (20 gauge) stud framing at high span areas where span requires thicker stud framing materials.
  - .3 Fire-Rated Partitions: fabricated from minimum 0.879 mm thick material; space studs at maximum 400 mm on centre or as otherwise indicated.
  - .4 At wall-mounted millwork and cabinetry, acoustical panels, toilet accessories, storage shelving, furniture and equipment, kitchen equipment and services, and other items requiring blocking and support to resist loads, supply and install the following as required to provide adequate support to resist loads:
    - .1 Backer Plates: 150 mm wide x 1.2 mm thick (minimum) steel backer plates in wall cut to fit and fixed to studs as required.
    - .2 Studs: fabricated from 0.84 mm thick material, minimum.
    - .3 Space studs at 300 mm on centre, or less as required.
  - .5 Single jamb studs at openings: fabricated from 0.84 mm thick material, minimum.
    - .1 Provide double stud framing at jambs.
- .4 Studs shall be hot dipped galvanized steel; roll formed with knurled flanges, services and bracing cut outs.
- .5 Knock-out service holes at 460 mm centres.
- .6 Runners: Width, gauge and galvanizing to match steel studs, and as follows:
  - .1 Bailey Carpet Base Track, or equivalent, manufactured with a 124 mm (4-7/8") deep leg. Provide at all gypsum board wall locations to receive epoxy integral cove base.
  - .2 Double Runner Deflection Track: Outside runner using 50 mm flanges; inner runner 33 mm; maintaining 25 mm minimum deflection space.
  - .3 Slotted Deflection Track for Fire Separations: Premanufactured slotted top runner with 63 mm down standing legs and having 6 mm wide x 38 mm high slots spaced at 25 mm on centre along length of runner; tested and certified for use in fire rated wall construction:
    - .1 Acceptable materials:



- .1 Brady Construction Innovations, SliptrackSystems
  - .2 Dietrich Metal Framing, SLP-TRK
- .2 Base Runner: Bottom track with 33 mm upstanding legs.
- .7 Gypsum board furring channels: 0.75 mm core thickness galvanized steel channels for screw attachment of gypsum board.
- .8 Resilient clips and channels as required: 0.5 mm base steel thickness galvanized steel for resilient attachment of gypsum board.
- .9 Dielectric Separator / Isolation Coating: Eck® Corrosion Prevention Coating, by Van Nay, LLC, or approved equivalent.
- .10 Acoustical sealant: to Section 07 92 00.
- .11 Insulating strip: rubberized, moisture resistant 3 mm thick cork or foam strip, 12 mm wide, with self sticking adhesive on one face, lengths as required.
- .12 Fasteners for Metal Framing: Type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- .13 Horizontal and Vertical Shaft Liner Framing System: to ASTM C645 manufacturer's standard shaft wall steel framing system having ASTM A653M, Z180, hot-dip galvanized zinc coating; minimum steel thickness of 0.84 mm thick (20 gauge) or heavier as required by detailed design required for indicated spans; including head and bottom rails, channels, trim and accessories required for a complete installation:
  - .1 Acceptable materials:
    - .1 Shaftwall Systems (CT Studs, J-Tabbed Tracks), by Bailey Metal Products Limited.
    - .2 C-H Stud Framing System, CGC Inc.
    - .3 C-T Stud Framing System, Georgia-Pacific Canada, Inc.
    - .4 Series IV – I Studs, CertainTeed.

## **2.3 ACOUSTIC WALL ASSEMBLY AND NOISE BARRIER CEILING MATERIALS**

- .1 Acoustic sealant: purpose made, non-skinning, non-hardening type to Section 07 92 00 - Joint Sealants, as manufactured by Tremco, CGC or approved equivalent.
- .2 Acoustic compound: premixed perlite plaster.
- .3 Acoustic insulation:
  - .1 Mineral-fibre batts: to CAN/ULC-S702, Type 1, and to CAN/ULC-S114.
  - .2 Acceptable products:
    - .1 Dense glass fibre: Rockwool AFB or equal.
  - .3 Thickness: 50 mm at 64 mm stud partitions. 75 mm (3") minimum at 92 mm stud partitions and as otherwise indicated.
  - .4 Fasteners: use mechanical fasteners to secure batts into position as recommended by manufacturer.
- .4 Acoustic insulation above ceilings, and at perimeters and penetrations of ceilings:  
Semi-rigid fibrous board: Noise-Stop, by Fiberglas Canada Inc., or equivalent product by other manufacturer approved by the Consultant - minimum 75 mm thick.

## **Part 3 Execution**

### **3.1 GENERAL**

- .1 Stud end bearing shall be a minimum of 25 mm.

- .2 Limiting heights shall be calculated using ICC-ES AC86.
- .3 Non-structural sections shall comply with ASTM C645.

### **3.2 ISOLATION COATING**

- .1 Apply isolation coating to contact surfaces in contact with cementitious materials, wood materials, and dissimilar metals.

### **3.3 ERECTION**

- .1 Install steel studs to ASTM C754 and to Ontario Building Code and amendments.
- .2 Predrill holes for gypsum board installation where stud material thickness is too great to accept typical self-tapping screw installation methods.
- .3 Align partition tracks at floor and ceiling and secure at 600 mm on centre maximum.
- .4 Install damp proof course under stud shoe tracks of partitions on slabs on grade.
- .5 Place studs vertically at 400 mm on centre, or as otherwise indicated or specified elsewhere in this Section, and not more than 50 mm from abutting walls, and at each side of openings and corners. Position studs in tracks at floor and ceiling. Cross-brace steel studs as required to provide rigid installation to manufacturer's instructions.
- .6 Erect metal studding to tolerance of 1:1000.
- .7 Attach studs to bottom track using screws; allow for 25 mm deflection at top track, or as otherwise stipulated by the structural drawings.
- .8 Coordinate simultaneous erection of studs with installation of service lines. When erecting studs, ensure web openings are aligned.
- .9 Coordinate erection of studs with installation of door/window frames and special supports or anchorage for work specified in other Sections.
- .10 Provide two studs extending from floor to ceiling at each side of openings wider than stud centres specified. Secure studs together, 50 mm apart using column clips or other approved means of fastening placed alongside frame anchor clips.
- .11 Install 1.438 mm thick (Design Thickness) single jamb studs at openings.
- .12 Erect track at head of door/window openings and sills of sidelight/window openings to accommodate intermediate studs. Secure track to studs at each end, in accordance with manufacturer's instructions. Install intermediate studs above and below openings in same manner and spacing as wall studs.
- .13 Frame openings and around built-in equipment, cabinets, access panels, on four sides. Extend framing into reveals. Check clearances with equipment suppliers.
- .14 Provide 40 mm stud or backer plates secured between studs for attachment of fixtures behind lavatory basins, toilet and bathroom accessories, and other fixtures including grab bars and towel rails, attached to steel stud partitions.
- .15 Install steel studs or backer plates between studs for attaching electrical and other boxes.
- .16 Extend partitions full height to underside of structure above (with allowances for structural movement) except where noted otherwise on drawings, or as otherwise required by OBC.
- .17 Maintain clearance under beams and structural slabs to avoid transmission of structural loads to studs. Use 50 mm leg ceiling tracks. Use double track slip joint as indicated.
- .18 Install continuous insulating strips to isolate studs from uninsulated surfaces.
- .19 Install two continuous beads of acoustical sealant or continuous insulating strip under studs and tracks around perimeter of sound control partitions.

- .20 Unless otherwise indicated, partitions, together with gypsum board facings, shall extend above ceilings to underside of structural slab or deck above.
- .21 Maintain clearance to avoid transference to structural loads to studs.
- .22 At fire rated and sound rated partitions, offset framing around beams and, if necessary, around ductwork running above top of partitions in order to maintain required separation.
- .23 At locations where partitions extend higher than 420 mm, provide diagonal stud framing to laterally brace partition framing above ceilings.
- .24 Lateral Support Bracing Channels:
  - .1 Stiffen partitions over 3 meters in vertical span at mid-height to maximum vertical spacing of 2400 mm on centre with at least one 19 mm horizontal bracing channel extending full length of partition, overlapping at least two stud spaces at ends of bracing channels. Secure bracing to stud framing.
  - .2 Stiffen partitions at not more than 150 mm from the top and bottom of openings and across two full stud spaces at each side of openings with horizontal bracing channel.
- .25 Double studs with continuous wood blocking (to Section 06 10 00 - Rough Carpentry) at jambs of openings.
- .26 Blocking:
  - .1 Attach adequate batten plates to framing as required to support the load of, and to withstand the withdrawal and shear forces imposed by, items studded upon the work of this Section, including but not necessarily limited to the following conditions:
    - .1 Washroom accessories.
    - .2 Cabinet work and finish carpentry.
    - .3 Miscellaneous specialties.
    - .4 Additional items indicated to be mounted on gypsum board partitions.

### **3.4 INSTALLATION: CEILING SUPPORT MATERIALS AND SYSTEMS**

- .1 Arrange hangers for suspended gypsum board ceilings to provide support independent of walls, columns, pipes, ducts; erect plumb, and securely anchored to structural frame, or embed in concrete slabs.
- .2 Keep lateral braces at hangers back 450 mm (18") unless otherwise noted.
- .3 Space hangers at 914 mm (36") on centre maximum along runner channels, and not more than 150 mm (6") from ends.
- .4 Space runner channels at 1220 mm (48") on centre, maximum, and not more than 150 mm (6") from boundary walls, interruptions of continuity, and changes in direction. Run channels transversely to structural framing members.
- .5 Where splices are necessary, lap members at least 200 mm (8") and wire each end with 2 loops. Avoid clustering or lining up of splices.
- .6 Attach to rod hangers by bending hanger sharply under bottom flange of runner, and securely wiring in place with saddle tie.
- .7 Where hangers are suspended from steel roof deck, make holes through both sides of deck troughs and pass hanger wire through and down both sides of trough. Wrap around vertical hanger rod.

- .8 Erect cross furring channels transversely across runner channels at 400 mm (16") on centre maximum, 305 mm (12") on centre at fire rated assemblies, at not more than 150 mm (6") from boundary wall openings, interruptions in ceiling continuity, and changes in direction.
- .9 Secure furring channels to each support with purpose-made slips or wire tie. Splice joints by lapping channels and tying together.
- .10 Install proprietary ceiling systems in accordance with manufacturer's printed directions.
- .11 Level cross furring channels to maximum tolerance of 3 mm in 3 m (1/8" in 10 ft.).
- .12 Where ductwork, piping, and other elements within ceiling spaces interfere with direct suspension of ceiling from structure, install additional framing securely fastened to main structure to accommodate proper hanging of ceiling.
- .13 Erect exterior soffit framing in accordance with reviewed shop drawings. Suspend soffit framing with metal studs and brace system to withstand positive and negative wind pressures without detrimental effects. Fasten furring members to surrounding walls. Use minimum 1.2 mm thick framing members.

### **3.5 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning. 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. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3 Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 – Waste Management and Disposal.

### **3.6 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .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 – Joint Sealants
- .5 Section 09 21 16 – Gypsum Board Assemblies
- .6 Schedule A – Finishes

**1.2 REFERENCES**

- .1 American National Standards Institute (ANSI)/Ceramic Tile Institute (CTI):
  - .1 ANSI/CTI A108/A118/A136-2020, Specification for the Installation of Ceramic Tile.
  - .2 ANSI/CTI A118.3-2013, Specifications for Chemical Resistant, Water Cleanable Tile-Setting and Grouting Epoxy and Water Cleanable Tile Setting Epoxy Adhesive.
  - .3 ANSI/CTI A118.4-2019, Specifications for Modified Dry-Set Cement Mortar.
  - .4 ANSI/CTI A118.5-1999 (R2021), Specification for Chemical Resistant Furan Resin Mortars and Grouts for Tile Installation.
  - .5 ANSI/CTI A118.6-2019, Specification for Standard Cement Grouts for Tile Installation.
  - .6 ANSI/CTI A118.7-2019, Specifications for High Performance Cement Grouts for Tile Installation.
  - .7 ANSI/CTI A118.10-2019, Specifications for Load Bearing, Bonded, Waterproof Membranes for Thin- Set Ceramic Tile and Dimension Stone Installation.
  - .8 ANSI/CTI A118.11-2017, Standard Specifications for EGP (Exterior Glue Plywood) Latex-Portland Cement Mortar.
  - .9 ANSI/CTI A118.15-2019, Specifications for Improved Modified Dry-Set Cement Mortar.
  - .10 ANSI A137.1-2019, American National Standards Specifications for Ceramic Tile.
  - .11 ANSI A326.3 – 2017, American National Standard Test Method for Measuring Dynamic Coefficient of Friction of Hard Surface Materials.
- .2 ASTM International (ASTM)
  - .1 ASTM C136/C136M-19, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
  - .2 ASTM C144-18, Standard Specification for Aggregate for Masonry Mortar.
  - .3 ASTM C150/C150M-20, Standard Specification for Portland Cement
  - .4 ASTM C207-18, Standard Specification for Hydrated Lime for Masonry Purposes.
  - .5 ASTM C373-18, Standard Test Methods for Determination of Water Absorption and Associated Properties by Vacuum Method for Pressed Ceramic Tiles and Glass Tiles and Boil Method for Extruded Ceramic Tiles and Non-tile Fired Ceramic Whiteware Products
  - .6 ASTM C627-18, Standard Test Method for Evaluating Ceramic Floor Tile Installation Systems Using the Robinson-Type Floor Tester.
  - .7 ASTM C847-18, Standard Specification for Metal Lath.

- .8 ASTM C979/C979M-16, Standard Specification for Pigments for Integrally Coloured Concrete.
- .9 ASTM E84-21, Standard Test Method for Surface Burning Characteristics of Building Materials.
- .3 CSA Group
  - .1 CSA-A3000-18, Cementitious materials compendium.
  - .2 CSA B651-18, Accessible Design for the Built Environment.
- .4 International Organization for Standardization (ISO)
  - .1 ISO 13007:2020, Ceramic Tiles- Grouts and Adhesives.
- .5 South Coast Air Quality Management District (SCAQMD), California State:
  - .1 SCAQMD Rule 1168-17, Adhesives and Sealants Applications.
- .6 Terrazzo Tile and Marble Association of Canada (TTMAC)
  - .1 Tile Specification Guide 09 30 00, 2019-2021, Tile Installation Manual.
  - .2 Hard Surface Maintenance Guide.
- .7 Tile Council of North America (TCNA)
  - .1 2021 TCNA Handbook for Ceramic, Glass, and Stone Tile Installation.
- .8 ULC Standards
  - .1 ULC 102.2- 2018, Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings, and Miscellaneous Materials and Assemblies.

### **1.3 ADMINISTRATIVE REQUIREMENTS**

- .1 Preconstruction Meeting: Arrange a preconstruction meeting in accordance with Section 01 31 19 – Project Meetings attended by Contractor, Consultant, 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 ACTION SUBMITTALS / INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Include manufacturer's information on:
    - .1 Ceramic tile, marked to show each type, size, and shape required.
    - .2 Mortars.
    - .3 Grouts
    - .4 Finishing and transition strips.
    - .5 Levelling compound.
    - .6 Waterproofing/crack isolation/uncoupling membrane.
    - .7 Expansion joints.

- .3 Submit shop drawings:
  - .1 Indicate tile layout, patterns, colour arrangement, perimeter conditions, junctions with dissimilar materials, thresholds, and setting details.
  - .2 Locate and detail movement joints.
- .4 Submit samples:
  - .1 Tile: Submit full-sized 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 Trims and transitions strips: submit duplicate manufacturer's samples, showing profile, material, and finish.

## **1.5 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Extra Materials
  - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
  - .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 Installer Qualifications: Specializing in tile work having minimum of five 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.
- .2 Conform to requirements of Terrazzo, Tile and Marble Association of Canada (TTMAC), Tile Specification Guide 09 30 13 - Tiling, Tile Installation Manual.
- .3 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.
- .4 Obtain setting and grouting materials from one manufacturer to ensure compatibility.

## **1.7 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver materials in containers with labels legible and intact and grade-seals unbroken.
- .2 Store materials to prevent damage or contamination.
- .3 Store materials in dry area, protected from freezing, staining and damage.
- .4 Store cementitious materials on dry surface.

## **1.8 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°C for 48 hours before, during, and 48 hours after, installation. Tile and setting material stored at same conditions 48 hours before and seven days after application.
- .3 Do not install tiles at temperatures less than 12°C or above 38°C.
- .4 Do not apply epoxy mortar and grouts at temperatures below 15°C or above 25°C.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Factory blend tile that exhibits colour variations within the ranges selected and package, therefore 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 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 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 - Concrete Finishing; measurements will be made in the same manner as used in Section 03 35 00 - Concrete Finishing.
    - .1 Large Format Tiles: provide minimum floor flatness of FF50; equivalent to 3 mm with no more than two gaps under 3000 mm straightedge measurement.

### **2.2 TILE**

- .1 Refer to Finishes Legend for acceptable products for Wall and Ceiling Tile.
- .2 Refer to Drawings for tile installation patterns.

### **2.3 MORTAR AND ADHESIVE MATERIALS**

- .1 Mortar to be of the following properties unless otherwise specified:
  - .1 Cement: Grey meeting requirements of CSA A3000.
  - .2 Sand: to ASTM C144, passing 16 mesh.
  - .3 Hydrated lime: to ASTM C207.
  - .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 Floor tile: premium, dry-set, large-format tile mortar, complying with ANSI A118.1, for use with systems with uncoupling membrane.
  - .1 Acceptable Materials:
    - .1 Uncoupling Membrane Mortar, MAPEI Inc.
- .3 Wall tile: premium, lightweight, polymer modified, non-sag, lightweight cement mortar with polymer and complying with ANSI A118.4, A118.11.
  - .1 Acceptable Materials:
    - .1 Ultralite Mortar, MAPEI Inc.



## **2.4 GROUT**

- .1 Floor tile: Epoxy grout, two-component, factory prepared, 100 percent solids epoxy with sand or mineral filler material; comply with ANSI A118.3 and ISO 130007 Classification R2/RG.
  - .1 Acceptable Materials:
    - .1 ARDEX WA by ARDEX Canada.
    - .2 Colour: As selected by Consultant from manufacturer's full range.
  - .2 Wall tile: ready-to-use grout, professional-grade, ready-to-use, colour consistent quartz aggregate, for use with grout joints 1.5 to 12 mm.
    - .1 Acceptable Materials:
      - .1 ARDEX DG-1 by ARDEX Canada.
      - .2 Colour: As selected by Consultant from manufacturer's full range.

## **2.5 MEMBRANES**

- .1 Uncoupling Membrane: Sheet membrane.
  - .1 Acceptable Materials:
    - .1 DITRA, Schluter Systems.
  - .2 Crack Suppression Membranes: Load bearing, liquid applied lightweight fabric reinforced crack isolation membrane; manufactured to accommodate in-plane substrate movement in thin set applications meeting requirements of ANSI A118.12 and as follows:
    - .1 Acceptable Materials:
      - .1 Mapelastic CI or AquaDefence, MAPEI Inc.
      - .2 RedGard Waterproofing and Crack Prevention Membrane, Custom Building Products.
      - .3 WP900 or WP980 WP/Crack Isolation Membrane with reinforcing fabric, Flextile Ltd.
      - .4 Hydro Ban, Laticrete International Inc.
- .3 Crack Isolation Membrane: Sheet membrane.
  - .1 Acceptable Materials:
    - .1 Mapeguard 2, MAPEI Inc.
    - .2 Crack Buster Pro Crack Prevention Mat with Peel & Stick Primer, Custom Building Products.
    - .3 Flexilastic 1000 Crack Isolation Membrane with 4000 Primer, Flextile Ltd.
    - .4 Fracture Ban, Laticrete International Inc.

## **2.6 ACCESSORIES**

- .1 Reinforcing mesh: 50 x 50 x 1.6 x 1.6 mm galvanized steel wire mesh, welded fabric design, in flat sheets.
- .2 Expansion and Control Joints: profiles joined by a thermoplastic rubber insert, with integral perforated anchoring legs for setting joint into setting bed:
  - .1 Height: As required to suit application.
  - .2 Colour: As selected by Consultant.
  - .3 Basis-of-Design Materials:
    - .1 DILEX, Schlüter®
- .3 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 Finishing strips for wall tile: profile with L-shaped visible surface, integrated perforated anchoring leg and integrated grout joint spacer.
  - .1 Material: anodized aluminum, matte white.
  - .2 Height: As required to suit application.
  - .3 Basis-of-Design Materials:
    - .1 JOLLY, Schlüter®.
- .5 Transition joint strip with integral perforated anchoring leg:
  - .1 Install at carpet-to-concrete transitions.
  - .2 Height: As required to suit application; ensure transition conforms to CSA B651 for accessibility.
  - .3 Material: brushed stainless steel.
  - .4 Basis-of-Design Materials:
    - .1 RENO-U Schlüter®.
- .6 Straight edge strips with integral perforated anchoring leg:
  - .1 Install at tile-to-concrete flooring transitions.
  - .2 Material: brushed stainless steel.
  - .3 Height: As required to suit application.
  - .4 Basis-of-Design Materials:
    - .1 SCHIENE, Schlüter®.
- .4 Sealant: in accordance with Section 07 92 00 - 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 one or two to tile and grout manufacturers recommendations.

## **2.7 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 NXT Level Plus, Laticrete International Inc.
  - .2 CustomTech TechLevel 150 with CustomTech TechPrime A, Custom Building Products.
  - .3 59 Flex Flo with 4040 Concrete Primer, Flextile Ltd.

.4 Ultraplan1 Plus, MAPEI Inc.

## **2.8 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 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.

### **3.2 INSTALLATION**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.
- .2 Perform tile work in accordance with TTMAC Tile Installation Manual except where specified otherwise.
- .3 Apply tile or backing coats to clean and sound surfaces.
- .4 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 sides 305 mm or larger in any dimension.
  - .2 Tile installed with chemical resistant mortars and grouts.
  - .3 Tile having 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.
- .5 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.
- .6 Maximum surface tolerance 1:800.
- .7 Make joints between tile uniform, plumb, straight, true, even and flush with adjacent tile. Confirm joint width with Consultant. Ensure sheet layout not visible after installation. Align patterns.
- .8 Lay out tiles as indicated on drawings so perimeter tiles are minimum 1/2 size.

- .9 Sound tiles after setting and replace hollow-sounding units to obtain full bond.
- .10 Install divider strips at junction of tile flooring and dissimilar materials.
- .11 Allow minimum 24 hours after installation of tiles, before grouting.
- .12 Clean installed tile surfaces after installation and grouting cured.
- .13 Install prefabricated control and movement joints in tile Work in accordance with detail 301MJ from TTMAC Installation Manual to suit installation indicated.
- .14 Locate expansion, control, contraction, and isolation joints, as indicated in TTMAC Installation manual to suit installation.
- .15 Fill control joints with sealant in accordance with Section 07 92 00 - Sealants. Keep building expansion joints free of mortar and grout.

### **3.3 WATERPROOFING AND UNCOUPLING MEMBRANE INSTALLATION**

- .1 Install waterproofing and uncoupling membrane in accordance with manufacturer's written instructions to produce membrane of uniform thickness bonded securely to substrate.

### **3.4 WALL TILE**

- .1 Install wall tile and tile wall base on gypsum board to TTMAC detail 305W.

### **3.5 FLOOR TILE**

- .1 Install large format floor tile in accordance with TTMAC detail 329 LFT.
  - .1 Include uncoupling membrane.
  - .2 Include movement and control joints.

### **3.6 TILE SEALER AND PROTECTIVE COATING**

- .1 Apply manufacturer's recommended floor sealer in accordance with manufacturer's written instructions for the specific tile type being sealed.

### **3.7 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.

### **3.8 CLEANING**

- .1 On completion of placement and grouting, clean 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 ten 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 grout manufacturer. Trap and remove coating to prevent it from clogging drains.

### **3.9 PROTECTION**

- .1 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 72 hours after completion of grouting.
    - .2 Use stepping boards where access is required for light foot traffic only after 24 hours from completion of grouting.
- .2 Provide protective covering until Substantial Performance of the Work.
- .3 Protect wall tiles and bases from impact, vibration, heavy hammering on adjacent and opposite walls for minimum 14 days after installation.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 09 21 16 – Gypsum Board Assemblies.
- .2 Section 09 53 00.01 – Acoustical Suspension.
- .3 Division 23 – Mechanical.
- .4 Division 26 – Electrical.
- .5 Legends on Drawings and Interior Finish Schedule.

**1.2 REFERENCES**

- .1 ASTM International (ASTM)
  - .1 ASTM C423-17, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
  - .2 ASTM E1110-06(2019), Standard Classification for Determination of Articulation Class.
  - .3 ASTM E1111/E1111M-14, Standard Test Method for Measuring the Interzone Attenuation of Open Office Components.
  - .4 ASTM E1264-19, Standard Classification for Acoustical Ceiling Products.
  - .5 ASTM E1414/E1414M-21 Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum.
- .2 ULC Standards
  - .1 CAN/ULC S102-18, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and data sheet for each product specified.
- .3 Samples:
  - .1 Submit duplicate manufacturer samples of each type of acoustical unit.
  - .2 Include accessories and mitered interior and exterior corners of wall moulding.
- .4 Shop Drawings.
  - .1 Submit Shop Drawings: Layout and details of acoustical ceilings. Show locations of items which are to be coordinated with, or supported by, ceilings.
- .5 Certifications: submit manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards. For acoustical performance, each carton of material shall carry an approved independent laboratory classification of NRC, CAC, and AC.

**1.4 QUALITY ASSURANCE**

- .1 Single-Source Responsibility: Provide perimeter trim components, panels and grid components by a single manufacturer.
- .2 Coordination of Work: Coordinate acoustical ceiling work with installers of related work including, but not limited to applied fireproofing, insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.

- .3 Certifications: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .4 Products shall meet or exceed Building Code requirements.
- .5 Mock-ups:
  - .1 Construct mock-ups in accordance with Section 01 45 00 – Quality Control.
  - .2 Construct mock-up 10 m<sup>2</sup> minimum of each type of acoustical panel, tile ceiling including one inside corner and one outside corner.
  - .3 Construct mock-up where directed.
  - .4 Allow 24 hours for inspection of mock-up by Consultant before proceeding with ceiling work.
  - .5 When accepted, mock-up will demonstrate minimum standard for this work. Mock-up may remain as part of the finished work.

#### **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.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect acoustical ceiling tiles and tracks from nicks, scratches, and blemishes, and other types of damage that may impair installation processes, resultant functionality, or durability of installation.
  - .3 Replace defective or damaged materials with new.

#### **1.6 SITE CONDITIONS**

- .1 Permit wet work to dry before beginning to install (e.g., paint, caulking, etc.).
- .2 Maintain uniform minimum temperature of 15°C and relative humidity of 20 40% before and during installation.
- .3 Store materials in work area 48 hours prior to installation.

#### **1.7 EXTRA MATERIALS**

- .1 Provide extra materials of acoustic units in accordance with Section 01 78 00 –Closeout Submittals.
- .2 Provide 2 sealed cartons of each type and finish of acoustical units incorporated into the Work.
- .3 Ensure extra materials are from same production run as installed materials.
- .4 Clearly identify each type of acoustic unit, including colour and texture.
- .5 Deliver to Owner upon completion of the work of this section.

#### **1.8 WARRANTIES**

- .1 Contractor agrees to correct any deficiencies in labour or material found in the work performed for 2 years from date of Substantial Performance.
- .2 Submit manufacturer's warranty in accordance with the requirements of Section 01 78 00 - Closeout Submittals, made out in Owner's name, for each Product specified.

## **Part 2 Products**

### **2.1 DESIGN REQUIREMENTS**

- .1 Maximum deflection: 1/360th of span to ASTM C635 deflection test.
- .2 Refer to Interior Finish Schedule on Drawings.

### **2.2 MATERIALS**

- .1 Acoustic Panels: conforming to ASTM E1264.
  - .1 Standard of Acceptance: Armstrong Lyra.
    - .1 Classification: Type XII, Form 2, Pattern E.
    - .2 Sizes: as indicated.
    - .3 Thickness: 24 mm (15/16 inch).
    - .4 Material: fibreglass.
    - .5 Surface Finish: Acoustically transparent membrane with factory applied latex paint.
    - .6 Edges: square tegular.
    - .7 Colour: as selected by Consultant from manufacturer's full range.
    - .8 Texture: Smooth.
    - .9 Noise Reduction Coefficient (NRC): 0.95.
    - .10 Fire Class (CAN/ULC S102): Class A.
    - .11 Light Reflectance (LR): 0.88.
    - .12 VOC Emissions: GreenGuard Gold Certified.
- .2 Suspension systems: to Section 09 53 00.01 – Acoustical Suspension specifications.
- .3 Accessories: manufacturer's supplied or recommended accessories as required for complete installations.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions are acceptable for product installation in accordance with manufacturer's written instructions.
  - .1 Check and verify that no irregularities exist that would affect quality of execution of work specified.
  - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

### **3.2 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's printed preparation and installation instructions, technical datasheets, and specifications.

### **3.3 COORDINATION AND SEQUENCING**

- .1 Coordinate and sequence work with work of other trades to ensure proper installations, maintenance of project construction schedule, and completion of necessary work that is required above suspended ceiling system. Do not install panels until work above ceiling panels has been reviewed by Consultant.



- .2 Coordinate ceiling work to accommodate components of other sections, such as light fixtures, diffusers, speakers, sprinkler heads, to be built into acoustical ceiling components.
- .3 Work of Section 09 53 00.01 - Acoustical Suspension shall be coordinated, and in place as required, ready for installation of panels.

### **3.4 INSTALLATION**

- .1 Install acoustical panels and tiles in ceiling suspension system in accordance with manufacturer's printed installation instructions and details.
- .2 Install acoustical units parallel to building lines with edge unit not less than 50% of unit width with directional pattern running in same direction. Refer to reflected ceiling plan.
- .3 Scribe acoustic units to fit adjacent work. Butt joints tight, terminate edges with moulding.
- .4 Finish cut edges with manufacturer's touch-up paint.

### **3.5 CLEANING**

- .1 Cleaning: in accordance with Section 01 74 11 - Cleaning. Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3 Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 – Waste Management and Disposal.

### **3.6 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 09 51 13 – Acoustical Panel Ceilings.
- .2 Section 09 21 16 – Gypsum Board Assemblies.
- .3 Division 23 – Mechanical.
- .4 Division 26 – Electrical.
- .5 Schedules.

**1.2 REFERENCES**

- .1 ASTM International (ASTM)
  - .1 ASTM A641/A641M-19, Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
  - .2 ASTM C635/C635M-17, Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
  - .3 ASTM C636/C636M-19, Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for acoustical suspension and include product characteristics, performance criteria, physical size, finish, and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
  - .2 Submit reflected ceiling plans for special grid patterns as indicated.
  - .3 Indicate lay-out, insert and hanger spacing and fastening details, splicing method for main and cross runners, location of access splines, change in level details, access door dimensions, and locations, acoustical unit support at ceiling fixture, and lateral bracing and accessories.
- .4 Samples:
  - .1 Submit for review and acceptance of each unit.
  - .2 Samples will be returned for inclusion into work.
  - .3 Submit one representative model of each type ceiling suspension system.
  - .4 Ceiling system to show basic construction and assembly, treatment at walls, recessed fixtures, splicing, interlocking, finishes, acoustical unit installation.

**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 acoustical suspension for incorporation into manual.

## **1.5 MOCK-UPS**

- .1 Erect mock-up in accordance with Section 01 45 00.
- .2 Construct in locations acceptable to Consultant a typical sample installation. Modify sample as directed and as required to obtain acceptance. Upon acceptance retain sample as standard of quality for acoustical ceiling.
- .3 Do not begin fabrication and erection of remainder of ceiling system until sample installation has been reviewed and accepted. Accepted sample may become part of the Work, subject of approval of Consultant.

## **1.6 CERTIFICATE OF COMPLIANCE**

- .1 Provide certificate of compliance stating that the suspension system provided, including materials and installation, comply with the requirements of the Contract Documents.

## **1.7 QUALITY ASSURANCE**

- .1 Certifications: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .2 Coordinate and sequence work to permit electrical, mechanical and fireproofing work to be performed before installing suspension systems. Coordinate installation and anchors and tie wire with fireproofing to ensure applied fireproofing is not compromised by installation work.

## **1.8 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .2 Storage and Handling Requirements:
  - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect acoustical ceiling tiles and tracks from nicks, scratches, and blemishes, and other types of damage that may impair installation processes, resultant functionality, or durability of installation.
  - .3 Replace defective or damaged materials with new.

## **1.9 WARRANTIES**

- .1 Contractor agrees to correct deficiencies in labour or material found in the work performed for a period of 2 years from date of Substantial Performance.

## **Part 2 Products**

### **2.1 DESIGN**

- .1 Design Requirements: maximum deflection: L/360 of span to ASTM C635/ASTM C635M deflection test.
- .2 Subject to requirements of Section 01 62 00 - Product Options and Substitutions, refer to schedules on Drawings suspension system requirements. Coordinate with Drawings.
- .3 Design suspension system to support safely, and without distortion, the superimposed loads of:
  - .1 Air supply diffusers and return grilles.

- .2 Lighting fixtures according to local building regulations and submit permits as required under the Ontario Building Code and Canadian Electrical Code.
- .4 Coordinate installation and cooperate with mechanical and electrical Subcontractors, to accommodate mechanical and electrical items, or any other work required to be incorporated in or coordinated with the ceiling system.

## 2.2 METAL SUSPENSION SYSTEMS

- .1 Dielectric Separator / Isolation Coating.
- .2 Concrete hanger anchors; post installed: Steel eye bolts and nuts to suit ceiling hangers with capability to sustain, without failure, load equal to 4 times that imposed by ceiling construction, as determined by testing per ASTM E488, conducted by a qualified independent testing laboratory.
  - .1 Dynabolt Sleeve Anchor 'TW-1614' or Rendi-Tie-Drive 'TD4-112' tie wire anchor by ITW Ramset/Red Head.
  - .2 Kwik-Bolt II 'HCKB 1/4' tie wire anchor by Hilti Corporation.
  - .3 Fasteners exposed to weather, condensation, and corrosion: Zinc-plated or stainless steel fasteners in applicable product lines specified in preceding paragraphs.
- .3 Hangers: Galvanized wire, recommended by manufacturer of suspension system, minimum 2.66 mm diameter.
- .4 Tie Wire: 1.519 mm diameter, galvanized steel wire.
- .5 Metal Finish: Metal exposed in finished work shall have a pre-coated baked enamel finish in non-yellowing, flat white. Submit paint formulation of grid system to lighting fixture, speaker grille, sprinkler and diffuser manufacturers to ensure consistency of colour, sheen and texture of all exposed metal components in the ceiling assemblies.
- .6 Standard Suspension systems:
  - .1 Standard exposed grid system, 'Prelude XL' by Armstrong or equivalent system by other manufacturer acceptable to Consultant and as follows:
    - .1 Main tees: 38 mm high x 25 mm exposed face bulb section, minimum 0.5 mm thick cold rolled galvanized steel.
    - .2 Cross tees: 25 mm wide, minimum 0.5 mm thick cold rolled galvanized steel; profile designed to limit deflection to 1/360 of span; designed to have suitable detail to rest on, automatically engage, level and lock to main tee.
    - .3 Wall moulding: pre-finished 25 mm exposed face galvanized steel shadow moulding with 13 mm reveal, #7875 by Armstrong or equal. Use preformed corner mouldings.
    - .4 Wall mouldings at round columns: Extruded aluminum with finish to match ceiling grid, Fry Column Collar for acoustic ceilings with white PVC spacer.
    - .5 Hangers: minimum 2.5 mm galvanized steel wire.
    - .6 Carrying channels: minimum 1.5 mm thick cold-rolled galvanized steel channels 50 x 25 mm.
  - .2 Unless otherwise specified or indicated on drawings, finish for exposed metal surfaces: satin enamel white and bright white, matching acoustic panels.
  - .3 Provide hot dipped galvanized suspension system for high-humidity areas; confirm locations with Consultant prior to ordering materials and installing suspended ceilings (examples of high-humidity rooms are rooms like laundry, kitchen, any room with a shower stall in it, and similar). Provide white enamel finish on exposed surfaces.

- .4 Suspension system accessories: Splices, clips, and perimeter shadow moulding, of manufacturer's standard type to suit the applicable conditions unless special conditions and access area are shown or specified.
- .5 Ceiling trim at recessed roll down window blinds: Clear anodized extruded aluminum "T" trim, 38 mm exposed face, 19 mm vertical leg, to suit roll down blind mounting.
- .7 Accessories: manufacturer's supplied or recommended accessories as required for complete installations.

## **2.3 NOISE BARRIER CEILING MATERIALS**

- .1 Locations: ceilings beneath mechanical room floor slabs.
- .2 Acoustic sealant: purpose made, non-skinning, non-hardening type to Section 07 92 00 - Joint Sealants, as manufactured by Tremco, CGC or approved equivalent.
- .3 Acoustic insulation above ceilings, and at perimeters and penetrations of ceilings: Semi-rigid fibrous board: Noise-Stop, by Fiberglas Canada Inc., or equivalent product by other manufacturer approved by the Consultant - minimum 75mm thick.
- .4 Spring hangers for acoustic ceiling construction: supplied by Section 13 48 23 - Fabricated Sound and Vibration Control Assemblies, and installed by this Section for acoustical panel ceiling finishes beneath mechanical rooms, and as indicated.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions are acceptable for product installation in accordance with manufacturer's written instructions.
  - .1 Check and verify that no irregularities exist that would affect quality of execution of work specified.
  - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

### **3.2 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's printed preparation and installation instructions, technical datasheets, recommended details and specifications.

### **3.3 ISOLATION COATING**

- .1 Apply isolation coating to contact surfaces in contact with cementitious materials, wood materials, and dissimilar metals.

### **3.4 INSTALLATION - GENERAL**

- .1 Do not start installation until exterior glazing has been completed and exterior openings are closed in. Ensure wet work is completed and dried out to a degree acceptable to panel manufacturer before installation is commenced. Maintain uniform temperatures of at least 16 °C for 72 hours prior to commencement of the work of this section and maintain temperature until completion of the work of this section.
- .2 Install ceiling panels and metal suspension system in accordance with manufacturer's directions. Where manufacturer's directions are at variance with Contract Documents, notify Consultant before proceeding with installation.

- .3 Do not commence installation until work above suspended ceiling has been completed, inspected, and accepted.
- .4 Ensure that work to be concealed by ceiling systems has been installed, tested, inspected, and approved before starting work.
- .5 Lay out ceilings in accordance with reflected ceiling plans and symmetrical within each area to obtain uniform borders. Where layout is not shown, install ceilings as directed by Consultant.

### **3.5 INSTALLATION - SUSPENSION SYSTEM**

- .1 Install noise barrier ceiling materials as required.
- .2 Install suspension system rigid, secure, square, level and plumb, framed and erected to maintain dimensions and contours indicated, and in accordance with ASTM C636, CISCA installation standards and any other applicable national or local code requirements. Make allowance for thermal and structural movement.
- .3 Suspend ceilings directly from structural members and not from ducts, pipes, conduits.
- .4 Where ductwork, piping and other elements within ceiling spaces interfere with direct suspension of ceiling from structure, install additional framing securely fastened to main structure to accommodate proper hanging of ceiling.
- .5 At light fixtures occurring on and in suspended ceilings, provide suspension hanger at each corner of fixture and at maximum 610 mm on centre around perimeter of fixture.
- .6 Attach hangers to structure with inserts and hanger supports. Do not use powder activated fasteners.
- .7 Support hangers for suspended ceiling grid independent of walls, columns, pipes and ducts.
- .8 Space hangers for ceilings at maximum 1220 mm (48 inches) on centre in both directions. Provide additional hangers as required.
- .9 Locate hangers at not more than 150 mm (6 inches) from ends of main tee members.
- .10 Erect suspension systems at required heights and water tube, transit, or laser beam level to tolerance of 1:1200.
- .11 Allowable tolerances: to ASTM C636.
- .12 Design suspension systems for maximum mid-span deflection of  $L/360$ .
- .13 Install exposed tee members to pattern indicated. Securely attach hangers to main tee members.
- .14 Make exposed tees in greatest lengths possible to minimize joints. Make joints square, tight, flush and reinforce with splines. Distribute joints to prevent clustering in one area.
- .15 Space tee bars to suit ceiling panels and as detailed, and to accommodate lighting fixtures, diffusers and return grilles.
- .16 Cooperate in installation of ceiling systems, making adjustments where required to ensure that lighting fixtures, supply diffusers, exhaust grilles and other built-in items properly fit into ceiling module and finish flush with rest of ceiling.
- .17 Restrict creep inside module panels so that in all cases strips are centred on module lines.
- .18 Install perimeter shadow moulding where ceiling abuts vertical surfaces and abuts adjacent gypsum board ceiling system. Mitre all corners, use maximum lengths to minimize joints. Make joints square, tight and flush.

- .19 Apply continuous ribbon of acoustical sealant, concealed on back of vertical leg before installing mouldings.
- .20 Screw-attach mouldings to substrates at intervals not more than 400 mm (16") on centre and not more than 210 mm (8") from ends, levelling with suspension system to tolerance of 3 mm in 3660 mm (1/8" in 12'-0"). Mitre corners accurately and connect securely.
- .21 Provide perimeter shadow wall mouldings and cross tees at radiant heating panels mounted in both acoustic and gypsum board ceilings, as required to support heating panels (full perimeter). Provide cross tees at joints, splices, intermediate supports and access panels in radiant heating panels. Design system to adequately support radiant heating units. Coordinate with Mechanical Division.
- .22 Provide metal edge trim at perimeter of floating acoustic ceiling system at required locations, as detailed. Provide concealed connections to suspension system and prefabricated covers.

### **3.6 ROLL DOWN BLINDS (ROLLER WINDOW SHADES)**

- .1 Install mounting brackets for blinds head assembly supplied by Section 12 21 16 - Roller Shades where blinds are to be recessed into ceiling assembly. Securely fasten to supporting substrate, at maximum 1500 mm spacing and at ends of each blind unit.
- .2 Supply and install clear anodized extruded aluminum ceiling trim at recessed roll down blinds head assembly, continuous full length of blinds and window opening. Securely fasten trim to blind mounting brackets.
- .3 Coordinate installation of roll down blind mounting brackets and ceiling trim with Section 09 21 16 - Gypsum Board Assemblies. Install brackets and trim level, flush with adjacent ceiling. Ceiling framing system not to be fastened to or supported on blind brackets and trim.

### **3.7 INSTALLATION – ACOUSTICAL PANELS**

- .1 Take precautions during installation to ensure tile edges are not chipped or otherwise damaged.
- .2 Install acoustical tiles to form horizontal and level ceiling with all parts flush and joints butted tightly to hairline appearance.
- .3 Distribute variations in colour and texture of panels to obtain uniform appearance.
- .4 Minimize field cutting. Where necessary, match factory cut edge and colour.
- .5 Install tiles so that work is clean and unmarked.
- .6 Neatly cut and fit tiles as required to suit ceiling layout and to accommodate other work.
- .7 Recessed items shall replace or be centred on tile unless otherwise indicated.

### **3.8 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning. 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. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3 Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.

**3.9 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Division 23 Mechanical: HVAC.
- .2 Division 26 Electrical: Lighting.
- .3 Drawings and ROOM FINISH SCHEDULE.

**1.2 REFERENCES**

- .1 ASTM International (ASTM)
  - .1 ASTM A641/A641M-09a(2014), Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
  - .2 ASTM A653/A653M-18, Standard Specification for Steel Sheet, Zinc-coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .3 ASTM A1008/A1008M-18, 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.
  - .4 ASTM C423-17, Standard Test Method for Sound Absorbing and Sound Absorbing Coefficient by Reverberation Room Method.
  - .5 ASTM C635/C635M-17, Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
  - .6 ASTM C636/C636M-19, Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.
  - .7 ASTM E84-19a, Standard Test Method for Surface Burning Characteristics of Building Materials.
- .2 ULC Standards
  - .1 CAN/ULC 102-18, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .3 Architectural Woodwork Manufacturers Association of Canada (AWMAC)
  - .1 North American Architectural Woodwork Standards, v 4.0, 2021, including Errata.
- .4 Ceilings and Interior Systems Construction Association (CISCA)
  - .1 Ceiling Systems Handbook.

**1.3 ADMINISTRATIVE REQUIREMENTS**

- .1 Coordination: Coordinate ceiling work with installers of related work including, but not limited to building insulation, gypsum board, acoustic ceilings, light fixtures, mechanical systems, electrical systems, and sprinklers.

**1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Datasheets:
  - .1 Submit manufacturer's product data sheets for suspension system components, including manufacturer's written installation instructions.
  - .2 Submit product data for wood slats, including fire ratings.
- .3 Shop Drawings:

- .1 Wood slat structural support and connections to structure: Submit engineered shop drawings for each ceiling type, designed and sealed by a Professional Engineer licenced to practice in Ontario showing details of construction and attachment to structure sufficient to withstand loads calculated to OBC criteria.

.4 Samples.

- .1 Submit duplicate 150 mm samples, full profile, of finished wood slats.
- .2 Submit duplicate manufacturer samples of Unistrut and threaded rod system.

**1.5 EXTRA MATERIALS**

- .1 Ceiling Units: Provide full-sized units equal to 5% of amount installed.
- .2 Suspension System Components: Provide Unistrut system components equal to 2% of amount installed.
- .3 Ensure extra materials are from same production run as installed materials.
- .4 Clearly identify each type of wood slat unit, including colour and texture.
- .5 Deliver to Consultant, upon completion of the work of this section.

**1.6 QUALITY ASSURANCE**

- .1 Coordination of Work: Coordinate wood slat ceiling work with installers of related work including, but not limited to applied fireproofing, insulation, gypsum board, light fixtures, mechanical systems, electrical systems, sprinklers, and painting.
- .2 Installers: Use installers having proven experience in completing wood ceilings having similar material, design, and complexity as that required for this project and having a record of successful in-service performance for the previous 2 years.
- .3 Manufacturers: Obtain materials from one source with resources to provide products from the same production run for each contiguous area of consistent quality in appearance and physical properties.

**1.7 MOCK-UPS**

- .1 Construct mock-up 10 m<sup>2</sup> minimum of each type of wood slat ceiling including one inside corner and one outside corner.
- .2 Construct mock-up where directed.
- .3 Allow for inspection of mock-up by Consultant before proceeding with ceiling work.
- .4 Accepted mock-up will demonstrate minimum standard for this work.
- .5 Mock-up may remain as part of the finished work.

**1.8 DELIVERY, STORAGE AND HANDLING**

- .1 Store materials in original, undamaged containers or wrapping with manufacturer's seals and labels intact.
- .2 Store materials in a dry interior location at room temperature and in a flat horizontal position.
- .3 Handle units to avoid chipped edges.

## **1.9 ENVIRONMENTAL REQUIREMENTS**

- .1 Perform installation when heating and cooling systems are operational, and temperature and humidity closely approximate interior operating conditions required for the final construction; allow wood materials to acclimate and stabilize to site conditions minimum 72 hours before installation, when site is free of wet and dusty work, and above ceiling work including lighting and other electrical and mechanical devices are completely installed.

## **1.10 WARRANTY**

- .1 Submit manufacturer's warranty in accordance with the requirements of Section 01 78 00 - Closeout Submittals, made out in Owner's name, for each Product specified.

## **Part 2 Products**

### **2.1 WOOD SLAT CEILING**

- .1 **(WSC1)** Wood Slat Ceiling:
  - .1 Wood: MDF, Class A rating to ASTM E84.
    - .1 Flame spread: maximum 25.
    - .2 Smoke developed: maximum 450.
  - .2 Faces: Wood Veneer, minimum 0.050 inch (1.27 mm) thick.
    - .1 Species: Refer to Finish Schedule.
  - .3 Finish: Refer to Finish Schedule.
  - .4 Plank size: 2 x 9-3/4 inches.

### **2.2 METAL SUSPENSION SYSTEMS**

- .1 Unistrut with threaded rod system, in galvanized steel, in sizes and quantities as determined by Professional Engineer, attachment to structure sufficient to withstand loads calculated to OBC criteria.
  - .1 Finish: paint in colours to match concrete slab.

### **2.3 ACCESSORIES**

- .1 Dielectric Separator / Isolation Coating: C.R. Laurence bituminous paint or aerosol, or accepted equivalent.

## **Part 3 Execution**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's printed installation instructions, technical datasheets, details and specifications.
- .2 Comply with OBC and requirements of authority having jurisdiction.

### **3.2 EXAMINATION**

- .1 Examine substrates and structural framing for compliance with requirements specified in this and other work that affect ceiling installation, anchorage, and other conditions affecting performance of wood panel ceiling.
- .2 Installation of ceiling system indicates acceptance of conditions.

### **3.3 PREPARATION**

- .1 Coordination: Furnish layouts for cast-in-place anchors, clips, and other ceiling anchors whose installation is specified in other Sections.
- .2 Layout: conform to layout shown on reflected ceiling plans in accordance with accepted Shop Drawings.

### **3.4 ISOLATION COATING**

- .1 Apply isolation coating to contact surfaces in contact with cementitious materials, wood materials, and dissimilar metals.
- .2 Apply isolation coating into drilled holes, onto fasteners (e.g., bolts, screws, rivets).
- .3 Generally, 2 – 3 mil thickness is required per application. Apply enough product so that excess isolation coating “oozes out” during assembly to ensure proper seal.
- .4 Assemble and wipe away excess isolation coating.

### **3.5 INSTALLATION**

- .1 Install ceiling suspension systems in accordance with ASTM C636 and OBC. Install, align, brace, tie-off, mount, handle interferences, and space suspension in accordance with accepted Shop Drawings.
- .2 Secure hangers to overhead structure using attachment methods in accordance with engineered, stamped shop drawings, Ontario Building Code requirements, and to the acceptance of authorities having jurisdiction.
- .3 Install suspension system as required by engineered, stamped shop drawings.
- .4 Install hangers, plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
- .5 Install wood ceiling in compliance with all local codes and regulations. Install with undamaged edges and fitted accurately to suspension system. Scribe and cut wood panels at borders and penetrations to provide a neat, precise fit, as required.
- .6 Install access panels as per manufacturer’s instructions in locations indicated on Drawings.
- .7 Coordinate with electrical and mechanical fittings, fixtures and products that penetrate the ceiling and need to be supported by structure. Treat all cut-outs to match finished of exposed wood.

### **3.6 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning. 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. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3 Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.

### **3.7 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 ASTM International
  - .1 ASTM A276/A276M-23, Standard Specification for Stainless Steel Bars and Shapes.
  - .2 ASTM C1028-96, Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method.

**1.2 ACTION AND INFORMATION SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00.
- .2 Product data:
  - .1 Submit product data sheets for each product supplied, including physical properties and performance characteristics, methods of installation, and limitations.
  - .2 Provide two copies of WHMIS SDS Safety Data Sheets.
- .3 Manufacturer's Instructions: Submit manufacturer's written installation instructions and illustrations.
- .4 Shop drawings: clearly indicate fabrication details, plans, elevations, hardware, and installation details. Show patterns for tactile warning domes.
- .5 Templates: Submit templates to Contractor for use by installers for proper spacing and installation of hardware.

**1.3 DELIVERY, STORAGE AND HANDLING**

- .1 Provide and maintain dry, off ground weatherproof storage.
- .2 Store products in dry and protected location providing protection from damage, humidity and exposure to the elements.
- .3 Store materials in accordance with manufacturer's written instructions.

**1.4 WARRANTIES**

- .1 Contractor agrees to correct any deficiencies found in the Work performed for a period of 24 months from the date of Substantial Performance.
- .2 Provide manufacturer's standard limited product warranty for each product supplied to project.

**Part 2 Products**

**2.1 TACTILE WARNING SYSTEMS**

- .1 Supply and install tactile attention indicators, conforming to OBC Article 3.8.3.18, at tops of exit stairs, starting one tread depth back from edge of top stair; and at leading edge of landings where a doorway opens onto stairs, starting one tread depth back from edge of landing.
- .2 Tactile Warning Surfacing: Peg type with truncated domes, Type 316 stainless steel to ASTM A276, adhesive installed.
  - .1 Static coefficient of friction (ASTM C1028):  $\geq 0.8$  wet/dry.
  - .2 Acceptable materials:

- .1 Advantage ONE Tactile Walking Surface Indicators, Kinesik Engineered Products.
- .1 Pattern: Concentric Rings.

### **Part 3 Execution**

#### **3.1 COMPLIANCE**

- .1 Comply with manufacturer's printed installation instructions and illustrations, technical datasheets, and specifications.

#### **3.2 INSTALLATION**

- .1 Install materials, products and systems in accordance with manufacturer's published installation instructions and illustrations.
- .2 Submit manufacturer's information and templates required for installation of work specified in this Section.
- .3 Carefully drill holes to manufacturer's recommended depth using templates acceptable to Consultant. Clean dust and debris from holes.
- .4 Install using adhesive as recommended by manufacturer, being careful to not overfill holes with adhesive. Immediately clean excess adhesive with manufacturer's recommended cleaning agent to avoid staining.

#### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning. 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. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3 Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.

#### **3.4 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 07 92 00 – Joint Sealants.
- .2 Section 09 30 13 – Tiling.
- .3 Section 09 91 00 – Painting.
- .4 Refer to Drawings and Room Finish Schedule.

**1.2 REFERENCE STANDARDS**

- .1 ASTM International (ASTM)
  - .1 ASTM F1303-04(2021), Standard Specification for Sheet Vinyl Floor Covering with Backing
  - .2 ASTM F1861-21, Standard Specification for Resilient Wall Base
  - .3 ASTM D2047-17, Standard Test Method for Static Coefficient of Friction of Polish-Coated Flooring Surfaces as Measured by the James Machine
  - .4 ASTM D3389-21, Standard Test Method for Coated Fabrics Abrasion Resistance (Rotary Platform Abrader)

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product data:
  - .1 Submit manufacturer's product data sheets for resilient flooring, rubber base, transition strips, adhesives, and subfloor patching compound.
  - .2 Submit WHMIS SDS - Safety Data Sheets acceptable to Labour Canada and Health Canada for carpet adhesive and seam adhesive. Indicate VOC content. Indoor carpet adhesives shall not exceed 50 g/L VOC limit.
  - .3 Submit data on specified products, describing physical and performance characteristics, sizes, patterns, colours, and methods of installation.
- .3 Submit duplicate 300 x 300 mm manufacturer sample pieces of sheet material, and 300 mm lengths of base and transition strips.
- .4 Closeout Submittals:
  - .1 Provide maintenance data for resilient flooring for incorporation into Operation and Maintenance Manual.

**1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Manufacturer's written requirements.
- .2 Waste Management and Disposal:
  - .1 Separate waste materials for recycling in accordance with Waste Management Plan.

**1.5 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.

## **1.6 MAINTENANCE**

- .1 Extra Materials:
  - .1 Provide extra materials: 5 m<sup>2</sup> of each colour, pattern and type flooring material required for project for maintenance use.
  - .2 Extra materials one piece and from same production run as installed materials.
  - .3 Identify each roll of sheet flooring and each container of adhesive.
  - .4 Deliver to Place of Work at one week prior to Substantial Completion.

## **1.7 WARRANTIES**

- .1 Contractor shall correct any deficiencies of labour or material found in the work performed for a period of 2-years from date of Substantial Performance.
- .2 Provide manufacturers' warranties as specified in article 2.1 MATERIALS.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Resilient sheet flooring (**L-1**): To ASTM F1303, Type I, Grade 1, Class B; sheet vinyl floor covering with backing.
  - .1 Total Thickness: 2.0 mm.
  - .2 Wear layer: 0.8 mm.
  - .3 Minimum width: 2.0 meters.
  - .4 Static coefficient of friction (ASTM D2047):  $\geq 0.5$ .
  - .5 Acceptable material:
    - .1 Tarkett Acczent Concrete.
      - .1 Colour: 28500 – Cool Grey.
- .2 Resilient athletic flooring (**RAF-1**): Indoor resilient multipurpose flooring, blended rubber.
  - .1 Total thickness: 9.5 mm (3/8 inch).
  - .2 Shore A hardness (ASTM D2240):  $65 \pm 5$ .
  - .3 Coefficient of friction (ASTM D2047): Minimum 0.5.
  - .4 Abrasion (ASTM D3389): < 1.00 g loss.
  - .5 Weight: 2.0 lb/ft<sup>2</sup>.
  - .6 Roll width: 48 inches (1200 mm).
  - .7 Acceptable material:
    - .1 Tarkett Replay Multi-functional and Sports Flooring.
      - .1 Colour: Speckled Biscuit.
- .3 Resilient base: To ASTM F1861, continuous, top set, complete with pre-moulded end stops and external corners:
  - .1 Type: TV - Thermoplastic Rubber.
  - .2 Group: 1 - solid.
  - .3 Thickness: 1/8 inch.
  - .4 Height: 2-1/2 inches.
  - .5 Acceptable material:
    - .1 Tarkett Johnsonite Traditional Vinyl Wall Base.



- .2 Colours: as selected by Consultant from manufacturer's standard range. Allow for six different colours.
- .4 Vinyl reducing strips, and wheeled traffic transition strips and adapters, tapered, to suit thickness of flooring, colours as selected by Consultant.
  - .1 Acceptable Materials:
    - .1 Product types as selected by Consultant to suit flooring and conditions, by Johnsonite, or equivalent.
- .5 Cementitious underlayment: Self-levelling, polymer-modified, quick-setting cement based underlayment.
  - .1 Acceptable Materials:
    - .1 59 Flex-Flo by Flextile for levelling up to 12.7 mm (1/2") in thickness,
    - .2 5900 Flex-Flo Plus by Flextile for levelling up to 50 mm (2") in thickness,
    - .3 or equivalent.
- .6 External corner protectors: stainless steel, type recommended by flooring manufacturer.
- .7 Sub-floor filler and leveller: white premix latex requiring water only to produce cementitious paste as recommended by flooring manufacturer for use with their product.
- .8 Primers and adhesives: of types recommended by resilient flooring manufacturer for specific material on applicable substrate, above, on or below grade.
- .9 Welding rod: designed to weld seams of sheet flooring, as recommended by flooring manufacturer, colour as directed by Consultant.
- .10 Profiles and transition strips: refer to Drawings.
- .11 Sealer and wax: type recommended by resilient flooring material manufacturer for material type and location.
- .12 Acoustic Sealant: Tremco Acoustical Sealant or Pecora AC-20 FTR.

### **Part 3 Execution**

#### **3.1 MANUFACTURER'S INSTRUCTIONS**

- .1 Comply with manufacturer's written installation instructions, data sheets and standard details.

#### **3.2 SITE VERIFICATION OF CONDITIONS**

- .1 Ensure concrete floors exhibit normal alkalinity and no carbonization or dusting.
- .2 Coordinate with other trades to ensure substrate has been prepared adequately for flooring installation.

#### **3.3 PREPARATION**

- .1 Concrete floors must be fully cured and permanently dry. Subfloor shall be dry, clean, smooth, level, and structurally sound. It should be free of dust, solvent, paint, wax, oil, grease, asphalt, sealers, curing and hardening compounds, alkaline salts, old adhesive residue, and other extraneous materials, according to ASTM F710.

- .2 Subfloor should be smooth to prevent irregularities, roughness, or other defects from affecting the material above it. The surface should be flat to the equivalent of 3/16" in 10', as described in ACI 117R, or as recommended by the floor manufacturer.
- .3 Mechanically remove all traces of old adhesives, paint, or other debris by scraping, sanding, or scarifying the substrate. DO NOT use solvents.
- .4 Grind high spots until level and fill low spots with an approved leveling compound.
- .5 All saw cuts (control joints), cracks, indentations, and other non-moving joints in the concrete must be filled with an approved patching/levelling compound. Allow patching material to dry thoroughly.
- .6 Any concrete subfloor can be a source of moisture-related flooring failures. It is the installer's responsibility to test the concrete or other cement-like material for moisture.
- .7 Consult and follow manufacturer's instruction for maximum moisture vapour transmission and use appropriate adhesives.
- .8 Consult and follow manufacturer's instruction for maximum humidity and use appropriate adhesives.

### **3.4 UNDERLAYMENT**

- .1 Where resilient flooring abuts other flooring of different thickness, provide cementitious underlayment allowing for smooth and level transition between finished floor surfaces. Provide cementitious underlayment where substrate surfaces are not level and uniform to specified tolerances in order to provide smooth and level surfaces prior to application of flooring.
- .2 Mix, apply and finish underlayment in accordance with manufacturer's recommendations.

### **3.5 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 Continue flooring over areas which will be under built-in furniture.
- .5 Continue flooring through areas to receive movable type partitions without interrupting floor pattern.
- .6 Terminate flooring at centreline of door in openings where adjacent floor finish or colour is dissimilar.
- .7 Provide vinyl reducer strip, fully bonded to floor, where floor covering terminates, exposing edge of floor.
- .8 Provide vinyl reducing strips where resilient floor meets concrete.
- .9 Provide vinyl wheeled traffic transition or adapter strips at transitions from resilient flooring to other flooring finishes; types to suit flooring thickness and to provide level transition.

### **3.6 INSTALLATION: SHEET FLOORING**

- .1 Apply adhesive uniformly using recommended trowel. Do not spread more adhesive than can be covered by flooring before initial set takes place. At perimeter of flooring and at seam locations provide minimum 100 mm wide strip of seaming adhesive.
- .2 Always lay sheets in sequence and follow numerical consecutive order of rolls. Unless otherwise indicated, lay flooring with seams parallel to building lines to produce a minimum number of seams.
- .3 Double cut sheet joints for tight fit according to manufacturer's recommendations when seams required. Provide additional length on the second and succeeding sheets to allow for proper pattern alignment. Always position flooring using Reverse method.
- .4 Unless otherwise indicated lay flooring with seams parallel to building lines to produce a minimum number of seams. No end seams unless room length exceeds length of roll.
- .5 As installation progresses, and after installation, roll flooring with roller of weight recommended by manufacturer to ensure full adhesion and to expel trapped air.
- .6 Heat-weld seams in accordance with flooring manufacturer's written instructions. At all seams, groove out joints and heat weld seams with suitable welding equipment and welding rod of colour as selected by Consultant, to matching flooring. Trim flush with surface of flooring. Finish flooring in accordance with material manufacturer's written requirements.
- .7 Adhere sheet flooring goods directly to the substrate using manufacturer's recommended adhesive, depending on the application. Follow instructions on the adhesive pail or those available from the flooring manufacturer.
- .8 As installation progresses and after installation is complete, roll resilient sheet flooring in accordance with manufacturer's instructions.

### **3.7 INSTALLATION: BASE**

- .1 Seal floor-to-wall perimeter joint with acoustical sealant prior to installing base.
- .2 Lay out base to keep number of joints at minimum.
- .3 Clean substrate and prime with one coat of adhesive.
- .4 Apply adhesive to back of base.
- .5 Set base against wall and floor surfaces tightly by using 3 kg hand roller.
- .6 Install straight and level to variation of 1:1000.
- .7 Scribe and fit to door frames and other obstructions. Use pre-moulded end pieces at flush door frames.
- .8 Cope internal corners. Use pre-moulded corner units for right angle external corners. Use formed straight base material for external corners of other angles.
- .9 Heat weld base in accordance with manufacturer's printed instructions.

### **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 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning. 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. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3 Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.

**3.10 PROTECTION**

- .1 Protect installed products and components from damage during construction. Prohibit traffic on floor for 48 hours after installation.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 03 35 00 – Concrete Finishing
- .2 Section 09 65 00 – Resilient Flooring
- .3 Schedule A – Finishes

**1.2 REFERENCES**

- .1 American Association of Textile Chemists and Colourists (AATCC)
  - .1 AATCC 134-2019, Electrostatic Propensity of Carpet.
  - .2 AATCC 171-2019, Carpets: Cleaning of; Hot Water Extraction Method.
  - .3 AATCC 174-2016, Antimicrobial Activity Assessment of Carpets.
  - .4 AATCC 175-2013, Stain Resistance: Pile Floor Coverings.
  - .5 AATCC 189-2017, Fluorine Content of Carpet Fibers.
- .2 ASTM International
  - .1 ASTM D1335-21, Standard Test Method for Tuft Bind of Pile Yarn Floor Coverings.
  - .2 ASTM D3936-21 Standard Test Method for Resistance to Delamination of the Secondary Backing of Pile Yarn Floor Covering.
  - .3 ASTM D5252-20, Standard Practice for the Operation of the Hexapod Tumble Drum Tester.
  - .4 ASTM D5417-16, Standard Practice for Operation of the Vettermann Drum Tester.
  - .5 ASTM E84-21, Standard Test Method for Surface Burning Characteristics of Building Materials.
  - .6 ASTM E648-19ae1, Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.
  - .7 ASTM E662-21, Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials.
- .3 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-4.2 No.77.1-94/ISO 4919:1978 (R2012), Textile Test Methods - Carpets - Determination of Tuft Withdrawal Force. (Withdrawn)
  - .2 CAN/CGSB 4.129-93, Carpet for Commercial Use. (Withdrawn)
- .4 Carpet and Rug Institute (CRI)/Canadian Carpet Institute (CCI)
  - .1 CRI 104/105, Carpet Installation Standards
  - .2 CRI Indoor Air Quality Carpet Testing Programs.
- .5 National Floor Covering Association (NFCA)
  - .1 NFCA Floor Covering Reference Manual.
- .6 South Coast Air Quality Management District (SCAQMD), California State
  - .1 SCAQMD Rule 1168-05, Adhesives and Sealants Applications.
- .7 ULC Standards
  - .1 CAN/ULC 102-18, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

### **1.3 ACTION SUBMITTALS / INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product data:
  - .1 Submit product data sheet for carpet, adhesive, carpet protection, and subfloor patching compound.
  - .2 Submit WHMIS SDS - Safety Data Sheets acceptable to Labour Canada and Health Canada for carpet adhesive. Indicate VOC content. Indoor carpet adhesives shall not exceed 50 g/L VOC limit.
  - .3 Submit data on specified products, describing physical and performance characteristics, sizes, patterns, colours, and methods of installation.
- .3 Shop drawings:
  - .1 Indicate locations and lengths of seams for carpeted areas.
  - .2 Indicate nap direction, open edges, special patterns, and other details required by Consultant to clarify work.
  - .3 Submit drawings showing columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cut-outs are required, direction of carpet pile and pattern, location of edge moldings to Consultant for review prior to installation of carpet.
  - .4 Submit carpet schedule using same room designations indicated on drawings.
- .4 Samples:
  - .1 Submit duplicate full sized samples of each type of carpet and base strip specified.
- .5 Submit carpet manufacturer's installation instructions: Indicate special procedures and perimeter conditions requiring special attention.
- .6 Submit proof that carpet has been tested and passed the Indoor Air Quality (IAQ) Carpet Testing Program requirements of the Carpet and Rug Institute (CRI) and the Canadian Carpet Institute (CCI).
- .7 Submit report outlining proposed dust control measures.

### **1.4 CLOSEOUT SUBMITTALS**

- .1 Submit closeout data in accordance with Section 01 78 00 – Closeout Submittals.
  - .1 Submit maintenance data: Include maintenance procedures, recommendations for maintenance materials and equipment, and suggested schedule for cleaning.

### **1.5 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Extra Materials:
  - .1 Provide extra materials of carpet and adhesives in accordance with Section 01 78 00 - Closeout Submittals.
  - .2 Provide 5% of each colour, pattern, and type of carpeting. Provide in one continuous full width roll.
  - .3 Extra materials to be from same production run as installed materials.
  - .4 Identify each package of carpet and each container of adhesive.
  - .5 Store where directed by Consultant.

## **1.6 QUALITY ASSURANCE**

- .1 Regulatory Requirements:
  - .1 Indoor Air Quality: compliance with CRI/CCI Green Label Indoor Air Quality Program, CRI/CCI-IAQ requirements for maximum total volatile chemicals released into air. Label each carpet product with CRI/CCI-IAQ label.
- .2 Installer Qualifications:
  - .1 Flooring contractor requirements.
    - .1 Specialty contractor normally engaged in this type of work, with prior experience in installation of these types of materials.
    - .2 Certified by carpet manufacturer prior to bid submission.
    - .3 Must not sub-contract labour without written approval of Consultant.
- .3 Be responsible for proper product installation, including floor testing and preparation as specified and in accordance with carpet manufacturers written instructions.
- .4 Mock-Up:
  - .1 Provide mock-ups in accordance with Section 01 45 00 – Quality Control.
  - .2 Construct mock-ups as directed by Consultant to verify selections made under sample Submittals and to demonstrate aesthetic effects, patterns, and qualities of materials, and execution before installing flooring materials and accessories in accordance with requirements in Section 01 45 00 – Quality Control.
  - .3 Install in area designated by Consultant, flooring mock-up of at least 10 m<sup>2</sup> in area showing pattern as directed by Consultant, colour matching, and longitudinal and transverse joints for Consultant's review and acceptance.
  - .4 Mock-up shall represent minimum acceptable standard for the Work when identified modifications to mock-up are completed, reviewed, and accepted by the Consultant.
  - .5 Accepted mock-up installation can remain as part of the Work.

## **1.7 DELIVERY, STORAGE, AND HANDLING**

- .1 Label packaged materials.
- .2 Store packaged materials in original containers or wrapping with manufacturer's seals and labels intact.
- .3 Store carpeting and accessories in location as directed by Consultant. Store carpet and adhesive at minimum temperature of 18°C and relative humidity of maximum 65% for minimum of 48 hours before installation.
- .4 Prevent damage to materials during handling and storage. Keep materials under cover and free from dampness.
- .5 Store materials in area of installation for minimum period of 48 hours prior to installation.
- .6 Tile carpet: store on pallet form as supplied by Manufacturer. Do not stack pallets.

## **1.8 SITE CONDITIONS**

- .1 Moisture: Ensure substrate is within moisture limits and alkalinity limits prescribed by manufacturer. Prepare moisture testing and provide report to Consultant.
- .2 Temperature: Maintain ambient temperature of not less than 18°C from 48 hours before installation to at least 48 hours after completion of work.
- .3 Relative humidity: Maintain relative humidity between 10 and 65% RH for 48 hours before, during and 48 hours after installation.

- .4 Safety: Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials.
- .5 Ventilation:
  - .1 Arrange for ventilation system to be operated during installation of carpet by use of approved portable supply and exhaust fans.
  - .2 Ventilate enclosed spaces in accordance with Section 01 51 00 - Temporary Utilities. Provide fans with HEPA filters.
  - .3 Provide continuous ventilation during and after carpet application. Run ventilation system 24 hours per day during installation; provide continuous ventilation for seven days after completion of carpet installation.
- .6 Do not install carpet until space is enclosed and weatherproof, wet-work in space is completed and nominally dry, work above ceilings is complete.

## 1.9 WARRANTY

- .1 Manufacturer Warranty:
  - .1 Provide manufacturers warranty for fifteen years from date of Substantial Performance and as follows:
    - .1 Ten year limited abrasive wear warranty.
    - .2 Lifetime limited anti-static warranty.

## Part 2 Products

### 2.1 MATERIALS

- .1 Carpet Tile **CPT-1**:
  - .1 Construction: tufted.
  - .2 Texture: textured patterned multi-coloured loop.
  - .3 Yarn: nylon, minimum 50% recycled content.
  - .4 Dye Method: 100% solution dyed.
  - .5 Face Yarn Weight: 780 g/m<sup>2</sup> (23 oz/yd<sup>2</sup>).
  - .6 Overall Thickness: 7.2 mm.
  - .7 Stitches/Gauge: 47 rows per 10 cm.
  - .8 Pile density: 9098 oz/yd<sup>3</sup>.
  - .9 Traffic classification: heavy.
  - .10 Flammability (ASTM E648): Class 1.
  - .11 Smoke density (ASTM E663): ≤ 450.
  - .12 Static Control (AATCC 134) < 3.5 kV.
  - .13 Size: 12 x 36 inches.
  - .14 Backing: polyolefin.
  - .15 Installation: refer to drawings for plank orientation.
  - .16 Acceptable Materials:
    - .1 mellowD – GT426 by Mohawk Group.
    - .1 Colour: 922 Sanctuary.
- .2 Carpet Tile **CPT-3**:
  - .1 Fibre: nylon or polypropylene or composite.
  - .2 Size: 50 x 50 cm.
  - .3 Acceptable Materials:



- .1 Industrious by FLOR.
  - .1 Colour: 21-1552-06 Beige.
- .2 Alternate: Burmatex Grimebuster 50 Entrance Collection
  - .1 Colour: 1640 Newmarket Grey.

## **2.2 ACCESSORIES**

- .1 Subfloor filler: premix latex requiring only water to produce cementitious paste.
- .2 Base: refer to Section 09 65 00 – Resilient Flooring.
- .3 Floor carpet tile adhesive: self release type, recommended by carpet tile manufacturer, low odour type, free of volatile hydrocarbons such as toluene and mineral spirits.
- .4 Carpet protection: non-staining heavy duty kraft paper.
- .5 Subfloor patching compound: refer to Section 03 35 00 – Concrete Finishing.

## **Part 3 Execution**

### **3.1 PREPARATION**

- .1 Prepare floor surfaces in accordance with CRI Carpet Installation Standard for Installation of Commercial Carpet.
- .2 Ensure concrete substrates are free of paint, dirt, grease, oil, curing or parting agents, and other contaminants, including sealers, that may interfere with bonding of adhesive.
- .3 Seal porous and powdery surfaces with concrete floor sealer and apply sub-floor filler to low spots and cracks to achieve level floor to tolerance of 1:500 in accordance with manufacturer's written requirements.
- .4 Pre-condition carpeting following manufacturer's printed instructions.
- .5 Lay down area as indicated to confirm pattern direction with Consultant.

### **3.2 INSTALLATION**

- .1 Install in accordance with manufacturer's printed instructions and in accordance with Carpet and Rug Institute Carpet Installation Standard of Commercial Carpet.
- .2 Finish installation to present smooth wearing surface free from conspicuous seams, burring and other faults.
- .3 Use material from same dye lot. Ensure colour, pattern, and texture match within any one visual area. Maintain constant pile direction.
- .4 Fit neatly around architectural, mechanical, electrical and telephone outlets, and furniture fitments, around perimeter of rooms into recesses, and around projections.
- .5 Install carpeting to underfloor duct system and to access covers.
- .6 Install carpeting in pan type floor access covers.
- .7 Extend carpet into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- .8 Install carpet smooth and free of bubbles, puckers, and other defects.

### **3.3 BASE INSTALLATION**

- .1 Refer to Section 09 65 00 – Resilient Flooring.

**3.4 TILE CARPET**

- .1 Apply adhesive and install tile carpet in accordance with manufacturer's written instructions.
- .2 Lay tile carpet with seams butted.
- .3 Roll tile carpet with appropriate roller for complete contact of carpet with adhesive to sub-floor.

**3.5 CLEANING**

- .1 Cleaning: in accordance with Section 01 74 00 – Cleaning and Waste Management. Leave Work area clean at end of each day.
- .2 Vacuum carpets clean immediately after completion of installation. Protect traffic areas.
- .3 Final Cleaning: upon completion remove surplus materials, rubbish, tools, and equipment. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .4 Manage and dispose of demolition and construction waste materials.

**3.6 PROTECTION**

- .1 Prohibit traffic on carpet for a period of 24 hours until adhesive is cured.
- .2 Install carpet protection to satisfaction of Consultant.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 09 21 16 – Gypsum Board Assemblies.

**1.2 ADMINISTRATIVE REQUIREMENTS**

- .1 Scheduling
  - .1 Submit work schedule for wall covering hanging to Consultant for review. Submit schedule minimum of 48-hours in advance of proposed operations.
  - .2 Schedule wall covering hanging operations to prevent disruption of and by other trades.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit WHMIS SDS - Safety Data Sheets in accordance with Section 01 35 29 – Health and Safety Requirements. acceptable to Labour Canada and Health and Welfare Canada. Indicate VOC content.
  - .2 Submit complete written description, including total fabric weight, name of fabric backing, tensile strength, tear strength and fire rating characteristics.
- .3 Samples:
  - .1 Due to product lead times, order material immediately upon approval of wall covering from Consultant.
  - .2 Submit duplicate 300 x 300 mm samples of colours and textures of wall coverings.
  - .3 There will be additional Consultant coordination for samples and submittals. Allow up to 2 rounds of coordination for custom graphic printing designs.
- .4 Closeout Submittals:
  - .1 Provide maintenance data for vinyl-coated fabric wall covering in accordance with Section 01 78 00 - Closeout Submittals.
- .5 Provide proof of membership in the Wallcovering Installers Association, and continuous membership over the past 5-years including the current year.

**1.4 QUALITY ASSURANCE**

- .1 Allow time in construction schedule to custom order the products specified herein, which are custom.
- .2 The vinyl wall graphics are custom and coordination between Consultant and installer is required to finalize graphics and substrates. Allow time in schedule for this type of coordination and review to take place.

**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.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:

- .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect specified materials from nicks, scratches, and blemishes, and other types of damage that may impair proper hanging of materials, functioning, appearance or durability.
- .3 Replace defective or damaged materials with new.

## **1.6 SITE CONDITIONS**

- .1 Temperature: maintain air temperature and structural base temperature at wall covering installation area above 20 degrees C and relative humidity below 40% for 72-hours before, during and 72-hours after installation.
- .2 Ventilation:
  - .1 Ventilate enclosed spaces in accordance with Section 01 51 00 - Temporary Utilities.
  - .2 Provide continuous ventilation during and after coating application.
- .3 Ensure ventilation system is operated on maximum outdoor air and exhaust during installation of vinyl film materials. Ventilate area of work by use of approved portable supply and exhaust fans.

## **1.7 WARRANTY**

- .1 Contractor agrees to correct any deficiencies of labour or material found in the work performed for a period of 2 years from date of Substantial Completion.
- .2 Submit manufacturer's warranty in accordance with the requirements of Section 01 78 00 - Closeout Submittals, made out in Owner's name.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Supply all products noted, backing materials, and all accessories and ancillary products as required for a complete installation.
- .2 Acceptable material:
  - .1 Vinyl Film: Type II Custom Image Digital Print Film, by 3M, or equivalent.
  - .2 Custom graphics: as provided by Owner.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions are acceptable for product installation in accordance with manufacturer's written instructions.
  - .1 Check and verify that no irregularities exist that would affect quality of execution of work specified.
  - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

### **3.2 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with vinyl film manufacturer's printed preparation and application instructions, technical datasheets, and specifications.

### **3.3 PREPARATION**

- .1 Unwrap vinyl materials when ventilation conditions are accelerated. Allow 24-hours acclimation in installation before application.
- .2 Fill and sand minor imperfections in gypsum board surfaces using joint cement. Prime surface in accordance with the vinyl film manufacturer's instructions.
- .3 Prior to Work remove all electrical plates and covers, surface hardware, fittings and fastenings and store in a protected area. After vinyl film applied, clean and replace.
- .4 Before installing, examine pattern for colour uniformity and repeat in design.
- .5 Before installation, verify that wall moisture content does not exceed 4% (using a suitable moisture meter) and that active moisture or water vapour.

### **3.4 INSTALLATION**

- .1 Install graphics film in accordance with manufacturer's written instructions with no gaps or overlaps, no lifted or curled edges and no visible shrinkage; remove air bubbles, wrinkles, blisters and other defects.
- .2 No horizontal seams permitted.
- .3 Leave completed work smooth, clean, without wrinkles, gaps, overlaps or air pockets.

### **3.5 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning. 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. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3 Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 – Waste Management and Disposal.

### **3.6 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 06 10 00 – Rough Carpentry
- .2 Section 06 20 00 – Finish Carpentry
- .3 Section 09 21 16 – Gypsum Board Assemblies

**1.2 REFERENCES**

- .1 ASTM International (ASTM)
  - .1 ASTM C423-17, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
  - .2 ASTM D1779-98 (2017), Standard Specification for Adhesive for Acoustical Materials.
  - .3 ASTM D5034-21, Standard Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test).
  - .4 ASTM D5035-11(2019), Standard Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method).
- .2 South Coast Air Quality Management District (SCAQMD), California State
  - .1 SCAQMD Rule 1168-05, Adhesives and Sealants Applications.
- .3 ULC Standards
  - .1 ULC 102, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies. (ULC S102)
  - .2 ULC 109, Flame Tests of Flame Resistant Fabrics and Films. (CAN/ULC S109-14)

**1.3 ACTION SUBMITTALS / INFORMATIONAL 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 WHMIS SDS - Safety Data Sheets. WHMIS SDS acceptable to Labour Canada and Health and Welfare Canada.
  - .3 Upon request, submit test data to substantiate that the requirements for Fire Hazard Classifications per Ontario Building Code are met.
- .2 Submit samples in accordance with Section 01 33 00 – Submittal Procedures.
  - .1 Submit duplicate minimum 300 mm x 500 mm mock-up of panel constructions, including anchorage and hangers.
  - .2 Submit 200 mm x 200 mm samples of each fabric specified to the Consultant for final approval prior to ordering. Label samples with manufacturer's name, quality, colour, texture and weight.

**1.1 CLOSEOUT SUBMITTALS**

- .1 Submit closeout data in accordance with Section 01 78 00 – Closeout Submittals.
  - .1 Submit fabric cleaning instructions for incorporation into the Operation and Maintenance Manual.

**1.2 QUALITY ASSURANCE**

- .1 Regulatory Requirements: Provide acoustical wall panels with the following surface burning characteristics as determined by testing identical products in accordance with

ULC S102, CAN/ULC S102.1, ULC S109, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify acoustical wall panels with appropriate markings of applicable testing and inspecting agency, for the following criteria:

- .1 Flame Spread: 25 or less.
- .2 Smoke Developed: 450 or less.
- .2 Certifications:
  - .1 Materials shall be approved by Underwriters Laboratories of Canada, for Fire Hazard Classifications per Ontario Building Code and National Fire Code.
- .3 Mock-Up:
  - .1 Provide mock-ups in accordance with Section 01 45 00 – Quality Control.
  - .2 Construct mock-ups as directed by Consultant to verify selections made under sample Submittals and to demonstrate aesthetic effects, patterns, and qualities of materials, and execution before installing materials and accessories in accordance with requirements in Section 01 45 00 – Quality Control.
  - .3 Install in area designated by Consultant, mock-up of at least 5 m<sup>2</sup> in area showing pattern as directed by Consultant, colour matching, and longitudinal and transverse joints for Consultant's review and acceptance.
  - .4 Mock-up shall represent minimum acceptable standard for the Work when identified modifications to mock-up are completed, reviewed, and accepted by the Consultant.
  - .5 Accepted mock-up installation can remain as part of the Work.

### **1.3 DELIVERY, STORAGE, AND HANDLING**

- .1 Storage and Handling Requirements:
  - .1 Store panels flat in a clean, dry storage area where temperature is a minimum 7°C with normal humidity. Do not store materials in upright position. Protect end of rolled materials from damage.
  - .2 Store toxic and/or explosive solvents and adhesives in properly ventilated areas.
  - .3 Take precautionary measures to prevent fire hazards with adhesives and solvents.

### **1.4 SITE CONDITIONS**

- .1 Ambient Conditions: Install acoustical panels only when building is fully enclosed and HVAC system is operational; maintain manufacturer's recommended temperature and humidity conditions in area of installation for 24 hours before, during and after installation.
- .2 Do not install acoustical wall panels fabric until the following conditions have been met:
  - .1 Wet work is complete and dry.
  - .2 Painting, flooring, and wall base has been installed.
  - .3 Adjacent work including, architectural woodwork, masonry, doors and frames, gypsum, plastering, wall covering, painting, ceiling grid, and electrical work is complete.
  - .4 Permanent lighting is in place and operational.

## **1.5 WARRANTY**

- .1 Manufacturer Warranty: Provide manufacturers standard two year written warranty indicating replacement of fabrics that have sagged or failed to anchor to edge clip system arising from defects in materials or workmanship.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Panels:
  - .1 **WP-1** - Reception Area: 100% polyester felt, double layer, minimum 60% recycled content.
    - .1 Weight: 0.49 lb/ft<sup>2</sup>.
    - .2 Overall Thickness: 12 mm.
    - .3 Acceptable material:
      - .1 Fracture Two Tone Panel by Acoufelt.
    - .4 Colour and Pattern: As selected by Consultant from manufacturer's full range..
  - .2 **WP-2** – Study Rooms: 100% polyester felt, minimum 60% recycled content.
    - .1 Weight: 0.082 lb/ft<sup>2</sup>.
    - .2 Thickness: 2 mm.
    - .3 Acceptable material:
      - .1 Solid Panel by Acoufelt.
    - .4 Colour and Pattern: As selected by Consultant from manufacturer's full range. Allow for 5 colours.

### **2.2 ACCESSORIES**

- .1 Mounting system: Mechanical attachment Z-clip system.
  - .1 Provide clips and fasteners as required for complete installation.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Ensure surfaces to receive wall panels are clean, true, free of irregularities.
- .2 Ensure work penetrating substrate is completed before installing wall panels.
- .3 Inspect surfaces and job conditions before commencing work and report defects in writing to Consultant.

### **3.2 INSTALLATION**

- .1 Field measure each wall area to receive panels, prior to fabrication, in order to establish exact layout of units as shown on elevations.
- .2 Coordinate work with mechanical and electrical work.
- .3 Install panels in accordance with manufacturer's instructions, to pattern indicated on reviewed and accepted shop drawings.
- .4 Install panels level, plumb, and straight, and in accordance with manufacturer's written instructions.



- .5 Ensure clips and mounting tracks are fully engaged in final installation.

### **3.3 CLEANING**

- .1 Keep acoustic installation and components clean. Remove blemishes immediately.
- .2 Cleaning: Clean exposed surfaces of acoustical wall panels in accordance with manufacturer's recommendations and as follows:
  - .1 Trim and remove loose threads.
  - .2 Vacuum and clean new fabric of dust and dirt.
  - .3 Touch up minor finish damage; remove and replace work which cannot be successfully cleaned and repaired to eliminate evidence of damage.

### **3.4 PROTECTION**

- .1 Protection: Protect installed work from damage due to subsequent construction activity, including temperature and humidity limitations and dust control.

**END OF SECTION**

**Part 1 General**

**1.1 SUMMARY**

- .1 Section Includes:
  - .1 Material and installation of site-applied paint finishes to exterior and interior surfaces, including site painting of shop-primed surfaces, preparation of surfaces as required, and repainting.
  - .2 Except as otherwise indicated, interior surfaces, new and existing, shall be finished/refinished in accordance with the requirements of this specification section.
- .2 Related Requirements:
  - .1 Section 05 50 00 - Metal Fabrications.
  - .2 Section 06 10 00 - Rough Carpentry.
  - .3 Section 06 20 00 - Finish Carpentry.
  - .4 Section 08 11 13 - Steel Doors and Frames.
  - .5 Section 09 21 16 - Gypsum Board Assemblies.
  - .6 Other as noted on drawings.

**1.2 REFERENCES**

- .1 ASTM International (ASTM)
  - .1 ASTM D16-19, Standard Terminology for Paint, Related Coatings, Materials, and Applications.
  - .2 ASTM E84-22, Standard Test Method for Surface Burning Characteristics of Building Materials.
- .2 Green Seal
  - .1 Green Seal Standards GS-11, Paint.
  - .2 Green Seal Standard GC-03, Anti-Corrosive Paints.
- .3 Department of Justice Canada (Jus)
  - .1 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
- .4 Environmental Protection Agency (EPA)
  - .1 EPA Test Method for Measuring Total Volatile Organic Compound Content of Consumer Products, Method 24 - 1995, (for Surface Coatings).
- .5 Master Painters Institute (MPI)
  - .1 MPI Architectural Painting Specifications Manual.
- .6 National Fire Code of Canada.
- .7 South Coast Air Quality Management District (SCAQMD), California State
  - .1 SCAQMD Rule 1113-04, Architectural Coatings.
- .8 Society for Protective Coatings (SSPC)
  - .1 SSPC Painting Manual, 2016 Edition.

### **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 trades.
    - .4 Review manufacturer's installation instructions and warranty requirements.
- .2 Scheduling
  - .1 Submit work schedule for various stages of painting to Consultant for review. Submit schedule minimum of 48 hours in advance of proposed operations.
  - .2 Obtain written authorization from Consultant for changes in work schedule.
  - .3 Schedule painting operations to prevent disruption of and by other trades.
- .3 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Health and Safety Requirements.

### **1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit product data in accordance with Section 01 33 00 – Submittal Procedures:
  - .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.
- .2 Submit samples in accordance with Section 01 33 00 – Submittal Procedures:
  - .1 Submit full range colour sample chips to indicate where colour availability is restricted.
  - .2 Submit duplicate 200 x 300 mm (10" x 12") sample panels of each paint, stain, clear coating, and special finish 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 (1/8") plate steel for finishes over metal surfaces.
    - .2 13 mm (1/8") birch plywood for finishes over wood surfaces.
    - .3 50 mm (1/2") concrete block for finishes over concrete or concrete masonry surfaces.
    - .4 13 mm (1/8") gypsum board for finishes over gypsum board and other smooth surfaces.
    - .5 10 mm (0.4") 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, to Section 01 78 15 - Contract Closeout: submit maintenance data for incorporation into Operations and Maintenance Manual, and include following:
  - .1 Product name, type and use.
  - .2 Manufacturer's product number.
  - .3 Colour numbers.
  - .4 MPI Environmentally Friendly classification system rating.

- .4 Manufacturer's Instructions:
  - .1 Submit manufacturer's installation and application instructions.
- .5 Submit quality assurance submittals in accordance with Section 01 45 00 - Quality Control.
  - .1 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 Journey trades: qualified journey trades 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.

## 1.6 MOCK-UPS

- .1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control.
  - .1 Provide 3 m x 3 m (10' x 10') 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°C to 30°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 SITE CONDITIONS

- .1 Heating, Ventilation and Lighting:
  - .1 Ventilate enclosed spaces.
  - .2 Provide heating facilities to maintain ambient air and substrate temperatures above 10°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 Provide temporary ventilating and heating equipment as required.
  - .5 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 Consultant and product manufacturer, perform no painting when:
    - .1 Ambient air and substrate temperatures are below 10°C.
    - .2 Substrate temperature is above 32°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 above 85% or when the dew point is more than 3 degrees C variance between the air/surface temperatures. 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 Consultant 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°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.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Only qualified products with E2 "Environmentally Friendly" ratings are acceptable for use on this project, Use E3 rated products where available.
- .2 Use only MPI listed L-rated materials.
- .3 Water-borne paints and stains, recycled water-borne surface coatings and water borne varnishes to meet minimum "Environmentally Friendly" E2 rating.
- .4 Recycled water-borne surface coatings to contain 50% post-consumer material by volume.

- .5 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.
- .6 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.
- .7 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.
- .8 VOC limits for wood finishes, floor coatings, stains, primers and shellacs applied to interior elements in accordance with SCAQMD Rule 113 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 MATERIALS - GENERAL

- .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 Conform to latest MPI requirements for all painting work including preparation and priming.
- .4 Materials (primers, paints, coatings, varnishes, stains, lacquers, fillers, thinners, solvents, etc.) in accordance with MPI - Architectural Painting Specification Manual "Approved Product" listing.
- .5 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.
- .6 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.
- .7 Formulate and manufacture water-borne surface coatings with no aromatic solvents, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavalent chromium or their compounds.
- .8 Flash point: 61.0°C or greater for water-borne surface coatings and recycled water-borne surface coatings.
- .9 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.

## 2.3 COLOURS

- .1 Refer to Finishes Legend for colours and locations.
- .2 Colours to be selected by Consultant from manufacturer's full range; the number of different colours required for the project is not expected to exceed 6 field colours and 6 accent colours overall (plus tinted 2nd coat colour of each); some rooms will require a feature wall painted a different colour than the remaining walls, so assume one feature wall per room space; associated painted trim to match adjacent wall.
- .3 Minimum number of coats shall be three: primer and two topcoats, minimum, plus additional coats as required to achieve an opaque, uniform colour.
- .4 Second coat in three-coat system to be tinted slightly lighter colour than topcoat to show visible difference between coats.

## 2.4 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.

## 2.5 GLOSS/SHEEN RATINGS

- .1 Paint gloss is defined as sheen rating of applied paint, in accordance with following values:

Description / Gloss Level	Gloss @ 60 degrees	Sheen @ 85 degrees
G1 - Matte Finish (flat)	Max. 5	Max. 10
G2 - Velvet-Like Finish	Max.10	10 to 35
G3 - Eggshell Finish	10 to 25	10 to 35
G4 - Satin-Like Finish	20 to 35	min. 35
G5 - Traditional Semi-Gloss Finish	35 to 70	



<b>Description / Gloss Level</b>	<b>Gloss @ 60 degrees</b>	<b>Sheen @ 85 degrees</b>
G6 - Traditional Gloss	70 to 85	
G7 - High Gloss Finish	More than 85	

- .2 Gloss level ratings of painted surfaces as indicated or otherwise specified.

## **2.6 EXTERIOR PAINTING**

- .1 All exterior painting work to be in accordance with MPI Premium Grade finish requirements, minimum 1 coat of primer, 2 intermediate coats, and finish coat. Refer to Schedules for instructions.
- .2 Structural Steel and Metal Fabrications: columns, beams, joists and miscellaneous metal:
- .1 All structural steel, metal fabrications, railings, etc., at building enclosure, whether exposed or within exterior wall assembly, and all exposed steel elements, shall be hot dip galvanized after fabrication and then painted:
- .1 Galvanizing: hot-dip method with minimum zinc coating of 705 g/m<sup>2</sup> conforming to ASTM A123 for fabricated assemblies. ASTM A153/A153M for all hardware (average zinc coating of 381 g/m<sup>2</sup>). Hot dip galvanize after fabrication.
- .2 Touch-up galvanized surfaces with zinc rich coating, to ASTM A780: DOD-P-21035 zinc rich paint, minimum DFT 8 mils.
- .3 EXT 5.1P - Polyurethane, pigmented finish (over epoxy zinc rich primer).
- .3 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.
- .4 Galvanized Metal: non-chromate passivated; high contact/high traffic areas (doors, frames, railings and handrails, etc.):
- .1 EXT 5.3D – Polyurethane, pigmented finish (over vinyl wash and epoxy primer).
- .5 Bituminous Coated Surfaces: cast iron pipe, concrete, etc.:
- .1 EXT 10.2A – Latex semi-gloss finish.

## **2.7 INTERIOR PAINTING**

- .1 All interior painting work to be in accordance with MPI Premium Grade finish requirements, minimum 1 coat of primer, 2 intermediate coats, and finish coat. Refer to schedules on Drawings to coordinate locations and determine finishes required.
- .2 Structural, electrical and mechanical elements at exposed areas, including visible inside portions of ductwork and louvers, shall be primed and finish painted to MPI Premium Grade requirements.
- .3 Wood; Stained and varnished (transparent finish); Semi-transparent stain Polyurethane varnish (single component) finish, INT 6.4V:
- .1 1st Coat: Wood Filler.
- .2 2nd Coat: Stain.
- .3 3rd Coat: Polyurethane (reduced).
- .4 4th Coat: Polyurethane.
- .5 5th Coat: Polyurethane.
- .6 Gloss: Satin.

- .4 Wood; Clear Polyurethane varnish (single component) finish (transparent finish),  
INT 6.4J:
  - .1 1st Coat: Wood Filler.
  - .2 2nd Coat: Polyurethane (reduced)
  - .3 3rd Coat: Polyurethane.
  - .4 4th Coat: Polyurethane.
  - .5 Gloss: Satin.
- .5 High-Humidity Areas: laundry rooms, bathrooms, kitchens and other wet areas that  
normally develop higher relative humidity:
  - .1 Gloss: matte.
  - .2 Basis-of-Design:
    - .1 Benjamin Moore, Aura Bath & Spa.
- .6 Trim and Doors:
  - .1 Gloss: semi-gloss.
  - .2 Basis-of-Design:
    - .1 Benjamin Moore, Advance
- .7 Gypsum Board; walls and partitions; Latex finish, INT 9.2B:
  - .1 1st Coat: Latex Primer Sealer.
  - .2 2nd Coat: Acrylic latex.
  - .3 3rd Coat: Acrylic latex.
  - .4 Gloss:
    - .1 Typical walls: Eggshell.
    - .2 Wet and Service Areas; walls and ceilings: Semi-Gloss.
- .8 Gypsum Board; ceilings and bulkheads; Latex finish, INT 9.2B:
  - .1 1st Coat: Latex Primer Sealer.
  - .2 2nd Coat: Acrylic latex.
  - .3 3rd Coat: Acrylic latex.
  - .4 Gloss:
    - .1 Typical ceilings: Flat.
    - .2 Wet and Service Areas; walls and ceilings: Semi-Gloss.
- .9 Exposed piping and ductwork, wrapped; Latex finish, INT 5.3M or 5.1R as applicable:
  - .1 1st coat latex primer sealer.
  - .2 2nd coat acrylic latex.
  - .3 3rd coat acrylic latex.
  - .4 Gloss: Semi-gloss.
- .10 Structural steel and steel fabrications; Latex finish INT 5.1R:
  - .1 1st Coat: Latex Metal Primer.
  - .2 2nd Coat: Acrylic Latex Enamel.
  - .3 3rd Coat: Acrylic Latex Enamel.
  - .4 Gloss: Semi-Gloss.
- .11 Galvanized metal (zinc coated steel), including exposed piping and conduit unwrapped;  
Alkyd finish, INT 5.3L:
  - .1 1st Coat: Galvanized metal primer.
  - .2 2nd Coat: Acrylic latex finish.

- .3 3rd Coat: Acrylic latex finish.
- .4 Gloss: Semi-Gloss.
- .12 Bituminous coated surfaces: cast iron pipe, concrete, etc.:
  - .1 INT 10.2A - Latex G5 finish.
- .13 Fire Retardant Paint (electrical and communications plywood panels):
  - .1 Standard of Acceptance:
    - .1 Fire Retardant Paint FR-110, by Incl-x, or similar from Great Northern Insulation, InnovProtect, or AD Fire Protection Systems.
  - .2 Colour: white.
  - .3 CSA Class A - flame spread rating 0 - 25.

## **2.8 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 Apply lacquers in shop to extent practicable and allow cure before bringing to site.

### **3.3 EXAMINATION**

- .1 Investigate existing substrates for problems related to proper and complete preparation of surfaces to be painted. Report to Consultant damages, defects, unsatisfactory or unfavourable conditions before proceeding with work. Proceeding with work means acceptance of conditions.
- .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%.
- .4 Prior to commencement of painting work, thoroughly examine (and test as required) all interior conditions and surfaces scheduled to be painted and report in writing to the Consultant any conditions or surfaces that adversely affect work of this section.
- .5 Correct defects as required, ready to be painted. Coordinate with other trades as needed.

### **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 Consultant.
  - .2 Protect items that are permanently attached such as Fire Labels on doors and frames.
  - .3 Protect factory finished products and equipment.
  - .4 Protect passing pedestrians, other workers, and public in and about the building and worksite.
- .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 Consultant.
- .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 pre-treatment as soon as possible after cleaning and before deterioration occurs.
- .5 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.
- .6 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.
- .7 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 vacuum cleaning.
- .8 Touch up of shop primers with primer as specified.
- .9 Do not apply paint until prepared surfaces have been accepted by Consultant.

### 3.5 APPLICATION

- .1 Method of application shall be as approved by Consultant and Owner. 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, 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, 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 period as recommended by manufacturer.
- .7 Sand and dust between each coat to provide an anchor for next coat and to remove defects in previous coat (runs, sags, etc.) visible from a distance up to 1000 mm (39").
- .8 To avoid air entrapment in applied coats, apply materials in accordance with manufacturer's spread rates and application requirements.
- .9 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.
- .10 Finish inside of cupboards and cabinets as specified for outside surfaces.
- .11 Finish closets and alcoves as specified for adjoining rooms.
- .12 Finish top, bottom, edges, and cut-outs of doors after fitting as specified for door surfaces.
- .13 Contractor to allow for required touch-ups as required after installation of Owner-installed furniture, fixtures and equipment (FF&E).

### **3.6 MECHANICAL/ELECTRICAL EQUIPMENT**

- .1 Unless otherwise noted, repainting shall also include exposed to view / previously painted mechanical and electrical equipment and components (panels, conduits, piping, hangers, ductwork, etc.).
- .2 Touch up scratches and marks and repaint such mechanical and electrical equipment and components with colour, and sheen finish to match existing unless otherwise noted or scheduled.
- .3 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.
- .4 Boiler room, mechanical and electrical rooms: paint exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment.
- .5 Other unfinished areas: leave exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment in original finish and touch up scratches and marks.
- .6 Do not paint over nameplates.
- .7 Keep sprinkler heads free of paint.
- .8 Paint inside of ductwork where visible behind grilles, registers, and diffusers with primer and one coat of matt black paint.
- .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 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 Owner
- .2 Advise Consultant 24 hours in advance (minimum 1 full working day) when surfaces and applied coating is ready for inspection. Do not proceed with subsequent coats until previous coat has been approved.
- .3 Retain purchase orders, invoices and other documents to prove conformance with noted MPI requirements when requested by Consultant.
- .4 Painted interior surfaces shall be considered to lack uniformity and soundness if any of the following defects are apparent to the Consultant:
  - .1 brush / roller marks, streaks, laps, runs, sags, drips, heavy stippling, hiding or shadowing by inefficient application methods, skipped or missed areas, and foreign materials in paint coatings.
  - .2 evidence of poor coverage at rivet heads, plate edges, lap joints, crevices, pockets, corners and re-entrant angles.
  - .3 damage due to touching before paint is sufficiently dry or any other contributory cause.
  - .4 damage due to application on moist surfaces or caused by inadequate protection from the weather.
  - .5 damage and/or contamination of paint due to blown contaminants (dust, spray paint, etc.).
- .5 Painted interior surfaces shall be considered unacceptable if any of the following are evident under final lighting source conditions:
  - .1 visible defects are evident on vertical surfaces when viewed at 90 degrees to the surface from a distance of 1000 mm (39").
  - .2 visible defects are evident on horizontal surfaces when viewed at 45 degrees to the surface from a distance of 1000 mm (39").
  - .3 visible defects are evident on ceiling surfaces when viewed at 45 degrees to the surface.
  - .4 when the final coat on any surface exhibits a lack of uniformity of sheen across full surface area.
- .6 Painted surfaces rejected by the Consultant 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.

### **3.1 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning. 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. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3 Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 - Construction Waste Management.

**3.2 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**END OF SECTION**



**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 05 50 00 – Metal Fabrications.

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Provide electrostatic coating materials manufacturer's technical data sheets and performance evaluations for products listed in this Section indicating compliance with specified requirements.
  - .2 Safety Data Sheets: Post manufacturer's standard SDS information for products specified in this Section in visible location with cautions, hazards and recommended safety procedures clearly identified for duration of the work of this Section on site.
- .3 Samples:
  - .1 Samples for Verification: Submit duplicate samples indicating final colour match to Consultant for verification before ordering coating materials.
- .4 Operation and Maintenance Data: Submit manufacturer's written instructions for cleaning and maintenance procedures; include name of original installer and contact information in accordance with Section 01 78 00 – Closeout Submittals.

**1.3 QUALITY ASSURANCE**

- .1 Electrostatic paint company shall have minimum five years' experience who has completed systems similar in material, design, and extent to that indicated for Project and with record of successful performance
- .2 Applicator shall be fully experienced, have full knowledge of specified paints and primers, valid autobody journey trade certificate or equivalent, and trained in the use of specified electrostatic painting equipment.
- .3 Paint applications shall be "premium grade" unless specified otherwise.

**1.4 ENVIRONMENTAL REQUIREMENTS**

- .1 Ambient Conditions: Provide adequate ventilation in areas that electrostatic coatings are being applied; in areas free from dust generating activities; and with air and surface temperatures within manufacturer's recommended temperature and humidity range.
- .2 Do not apply electrostatic paint finish in areas where dust is being generated.
- .3 Provide an 11 kg CO<sub>2</sub> fire extinguisher adjacent to items being coated.
- .4 Keep oily rags, waste and other similar combustible materials in closed metal containers and remove at end of each day. Take precautions to avoid spontaneous combustion.
- .5 Provide adequate cover for all finished Work close to surfaces to be painted. Place covers before painting commences and leave in place until completed.
- .6 Post "wet paint" signs while Work is in progress or drying.
- .7 Post "no smoking" signs where volatile materials are being used.

**1.5 WARRANTY**

- .1 Submit manufacturer's standard 20-year powder coating warranty.

## Part 2 Products

### 2.1 POWDER COAT FINISH SYSTEM

- .1 Epoxy pre-coat / Colour Coat / Polyester Powder Coat Finish 20-Year Warranty System.
- .2 Colours: as determined by Consultant; refer to Drawings.

### 2.2 SYSTEM REQUIREMENTS

<u>Test Methods</u>	<u>Powder Properties</u>	<u>Requirement</u>
		<b>Final Coating</b>
Prime coat	Epoxy pre-coat by DuPont	
Colour coat	Polyester Powder Coat by DuPont	
ASTM D5965	Specific Gravity	1.29 +/- 0.05
	Theoretical Coverage	1.49 ft 2/lb/mil
ASTM D3451	Mass Loss During Cure	less than 1%
	Max. Storage Temp.	75°F
<u>Test Methods</u>	<u>Coating Properties</u>	<u>Requirement</u>
ASTM D523	Gloss at 60 percent	85+
DPC TM 10.219	PCI Powder Smoothness	8
ASTM D2454	Overbake Resistance,	Time 100%
ASTM D3363	Pencil Hardness	2H
ASTM D2794	Dir/Rev Impact, Gardner	160/160in/lbs
ASTM D3359	Adhesion, Cross Hatch	5Bpass
ASTM D522	Flexibility, Mandrel	1/8"dia. no fracture
ASTM B117	Salt Spray	4,000 hours
<u>Application</u>		
Electrostatic Spray, 300 degrees F.		<b>Cure Schedule</b>
		(Time at substrate temp.)
Pretreatment: White Metal Blast (2mil. Min. Etch)		
Substrate: 0.032 in. CRS		10 Min. @ 400°F
Film Thickness		8.0-10.0 Mils

### 2.3 ACCESSORIES

- .1 Supply manufacturer's recommended materials and accessories as required for complete application.

## Part 3 Execution

### 3.1 PREPARATION

- .1 Prepare surfaces to be painted or finished in accordance with manufacturer's instructions and the following.
- .2 Thoroughly examine surfaces to determine extent of visible defects. Fill or remove dents and scratches by using mandrel and metal working techniques or filling with automotive body filler.
- .3 Sandblast fabricated products to white metal for removal of scale, oil, and debris to create minimum 2 mil etching for proper adhesion.

### **3.2 APPLICATION**

- .1 Painting Work shall be applied to manufacturer's directions. Apply paint only under dust-free conditions. Results shall be even, uniform in sheen, colour, and texture, free from brush or roller marks, or other defects.
- .2 Electrostatic application of epoxy powder primer with 375°F minimum 15-minute duration heat cure for maximum corrosion protection.
- .3 Immediately apply electrostatic application of polyester powder colour coat while metal temperature is minimum of 300°F and heat cure for minimum 10 minutes at 400°F.
- .4 Powder coating process shall provide an average of 8-10 mils total coating thickness, minimum 8 mils. Coating to be able to withstand more than 4,000 hours salt spray.
- .5 Finish exposed surfaces after fabrication.
- .6 Painting coats as specified are intended to cover surfaces completely. If surfaces finished as specified are not covered completely, apply additional coats at no additional cost.
- .7 Polarity level of paint shall be tested by applicator and adjusted to suit application requirements.
- .8 Primer shall be compatible with colour coat.
- .9 Mask adjacent surfaces against overspray.

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning. 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. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3 Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.

### **3.4 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Division 03 Cast-in-Place Concrete.
- .2 Section 05 50 00 – Metal Fabrications.

**1.2 ACTION AND INFORMATION SUBMITTALS**

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures:
  - .1 Submit product data sheets for each product supplied, including physical properties and performance characteristics, methods of installation, and limitations.
  - .2 Provide two copies of WHMIS SDS - Safety Data Sheets.
- .2 Manufacturer's Instructions: Submit manufacturer's written installation instructions and illustrations.
- .3 Upon Consultant's request, submit samples of all units complete with fastenings, for approval by Consultant and do not supply units to site until approval is obtained.
- .4 Product data: submit manufacturer's product data for products proposed for use in the work of this section.
- .5 Shop drawings: clearly indicate fabrication details, plans, elevations, hardware, and installation details.
- .6 Maintenance Data: Submit operation and maintenance data for incorporation into maintenance manual specified in Section 01 78 00.
- .7 Templates: Submit templates to Contractor for use by installers and fabricators as required for proper location and installation of hardware.
- .8 Submit close-out documents in accordance with Section 01 78 00.
  - .1 Operation and Maintenance Data: Operation and maintenance data for installed products. Include methods for maintaining products, and precautions against cleaning materials and methods detrimental to finishes and performance.
  - .2 Warranty: Warranty documents certified by manufacturers.

**1.3 DELIVERY, STORAGE AND HANDLING**

- .1 Provide and maintain dry, off ground weatherproof storage.
- .2 Store products in dry and protected location providing protection from damage, humidity and exposure to the elements.
- .3 Store materials in accordance with manufacturer's written instructions.

**1.4 WARRANTIES**

- .1 Contractor agrees to correct any deficiencies found in the Work performed for a period of 24 months from the date of Substantial Performance.
- .2 Provide manufacturer's product warranty.

**Part 2 Products**

**2.1 EXTERIOR TACTILE WARNING SYSTEMS**

- .1 Supply and install tactile attention indicators, conforming to OBC, Article 3.8.3.18.

- .2 Supply the following items to Division 03 as required to maintain the project schedule and integrate into the Work; coordinate as required:
  - .1 Top and bottom of exterior stairs and ramped sidewalks: supply tactile plates, full width of stair and ramp, to Division 03 for incorporation into the concrete Work, Type 316L marine grade stainless steel.
  - .2 Standard of Acceptance:
    - .1 Tactile Warning Plates, by Advantage Tactile Systems, Kinesik Engineered Products.

## **2.2 BIKE RACKS**

- .1 Cast aluminum, trapezoidal shape, powder coat finish.
- .2 Colour: As selected by Consultant from manufacturer's full range.
- .3 Acceptable material:
  - .1 Maglin Iconic MBR 2300-S

## **2.3 TRASH CONTAINERS**

- .1 Steel frame with high density polyethylene (HDPE) panels; 32 gallon LLDPE plastic liner.
- .2 Steel finish: manufacturer's standard powder coat.
- .3 Colours: As selected by Consultant from manufacturer's full range.
- .4 Acceptable material:
  - .1 Maglin MLWR1050-HDPE

## **2.4 BIKE REPAIR STATIONS**

- .1 Main body: 6 x 12 g. tube.
- .2 Bike Hanger: 1" solid round bar.
- .3 Foot: 10" dia. x 0.25" plate.
- .4 Tool tethers: 3/16" stainless steel cable.
- .5 Manual air pump.
- .6 Hand tools:
  - .1 Philips and flat head screwdrivers
  - .2 2.5, 3, 4, 5, 6, 8mm Allen wrenches
  - .3 T25 Torx wrench
  - .4 32 mm headset wrench
  - .5 15 mm pedal wrench
  - .6 8, 9, 10, and 11 mm box wrenches
  - .7 Tire levers
- .7 Finish: Galvanized after fabrication; followed with manufacturer's TGIC powder coat finish.
  - .1 Colours: As selected by Consultant from manufacturer's full range.
- .8 Acceptable material:
  - .1 Dero Fixit Bike Repair Station.

## **2.5 ACCESSORIES**

- .1 Provide all accessories, anchors and fasteners s required for complete installations.
- .2 Isolation Coating:
  - .1 Provide CRL Black Bituminous Paint – aerosol or paint, by C.R. Laurence of Canada, or equivalent.

## **Part 3 Execution**

### **3.1 COMPLIANCE**

- .1 Comply with manufacturer's printed installation instructions and illustrations, technical datasheets and specifications.

### **3.2 ISOLATION COATING**

- .1 Apply isolation coating to contact surfaces in contact with cementitious materials, wood materials, and dissimilar metals.
- .2 Apply into all drilled holes, onto all fasteners (e.g., bolts, screws, rivets) and between all flat surfaces (e.g., behind door handles, hinges, lamp-housings, diamond plate, mirror housing, latches, brackets, door trim, frame rails, suspension mounts, etc).
- .3 Generally, 2 – 3 mil thickness is required per application. Each application needs enough product applied so that excess material "oozes out" during assembly (this will ensure you have created a proper seal).
- .4 Assemble and wipe away any excess product.

### **3.3 INSTALLATION**

- .1 Install materials, products and systems in accordance with manufacturer's published installation instructions and illustrations.
- .2 Submit manufacturer's information and templates required for installation of work specified in this Section, and assist or supervise, or both, the setting of anchorage devices, and construction of other work as required to ensure that installations function as intended and according to manufacturer's specifications.
- .3 Install work to meet manufacturers' recommended specifications, true, tightly fitted, and level or flush to adjacent surfaces, as suitable for installation.
- .4 Mounting heights, where applicable as shown; where not shown as directed by Consultant.
- .5 Include reinforcing, anchorage and mounting devices required for the installation of each Product.
- .6 Fit joints and junction between components tightly and in true planes, conceal and weld joints where possible.
- .7 Supply handling instructions, anchorage information, roughing-in dimensions, templates and service requirements for installation of the work of this section, and assist or supervise, or both, the setting of anchorage devices and construction of other work incorporated with Products specified in this section.
- .8 Back paint components where contact is made with building finishes to prevent electrolysis.

**3.4 ADJUSTING**

- .1 Verify under work of this section that installed Products function properly, and adjust them accordingly to ensure satisfactory operation.

**3.5 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning. 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. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3 Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.

**3.6 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 09 21 16 – Gypsum Board Assemblies

**1.2 REFERENCES**

- .1 Aluminum Association (AA)
  - .1 AA DAF-45-03 (2009), Designation System for Aluminum Finishes.
- .2 American National Standards Institute (ANSI)
  - .1 NPA A208.1-2009, Particleboard Standard.
  - .2 NAP A208.2-2009, Medium Density Fiberboard (MDF) for Interior Applications.
- .3 ASTM International (ASTM):
  - .1 ASTM F2034-18, Standard Specification for Sheet Linoleum Floor Covering.
- .4 CSA Group (CSA)
  - .1 CSA O151:17, Canadian softwood plywood.
- .5 ULC Standards
  - .1 CAN/ULC-S102-2019, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Division 01 requirements.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications, and data sheets.
- .3 Shop Drawings:
  - .1 Submit shop drawings and indicate location, type, size, panel arrangement, backing, hardware, anchor or mounting details, frames or trim and accessories.
- .4 Submittals.
  - .1 Tackboards: Submit minimum 305 mm x 305 mm sample of face material in each colour required.
  - .2 Submit 300 mm long sample of trim in each finish type and colour.
- .5 Manufacturer's Instructions:
  - .1 Submit manufacturer's installation instructions.
- .6 Submit closeout data in accordance with Division 01 requirements.
  - .1 Provide manufacturer's printed recommendations for general maintenance, including cleaning instructions.

**1.4 QUALITY ASSURANCE**

- .1 Regulatory Requirements:
  - .1 Surface burning characteristics of materials: listed and labelled by an organization accredited by Standards Council of Canada.



- .2 Engage an experienced installer who is an authorized representative of visual display board manufacturer for both installation and maintenance of the type of products required for this Project.

## **Part 2 Products**

### **2.1 TACKBOARDS**

- .1 Linoleum Faced Tackboards (Pin-Up Boards): High pressure laminated, linoleum tackboards of 3-ply construction consisting of face sheet, core material, and backing and as follows:
  - .1 Face Sheet: To ASTM F2034, 6 mm thick resilient linoleum tackable surface composed of granulated cork, linseed oil, rosin binders and calendared onto a jute backing with a coloured facing.
  - .2 Colour: as selected by Consultant from manufacturer's full range.
  - .3 Core Material: 6 mm thick low-density fibreboard or 8 mm thick particleboard to manufacturer's standard.
  - .4 Laminating Adhesive: Manufacturer's standard, moisture resistant, thermoplastic type adhesive.
  - .5 Trim and Framing: Extruded aluminum to profiles indicated using manufacturer's standard sections appropriate for installation conditions.
- .2 Acceptable material:
  - .1 Forbo Bulletin Board.
    - .1 Colour:
      - .1 **WP-3: 2186 Blanched Almond.**

### **2.2 ACCESSORIES**

- .1 Supply mounting hardware for each board as required to suit conditions and substrate to which board is to be installed.
- .2 Joint reinforcement: concealed mechanical jointing system to provide straight, rigid, continuously supported, tight butt, flush joints at surface.
- .3 Anchor clips, mounting brackets, anchors and fasteners: concealed-type system, recommended by manufacturer for fixed installation.
- .4 Chalk Trough: Manufacturer's standard, plate type, continuous for full length of each installation, complete with end closures and matching trim and frame materials.
- .5 Dielectric Separator / Isolation Coating: Eck® Corrosion Prevention Coating, by Van Nay, LLC, or approved equivalent.

### **2.3 FABRICATION**

- .1 Shop fabricated display boards in one piece for lengths 3600 mm or less, for longer sections colour match adjacent pieces.
- .2 Laminate display board and backing sheet to core in accordance with display board manufacturer's recommendations.
- .3 Install trim on panels in factory. Make mitres and joints to hair-line fit, free of rough edges with concealed brackets to reinforce and hold joints tight and flush. No exposed fasteners permitted.

- .4 Overlap trim 6 mm onto panels. Provide closed ends for chalk troughs and open-end extrusions.
- .5 Factory fit assemblies too large for shipment to site in one piece, disassemble for delivery and site assembly.

## **2.4 FINISHES**

- .1 Aluminum trim finishes:
  - .1 Finish exposed surfaces of aluminum components in accordance with Aluminum Association Designation System for Aluminum Finishes, clear anodic finish.

## **Part 3 Execution**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

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

### **3.2 ISOLATION COATING**

- .1 Apply isolation coating to contact surfaces in contact with cementitious materials, wood materials, and dissimilar metals.
- .2 Apply coating into all drilled holes, onto all fasteners (e.g., bolts, screws, rivets) and between all flat surfaces (e.g., behind door handles, hinges, lamp-housings, diamond plate, mirror housing, latches, brackets, door trim, frame rails, suspension mounts, etc).
- .3 Generally, 2 – 3 mil thickness is required per application. Apply enough product so that excess material “oozes out” during assembly to ensure proper sealing.
- .4 Assemble and wipe away any excess product.

### **3.3 INSTALLATION**

- .1 Install display boards in accordance with manufacturer's published installation instructions, parallel to floor, plumb and level, to provide rigid, secure surface.
- .2 Install trim and framing around display boards panels. Make mitres and joints to hair-line fit, free of rough edges. Use concealed brackets to reinforce and hold joints tight and flush. No exposed fasteners permitted.
- .3 Mechanical attachment:
  - .1 To concrete or solid masonry use lag screw and expansion bolts or screws and fibre plugs as appropriate for stresses involved.
  - .2 To hollow masonry use toggle bolts or equivalent.
  - .3 To wood or sheet metal use screws. Secure into framing members in stud walls.

### **3.1 CLEANING**

- .1 Progress Cleaning: clean in accordance with Division 01 requirements. Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment. Perform cleaning after installation to remove construction and accumulated environmental dirt.

- .3      Manage and dispose of demolition and construction waste materials in accordance with Division 01 requirements.

**3.2            PROTECTION**

- .1      Protect installed products and components from damage during construction.
- .2      Repair damage to adjacent materials caused by Work of this Section.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 05 50 00 – Metal Fabrications.
- .2 Section 10 28 13 - Toilet Accessories.

**1.2 REFERENCES**

- .1 ASTM 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 A666-15, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
  - .3 ASTM A743/A743M-13ae1, Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.
  - .4 ASTM B86-13, Standard Specification for Zinc and Zinc-Aluminum (ZA) Alloy Foundry and Die Castings.
  - .5 ASTM B221-21, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
  - .6 ASTM D570-98(2010)e1, Standard Test Method for Water Absorption of Plastics.
  - .7 ASTM D638-14, Standard Test Method for Tensile Properties of Plastics.
  - .8 ASTM D790-17, Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
  - .9 ASTM D1037-12, Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials.
  - .10 ASTM D6578/D6578M-13 (2018), Standard Practice for Determination of Graffiti Resistance
  - .11 ASTM D2197-16 (2022), Standard Test Method for Adhesion of Organic Coatings by Scrape Adhesion
  - .12 ASTM D2794-92 (2024), Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
- .2 CSA Group (CSA)
  - .1 CSA B651:23, Accessible Design for the Built Environment.
- .3 ULC Standards
  - .1 CAN/ULC S102-10, Standard Method of Tests for Surface Burning Characteristics of Building Materials and Assemblies.

**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 Consultant in accordance with Division 01 requirements to:
  - .1 Verify project requirements.
  - .2 Review installation and substrate conditions.
  - .3 Coordinate building trades.
  - .4 Review manufacturer's installation instructions.

**1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Division 01 requirements.

- .2 Product Data:
  - .1 Submit manufacturer's printed product literature for partitions and components, specifications, and datasheets, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Submit Shop Drawings:
  - .1 Indicate fabrication details, plans, elevations, hardware, and installation details.
- .4 Samples:
  - .1 Submit samples of manufacturer's full range of colours for initial selection.
  - .2 Submit duplicate 100 x 100 mm samples showing finish on both sides, two finished edges and core construction.
  - .3 Submit duplicate representative samples of each hardware item, including brackets, fasteners, and trim.
- .5 Manufacturer's Instructions:
  - .1 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence and cleaning procedures.
- .6 Submit test reports and certificates specified.
- .7 Manufacturer's field reports: submit manufacturer's written reports within 3-days of review, verifying compliance of Work.
- .8 Submit closeout data in accordance with Division 01 requirements:
  - .1 Provide manufacturer's printed recommendations for general maintenance, including cleaning instructions.
  - .2 Submit warranty.

## **1.5 COORDINATION AND SEQUENCING**

- .1 Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and direction for installing anchorages, including sleeves, inserts, anchor bolts, and items with integral anchors, that are to be incorporated into gypsum board assembly construction. Deliver such items to project site in time for installation in conformance with Project Schedule.

## **1.6 QUALITY ASSURANCE – TOILET PARTITIONS**

- .1 Manufacturer Qualifications manufacturer with minimum 5-years' experience in manufacture of toilet compartments. Manufacturers seeking approval to submit the following:
  - .1 Product data, including test data from qualified independent testing agency indicating compliance with requirements.
  - .2 Samples of each component of product specified.
  - .3 List of successful installations of similar products available for evaluation by Consultant.
- .2 Installers Qualifications: Experienced installation personnel, all of whom have been regularly engaged in installation of toilet compartments for minimum 3-years.
- .3 Source Limitations: Obtain toilet compartment components and accessories from single manufacturer.
- .4 Accessibility Requirements: Comply with requirements of CSA B651, and with requirements of authorities having jurisdiction.
- .5 Test Reports: certified test reports showing compliance with specified requirements.

- .6 Certificates: product certificates signed by manufacturer certifying materials comply with requirements.

## **1.7 DELIVERY, STORAGE AND HANDLING**

- .1 Do not deliver toilet compartments to site until building is enclosed and HVAC systems are in operation.
- .2 Deliver, handle, and store units in accordance with manufacturer's instructions.
- .3 Store units on raised wood pallets protected from the elements and corrosive materials.
- .4 Do not remove from crates or other protective covering until ready for installation.

## **1.8 PROJECT CONDITIONS**

- .1 Field Measurements: where metal fabrications are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication and indicate measurements on shop drawings. Coordinate fabrication schedule with Construction Schedule to avoid delaying the project work.
  - .1 Establish Dimensions: where field measurements cannot be made without delaying the Construction Schedule, establish dimensions and proceed with fabrications without field measurements. Coordinate wall and other contiguous construction to ensure actual dimensions correspond to established dimensions.
  - .2 Provide allowance for trimming and fitting at site.

## **1.9 WARRANTY**

- .1 Extend warranty period specified in General Conditions of Contract to 3-years for the work specified in this specification section.
- .2 Manufacturer's Warranty: Provide manufacturer's warranty in which manufacturer agrees to repair or replace products that fail in materials or workmanship during the following period after substantial completion: Toilet Partitions: 3-years.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Solid Color Reinforced Composite (SCRC) toilet partition and urinal screen panels:
  - .1 Composition: Dyes, organic fibrous material, and polycarbonate/phenolic resins
  - .2 Surface Treatment: Non-ghosting, graffiti resistant surface integrally bonded to core through thermal and mechanical pressure.
  - .3 Edges: Same color as surface
  - .4 Minimum panel thickness:
    - .1 Doors and pilasters: 19 mm.
    - .2 Panels and screens: 13 mm.
  - .5 Graffiti Resistance (ASTM D6578): Passed cleanability test; 5 staining agents.
  - .6 Scratch Resistance (ASTM D2197): Maximum load value exceeds 10 kilograms.
  - .7 Impact Resistance (ASTM D2794): Maximum impact force exceeds 30 inch-pounds.
- .2 Colour: as selected by Consultant from manufacturer's full range.
- .3 Aluminum Extrusions: ASTM B221/B221M, 6063 alloy, T6 temper.
- .4 Zamac: ASTM B86, commercial zinc-alloy die castings, chrome plated.

## **2.2 PLASTIC TOILET COMPARTMENTS**

- .1 Toilet Partitions: floor anchored, overhead braced:
  - .1 Screen Standard Height: 58 inches (178 cm) with floor clearance 12 inches (30 cm)
  - .2 Coordinate with other trades. Provide overhead structural support as required.
  - .3 Supply studs for installation.
- .2 Hardware and Fittings:
  - .1 Brushed stainless steel continuous hinge, cam type, swings to closed or partially open position.
  - .2 Latch and Keeper: Brushed stainless steel surface mount slide.
  - .3 Full height stainless steel channels shall be used at the panel to wall, panel to pilaster, and pilaster to wall connections. Inswing doors shall be fitted with zinc die cast, #4 brushed combined coat hook and bumper.
  - .4 Coat Hooks: Manufacturer's standard coat hook with rubber bumper; one per compartment, mounted on door.
  - .5 Door Pulls: Provide door pull for out swinging doors. Provide on both sides of doors designated as accessible.
  - .6 Door Bumpers: Provide rubber-tipped door bumpers at out-swinging doors.
- .3 Fasteners: theft-proof 6-lobe security-head stainless steel screws.
- .4 Urinal screens: Panels of same construction as toilet partitions, wall-hung with heavy-duty wall brackets, 3 per panel.
- .5 Acceptable material:
  - .1 SierraSeries 1090 Solid Colour Reinforced Composite Partitions and Screens by Bobrick.

## **2.3 FABRICATION – PARTITIONS AND SCREENS**

- .1 Fabricate compartments in accordance with CSA B651.
- .2 Fabricate toilet compartment components to sizes indicated.
- .3 Coordinate requirements and provide cut-outs for through-partition toilet accessories and solid blocking within panel where required for attachment of toilet accessories.
- .4 Provide shoes and caps at pilasters and posts to conceal anchorage, supports, and leveling mechanisms.
- .5 Provide manufacturer's standard corrosion-resistant supports, leveling mechanisms, anchors, and anchoring assemblies for pilasters and posts.
- .6 Standard Head Rails: Hollow anodized aluminum tube, 25 mm by 41 mm, with anti-grip surface and aluminum wall brackets.

## **Part 3 Execution**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's printed installation instructions, installation details and illustrations, and technical datasheets.

### **3.2 EXAMINATION**

- .1 Examine work area to verify that measurements, substrates, supports, and environmental conditions are in accordance with manufacturer's requirements to allow installation.

- .2 Proceed with installation once conditions meet manufacturer's requirements.

### **3.3 PREPARATION**

- .1 Ensure supplementary anchorage is in place.
- .2 Do work in accordance with CSA B651.

### **3.4 INSTALLATION – PARTITIONS**

- .1 Install partitions secure, plumb and square.
- .2 Provide and install manufacturer's recommended components for complete privacy of visible spaces between doors and pilasters, pilasters and panels and at walls.
  - .1 Provide clearances of not more than 12 mm between pilasters and panels, and not more than 25 mm between pilasters/panels and walls.
- .3 No evidence of drilling, cutting and patching shall be visible in finished work.
- .4 Anchor mounting brackets using fasteners, bolts and anchors to suit substrate and structure:
  - .1 Coordinate in-wall blocking and reinforcement as required to provide positive anchorage and adequate structural support to resist loads.
  - .2 Provide fasteners and anchors suitable for substrate and recommended by manufacturer.
- .5 Attach panel to brackets with through-type sleeve bolt and nut.
- .6 Floor supported and overhead braced partition installation:
  - .1 Attach pilasters to floor with pilaster supports and level, plumb, and tighten installation with levelling device.
  - .2 Secure pilaster shoes in position.
  - .3 Secure headrail to pilaster face with not less than two fasteners per face.
  - .4 Set tops of doors parallel with overhead brace when doors are in closed position.
- .7 Equip each door with hinges, latch set, and coat hooks, and as follows:
  - .1 Mount coat hooks on doors.
  - .2 Provide 1 coat hook at 1650 mm for standard stalls.
  - .3 Provide 1 additional coat hook (2 total) at 1250 mm from floor on barrier free door:
    - .1 Adjust and align hardware for smooth, proper function.
    - .2 Set door open position at 30° to front, and in compliance with CSA B651 at accessible units. Install door bumper; door mounting.
- .8 Equip out-swinging doors with door pulls on inside and outside of doors in accordance with CSA B651.

### **3.5 INSTALLATION – SCREENS**

- .1 Screen installation:
  - .1 Provide screens consisting of panels and brackets of same material and colour as specified for toilet compartments.
  - .2 Screens: Attach with anchoring devices according to manufacturer's printed instructions and to suit supporting substrate and structure. Set units level and plumb.
  - .3 Anchor each screen panel to wall structure with 3 panel brackets anchored to wall.



**3.6 INSTALLATION – ACCESSORIES**

- .1 Mount accessories in accordance with accessory manufacturer's instructions, located as indicated; exact locations determined by Consultant.

**3.7 ADJUSTING**

- .1 Hardware Adjustment: Adjust hardware according to manufacturer's written instructions for proper operation. Adjust cam on all out-swinging doors to hold doors in closed position when unlatched. Adjust cam on all in-swinging doors to hold doors in open position when unlatched.

**3.8 TOLERANCES**

- .1 Maximum Variation from True Position: 1/4 inch (6 mm).
- .2 Maximum Variation from Plumb: 1/8 inch (3 mm).

**3.9 FIELD QUALITY CONTROL**

- .1 Manufacturers' Field Services:
  - .1 Provide manufacturers' field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

**3.10 CLEANING**

- .1 Progress Cleaning: clean in accordance with Division 01 requirements. Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools, and equipment. Perform cleaning after installation to remove construction and accumulated environmental dirt. All track and panel surfaces shall be wiped clean and free of handprints, grease, and soil.
- .3 Manage and dispose of demolition and construction waste materials in accordance with Division 01 requirements.

**3.11 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 08 80 50 – Glazing: Mirrors.
- .2 Section 09 21 16 – Gypsum Board Assemblies.

**1.2 REFERENCES**

- .1 ASTM International (ASTM)
  - .1 ASTM A123/A123M-24, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - .2 ASTM A153/A153M-23, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
  - .3 ASTM A653/A653M-23, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .4 ASTM A666/A666M-24, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
  - .5 ASTM A924/A924M-22a, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
  - .6 ASTM A1008/A1008M-24, 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-24, Standard Specifications for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines.
  - .8 ASTM B19-20, Standard Specification for Cartridge Brass Sheet, Strip, Plate, Bar, and Disks.
  - .9 ASTM B456-17, Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.
  - .10 ASTM C1503-24, Standard Specification for Silvered Flat Glass Mirror.
- .2 CSA Group
  - .1 CSA/ASC B651:23, Accessible design for the built environment.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet.
- .3 Submit shop drawings and indicate size and description of components, base material, surface finish inside and out, hardware and locks, attachment devices, description of rough-in-frame, building-in details of anchors for grab bars.
  - .1 Submit engineered shop drawings drawn and stamped by a Professional Engineer licenced to practice in Ontario, showing building-in details of anchors and blocking support of grab bars; submit engineering calculations.
- .4 Submit samples for confirmation of compliance with design intent.
  - .1 Samples to be returned for inclusion into work.
- .5 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 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 Consultant.

### **Part 2 Products**

#### **2.1 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/A666M, 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.

#### **2.2 ACCESSORY COMPONENTS**

- .1 Refer to Accessories Schedule on the Drawings.

#### **2.3 FABRICATION**

- .1 Weld and grind joints of fabricated components flush and smooth. Use mechanical fasteners only where approved.
- .2 Wherever possible form exposed surfaces from one sheet of stock, free of joints.
- .3 Form surfaces flat without distortion. Maintain flat surfaces without scratches or dents.
- .4 Back paint components where contact is made with building finishes to prevent electrolysis.
- .5 Hot dip galvanize concealed ferrous metal anchors and fastening devices to ASTM A153/A153M and ASTM A123/A123M.
- .6 Shop assemble components and package complete with anchors and fittings.
- .7 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.
- .8 Provide steel anchor plates and components for installation on studding and building framing.

#### **2.4 FINISHES**

- .1 Labels: Non-exposed faces, provide maximum 38 mm diameter stamped manufacturer logo.

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**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 Consultant 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               ISOLATION COATING**

- .1      Apply isolation coating to metal contact surfaces in contact with cementitious materials, wood materials, and dissimilar metals.
- .2      Apply into all drilled holes, onto all fasteners (e.g., bolts, screws, rivets) and between all flat surfaces (e.g., behind door handles, hinges, lamp-housings, diamond plate, mirror housing, latches, brackets, door trim, frame rails, suspension mounts, etc).
- .3      Generally, 2 – 3 mil thickness is required per application. Apply enough product so that excess isolation coating "oozes out" during assembly to ensure proper seal.
- .4      Assemble and wipe away excess product.

**3.3               INSTALLATION**

- .1      Install and secure accessories rigidly in place as follows:
  - .1      Stud walls: install steel back-plate to stud prior to plaster or drywall finish. Provide plate with threaded studs or plugs.
  - .2      Hollow masonry units 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.
- .2      Install grab bars on built-in anchors provided by bar manufacturer.
- .3      Use tamper proof screws/bolts for fasteners.
- .4      Fill units with necessary supplies shortly before final acceptance of building.

**3.4               COMMISSIONING**

- .1      Test components 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 components and leave in clean condition ready for operation.

**3.5 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning. 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. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3 Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 – Waste Management and Disposal.

**3.6 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**3.7 SCHEDULE**

- .1 Refer to Drawings and Schedules.
- .2 Comply with CSA/ASC B651 guidelines.
- .3 Locate accessories where indicated on drawings. Exact locations determined by Consultant.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 ASTM International
  - .1 ASTM A653/A653M-23, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .2 CSA Group (CSA):
  - .1 CSA G40.20-13/G40.21-13 (R2018), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel, Includes Update No.1 (2014).

**1.2 ADMINISTRATIVE REQUIREMENTS**

- .1 Coordination
  - .1 Coordinate size and location of prefabricated metal bases for metal lockers.
  - .2 Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related work specified in other Sections so that metal lockers can be supported and installed as indicated.

**1.3 SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures:
- .2 Product data: Submit manufacturer's printed product literature, specifications, and datasheets.
- .3 Shop drawings:
  - .1 Indicate:
    - .1 Type and class of locker.
    - .2 Thicknesses of metal.
    - .3 Fabrication and assembly methods.
    - .4 Assembled banks of lockers.
    - .5 Tops, hooks, bases, trim, numbers.
    - .6 Filler panels, doors, handles.
- .4 Samples: Submit duplicate 50 x 50 mm samples of colour and finish for metal, and for laminate doors.

**1.4 CLOSEOUT SUBMITTALS**

- .1 Provide operation and maintenance data indicating adjustments, repair methods and replacement of locker doors and latching mechanisms for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

**1.5 QUALITY ASSURANCE**

- .1 Installer to be an authorized representative of metal locker manufacturer for installation and maintenance of locker systems for this Project.
- .2 Obtain metal lockers and accessories through one source from a single manufacturer. Do not modify intended aesthetic appearance of metal lockers without the Consultant's written approval; submit comprehensive explanatory data to Consultant for review where modifications are necessary to meet project requirements before submission of Bids.

## **1.6 DELIVERY, STORAGE, AND HANDLING**

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

## **1.7 SITE CONDITIONS**

- .1 Site Measurements: Verify location of concealed framing, blocking, and reinforcements that support metal lockers before they are enclosed, and configuration of recessed openings by Site measurements before fabrication and indicate measurements on Shop Drawings.
- .2 Established Dimensions: Establish recessed opening dimensions and proceed with fabricating metal lockers without Site measurements where Site measurements cannot be made without delaying the Work. Coordinate wall and floor construction so that actual recessed opening dimensions correspond to established dimensions.

## **Part 2 Products**

### **2.1 MANUFACTURERS**

- .1 Basis-of-Design: Spacesaver Inc.
- .2 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 the following:
  - .1 American Specialties Inc.
  - .2 Access SMT.
  - .3 Canadian Locker Company Limited.
  - .4 General Storage Systems.
  - .5 Hadrian Manufacturing Inc.

### **2.2 MATERIALS**

- .1 Sheet Steel: ASTM A653/A653M coating Designation Z275, commercial grade, stretcher leveled, wiped coat galvanized; to the following minimum base metal thicknesses:
- .2 Steel Plates, Shapes, and Bars: In accordance with CSA G40.20/G40.21, Grade 300W.
- .3 Fasteners: Zinc or nickel plated steel, slotless type exposed bolt heads, and self locking nuts or lock washers for nuts on moving parts.

### **2.3 MANUFACTURED UNITS**

- .1 Lockers: double tiered configuration.
  - .1 Size: 305 mm wide x 610 mm deep x 1830 mm high.
- .2 Welded Frame: top, bottom, back, and sides constructed of minimum 18-gauge (1.21 mm) steel, welded.
  - .1 Multi-tier lockers: include fixed position shelf or shelves to separate tiers, constructed of minimum of 18-gauge (1.21 mm) steel, mechanically fastened to interior locker sides with locking lances.
- .3 Doors: High pressure laminate, full overlay style, 19 mm ( $\frac{3}{4}$ ") thick MDF with HPL on both faces.
  - .1 Matching 3 mm thick edge banding.
  - .2 Hinges:

- .1 Full overlay 1 inch hinges.
- .2 Steel, nickel-plated
- .3 Opening: 110 degrees.
- .4 Minimum of 2 hinges per door.
  - .1 Door heights up to 27 inches: 2 hinges.
  - .2 Door heights 28 to 56 inches: 3 hinges.

## **2.4 ACCESSORIES**

- .1 Locks: Electronic keypad type.
  - .1 Locks shall be centered vertically in door.
  - .2 Keypads shall have master override.
  - .3 Doors to remain closed when in unlocked mode.
- .2 Accessories:
  - .1 Coat hooks: manufacturer's standard, one hook per compartment.
  - .2 Trim: trim to manufacturer's standard including corner angles, jamb trim and fillers.
  - .3 Number Plates: Manufacturer's standard applied to door faces.
  - .4 Bases: Standard steel base as supplied by manufacturer, colour to match locker doors.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Examine walls, floors, and support bases for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- .2 Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- .1 Assemble and install lockers in accordance with manufacturer's written instructions.
- .2 Securely fasten lockers to grounds and nailing strips.
- .3 Install wall trim around recessed locker banks.
- .4 Install filler panels (false fronts) where indicated and where obstructions occur.
- .5 Install locker numbers.

### **3.3 REPAIR**

- .1 Touch up marred finishes or replace lockers that cannot be restored to factory finished appearance.

### **3.4 ADJUSTING**

- .1 Clean, lubricate, and adjust hardware.
- .2 Adjust doors and latches to operate easily without binding.
- .3 Verify that integral locking devices operate properly.



**3.5 PROTECTION**

- .1 Protect lockers from damage, abuse, dust, dirt, stain, or paint.
- .2 Do not permit metal locker use during construction.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 05 50 00 – Metal Fabrications.
- .2 Section 07 52 00 – Modified Bituminous Membrane Roofing.
- .3 Section 07 92 00 – Joint Sealants.

**1.2 REFERENCES**

- .1 ASTM International (ASTM):
  - .1 ASTM A53/A53M-24, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
  - .2 ASTM A123/A123M-24, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - .3 ASTM A153/A153M-23, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
  - .4 ASTM A276/A276M-24a, Standard Specification for Stainless Steel Bars and Shapes.
  - .5 ASTM A484/A484M-24b, Standard Specification for General Requirements for Stainless Steel Bars, Billets, and Forgings.
  - .6 ASTM A780/A780M-20., Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
  - .7 ASTM A999/A999M-23, Standard Specification for General Requirements for Alloy and Stainless Steel Pipe.
  - .8 ASTM A1011/A1011M-23, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
  - .9 ASTM B221-21, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
  - .10 ASTM B308/B308M-20, Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
  - .11 ASTM B429/B429M-20, Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
  - .12 ASTM D1056-20, Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber.
  - .13 ASTM D2000-18, Standard Classification System for Rubber Products in Automotive Applications.
  - .14 ASTM F593-24, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
  - .15 ASTM F594-24, Standard Specification for Stainless Steel Nuts.
  - .16 ASTM F887-23, Standard Specifications for Personal Climbing Equipment.
- .2 American National Standards Institute (ANSI):
  - .1 ANSI/ASSE Z359.1-2020, The Fall Protection Code.
- .3 Canadian Roofing Contractors' Association (CRCA)
  - .1 CRCA Roofing Specification Manual.

- .4 CSA Group (CSA):
  - .1 CSA G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel, Includes Update No. 1 (2014).
  - .2 CAN/CSA S16:24, Design of Steel Structures.
  - .3 CSA S136-16, Package, North American specification for the design of cold formed steel structural members and S136.1-19 - Commentary on North American specification for the design of cold-formed steel structural members.
  - .4 CSA S157-17/S157.1-17, Strength design in aluminum / Commentary on CSA S157-17, Strength design in aluminum.
  - .5 CSA W47.1:19, Certification of Companies for Fusion Welding of Steel.
  - .6 CSA W47.2-11 (R2020), Certification of companies for fusion welding of aluminum, Includes Update No. 1 (2011), Update No. 2 (2012).
  - .7 CSA W48:23, Filler Metals and Allied Materials for Metal Arc Welding.
  - .8 CSA W55.3-08 (R2023), Certification of companies for resistance welding of steel and aluminum.
  - .9 CSA W59:24, Welded Steel Construction.
  - .10 CAN/CSA Z91-17, Health and Safety Code for Suspended Equipment Operations.
  - .11 CSA Z259.12-16, Connecting components for personal fall arrest systems (PFAS).
  - .12 CAN/CSA Z271:20, Design of suspended access equipment.
- .5 Canadian Institute of Steel Construction (CISC):
  - .1 Fundamentals of Structural Shop Drafting.
  - .2 CISC Code of Standard Practice for Structural Steel, 8<sup>th</sup> Edition.
  - .3 Handbook of Steel Construction, 11<sup>th</sup> Edition.
- .6 The Society for Protective Coatings (SSPC) / National Association of Corrosion Engineers (NACE International):
  - .1 Coating Materials Guidelines.
  - .2 Surface Preparation Guidelines: SSPC-SP6/NACE No. 3, Commercial Blast Cleaning.
  - .3 Application, Inspection and Quality Control Guidelines.

### **1.3 ADMINISTRATIVE REQUIREMENTS**

- .1 Pre-construction Meeting: Convene a pre-construction meeting for the work specified in this section. Attendees must include, as a minimum, representatives of the following:
  - .1 Contractor (Site Superintendent & Project Manager),
  - .2 Installation Subcontractor (Site Foreman & Project Manager),
  - .3 Related Subcontractors (i.e. Roofing, Steel), and
  - .4 Consultant.

### **1.4 PERFORMANCE AND DESIGN REQUIREMENTS**

- .1 Arrange a meeting with the Consultant and authority having jurisdiction prior to ordering materials to clarify and discuss methods of attachment to structure.
- .2 Locate anchorages to suit suspension equipment that will be used on the building with respect to items such as reach, rigging, spacing, roof edge condition, and similar items.

- .3 Locate horizontal cable to suit suspension equipment that will be used on the building with respect to items such as rigging, spacing, roof edge condition and similar items.
- .4 Design, engineer and layout roof anchor safety systems that will permit others to clean all exterior surfaces of the building and for a crew to replace glazing, including the weight of 2 crew members, 2 insulating glass units (the replacement unit and the existing unit may be in the swing stage briefly while the installation is in progress), and required equipment.
- .5 Design all roof anchor safety systems to provide adequate attachment to the building and in conformance with applicable codes, laws and regulations. Ensure compatibility with industry standard equipment.
- .6 All roof anchor and stabilization systems to conform to proper engineering principles and to be designed by a Professional Engineer qualified in the design of window cleaning/suspended maintenance equipment, its application, and safety requirements, and licensed to practice in the province of Ontario.
- .7 Design roof and wall anchor systems to comply with the following structural requirements:
  - .1 Safety Anchors: designed to resist a 22.2 kN load in any direction without detachment or fracture occurring. To avoid deformation under normal usage, anchors are to be designed to resist a 4.5 kN static working load in any direction. Design of primary support equipment to be capable of sustaining without failure at least four times the maximum static working load applied or transmitted to the components; that is, a 4 to 1 stability factor.
- .8 Design horizontal cable systems as follows:
  - .1 Limit maximum arresting force on a user /employee to 1800 lbs (8 kN) maximum arrest force (MAF) when used with a body harness.
  - .2 Rigged such that a user/employee can neither free fall more than 6'-0" (1.8 m) nor contact any lower level.
  - .3 Hands-Free system: End supports, corner supports, and intermediate supports to which a horizontal lifeline is attached and the structure to which they are attached are designed to resist 2 times the reactions (obtained by analysis) generated by the horizontal lifeline system. The applied loads take into consideration that workers are wearing a 900 lbs (4.0 kN) shock absorber built into their lanyard and harness.
- .9 Each stage, carriage and platform used at the building perimeter to perform window maintenance and glass replacement work shall carry its own weight, the weight of all components and window washing accessories and tools, the weight of two men, and the weight of two windows.

## **1.5 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit design calculations and anchor loadings to the Consultant within 10 days of award of this contract.
- .2 Provide required information in accordance with Section 01 33 00 – Submittal Procedures, and as follows:
  - .1 Provide product data for each type of product specified.
  - .2 Provide Work Plan Drawings showing individual primary suspension line and safety lifeline anchors used for support of exterior maintenance equipment and personnel.
  - .3 Have a Professional Engineer (P.Eng.) licenced to practice in Ontario design and stamp Shop Drawings. Provide Shop Drawings using CISC standard drafting practices; detailing fabrication of steel components including, but not limited to, the following:

- .1 Include plans, elevations and large scale plans showing the layout and types of each item of equipment, including components and accessories.
- .2 Clearly indicated all drops of stages, platforms and chairs.
- .3 Clearly indicated design and fabrication details.
- .4 Show rough in dimensions, service connection details and the location of field connections.
- .5 Clearly indicate hardware and installation details.
- .6 Show required clearances for equipment service and operation.
- .7 Show wiring diagrams detailing wiring for power and control systems differentiating clearly between manufacturer installed wiring and field installed wiring.
- .8 Include installation and rigging instructions and all necessary restrictive and non-restrictive working usage notes and safety notes.
- .9 Layout and installation requirements for fall arrest anchors.
- .10 Location and installation requirements of items supplied under this section to be built in by other trades.
- .11 Each shop drawing shall bear the professional stamp and signature of a professional engineer licensed to practice in the province of Ontario.
- .4 Templates and Guides: Furnish to other trades, templates, guides and installation instructions for installation and alignment of tie-backs on exterior cladding as necessary for tying off of stages and bosoms chairs.
- .5 Test Reports: If requested, provide test reports as may be designated by the Consultant.

## **1.6 QUALITY ASSURANCE**

- .1 Manufacturer: Work of this Section to be executed by manufacturer specializing in the design, fabrication and installation of window cleaning/suspended maintenance systems having a minimum of five years documented experience.
- .2 Engineering: Ensure all anchor components conform to proper engineering principles and are engineered by a professional engineer qualified in the design of window cleaning/suspended maintenance equipment, its application and safety requirements.
- .3 Loading and safety assurance: Work of this Section to meet the requirements of governing codes and jurisdiction and to comply with properly engineered loading and safety criteria for the intended use.
- .4 Insurance: Manufacturer to carry specific liability insurance (products and completed operations) in the amount of \$2,000,000.00 to protect against product/system failure.
- .5 Welding to be executed by certified welders in accordance with CSA W59 and CSA W47.2 requirements.
- .6 Manufacturer's Inspections: Have representative of the window washing systems manufacturer visit site at commencement of work and periodically thereafter to advise on workmanship, and inspect work in progress.
- .7 Pre-construction Meeting: Convene a pre-construction meeting for the work specified in this section. Attendees must include, as a minimum, representatives of the following:
  - .1 Contractor (Site Superintendent & Project Manager),
  - .2 Installation Subcontractor (Site Foreman & Project Manager),
  - .3 Related Subcontractors (e.g., Roofing, Steel), and
  - .4 Consultant.

## **1.7 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver materials on pallets with manufacturer's original protective packaging and identifying labels intact.
- .2 Store products in an area protected from and construction activities.

## **1.8 MAINTENANCE DATA**

- .1 Operation and Maintenance Instructions: Provide operation and maintenance instructions for window washing systems supplemented as follows:
  - .1 Maintenance data shall include operating and maintenance instructions, parts lists, parts inventory list, purchase source for operational and maintenance materials, emergency instructions and similar information. Include name address, and phone number of the manufacturer's nearest service representative.
  - .2 Submit 1 copy of system Equipment Manual & Inspection Logbook, with "Initial Inspection - Certification for Use" and "Inspection Sign-Off" forms completed.
  - .3 Submit copies of a reduced plastic laminated as-built shop drawing showing equipment locations and details. This drawing is to be posted near each exit onto the roof.

## **1.9 STARTUP, TESTING AND DEMONSTRATION**

- .1 Prior to the date of Substantial Performance, Provide the services of a factory authorized service representative to provide start up service and to demonstrate and train the Owner's personnel as to proper care, maintenance and operation of the window washing systems, including demonstrations and teaching of code requirements regarding safety harnesses, and so on.

## **Part 2 Products**

### **2.1 MANUFACTURERS**

- .1 Subject to compliance with and ability to meet requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - .1 M.P. Anchors.
  - .2 Pro-Bel Enterprises Ltd.
  - .3 Suspended Stages.
  - .4 Telco Industries Inc.
  - .5 Trittech Fall Protection Systems
  - .6 Atlas Anchor Systems.
  - .7 Thaler Metal Industries Ltd.
- .2 Manufacturers meeting or exceeding the requirements of this section may apply to the Consultant prior to submission of bids for inclusion in the acceptable materials listing.

### **2.2 MATERIALS**

- .1 Metals:
  - .1 Rolled and Extruded Aluminum Members: Alloy and temper 6016-T6.
  - .2 Aluminum Tubing: Alloy and temper 6016-T6.
  - .3 Structural Aluminum Profiles, to ASTM B308: Alloy and temper 6016-T6.

- .4 Steel, Structural Shapes, Plates, Bars: Hot-rolled to meet specified requirements of CSA G40.20-13/G40.21, Grade 300W.
- .5 Steel, Hollow Structural Sections: Hot-formed, seamless, to meet specified requirements of CSA G40.20-13/G40.21, Grade 350W, Class H.
- .6 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.
- .2 Galvanizing:
  - .1 Hot dip components after fabrication to meet specified requirements of ASTM A123.
  - .2 Zinc Rich Paint: Conforming to DOD-P-21035 zinc rich paint. Apply one coat of zinc rich paint to surfaces exposed after assembly to minimum dry film thickness of 60  $\mu$ m (2.5 mil). Apply coating immediately after cleaning.
  - .3 Touch up galvanized surfaces with zinc rich coating, to ASTM A780: DOD-P-21035 zinc rich paint, minimum DFT 8 mils.
- .3 Isolation Coating: Apply an isolation coating to contact surfaces in contact with cementitious materials, wood materials and dissimilar metals except stainless steel.

## **2.3 DESCRIPTION OF SYSTEMS**

- .1 Roof and wall anchors:
  - .1 General: supply and install anchors per reviewed, engineered shop drawings. Coordinate with Contractor for correct placement of components with method of securement (cast-in-place, bolt-through, bolt-around, weldment, chemical epoxy) to suit substrate and structural conditions and location.
    - .1 Basis-of-design: Pro-Bel PB Series Roof Anchor,.
  - .2 Anchors to be supplied and installed in accordance with Regulatory Requirements and final engineered shop drawings.
  - .3 Safety U-Bars: Type 304 stainless steel with yield strength of 240 MPa. U-bar to be not less than 19 mm diameter material with 38 mm eye opening.
  - .4 Securement bolts: Type 304 stainless steel with yield strength of 44 Ksi (300 MPa)
  - .5 Hollow steel section (HSS) piers: mild steel, Type 300W with yield strength of 50 Ksi (350 MPa). Wall thickness to suit application, hot-dip galvanized to ASTM A123/A123M.
  - .6 Base plate and other sections: Type 304 stainless steel with yield strength of 44 Ksi (300 MPa); thickness and securement to suit application.
  - .7 Seamless spun aluminum Flashing: Type 6061-T6 alloy to ASTM B221 with deck flange flashed in to CRCA recommendations. Seal top of aluminium flashing with detachable watertight stainless steel cap.
  - .8 Miscellaneous bolts, nuts and washers: Type 304 stainless steel with yield strength of 35 Ksi (240 Pa).
  - .9 Rope stops: Stainless steel rope stops, cast-in-place type per reviewed engineered shop drawings.
- .2 Supply wall-mounted tie-back anchors as required meeting OBC requirements; coordinate with other trades as required for building in and adequate structure. Include in engineered, stamped shop drawings.

- .3 Horizontal Cable Assemblies:
  - .1 Supply equipment and materials as required for a complete assembly and fall restraint system in accordance with accepted Shop Drawings.
  - .2 Hollow steel section (HSS) pier supports: galvanized mild steel as above with yield strength of 50 Ksi (350 MPa). Wall thickness to suit application.
  - .3 Stainless steel flashing (for steel pier supports): Type 304 stainless steel with deck flange flashed in to ARCA recommendations. Seal top of flashing in accordance with roofing membrane specifications and recommended procedures.
  - .4 flashing with conformable mastic tape and torch
  - .5 Base plate and all other sections: galvanized mild steel as above with yield strength of 44 Ksi (300 MPa). Thickness and securement to suit application.
  - .6 Securement bolts: mild steel, Type 300W with yield strength of 44 Ksi (300 MPa), hot dipped galvanized to ASTM A123/A 123M-2000.
  - .7 Safety U-bars: Type 304 stainless steel with yield strength of 35 Ksi (240 MPa). U-bar to be not less than 3/4" (19 mm) diameter material with 1-1/2" (38 mm) eye opening.
  - .8 Cable: 5/16" (8 mm) dia., Type 316 stainless steel with minimum breaking strength of 19,125 lbs. (85 kN), complete with permanently swaged cable ends.
  - .9 Data plate: cable system entry points to be equipped with prominently displayed non-corrosive data plate clearly stating Maximum Service Capacity and Number of Users.
  - .10 Standard intermediate support brackets: multi-position Type 316 stainless steel with reinforcing end caps and suitable for installation at any height. Secured using 1/2" (13 mm) dia. fasteners.
  - .11 Mobile Intermediate support brackets: multi-position Type 316 stainless steel for working both sides of sloped roof at ridge point.
  - .12 Corner units: manufacturer's standard 90° or 135° flexible corner units as required.
  - .13 End terminal hardware: stainless steel swaged termination at one end and stainless steel tensioner with shock absorber at other end as required.
  - .14 Lanyard cable runner: Type 316 stainless steel with automatic runner bypass for continuous hands-free operation that can be inserted or removed anywhere on the cable.
  - .15 Harness: manufacturer's standard hands-free full body harness and lanyard complete with shock absorber. Supply two to Owner, in sizes required.

## **2.4 FABRICATION**

- .1 General:
  - .1 Fabricate work true to dimension, square, plumb, level and free from distortion or defects detrimental to appearance and performance.
  - .2 Grind off surplus welding material and ensure exposed internal corners have smooth lines.

## **2.5 FINISHES**

- .1 Isolation Coating: C.R. Laurence bituminous paint or aerosol.
- .2 Shop Preparation and Shop Primer: Track, supports, and other structural components: SSPC-SP6 ready for application of commercial grade anticorrosive primer.
- .3 Anchors Fabricated from Steel Pipe Uprights, Base Plates, and D-rings:



- .1 Mild Steel Components: Hot-dip galvanize after fabrication, as follows:
  - .1 Pipe: ASTM A53.
  - .2 Plate: ASTM A123 or ASTM A153.
  - .3 D-Rings: ASTM A153.
- .2 Stainless Steel Components: Manufacturer's standard.
- .4 Galvanizing Repair Compound: 95% zinc cold galvanizing compound in accordance with ASTM A780; field touch-up damaged galvanizing surface finishes with galvanizing repair compound.

### **Part 3 Execution**

#### **3.1 EXAMINATION**

- .1 Examine surfaces and areas upon which the work of this section depends. Report to the Contractor in writing, defects of work prepared by other trades and other unsatisfactory site conditions, which would cause defective installation of products, or cause latent defects in workmanship and function.
- .2 Verify site dimensions.
- .3 Commencement of work will imply acceptance of conditions on site.

#### **3.2 PREPARATION**

- .1 Supervise and assist in setting of anchorage devices required for installation of work of this Section but that do not form a part of the work of this Section.

#### **3.3 ISOLATION COATING**

- .1 Apply isolation coating to metal contact surfaces in contact with cementitious materials, wood materials, and dissimilar metals.
- .2 Apply into all drilled holes, onto all fasteners (e.g., bolts, screws, rivets) and between all flat surfaces (e.g., behind door handles, hinges, lamp-housings, diamond plate, mirror housing, latches, brackets, door trim, frame rails, suspension mounts, etc).
- .3 Generally, 2 – 3 mil thickness is required per application. Apply enough product so that excess isolation coating "oozes out" during assembly to ensure proper seal.
- .4 Assemble and wipe away excess product.

#### **3.4 INSTALLATION**

- .1 Install equipment in accordance with reviewed engineered shop drawings, and manufacturer's recommendations and guidelines.
- .2 Coordinate installation with work of other trades. All anchors to be properly flashed in compatible roofing materials. Coordinate with other trades for placement of built-in components.
- .3 Install work true, level, tightly fitted and flush with adjacent surfaces as required.
- .4 Deform threads of tail end of anchor studs after nuts have been tightened to prevent accidental removal or vandalism.
- .5 Structural steel to have adequate bearing surface to ensure 100% weld of applicable components.

### **3.5 FIELD QUALITY CONTROL**

- .1 Provide field review by manufacturer as follows:
  - .1 Provide field inspection and testing upon completion by manufacturer's technical representative.
  - .2 Note deficiencies and promptly make written report to Contractor, Owner, and Consultant.
  - .3 Issue Letter of Compliance and certifications of system issued by a qualified professional engineer registered in the province of the Work.
  - .4 Complete inspection logbook to certify the system for use; turn-over to Owner's representative.
- .2 The Owner will require a complete commissioning of fall arrest and restraint system, and window washing and equipment supports in accordance with the Owners commissioning plan.

### **3.6 COMMISSIONING**

- .1 Adjust and leave equipment in proper working order.
- .2 Complete "Initial Inspection - Certification for Use" form included in Equipment Manual & Inspection Logbook.
- .3 All anchors to be 100% tested on site using load cell test apparatus in accordance with manufacturer's recommendations.
- .4 Ensure that installations meet the requirements of authorities having jurisdiction.

### **3.7 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning. 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. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3 Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.

### **3.8 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

### **3.1 DEMONSTRATION AND TRAINING**

- .1 Demonstration and Training: refer to specification Section 01 79 10.99 - Architectural Systems and Equipment Demonstration and Training.
  - .1 Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain equipment.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .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 CSA Group
  - .1 CAN/CSA-C22.2 No.120-13 (R2023), Refrigeration equipment.
  - .2 CAN/CSA-C22.2 No.150-16 (R2021), Microwave ovens.

**1.3 ACTION SUBMITTALS / INFORMATION SUBMITTALS**

- .1 Submit product data in accordance with Section 01 33 00 – Submittal Procedures:
  - .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 be repaired or replaced that fail in materials or workmanship within manufacturers standard warranty period.

**Part 2 Products**

**2.1 MANUFACTURERS**

- .1 Materials other than Schedules products may be acceptable to the Consultant; submit information in accordance with Section 01 62 00 – Product Options no later than seven 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 Consultant will be listed in an Addendum.
  - .3 The Consultant 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 APPLIANCES**

- .1 Refrigerator (**EQ-1**): LG LBNC15251V 15 cu .ft. Bottom Freezer Refrigerator, 28" Wide, Platinum Silver.
- .2 Microwave (**EQ-2**): Panasonic Technology NN-SE995S, Stainless Steel.

## **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 SITE QUALITY CONTROL**

- .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.

### **3.4 CLEANING**

- .1 Remove packing material from appliances and leave units in clean condition, ready for operation.

### **3.5 DEMONSTRATION**

- .1 Engage a factory authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain appliances.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 07 46 16 – Preformed Metal Cladding.
- .2 Electrical drawings and specifications.

**1.2 ACTION AND INFORMATION SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product data: Submit product data sheets for book depositories, including physical properties and performance characteristics, WHMIS Safety Data Sheets, methods of installation, and limitations.
- .3 Manufacturer's Instructions: Submit manufacturer's written installation instructions and illustrations.
- .4 Shop drawings: clearly indicate fabrication details, plans, elevations, hardware, and installation details.
- .5 Maintenance Data: Submit operation and maintenance data for incorporation into maintenance manual specified in Section 01 78 00.

**1.3 DELIVERY, STORAGE AND HANDLING**

- .1 Provide and maintain dry, off ground weatherproof storage.
- .2 Store products in dry and protected location providing protection from damage, humidity and exposure to the elements.
- .3 Store materials in accordance with manufacturer's written instructions.

**1.4 WARRANTIES**

- .1 Contractor agrees to correct any deficiencies found in the Work performed for a period of 24 months from the date of Substantial Performance.

**Part 2 Products**

**2.1 BOOK DEPOSITORIES**

- .1 Book depositories: pre-assembled units complete with trims, weather- and draft-resistant, theft deterrent.
- .2 Overall dimensions: 571 W mm x 420 D mm x 520 H mm.
- .3 Opening size: 450 W mm x 73 H mm,
- .4 Interior: Aluminum body, 13 inch four-sided chute housing, neoprene rubber seals.
- .5 Exterior: heavy duty stainless steel faceplate, door flap, and built-in weather hood.
- .6 Interior locking with rotating knob mechanism.
- .7 Acceptable materials:
  - .1 Ease Single ThruWall 10-8100 with Thick Wall Extension Kit, by Kingsley Companies.

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**Part 3                    Execution**

**3.1                    COMPLIANCE**

- .1        Comply with manufacturer's printed installation instructions and illustrations, technical datasheets and specifications.

**3.2                    INSTALLATION**

- .1        Install book depositories in accordance with manufacturer's printed installation instructions and illustrations.
- .2        Submit manufacturer's information and templates required for installation of work specified in this Section, and assist or supervise, or both, the setting of anchorage devices, and construction of other work incorporated with Products specified in this Section as required to ensure that they function as intended.
- .3        Install work to meet manufacturers' recommended specifications, true, tightly fitted, and level or flush to adjacent surfaces, as suitable for installation.
- .4        Mounting heights, where applicable as shown; where not shown as directed by Consultant.
- .5        Include reinforcing, anchorage and mounting devices required for the installation of each Product.
- .6        Fit joints and junction between components tightly and in true planes, conceal and weld joints where possible.
- .7        Supply handling instructions, anchorage information, roughing-in dimensions, templates and service requirements for installation of the work of this section, and assist or supervise, or both, the setting of anchorage devices and construction of other work incorporated with Products specified in this section.
- .8        Back paint components where contact is made with building finishes to prevent electrolysis.

**3.3                    ADJUSTING**

- .1        Verify under work of this section that installed Products function properly, and adjust them accordingly to ensure satisfactory operation.

**3.4                    CLEANING**

- .1        Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning. 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. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3        Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 – Waste Management and Disposal.

**3.5                    PROTECTION**

- .1        Protect installed products and components from damage during construction.
- .2        Repair damage to adjacent materials caused by Work of this Section.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 09 21 16 – Gypsum Board Assemblies.

**1.2 REFERENCES**

- .1 ASTM International (ASTM)
  - .1 ASTM D3273-12e1, Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
  - .2 ASTM D6329-98(2015). Standard Guide for Developing Methodology for Evaluating the Ability of Indoor Materials to Support Microbial Growth Using Static Environmental Chambers.
  - .3 ASTM E2180-07(2012), Standard Test Method for Determining the Activity of Incorporated Antimicrobial Agent(s) In Polymeric or Hydrophobic Materials.
  - .4 ASTM G21-15, Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- .2 National Fire Protection Agency (NFPA)
  - .1 NFPA (Fire) 701: Standard Methods of Fire Tests for Flame Propagation of Textiles and Films, 2015 Edition.
- .3 ULC Standards
  - .1 CAN/ULC S109-14, Flame Tests of Flame Resistant Fabrics and Films.

**1.3 ACTION AND INFORMATION SUBMITTALS**

- .1 Submit product data in accordance with Section 01 33 00 – Submittal Procedures.
  - .1 Submit information for each type of product indicated including, but not limited to, the following:
    - .1 Styles, material descriptions, construction details, dimensions of individual components and profiles, features, and finishes.
    - .2 Motorized shade operator operating instructions.
    - .3 Motorized shade motor data, ratings, characteristics, and mounting arrangements.
    - .4 Operating instructions.
- .2 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.
  - .1 Indicate dimensions in relation to window jambs, operator details, head and sill anchorage details, hardware and accessories details.
  - .2 Locations and details for installing motorized operator components, switches, and controls; and motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
  - .3 Wiring diagrams indicating power, system, and control wiring.
- .3 Submit samples in accordance with Section 01 33 00 – Submittal Procedures.
  - .1 Submit one representative working sample of each type of shading device.
  - .2 After approval, samples will be returned for incorporation into the Work.

- .4 Submit closeout data to Section 01 78 00 - Closeout Submittals as follows:
  - .1 Methods for maintaining roller shades and finishes.
  - .2 Precautions about cleaning materials and methods that could be detrimental to fabrics, finishes, and performance.
  - .3 Operating hardware.
  - .4 Motorized shade operator.

#### **1.4 QUALITY ASSURANCE**

- .1 Manufacturer Qualifications: Obtain roller shades through one source from a single manufacturer with a minimum of twenty years' experience in manufacturing products comparable to those specified in this section.
- .2 Installer Qualifications: Installer trained and certified by the manufacturer with a minimum of ten years' experience in installing products comparable to those specified in this section.
- .3 Regulatory Requirements:
  - .1 Flame Spread Rating: Provide shade materials with flame spread and smoke developed characteristics required by Authorities Having Jurisdiction as determined by testing identical products in accordance with CAN/ULC S109.
  - .2 Anti-Microbial Characteristics: 'No Growth' per ASTM G21 results for fungi ATCC9642, ATCC 9644, ATCC9645.
  - .3 Electrical Requirements: Electrical components, devices, and accessories shall be listed and labelled in accordance with Canadian Standards Association and meet the requirements of the Canadian Electrical Code, and be marked for intended use.

#### **1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver material to site in manufacturer standard packaging. Store and handle as recommended by manufacturer.

#### **1.6 WARRANTY**

- .1 Manufacturer Warranty: Provide manufacturer's warranty from commencing from date of Substantial Performance covering the following minimum requirements for materials:
  - .1 Shade Hardware, including Electric Motors and Controllers: ten (10) years.
  - .2 Electronic Control Equipment: five (5) years
  - .3 Shade Fabric/Shade Cloth: ten (10) years.
  - .4 Metal Coatings: ten (10) years.



## **Part 2 Products**

### **2.1 MANUFACTURERS**

- .1 Basis of Design material:
  - .1 Altex.
- .2 Acceptable Manufacturers: Subject to compliance with requirements specified in this Section, manufacturers offering products that may be incorporated into the Work include the following:
  - .1 Light Harvesting Shading Solutions.
  - .2 Lutron Sivoia QS.
  - .3 MechoShade Systems.
  - .4 Nysan Shading Systems.
  - .5 Silent Gliss.
  - .6 Solarfective Products.

### **2.2 ROLLER SHADE COMPONENTS**

- .1 Roller Tube: One piece extruded 6061-T6 or 6063-T6 aluminum roller tube(s) meeting the requirements of ASTM B429, having clear anodized finish as follows:
  - .1 Protective Finish: AA-M12 Mechanical Finish; C22 Non-Specular; A21 Chemical Finish, etched, medium matte anodic coating; clear coating 0.025 mm or thicker to AMA 611; roller tube assemblies having mill finish will not be acceptable.
  - .2 Roller Tube: heavy-duty extruded aluminum shade tube shall be 2 mm thick with three internal continuous fins 11 mm high and nine at 6 mm high, for strength and drive capabilities when attached to the nylon sprocket. The fins shall be spaced 120 degrees apart. Maximum allowable deflection of tubes are L/700.
  - .3 Tube Configuration: Extrude tube with provision made for mechanical engagement with the operator and drive assembly; and having channels to accept fabric attachment spline.
- .2 Fabric Spline: Extruded vinyl profile, welded to fabric band or panel, allowing removal and re-installation of fabric bands or panels without removing the roller tube and hardware and having the following characteristics:
  - .1 Fabric bands or panels must be replaceable on site.
  - .2 Attachment of the fabric to the tube with double-sided adhesive tapes, adhesives, staples or rivets will not be acceptable.
- .3 Hem Bars and Hem Bar Pockets:
  - .1 Custom shaped oval, ergonomic aluminum profile; nominal 35 mm wide x 10 mm thick and having 1.8 mm wall thickness having matching end caps, pre-weighted to maintain bottom of shade fabric straight and flat; colour as selected by Consultant; with manufacturer's standard light seal applied to underside of hem bar; attached to fabric panel using welded fabric spline.
- .4 Fasteners: Non-corrosive fasteners as recommended by manufacturer.
- .5 Valance: As indicated by manufacturer's designation for style and colour.
- .6 Mounting: Inside mounting (confirm mounting with Consultant prior to ordering or fabrication), permitting easy removal and replacement without damaging roller shade or adjacent surfaces and finishes.

- .7 Hold-Down Brackets and Hooks or Pins and Side Channels: Manufacturer's standard for fixing shade in place, keeping shade panel material taut, and reducing light gaps when shades are closed.
- .8 Shade panel widths shall align with the exterior glazing mullions.

## **2.3 SHADE MATERIALS**

- .1 Roller fabric shall have the following minimum characteristics:
  - .1 Flame retardant to NFPA 701, and CAN/ULC S109.
  - .2 Bacterial and fungal resistance, to the following:
    - .1 ASTM E2180, ASTM G21, ASTM D3273, ASTM D6329.
  - .3 Basis-of-Design materials:
    - .1 **BL-1:** Deko – Texscreen Eco 6300-03 – Sand.
    - .2 **BL-2:** Deko – Texscreen Eco 1607-1 – 7%, White.
  - .4 Meet or exceed physical properties and performance characteristics of Basis-of-Design product.
- .2 Direction of Roll: Regular, from back of roller, and reverse, from front of roller, for double roller shades (confirm Direction with Consultant prior to ordering or fabrication).
- .3 Mounting Brackets: Fascia end caps, fabricated from steel finished to match fascia.
- .4 Fascia and Spacers: extruded aluminum, minimum 2 mm thick, with three continuous screw flutes. Fascia shall be capable of carrying and concealing wiring. Spacers shall be removable without the necessity for disassembly. Fascia shall return under roller assembly to support light shelf.
- .5 Bottom Bar: Steel or extruded aluminum, with plastic or metal capped ends. Provide concealed, by pocket of shade material, internal-type bottom bar with concealed weight bar as required for smooth, properly balanced shade operation.

## **2.4 OPERATORS**

- .1 Motorized Operators:
  - .1 Mounting Brackets: Angle shaped brackets size and thickness to manufacturer's standard; unitized pre-moulded assembly in lengths to suit system supplied; attached to high density polyethylene brackets, using manufacturer's standard adjustable motor coupling and end support assemblies.
  - .2 Motor Drive System: Manufacturer's standard in-tube motor drive having the following characteristics:
    - .3 Coupled shade panels being driven by a single motor may be coupled at a maximum angle of up to 90 degrees.
    - .4 Mounting assembly: Allow for continuous front or back roll fascia across multiple shades without exposed fasteners.
    - .5 Shade roller tube: Removable from mounting bracket without hardware removal; non-metal components shall be self-lubricating.
    - .6 Shade hardware system: Allow for site adjustments or component replacement without removing brackets, regardless of mounting location.
    - .7 Shade hardware: Allow for bottom up or sideways roller tube installation and removal without removing brackets.
    - .8 Motor Characteristics: Asynchronous motor unit, start and run, 120 Volt single phase 1.5 Amp, thermally protected, brushless motor, permanently lubricated

bearings and gearbox, containing all components for a properly functioning unit, and as follows:

- .1 Gears manufactured from non-corrosive metal containing a 3-phase planetary gear reducer; non-metallic planetary gearboxes will not be acceptable.
- .2 Shade motor located inside the extruded aluminum roller tube using appropriate adapters to allow for a smooth operation.
- .3 Lifting Capacity: 30% safety factor.
- .4 Sound Generated: not exceeding 30 dB.
- .5 Equip shade motor using disconnect plug at motor lead.
- .6 Shade motor shall contain a conical steel disk brake allowing no slippage and adjusting to high torque.
- .7 Fit shade motor with solid steel adjustable drive extensions, rectangular bar shaped for drive and torque transfer to single or multiple coupled extruded roller tubes, to suit installation.
- .8 Motor Speed: Adjustable from 12 to 30 RPM to suit Owner's requirements and correct operation.
- .9 Motor Lead: Plenum rated quality.
- .10 Equip shade motor with externally located control wheels that allow exact control of shade position at the upper and lower shade location, preventing over winding of the fabric shade cloth.

.2 Motorized Operator Controls:

- .1 Basic Control Functions:
  - .1 Switch Control: Shade manufacturer's standard control system.
  - .2 Group of roller shades controlled by one switch.
  - .3 Switch: Rocker type-maintained contact switch, recessed mounted, rated for 120V AC 15 Amp with cover plate selected by Consultant from manufacturer's standard range.
- .2 Group Control:
  - .1 Power roller shade motor shall use 3-conductor (plus ground) wire connected to dry contact relay system; supplied in groupings of even units mounted in junction boxes supplied under this section; include identification labels clearly indicating Groups that are controlled.
  - .2 Wire Group control switches to dry contact relays using low voltage 4-conductor wire.
- .3 Terminate wiring in dry contact relays using disconnect plug configuration.
- .4 Control system shall have the ability to upgrade to fully computerized control system without adding any additional wiring.

## 2.5 ROLLER SHADE FABRICATION

- .1 Product Description: Roller shade consisting of a roller, a means of supporting the roller, a flexible sheet or band of material carried by the roller, a means of attaching the material to the roller, a bottom bar, and an operating mechanism that lifts and lowers the shade.
- .2 Concealed Components: Non-corrodible or corrosion-resistant-coated materials.
  - .1 Lifting Mechanism: With permanently lubricated moving parts.

- .3 Unit Sizes: Obtain units fabricated in sizes to fill window and other openings as follows, measured at 23° C:
  - .1 Shade Units Installed between Inside Jambs: Edge of shade not more than 6 mm from face of jamb. Length equal to head to sill dimension of opening in which each shade is installed.
- .4 Installation Brackets: Designed for easy removal and reinstallation of shade, for supporting fascia, roller, and operating hardware and for hardware position and shade mounting method indicated.
- .5 Installation Fasteners: Not fewer than two fasteners per bracket, fabricated from metal noncorrosive to shade hardware and adjoining construction; type designed for securing to supporting substrate; and supporting shades and accessories under conditions of normal use.
- .6 Hembars and Hembar Pockets:
  - .1 Ergonomic designed exposed extruded aluminum alloy 6063-T5, custom oval shaped profile 35 mm x 10 mm x 1.78 mm thick, with matching end caps, pre-weighted, to maintain bottom of shade fabric straight and flat. Colour prefinished to match adjacent window framing or as selected by Consultant. Underside of hem bar available with schlegel light seal. Attached to fabric panel by welded fabric spline.
  - .2 Fasteners: Non-corrosive, as recommended by manufacturer.

## 2.6 ACCESSORIES

- .1 Aluminum Fascia:
  - .1 Back / Regular Roll Shade Fascia:
    - .1 Extruded aluminum alloy 6063-T5, prefinished, 105 mm x 45 mm x 1.6 mm wall thickness, custom designed profile to fit onto pre-moulded end mounting brackets without exposed fasteners. Colour prefinished to match adjacent window framing or as selected by Consultant.
    - .2 Fascia shall allow for continuous placement across multiple shades (to a maximum length of 6100 mm without exposed fasteners.
    - .3 Fascia shall conceal the mounting hardware, power and control cables, drive mechanism, roller tube, and all fabric rolled on the tube.
    - .4 Fascia shall not fit snug against side channels to prevent thermal shock to the glazing system.

## 2.7 FINISHES

- .1 Colour-Coated Finish: For metal components exposed to view, apply manufacturer's standard baked or anodized finish complying with manufacturer's written instructions for surface preparation including pre-treatment, application, baking, and minimum dry film thickness.
- .2 Colours of Metal and Plastic Components Exposed to View: as selected by Consultant from manufacturer's standard range.
- .3 Unexposed aluminum: mill finish.

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**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 Owner's Representative of unsatisfactory preparation before proceeding.

**3.2                    PREPARATION**

- .1        Clean surfaces thoroughly prior to installation.
- .2        Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

**3.3                    INSTALLATION**

- .1        Ceiling and wall mounted roller blinds are to be supported by wall or ceiling structure. Drywall support is not acceptable.
- .2        Install shades level, plumb, square, and true, according to manufacturer's written instructions, and located so shade band is no closer than 50 mm to interior face of glass. Allow proper clearances for window operation hardware.
- .3        Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.
- .4        Clean roller shade surfaces after installation, according to manufacturer's written instructions.
- .5        Engage Installer to train Owner's maintenance personnel to adjust, operate, and maintain roller shade systems.

**3.4                    CLEANING**

- .1        Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning. 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. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3        Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 – Waste Management and Disposal.

**3.5                    PROTECTION**

- .1        Protect installed products and components from damage during construction.
- .2        Repair damage to adjacent materials caused by Work of this Section.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 03 30 00 – Cast-in-Place Concrete.
- .2 Section 03 35 00 – Concrete Finishing.
- .3 Section 09 65 00 – Resilient Flooring.

**1.2 REFERENCES**

- .1 ASTM International (ASTM)
  - .1 ASTM A276/A276M-24a, Standard Specification for Stainless Steel Bars and Shapes
  - .2 ASTM D2047-17, Standard Test Method for Static Coefficient of Friction of Polish-Coated Flooring Surfaces as Measured by the James Machine.
- .2 National Floor Safety Institute (NFSI)

**1.3 ADMINISTRATIVE REQUIREMENTS**

- .1 Coordinate recessed frame installation with Section 03 30 00 - Cast-in-Place Concrete, provide measurements for recess size and frame anchorage requirements necessary for installation of entrance grid and frame system.
  - .1 Coordinate leveling grout as required to achieve proper depth and flatness.
- .2 Coordinate top of grid surfaces with bottom of doors swinging across entrance grids and frames, provide information to ensure clearance between grid without impinging operation of door.
- .3 Coordinate delivery of entrance grid system with building enclosure to ensure that installation conditions are complete and related interior finish work is in progress.

**1.4 ACTION SUBMITTALS / INFORMATIONAL 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 for each floor grid and frame specified. Include manufacture's installation instructions.
- .2 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.
  - .1 Show layout of grid and frame including, but not limited to, details indicating construction relative to materials, direction of traffic, spline locations, profiles, anchors and accessories.
- .3 Submit samples in accordance with Section 01 33 00 – Submittal Procedures.
  - .1 Submit samples showing finish of exposed floor grid, frame and accessories required for verification by Consultant.

**1.5 CLOSEOUT SUBMITTALS**

- .1 Submit closeout data in accordance with Section 01 78 00 – Closeout Submittals.
  - .1 Submit maintenance data: Include maintenance procedures, recommendations for maintenance materials and equipment, and suggested schedule for cleaning.

## **1.6 QUALITY ASSURANCE**

- .1 Obtain floor grids and frames from single source by single manufacturer installed by personnel experienced in similar projects and complexity to that specified.

## **1.7 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver materials to the project site ready for use and fabricated in as large sections and assemblies as practical, in unopened original factory packaging clearly labeled to identify manufacturer.

## **1.8 WARRANTY**

- .1 Provide Manufacturer's Warranty for product to be free from manufacturer defects for a period of five years from date of substantial performance.

## **Part 2 Products**

### **2.1 PERFORMANCE/DESIGN CRITERIA**

- .1 Slip resistance in accordance with ASTM D2047, Coefficient of Friction, minimum 0.60 for accessible routes tested in wet conditions.
- .2 Deflection under live load: Design foot grilles to minimum uniform load of 4110 N applied over a 100 mm square surface with maximum 1/180 deflection over a 1067 mm span..

### **2.2 ENTRANCE FLOOR GRIDS**

- .1 Entrance Floor Grids (GRL-1): Recessed primary grid intended to remove soil and debris from foot traffic and as follows:
  - .1 Recessed Frame:
    - .1 Stainless steel angles to ASTM A276/A276M, Type 304.
    - .2 Depth: 50 mm (2 inches).
  - .2 Grid: Stainless steel wire connected with support bar structure, to meet performance specified for loading.
    - .1 Construction: Stainless steel wire of two different widths, alternated evenly in grid, running perpendicularly to direction of traffic.
    - .2 Stainless steel wire to ASTM A276/A276M, Type 304.
    - .3 Wire sizes:
      - .1 9.5 x 3 x 25 mm, T-shaped profile.
      - .2 4.7 x 3 x 25 mm, T-shaped profile.
    - .4 Wire spacing: Maximum 4.7 mm (3/16 inch).
  - .3 Acceptable material:
    - .1 Design Line Model CO-37 by Grillage Bolar (Canada) Inc., as supplied by Richelieu Inc.

### **2.3 ACCESSORIES**

- .1 Levelling compound: as accordance with Section 03 35 00 – Concrete Finishing and as recommended by entrance grid manufacturer.
- .2 Coat surfaces of frames that will contact cementitious material with manufacturer's standard protective coating.
- .3 Gasket: Provide sound dampening gasket between frame and grid.

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Verify surfaces and conditions are ready to accept work of this Section. 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.
- .2 Field measurements: Check actual openings for grids by accurate field measurements before fabrication. Record actual measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of work.
- .3 Coordinate frame installation with concrete construction to ensure recess and frame anchorage are accurate and that the base is level and flat. Defer frame installation until building enclosure is complete and related interior finish work is in progress.
- .4 Ensure side walls of recesses are straight and smooth.
- .5 Ensure final recess depth matches frames and grids.

**3.2 PREPARATION**

- .1 Install levelling compound to screed level required for accurate recessed installation.

**3.3 INSTALLATION: RECESSED ENTRANCE FLOOR GRID**

- .1 Install entrance grids in accordance with manufacturer's written instructions.
- .2 Coordinate top of grid surfaces with bottom of door swings to provide clearance between doors and grids.
- .3 Install entrance grids immediately before declaration of Substantial Performance for the project and after construction traffic is completed.
- .4 Install entrance grids and frames in removable sections for ease of maintenance by Owner.

**3.4 CLEANING**

- .1 Clean tread surfaces and recessed well as frequently as possible to reduce the effects of accumulated soiling that may hinder performance and lifetime.

**3.5 PROTECTION**

- .1 After completing required frame installation and concrete work, provide temporary filler of plywood or fiberboard in recesses, and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and project is near time of substantial completion.
- .2 Defer installation of floor grids until time of substantial completion of project.

**3.6 DEMONSTRATION**

- .1 Train Owner's designated personnel in the maintenance of entrance grids and frames in accordance with Section 01 79 00 – Demonstration and Training.
- .2 Demonstrate cleaning methods required to maintain entrance grid and frame system, based on estimated foot traffic requirements for the completed project.

**END OF SECTION**



**LIST OF SECTIONS**  
**20 00 01**

SECTION NO.      SECTION TITLE

**SECTION 20    GENERAL MECHANICAL**

20 01 01 - MECHANICAL GENERAL REQUIREMENTS  
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20 01 03 - MECHANICAL COORDINATION AND INSTALLATION DESIGN SERVICES  
20 05 01 - BASIC MATERIALS AND METHODS  
20 05 19 - INDICATING GAUGES  
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20 05 24 - WELDING  
20 05 25 - EXCAVATING AND BACKFILLING  
20 05 29 - HANGERS AND SUPPORTS  
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20 07 16 - DUCTWORK INSULATION  
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20 08 01 - START-UP AND PERFORMANCE TESTING REPORTING  
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20 08 19 - PROJECT CLOSE-OUT

**SECTION 21    FIRE PROTECTION**

21 05 01 - FIRE PROTECTION GENERAL  
21 12 29 - FIRE EXTINGUISHERS

**SECTION 22    PLUMBING**

22 05 01 - PLUMBING GENERAL  
22 05 23 - PLUMBING SPECIALTIES & ACCESSORIES  
22 11 16 - DOMESTIC WATER SUPPLY PIPING – COPPER  
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22 33 13 - DOMESTIC WATER HEATERS  
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**SECTION 23    HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)**

23 11 23 - NATURAL GAS SYSTEMS  
23 31 01 - AIR DISTRIBUTION - GENERAL  
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23 33 46 - FLEXIBLE DUCTWORK  
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23 36 13 - TERMINAL BOXES  
23 37 13 - GRILLES, REGISTERS AND DIFFUSERS  
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23 82 38 - UNIT HEATERS

**SECTION 25    INTEGRATED AUTOMATION**

25 05 01 - BUILDING AUTOMATION SYSTEMS GENERAL  
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25 14 01 - B.A.S EQUIPMENT CONTROLLERS  
25 35 01 - B.A.S. INSTRUMENTATION AND ACTUATORS  
25 90 01 - B.A.S. SEQUENCE OF OPERATIONS  
25 90 01 - CS-001 BAS CONTROL SEQUENCE - RTU  
25 90 01 - CS-002 BAS CONTROL SEQUENCE – EF  
25 90 01 - CS-003 BAS CONTROL SEQUENCE – EF-2  
25 90 01 - CS-004 BAS CONTROL SEQUENCE – VAV BOXES

**END OF SECTION**

## **MECHANICAL GENERAL REQUIREMENTS**

### **20 01 01**

#### **1 GENERAL**

##### **1.1 General Contract Documents**

- .1 Comply with General Conditions of Contract, Supplementary Conditions and Division 01 - General Requirements.

##### **1.2 Work Included**

- .1 Work to be done under Divisions 20, 21, 22, 23 and 25 to include furnishing of labour, materials and equipment required for installation, testing and putting into proper operation complete mechanical systems as shown, as specified, as intended, and as otherwise required. Complete systems to be left ready for continuous and efficient satisfactory operation.

##### **1.3 Document Organization**

- .1 Applicable Divisions for Mechanical Work:
  - .1 Division 20 - Common Work for Mechanical
  - .2 Division 21 - Fire Protection
  - .3 Division 22 - Plumbing and Drainage
  - .4 Division 23 - Heating, Ventilation and Air Conditioning (HVAC)
  - .5 Division 25 - Building Automation System
- .2 For clarity, any reference in the Contract Documents to Division 20 includes Divisions 21, 22, 23 and 25.
- .3 The Specifications for these Divisions are arranged in Sections for convenience. It is not intended to recognize, set or define limits to any subcontract or to restrict Contractor in letting subcontracts.
- .4 Contractor is responsible for completion of work whether or not portions are sublet.

##### **1.4 Division 20, as it applies to Divisions 21, 22, 23 and 25**

- .1 Articles that are of a general nature, applicable to each Section of these Divisions.
- .2 Articles specifying materials, equipment, installation techniques and workmanship that are applicable to more than one Section of these Divisions.
- .3 Articles that are to be read in context with and form part of relevant Sections of these Divisions.

##### **1.5 Definitions**

- .1 The words "indicated", "shown", "noted", "listed" or similar words or phrases used in this Specification, mean that material or item referred to is "indicated", "shown", "listed" or "noted" on Drawings or in Specification.
- .2 The words "approved", "satisfactory", "as directed", "submit", "permitted", "inspected", or similar words or phrases used in this Specification, mean that material or item referred to is to be "approved by", "satisfactory to", "as directed by", "submitted to", "permitted by", "inspected by", Engineer.

- .3 Instructions using any form of word "provide" involves Contractor in furnishing labour, materials and services to supply and install referenced item.

## **1.6 Language**

- .1 The specification is written as a series of instructions addressed to the Contractor, and by implication to subcontractors and to suppliers. For clarity and brevity, use is made of numbered lists and bulleted lists. Where list follows a semi-colon (;) the punctuation is for clarity. Where a list follows a colon (:) the punctuation is to be read as a short-hand form of the verb "to be" or "to have" as context requires.
- .2 It is not intended to debate with the Contractor the reasons for these instructions, and words associated with justification for an instruction or restatement of anticipated performance have been omitted to avoid possible ambiguities.

## **1.7 Examination**

- .1 Examine any existing buildings, local conditions, building site, Specifications, and Drawings and report any condition, defect or interference that would prevent execution of the work.
- .2 No allowance will be made for any expense incurred through failure to make these examinations of the site and the documents prior to Tender or on account of any conditions on site or any growth or item existing there which was visible or known to exist at time of Tender.
- .3 Examine work of other Divisions before commencing this work, and report any defect or interference.

## **1.8 Design Services**

- .1 Provide design services for elements of the Work where specified in other sections of Division 20, sealed by a professional engineer licensed in the applicable jurisdiction.

## **1.9 Standard of Material and Equipment**

- .1 Provide materials and equipment in accordance with Division 01.
- .2 Materials and equipment:
  - .1 new and of uniform pattern throughout work,
  - .2 of Canadian manufacture where obtainable,
  - .3 standard products of approved manufacture.
  - .4 labeled or listed as required by Code and/or Inspection Authorities,
  - .5 registered in accordance with the requirements of TSSA Boilers and Pressure Vessels Safety Division Guidelines for the Registration of Non-nuclear Fittings in the Province of Ontario,
  - .6 in compliance with Standards and Regulations with respect to;
    - (a) chemical and physical properties of materials,
    - (b) design,
    - (c) performance characteristics, and
    - (d) methods of construction and installation.
  - .7 identical units of equipment to be of same manufacture.
  - .8 identical component parts of same manufacture in similar units of equipment, but various component parts of each unit need not be from one manufacturer.
- .3 Materials and equipment are described to establish standards of construction and workmanship.

- .1 Where manufacturers or manufacturers' products are identified in lists with the phrase "Standard of Acceptance", these are manufacturers and/or products which meet required standards with regard to performance, quality of material and workmanship.
- .2 Manufacturers and or products used are to be chosen from these lists.
- .4 Select materials and equipment in accordance with manufacturer's recommendations and install in accordance with manufacturer's instructions.
- .5 Materials and equipment not satisfying these selection criteria will be condemned.
- .6 Remove condemned materials from job site and provide properly selected and approved materials.

#### **1.10 Substitutions**

- .1 The use of a substitute article or material which the manufacturer represents to be of at least equal quality and of the required characteristics for the purpose intended may be permitted, subject to the following provisions:
  - .1 a substitution will not be considered for reasons of meeting the construction schedule unless the contractor can demonstrate to the satisfaction of the Engineer they made all reasonable efforts to procure the specified product or material in a timely fashion,
  - .2 the manufacturer must advise the Engineer of this intention to use an alternative article or material before doing so,
  - .3 the burden of proof as to the quality and suitability of alternatives to be upon the manufacturer and they shall supply all information necessary as required by the Engineer at no additional costs to the contract,
  - .4 the Engineer to be the sole judge as to the quality and suitability of alternative materials and their decision to be final,
  - .5 where use of an alternative material involves redesign or changes to other parts of the work, the costs and the time required to effect such redesign or changes will be considered in evaluating the suitability of the alternative materials,
  - .6 no test or action relating to the approval of substitute materials to be made until the request for substitution has been made in writing by the manufacturer and has been accompanied by complete data as to the quality of the materials proposed. Such request to be made in ample time to permit appropriate review without delaying the work, taking into consideration that such a substitution request may be rejected and require providing the product or material as originally specified,
  - .7 Whenever classification, listing, or other certification by a recognized standards body is a part of the specifications for any material, proposals for use of substitute materials to be accompanied by reports from the equivalent body indicating compliance with the requirements of the specifications,
  - .8 The costs of all testing required to prove equality of the material proposed to be borne by the manufacturer.

## **2 SUBMITTALS**

### **2.1 Requests for Information (RFIs)**

- .1 Submit requests for information (RFIs) in accordance with Division 01 specification:
  - .1 Submit to the Prime Consultant for distribution and tracking with the design team;
  - .2 Include relevant and applicable Drawing and/or Specification reference for the RFI;

- .3 Provide photos, hand sketches or other material to support and clarify the intent of the RFI.
- .2 If submitting the RFI directly to Loring Consulting Engineers for review and comment, the RFI shall be submitted with all necessary information by email to: [rfl.toronto@loringengineers.com](mailto:rfl.toronto@loringengineers.com)

## **2.2 Shop Drawings and Product Data Sheets**

- .1 Submit shop drawings, manufacturers and product data and samples in accordance with Division 01.
  - .1 Submit shop drawings in the same unit of measure as are used on the drawings. Both metric and imperial measures may be included.
  - .2 Submitted shop drawings by email to: [ca.toronto@loringengineers.com](mailto:ca.toronto@loringengineers.com)
- .2 Include a Loring Consulting Engineers, Inc. shop drawing cover sheet form prepared for this project, for each shop drawing, or, include the same information on the general or trade contractor's submittal cover sheet:
  - .1 Information required on each submission:
    - (a) Client/Architect name
    - (b) Project Name
    - (c) Loring project number
    - (d) Date
    - (e) Contractor name
    - (f) Contractor reference no.
    - (g) Manufacturer name
    - (h) Product type
    - (i) Specification section number
    - (j) Contractor trade: mechanical, electrical, elevators, or general trades
    - (k) If a re-submission, include the Loring number from the previous submission.
- .3 Submit shop drawings in PDF format;
  - .1 If submitted in hardcopy format, submit in 8.5 x 11 or 11 x 17 size, black and white originals of graphic quality suitable for photocopying. Allow one additional week for processing of shop drawings submitted in hardcopy format.
  - .2 for each item of equipment.
- .4 Manufacturer's letter sized printed data sheets, as black and white originals of graphic quality suitable for photocopying, are acceptable in place of shop drawings for standard production items.
- .5 Submit with manufacturers data sheets, typed schedules listing manufacturer's and supplier's name and catalogue model number for;
  - (a) valves,
  - (b) traps,
  - (c) expansion joints,
  - (d) pipe hangers
- .6 For plumbing fixtures, submit fixture cuts with catalogue numbers for fixtures to be used on job. Identify and arrange fixture cuts in same sequence as specification fixture list.
- .7 Shop drawings and product data to show;
  - (a) dimensioned outlines of equipment
  - (b) dimensioned details showing service connection points.

- (c) elevations illustrating locations of visible equipment such as gauges, pilot lights, breakers and their trip settings, windows, meters, access doors.
  - (d) description of operation.
  - (e) single line diagrams.
  - (f) general routing of bus ducts and connecting services.
  - (g) mounting and fixing arrangements.
  - (h) operating and maintenance clearances, and
  - (i) access door swing spaces.
- .8 Shop drawings and product data to be accompanied by;
  - (a) detailed drawings of bases, supports and anchor bolts,
  - (b) sound power data, where applicable, and
  - (c) performance curve for each piece of equipment marked with point of operation.
- .9 Shop drawing and data sheet submission is taken as certification;
  - .1 that units are from Manufacturer's current production and
  - .2 in compliance with applicable Codes, Standards, and Regulations.
- .10 Do not submit drawings showing internal construction details, component assemblies or interior piping and wiring diagrams. These may be necessary to understand correct functioning of equipment and should be submitted with operating and maintenance data.
- .11 Check and stamp each shop drawing as being correct before submission. Shop drawings without such stamps will be rejected and returned.
- .12 Keep one copy of each reviewed shop drawing and product data sheet on site available for reference purposes.
- .13 Where equipment is delivered without reviewed shop drawing available on site, equipment will be condemned and is to be removed from site and replaced with new equipment after shop drawing has been submitted and reviewed.

### **2.3 Field, Fabrication, or Installation Drawings**

- .1 Contractor field, fabrication, installation, and/or sleeving drawings will not be reviewed as shop drawings. If submitted as a shop drawing, a transmittal only will be returned identifying the submitted drawings have not been reviewed.
- .2 Maintain a copy on site of such drawings for reference by the Consultant.
- .3 Provide a copy of such drawings to the Consultant for general information purpose only, upon request.

### **2.4 Change Order Quotation Review**

- .1 Submit change order quotations in accordance with general conditions and as specified herein:
  - .1 Submit to the Prime Consultant for distribution and tracking with the design team
- .2 If submitting the quotation directly to Loring Consulting Engineers for review and comment, the quotation shall be submitted with all necessary information by email to: [ca.toronto@loringengineers.com](mailto:ca.toronto@loringengineers.com)

## **2.5 Progress Draw Certification**

- .1 For all trades applicable to the Division 20 scope of work (inclusive of Division 21, 22, 23 and 25), the Contractor is to submit to the Prime Consultant for distribution and tracking with the design team for review and recommendation;
  - .1 Include relevant invoice breakdowns that show itemized contract value, percent complete to date, and percent complete applicable to the current invoice;
  - .2 Itemize all approved Change Orders in similar fashion separate from the Base Bid breakdown.
- .2 If submitting the progress draw directly to Loring Consulting Engineers for review and comment, the progress draw shall be submitted with all necessary information by email to: [ca.toronto@loringengineers.com](mailto:ca.toronto@loringengineers.com)

## **3 REFERENCE CODES STANDARDS AND REGULATIONS**

### **3.1 Codes, Standards and Regulations**

- .1 Latest current versions in force at time of Tender.
- .2 Where relevant documents applicable to this work exist, follow these criterion, recommendations, and requirements as minimum standards.
- .3 In event of conflict between codes, regulations, or standards, or where work shown is in conflict with these documents, obtain interpretation before proceeding. Failure to clarify any ambiguity will result in an interpretation requiring application of most demanding requirements.

### **3.2 Confined Spaces**

- .1 Unless otherwise proscribed by the Constructor's / Owner's workplace safety program, treat spaces not designed and constructed for continuous human occupancy as "confined spaces", including but not limited to:
  - .1 horizontal and vertical service spaces, shafts, and tunnels,
  - .2 inside of equipment which permits entry of the head and/or whole body, and
  - .3 ceiling spaces which are identified as containing a hazardous substance.

### **3.3 Permits, Tests and Certificates**

- .1 Arrange and pay for permits, tests, and Certificates of Inspection required by Authorities having jurisdiction.
- .2 Submit applications requiring Owner's signature before commencing work.
- .3 Obtain and submit Inspection Certificates.
- .4 Certificates to be renewed as to remain in force for guarantee period.
- .5 Co-ordinate and perform testing required by Authorities having jurisdiction in accordance with Clause **TESTING** in this Section



## **4 EQUIPMENT**

### **4.1 Manufacturers Nameplates**

- .1 Metal nameplate with raised or recessed lettering, mounted on each piece of equipment.
- .2 On insulated equipment, mechanically fasten plates on metal stand-off bracket arranged to clear insulation and mount Underwriters Laboratories and/or CSA registration plates on same stand-off brackets.
- .3 Manufacturer's nameplate to indicate equipment size, capacity, model designation, manufacturer's name, serial number, voltage, cycle, phase and power rating of motors, and approval listings.

### **4.2 Factory Applied Finish Painting**

- .1 Apply prime and final paint coats to equipment and materials where specifically detailed in Sections of these Divisions.
- .2 Apply prime and final paint coats factory to pumps, air moving units, un-insulated pressure vessels and bare metal equipment items in boiler, mechanical and fan rooms.
- .3 Use heat resistant paint where conditions require.
- .4 Protect factory finished equipment during construction, and clean at completion of work.

### **4.3 Factory Applied Prime Painting**

- .1 Have prime paint factory applied to other equipment fabricated from iron or steel including access doors, registers, grilles, diffusers, dampers, metal radiation enclosures and fire hose cabinets.

### **4.4 Field Painting**

- .1 After equipment has been installed and piping and insulation is completed, clean rust and oil from exposed iron and steel work provided under this Division, whether or not it has been factory prime painted.
- .2 In "occupied" areas of building touch up any damage to prime coat resulting from shipping or installation and leave ready for final painting under Finishes, Division 9.
- .3 In "un-occupied" areas of the building such as mechanical equipment rooms, boiler rooms, fan rooms, crawl spaces, pipe tunnels and penthouses:
  - .1 paint exposed galvanized metal surfaces with one coat of zinc dust galvanized primer and one coat of 100% Alkyd base enamel in an approved colour; and
  - .2 paint exposed iron or steel work with one coat of chrome oxide phenolic base primer and one coat of 100% Alkyd base enamel in an approved colour.

### **4.5 Provision for Future**

- .1 Where space is indicated as reserved for future equipment or for future extension to building, leave such space clear and install piping, raceways and equipment so that connections can be made to future apparatus or building.
- .2 Identify provisions and service terminations for future on Record Drawings.

#### **4.6 Maintenance of Bearings**

- .1 "Turn over" rotating equipment at least once a month from delivery to site until start-up.
- .2 "Run-in" sleeve type bearings in accordance with manufacturer's written recommendation. After "run-in", drain, flush out and refill with new charge of oil or grease.
- .3 Protect bearings, shafts and sheaves against damage, corrosion and dust accumulation during building construction.

#### **4.7 Pre-purchased Equipment Damage and Ownership**

- .1 At time of receipt of pre-purchased or pre-tendered equipment at job site by the installing mechanical contractor, the manufacturer/Distributor/supplier technical representative to be present to inspect the equipment prior to unloading and report any damage to the Engineer. The technical representative to also witness the unloading and advise the contractor on the appropriate method for handling the equipment in order to avoid damage during the unloading, moving and setting in place phase of the equipment.
- .2 In the event the equipment has been found to be damaged before unloading it is to be returned immediately to the factory for repairs and/or replacement by the manufacturer/supplier.
- .3 In the event of damage occurring at any time during unloading and until the equipment is accepted by the Owner, the installing contractor is responsible for repairs and/or replacement to the satisfaction of the Owner.

### **5 OFFICE, STORAGE AND TOOLS**

#### **5.1 Office and Storage**

- .1 Provide temporary office and lunchroom facilities, workshop, and tools and material storage space. Facilities may be site trailers or as otherwise approved by the General Contractor/Construction Manager.
- .2 Assume responsibility for security of these facilities and provide heat, light and telephone and Internet service

#### **5.2 Appliances and Tools**

- .1 Provide tools, equipment, scaffolding, extension cords, lamps and miscellaneous consumable materials, required to carry out work.

### **6 COORDINATION**

#### **6.1 General**

- .1 Consultant drawings are diagrammatic and illustrate the general location of equipment, and intended routing of ductwork, piping, etc. and do not show every structural detail. In congested areas drawings at greater scale may be provided to improve interpretation of the Work. Where equipment or systems are shown as "double line", they are done so either to improve understanding of the Work, or simply as a result of the use of a CAD drawing tool, and in either case such drawings are not represented as fabrication or installation drawings.
- .2 Lay out and coordinate Work to avoid conflict with work under other Divisions.

- .3 Make good damage to Owner's property or to other trade's work caused by inaccurate layout or careless performance of work of this Division.
- .4 When equipment provided under other Sections connects with material or equipment supplied under this Section, confirm capacity and ratings of equipment being provided.
- .5 Take information involving accurate measurements from dimensioned Architectural Drawings or at building.
- .6 Install services and equipment which are to be concealed, close to building structure so that furring is kept to minimum dimensions.
- .7 Location of pipes, ductwork, raceways and equipment may be altered without extra cost provided instruction is given or approval is obtained, in advance of installation of items involved. Changes will be authorized by site instructions and are to be shown on Record Drawings.
- .8 Location of floor drains, hub drains, combination drains, plumbing fixtures, convectors, unit heaters, diffuser, registers grilles and other similar items may be altered without extra cost provided instruction is given prior to roughing in. No claim will be paid for extra labour and materials for relocating items up to 3 m (10 ft) from original location nor will credits be anticipated where relocation up to 3 m (10 ft) reduces material and labour.
- .9 Include incidental material and equipment not specifically noted on Drawings or mentioned in Specifications but which is needed to complete the work as an operating installation.

## **6.2 Field, Fabrication, and Installation Drawings**

- .1 Prepare field, fabrication, and/or installation drawings to show location of equipment and relative position of services, and to demonstrate coordination with works of other trades.
  - .1 Drawing scale: minimum 1:50 (1/4"=1'-0")
- .2 Use information from manufacturer's shop drawings for each trade and figured dimensions from latest Architectural and Structural Drawings.
- .3 Layout equipment and services to provide access for repair and maintenance.
- .4 Submit drawings to other trades involved in each area and include note in drawing title block as follows;
  - .1 "This drawing was prepared and circulated for review and mark-up to related subcontractors as noted and initialed in the table below. Corrections and concerns identified through this coordination process have been addressed on this drawing. Areas that incorporate significant changes from layouts shown on Contract Drawings have been circled for Consultants' review".

## **6.3 Cutting and Remedial Work**

- .1 For details of cutting and patching and Division of Work refer to Division 1.
- .2 Assume responsibility for prompt installation of work in advance of concrete pouring, masonry, roofing, finishing trades and similar work. Should any cutting or repairing of either unfinished or finished work be required because such installation was not done, employ the particular trade whose work is involved to do such cutting and patching. Pay for any resulting costs. Layout such work for approval by the Structural Engineer before undertaking same.

- .3 Neatly cut or fill holes required in existing construction to accommodate cable, raceways, bus duct or cabletray.
- .4 Division 20 contractor to be responsible for arranging and paying for all cutting and patching as required for own work. Before cutting, drilling, or sleeving structural load bearing elements, obtain the Engineer's approval of location and methods in writing. Employ original installer or expert in the finishing of material required to perform cutting or patching for weather exposed or moisture resistant elements or sight exposed surfaces.
  - .1 Layout cutting of structural elements, such as floors slabs, walls, columns or beams and obtain approval before starting work. Conduct an electromagnetic scan of reinforcing rods, such as Hilti PS200 Ferroskan, and review with Structural Engineer. Based on these results, arrange and pay for supplemental x-ray examination to locate concrete reinforcement and embedments where required. Submit x-rays and obtain approval before starting work Relocate core drilling location if steel or conduit is found in the proposed location and repeat procedure. Reroute any circuits damaged by core drilling.

#### **6.4 Anchors and Inserts**

- .1 Supply anchor bolts and locating templates for installation in advance of concrete pouring.

### **7 PROTECTION OF WORK AND PROPERTY**

#### **7.1 General**

- .1 Protect this work and work of other trades from damage.
- .2 Cover floors with tarpaulins and provide plywood and other temporary protection.
- .3 Assume responsibility for repairing damage to floor and wall surfaces resulting from failure to provide adequate protection.
- .4 Protect equipment, pipe and duct openings from dirt, dust and other foreign materials.

### **8 WORK IN EXISTING BUILDING**

#### **8.1 General**

- .1 During the tender period, the Contractor shall perform a site inspection of the place of work and surroundings including the accessible ceiling spaces and other areas where access could be considered reasonable. Make a thorough investigation of As Built conditions to determine scope of renovation or demolition work required prior to submitting tender.
- .2 Work includes changes to existing building and changes at junction of old and new construction. Route pipes, ducts, conduits and other services to avoid interference with existing installation.
- .3 Relocate existing pipes, ducts, conduits, bus ducts and any other equipment or services required for proper installation of new work, including as required for temporary removal and re-installation to suit new installation work.
- .4 Remove existing plumbing fixtures, lighting fixtures, piping, ductwork, wiring, and equipment to suit new construction. Cut back and cap drain, vent and water outlets, conduits and electrical outlets, not being used.

- .5 Contractor to include for sprinkler drain down(s) and refill(s) as required to complete the scope of work. Provide a fire watch for the duration of sprinkler shut-down. Restore sprinkler system to active conditions when the fire watch is not provided. Coordinate scheduling with building management/Owner.
- .6 Plumbing fixtures, piping, ductwork, conduit and wiring shown to be removed and not shown relocated, to become property of Contractor and to be taken from site.
- .7 On completion of relocations, confirm relocated equipment are in proper working order.
- .8 Where Owner wishes to take over renovated areas ahead of project completion date and these areas are to be fed from new distribution systems, make temporary connections to existing services in these areas. Reconnect to permanent services, at later date, when new distribution systems are available.

## **8.2 Continuity of Services**

- .1 Make connections to existing systems at approved times. Obtain written approval recording times when connections can be made. Arrange work so that physical access to existing buildings is not unduly interrupted.
- .2 Be responsible for and make good any damages caused to existing systems when making connections.
- .3 Keep existing buildings in operation with minimum length of shutdown periods. Include overtime work to tie-in piping or wiring at night or on weekends.

## **9 MOVING AND SETTING IN PLACE OF OWNER'S EQUIPMENT**

### **9.1 S.B.O. (Supplied by Owner)**

- .1 Items marked SBO on drawings will be;
  - .1 purchased by Owner.
  - .2 received, checked, and stored and
  - .3 subsequently unpacked, uncrated, assembled and located by Contractor under Division 1
- .2 Connect mechanical and electrical services to this equipment.

### **9.2 E.R. or Ex. Rel. (Existing Relocated) or otherwise so identified**

- .1 Items so marked on drawings will be;
  - .1 moved from their present location and reinstalled by Contractor under Division 1.
- .2 Disconnect and reconnect mechanical and electrical services to accommodate this equipment relocation.

## **10 TEMPORARY HEATING**

### **10.1 During Construction**

- .1 Temporary heating required while building is under construction will be provided under Division 1.
- .2 Permanent heating system may be used for temporary heating, when this equipment is installed in its permanent location and building is closed in and Contractor under Division 1 provides staff for

operation and maintenance whenever permanent heating system is being used for temporary heating..

- .3 Hot water boilers may not be used unless heating units, radiation, pumps and piping are complete and approved chemical water treatment is in operation.
- .4 Permanent heating equipment used for temporary heating to be thoroughly cleaned and put in first class approved operating condition and appearance at completion of job.

## **11 FINAL CLEANING AND ADJUSTMENTS**

### **11.1 General**

- .1 Conduct final cleaning in accordance with Division 01 and as specified herein.
- .2 Thoroughly clean exterior surface of exposed piping, and vacuum external surfaces of exposed ducts and interior surfaces of air handling units. Clean strainers in piping systems and install clean filters in air handling systems.
- .3 Remove tools and waste materials on completion of work and leave work in clean and perfect condition.
- .4 Calibrate components and controls and check function and sequencing of systems under operating conditions.
- .5 Supply lubricating oils and packing for proper operation of equipment and systems until work has been accepted.

## **12 RECORD DRAWINGS**

### **12.1 Record drawings**

- .1 Provide record drawings in accordance with Division 01 and as specified herein.
- .2 A set of design drawings in AutoCad on CD or DVD ROM will be provided by the Consultant. Make sets of white prints for each phase of Work, and as Work progresses and changes occur mark white prints in coloured inks to show revisions. Dimension locations of drains, pipes, ductwork, conduit, manholes, foundations and similar buried items within the building, with respect to building column centres. Mark level with respect to an elevation which will be provided.
- .3 Survey information from excavation and backfill of site services to be held on site, after approval, and to be similarly transferred to white prints.
- .4 Retain these drawings and make available to Consultant for periodic review.
- .5 At 50%, 75% and 90% project completion, scan marked-up drawings to Adobe .pdf format and submit copy to the Consultant, or to the project on-line document service if one is used.

### **12.2 As-built drawings**

- .1 Prior to testing, balancing and adjusting, transfer site record drawing information to AutoCad (CAD) files, to record final as-built condition. Obtain a current set of CAD files from the Consultant.
  - .1 Drawings are to remain set to and follow Consultants AutoCad Standards. Do not alter drawing scales, X-refs, colours, layers or text styles.

- .2 The Consultant's CAD files may not reflect all or any construction changes.
- .2 Where items have been deleted, moved, renumbered or otherwise changed from contract drawings, revise the CAD files to record these changes. "Bubble" these revisions, and place these annotations on a separate and easily identified drawing layer.
- .3 Show on mechanical as-built drawings final location of piping, ductwork, switches, starters, Motor Control Centres, thermostats, and equipment.
- .4 Show on site services as-built drawings survey information provided by Ontario Land Surveyor (OLS) monitoring services installation.
- .5 Identify each drawing in lower right hand corner in letters at least 12 mm (½ in) high as follows "AS-BUILT DRAWINGS. This drawing has been revised to show systems as installed" (Signature of Contractor) (Date). The site services drawings are to include signature and stamp of OLS surveyor attached to note.
- .6 Submit one (1) set of white prints of the draft as-built Cad files for Consultant's review.
- .7 Once "AS BUILT DRAWINGS" white prints are reviewed, transfer Consultant's comments to the CAD files. Return AutoCad drawings modified to "As Built" condition to Consultants on CD or DVD Rom.
- .8 Submit three (3) sets of white prints and three (3) copies of CAD files with Operating and Maintenance Manuals.

## **13 OPERATING AND MAINTENANCE INSTRUCTIONS**

### **13.1 Operating and Maintenance Manuals**

- .1 Provide operation and maintenance data bound in 210 mm x 300 mm x 50mm thick (8½ in x 11 in x 2 in thick) size, vinyl covered, hard back, three-ring covers.
  - .1 Organize material in volumes generally grouped by Trade Section; Site services, Plumbing, Fire Protection, Heating and Cooling Plant and Distribution, Air Handling, and Controls and Instrumentation.
  - .2 Title sheet in each volume to be labeled "Operating and Maintenance Manual" and to bear Project Name, Project Number, Date, Trade Section, and List of Contents.
- .2 In addition, provide Adobe PDF files for each document, produced from original direct-to-digital file creations.
  - .1 Organize documents into separate PDF files for each Trade Section identified above, and apply Adobe Bookmarks to create Table of Contents.
- .3 Operating data to include;
  - .1 control schematics for each system,
  - .2 description of each system and associated control elements,
  - .3 control operating sequences at various load conditions, reset schedules and anticipated seasonal variances,
  - .4 operating instructions for each system and each component,
  - .5 description of actions to be taken in event of equipment failure,
  - .6 valves schedule and flow diagram,
  - .7 service piping identification charts.

- .4 Maintenance data to include;
  - .1 manufacturer's literature covering, servicing, maintenance, operating and trouble-shooting instructions for each item of equipment,
  - .2 fault locating guide,
  - .3 manufacturer's parts list,
  - .4 reviewed shop drawings,
  - .5 equipment manufacturer's performance sheets,
  - .6 equipment performance verification test results,
  - .7 voltage and ampere rating for each item of electrical equipment,
  - .8 spare parts list and an itemized cost,
  - .9 name and telephone numbers of service organization and technical staff that will provide warranty service on the various items of equipment.
- .5 Approval procedure
  - .1 Submit one set of first draft of Operating and Maintenance Manuals for approval.
  - .2 Make corrections and resubmit as directed.
  - .3 Review contents of Operating and Maintenance Manuals with Owner's operating staff or representative to ensure thorough understanding of each item of equipment and its operation.
  - .4 Hand-over two copies of Operating and Maintenance Manuals to Owner's operating staff and obtain written confirmation of delivery.

### **13.2 Operating and Maintenance Instructions**

- .1 Provide instructions to Owners operations staff to thoroughly explain operation and maintenance of each system, incorporating specialized instruction by manufacturers as described under other Sections in these Divisions. Include classroom instruction and hands-on instruction, delivered by competent instructors.
- .2 Submit an outline of the training program for review, adjustment and approval by the Owner.
- .3 Structure each session to start with the classroom instruction for the overall system, followed by hands-on instruction for each equipment, utilizing the services of the manufacturers' representative as required.
- .4 Organize and schedule each training session to deliver the required instruction in an efficient and effective manner on a schedule agreed upon with the Owner. Allow for two (2) training sessions for each training session, separated by approximately one week each. Develop the proposed training plan and obtain approval from the Owner before commencing training.
- .5 Complete the training as close to Substantial Performance as possible, so that the operations staff are prepared to operate the systems after Substantial Performance is certified.
- .6 Organize each training sessions as follows:
  - .1 Fire Protection - Division 21
  - .2 Plumbing – Division 22
  - .3 HVAC – Division 23
  - .4 Building Management System – Division 25



- .7 Keep record of date and duration of each instruction period together with names of persons attending. Submit signed records at completion of instruction.
- .8 For each training session, include the following topics:
  - .1 General purpose of system (design intent),
  - .2 Use of O&M manuals,
  - .3 Review of control drawings and schematics,
  - .4 Start-up, normal operation, shutdown, unoccupied operation, seasonal changeover, manual operation, control set-up and programming troubleshooting, and alarms,
  - .5 Interaction with other systems,
  - .6 Adjustments and optimizing methods for energy conservation,
  - .7 Health and safety issues,
  - .8 Special maintenance and replacement sources,
  - .9 Occupancy interaction issues, and
  - .10 System response to different operating conditions.
- .9 Develop and provide training material, including printed documents and electronic presentation aids (e.g. MS PowerPoint) for each session. Submit three (3) copies of materials in both hardcopy and electronic format, in accordance with article on Operating and Maintenance Manuals.
- .10 Sessions may be videotaped by the Owner as an aid to ongoing training of Owners staff.

## **14 START-UP AND TESTING**

### **14.1 Care, Operation and Start-up**

- .1 Arrange and pay for services of manufacturer's factory service technician to supervise start-up of installation, check, adjust, balance and calibrate components.
- .2 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with every aspect of the operation, care and maintenance thereof.

### **14.2 TESTING - General**

- .1 Methods to comply with following references:
  - (a) The Ontario Building Code
  - (b) Ontario Installation Code for Oil-burning Equipment
  - (c) CSA B149.1 Natural Gas and Propane Installation Code
- .2 Conduct tests, during progress of Work and at its completion to show equipment and systems meet contract. Submit details of test methods in writing and obtain approval before commencing work.
- .3 Supply test equipment, apparatus, gauges, meters and data recorders, together with skilled personnel to perform tests and log results.
- .4 Submit written notice 24 hours in advance of each test series, setting out the time, place and nature of the tests, the Inspection Authority and personnel witnessing tests.
- .5 Conduct tests before application of external insulation and before any portion of pipes, ducts or equipment is concealed.

- .6 Do not subject expansion joints, flexible pipe connections, meters, control valves, convertors, and fixtures, to test pressures, greater than stated working pressure of equipment. Isolate or remove equipment or devices during tests when prescribed test pressure is greater than working pressure of any piece of equipment or device.
- .7 Should section of pipe or duct fail under test, replace faulty fittings or duct with new fittings, pipe or duct, repair and retest. Do not repair screwed joints by caulking nor welded joints by peening. Repeat tests until results are satisfactory.
- .8 Where it is necessary to test portions of duct or piping system before system is complete, overlap successive tests so that no joint or section of duct or pipe is missed in testing.
- .9 Upon completion of work and testing of same, submit logs to demonstrate that tests have been carried out satisfactorily. Repeat any tests if requested.

#### **14.3 Testing - Potable Water Piping**

- .1 Test potable water systems with water or air as required by The Ontario Building Code, Part 7.
- .2 For water service pipes 100 mm (4") and larger, disinfect the pipe with chlorine from the street valve to the first shut-off valve inside the building. Provide testing laboratory certificate confirming water contaminates are below the threshold values in O.Reg. 248/06.

#### **14.4 Testing - Other Piping**

- .1 Hydraulically test other water piping systems at 1½ times system design pressure (relief valve setting) or 1000 kPa (150 psi), whichever is greater, for 24 hours. Pressure must remain essentially constant throughout test period without pumping. Make allowance for correction of pressure readings for variations in ambient temperature between start and finish of test. Hammer test welded joints during hydrostatic test.
- .2 Test natural gas system to CSA B149.1
- .3 Test fuel oil systems to CSA B139
- .4 Test drainage, waste and vent piping for tightness and grade as required by The Ontario Building Code, Part 7.
- .5 Test special service piping as detailed.
- .6 Test high pressure steam piping and compressed air piping in accordance with requirements of local and Provincial Authorities.

#### **14.5 Testing - Ventilation**

- .1 Test ductwork in accordance with procedures detailed.

#### **14.6 Testing - Electrical**

- .1 Make tests of equipment and wiring.
- .2 Tests to include meggered insulation values, voltage and current readings to determine balance of panels and feeders under full load and examination of each piece of equipment for correct operation.

- .3 Test electrical work to standards and function of Specification and applicable Codes.
- .4 Replace defective equipment and wiring with new material.
- .5 Connect single phase loads to minimize unbalance of supply phases.

## **15 TEMPORARY AND TRIAL USAGE**

### **15.1 General**

- .1 Temporary and trial usage by Owner of any mechanical or electrical device, machinery, apparatus, equipment or any other work or materials before final completion and written acceptance is not to be construed as evidence of acceptance by Owner.
- .2 Owner to have privilege of such temporary and trial usage, as soon as that said work is claimed to be completed and in accordance with Contract Documents, for such reasonable length of time as is sufficient for making complete and thorough test of same.
- .3 No claims will be considered for damage to or failure of any parts of such work so used which may be discovered during temporary and trial usage, whether caused by weakness or inaccuracy of structural parts or by defective materials or workmanship of any kind whatsoever.
- .4 Defects in workmanship and materials identified during temporary and trial usage are to be rectified under guarantee.

## **16 SPECIAL TOOLS AND SPARE PARTS**

### **16.1 General**

- .1 Furnish spare parts as follows
  - .1 One set of packing for each pump gland.
  - .2 One casing joint gasket for each size pump.
  - .3 One head gasket for each heat exchanger.
  - .4 One glass for each gauge glass.
  - .5 One set of V-belts for each drive.
  - .6 One filter cartridge or set of filter media for each filter or filter bank installed.

## **17 PRICING OF CHANGE NOTICES**

- .1 The value of a proposed change in the work shall be determined in one or more of the following methods;
  - .1 by time and material,
  - .2 by unit prices set out in the Contract or subsequently agreed upon,
  - .3 by labour and material costs submitted in a detailed quotation.
- .2 In the case of changes in the Work to be paid for under the time and material or the unit price methods, the form of presentation of costs and methods of measurement shall be agreed to by the Consultant and Contractor before proceeding with the change. Keep accurate records, as agreed upon, of quantities or costs and present an account of the cost of the change in the Work, together with vouchers, material receipts and invoices where applicable.

- .3 In the case of changes in the Work to be paid for under the time and material or the labour and material method, the material costs are to be less trade discounts. Provide a 20% discount from list price for items included in the All Price catalogue or Mechanical Price Guide.
- .4 The detailed quotation referenced under the labour and material method is to include a summary of charges made up of three components: labour charges, material costs and fees.
  - .1 Labour Charges
    - (a) Labour costs are to include burden on wages such as taxes, worker compensation charges, CPP, EI, project insurance, safety meetings, estimating, as-built drawings, supervision, small tools, site facilities, labour warranty and clean up.
    - (b) The all-inclusive hourly journeyman labour rate applicable for quotations submitted for changes to the work is 2.9 times the base Schedule of Wage Rates issued by the Government of Canada for the Ontario – Toronto Zone. The hourly labour rate for specialists not governed by union agreements (technicians or engineers) is 3.5 times Schedule of Wage Rates issued by the Government of Canada for the Ontario – Toronto Zone.
    - (c) The all-inclusive hourly labour rate indicated above is to include:
      - Collective Agreement relevant to the place of work (vacation pay, parking fees, RRSP, Health & Welfare, RST of Health & Welfare, Pension, Union admin fund, ECA fund (or others), Secretariat).
      - Legislation as relevant to the place of work (Emp. Health Tax, E.I., CPP, WSIB, taxes)
      - Project insurance, safety meetings, estimating, lay outs, site facilities, warranties, storage,
      - Clean up, office supervision and miscellaneous charges.
    - (d) Foreman Mechanical rates shall be as for the calculated Journeyman rate above plus 10% of the Journeyman rate. A maximum of 10% of the total calculated journeymen hours on a change may be charged as overhead supervision hours at the Foreman rate.
    - (e) No other overhead supervision hours will be permitted.
  - .2 Fees
    - (a) The overhead and profit fee is to include for the Contractor's head office and site office expenses, project manager, assistants, site office and storage facilities, utility charges, site security, telephone and facsimile transmission costs, As-builts, expendable small tools, financing costs, coffee breaks, site facilities, general clean up and disposal, security, storekeeper, and all other non-productive labour.
    - (b) The Contractor is allowed a combined overhead and profit fee of 15% for work to be performed by his own forces.
    - (c) The Contractor is allowed an overhead and profit fee of 10% for work performed by a Sub-Contractor

## **18 CONSULTANT REVIEWS**

### **18.1 General**

- .1 Consultant's attendance at site including but not limited to site meetings, demonstrations, site reviews and any resulting reports are for the sole benefit of the Owner and the local authority have jurisdiction.

### **18.2 Site Reviews**

- .1 General reviews and progress reviews do not record deficiencies during the course of the Work until such time as a portion or all of the work is declared complete. In some instances before the work is completed, deficiencies may be recorded where the item is indicative of issues such as poor workmanship, incorrect materials or installation methods, or may be difficult to correct at a later date.

Any such reported items, or lack thereof, shall not be relied on in any way as part of the Contractors quality assurance program nor relieve the Contractor in the performance of the Work.

- .2 Deficiency reviews conducted by the Consultant are performed on a sampling basis, and any deficiency item is to be interpreted as being indicative of similar locations elsewhere in the Work, unless otherwise shown.

### **18.3 Milestone Reviews**

- .1 Specific milestone reviews may be conducted at key stages by the Consultant, including;
  - .1 before backfilling of buried drainage,
  - .2 before closing of shafts,
  - .3 before closing of ceilings,
  - .4 before closing of walls,
  - .5 equipment demonstration,
  - .6 Substantial Performance deficiency review,
  - .7 Total Performance deficiency review.
- .2 Coordinate with the Consultant the type and quantity of milestone reviews required and incorporate these requirements in the construction schedule.
- .3 Notify the Consultant in writing seven (7) calendar days in advance of work to be concealed to arrange a site review prior to the Work being concealed where required by the Consultant. Any noted deficiencies are to be corrected before being concealed. Failure to provide notification can result in the Work being exposed for review at the Contractor's cost.

### **18.4 Substantial Performance Review**

- .1 At the time of applying for project Substantial Performance, submit to Consultant a comprehensive list of items to be completed or corrected.

### **18.5 Final Review**

- .1 At project completion submit written request for final review of mechanical and electrical systems.
  - .1 Refer to section 20 08 19 Project Close-Out.
- .2 Include with the request a written certification that:
  - .1 reported deficiencies have been completed,
  - .2 systems have been balanced and tested and are ready for operation,
  - .3 completed maintenance and operating data have been submitted and approved,
  - .4 tags are in place and equipment identification is completed,
  - .5 cleaning is finished in every respect,
  - .6 all mechanical equipment surfaces have been touched up with matching paint, or re-finished as required,
  - .7 spare parts and replacement parts specified have been provided and receipt acknowledged,
  - .8 As-built and Record drawings are completed and approved,
  - .9 Owner's operating personnel have been instructed in operation and maintenance of systems,

.10 fire protection verification is 100% completed and Verification Certificates have been submitted and accepted.

## **19 CORRECTION AFTER COMPLETION**

### **19.1 General**

- .1 At completion, submit written guarantee undertaking to remedy defects in work for a period of one year from date of substantial completion. This guarantee is not to supplant other guarantees of longer period called for on certain equipment or materials.
- .2 Guarantee to encompass replacement of defective parts, materials or equipment, and to include incidental fluids, gaskets, lubricants, supplies, and labour for removal and reinstallation work.
- .3 Submit similar guarantee for one year from date of acceptance for any part of work accepted by Owner, before completion of whole work.

## **20 ATTACHMENTS**

### **20.1 Shop Drawing Submittal Form**

- .1 Attached sample of shop drawings submittal form.



## SHOP DRAWING SUBMITTAL

*Include this cover page with each shop drawing submission.  
Submissions without this form will be returned without review.  
Submit one submittal form per shop drawing; do not group under one submittal sheet*

Client/Architect:                      [Client/Architect name]

Project Name:                            [Project name]

Loring Project No:                      [Loring Project No]

**Contractor to complete the following for each submission.**

Date: \_\_\_\_\_

Contractor Name: \_\_\_\_\_ Ref No: \_\_\_\_\_

Manufacturer Name: \_\_\_\_\_

Product Type: \_\_\_\_\_

Specification Section No: \_\_\_\_\_

Contractor Trade:

<input type="checkbox"/> HVAC	<input type="checkbox"/> Plumbing	<input type="checkbox"/> Fire Protection	<input type="checkbox"/> Controls
<input type="checkbox"/> Electrical	<input type="checkbox"/> Communications	<input type="checkbox"/> Security	<input type="checkbox"/> General Trades

**If this is a resubmission, check here:** ☐

Previous submission Loring reference no.: \_\_\_\_\_

**END OF SECTION**

## **QUALIFICATIONS AND AUTHORITIES - ONTARIO 20 01 02**

### **1 GENERAL**

#### **1.1 Scope**

- .1 Qualification requirements for tradesmen in the province of Ontario.
- .2 Registration and inspection of systems.

### **2 QUALIFICATIONS**

#### **2.1 Trades Qualification and Apprenticeship Act**

- .1 Tradesmen to hold certification of applicable trades:
  - .1 Construction Millwright, O.Reg. 1048
  - .2 Electrician, O.Reg. 1051
  - .3 Plumber, O.Reg. 1073
  - .4 Refrigeration and air-conditioning mechanic, O.Reg. 75/05
  - .5 Sheet metal worker, O.Reg. 1077
  - .6 Sprinkler and fire protection installer, O.Reg. 1078
  - .7 Steamfitter, O.Reg. 1079

#### **2.2 Technical Standards and Safety Authority Act 2000**

- .1 Manufacturers and installers of regulated pressure piping parts and systems regulated to hold certificates of authorization under *Boilers and Pressure Vessels* O.Reg. 220/01, for;
  - .1 pressure piping systems, CSA B51 Boiler, Pressure Vessel and Pressure Piping Code
  - .2 refrigeration piping systems, CSA B52 *Mechanical Refrigeration Code*
- .2 Installers to hold certificates of authorization made under *Fuel Industry Certificates* O.Reg. 215/01 for;
  - .1 Gaseous Fuels, O.Reg. 212/01
  - .2 Propane Storage and Handling, O.Reg. 211/01
  - .3 Fuel Oil, O.Reg. 213/01
  - .4 Compressed Natural Gas, O.Reg. 214/01

### **3 AUTHOURITIES, REGISTRATION AND INSPECTION**

#### **3.1 Ontario Building Code**

- .1 Application for Building Permit including plumbing and HVAC has been made by the Owner. Arrange and coordinate for municipal inspections as required under the Ontario Building Code.

#### **3.2 Technical Standards and Safety Authority**

- .1 Arrange, provide documentation, and pay for registration and inspection of the following systems:
  - .1 Boiler, pressure vessel and pressure piping



- .2 Arrange, provide documentation, and pay for variance approvals and field inspections of the following systems:

- .1 Fuel safety, gas and/or oil, where Variance approval is required.

### **3.3 Electrical Safety Authority**

- .1 Provide, arrange and pay for permits and inspection of electrical systems in accordance with the Ontario Electrical Safety Code.

**END OF SECTION**

## **MECHANICAL COORDINATION AND INSTALLATION DESIGN SERVICES 20 01 03**

### **1 GENERAL**

#### **1.1 Scope**

- .1 Provide detailed coordination, fabrication, and installation design drawings for the services provided under Division 20. Integrate the coordination drawings provided under Division 26 into the design drawings provided under Division 20.
- .2 Provide the services of an experienced mechanical and electrical coordination supervisor to manage these contractors' design services. The supervisor is responsible for leading a multi-trade coordination effort including but not limited to: detailed inspection of existing conditions, layout and finalize routing of services, setting sleeves for structural openings and sequencing of service installation.

#### **1.2 Document Ownership**

- .1 Ownership and copyright of Contractors coordination, fabrication, and installation design drawings remains with the Contractor producing these documents, subject to the requirements of the project agreement. In the absence of any requirements in the project agreement, the Contractor will provide the Owner with a royalty-free, transferrable, and irrevocable license to copy and use the materials for the purpose of operating and maintaining the building and building systems.

#### **1.3 Consultant Drawings**

- .1 Consultant drawings are diagrammatic and illustrate the general location of equipment, and intended routing of ductwork, piping, bus duct, etc, and do not show every structural detail. In congested areas drawings at greater scale may be provided to improve interpretation of the Work. Where equipment or systems are shown as "double line", they are done so either to improve understanding of the Work, or simply as a result of the use of a CAD drawing tool, and in either case such drawings are not represented as fabrication or installation drawings.

#### **1.4 Requests for Information**

- .1 Requests for Information (RFI's or similar type of document) concerning coordination are to be submitted with sketch drawings indicating proposed solution for review by the Consultant. RFI's submitted without such proposals will be returned for re-submission.

#### **1.5 Itemized Price**

- .1 Include costs associated with this Section as an Itemized Price in the Bid documents.

### **2 INTERFERENCE CO-ORDINATION DRAWINGS**

#### **2.1 General**

- .1 Make good damage to Owner's property or to other trade's work caused by inaccurate layout or careless performance of work of this Division.
- .2 Take information involving accurate measurements from dimensioned Architectural Drawings or at building.

- .3 Install services and equipment which are to be concealed, close to building structure so that furring is kept to minimum dimensions.
- .4 Location of pipes, ductwork, raceways and equipment may be altered without extra cost provided instruction is given or approval is obtained, in advance of installation of items involved. Changes will be authorized by site instructions and are to be shown on Record Drawings.
- .5 Location of floor drains, hub drains, combination drains, plumbing fixtures, convectors, unit heaters, diffuser, registers grilles and other similar items may be altered without extra cost provided instruction is given prior to roughing in. No claim will be paid for extra labour and materials for relocating items up to 3 m (10 ft) from original location nor will credits be anticipated where relocation up to 3 m (10 ft) reduces material and labour.
- .6 Include incidental material and equipment not specifically shown but which is needed to complete the work as an operating installation.

## **2.2 Interference Coordination Drawings**

- .1 Prepare interference coordination drawings to show location of equipment and relative position of services, and to demonstrate coordination with works of other trades. Drawings shall be prepared by a specialist firm experienced in CAD mechanical and electrical interference drawing production. Interference drawings are to include coordination with all mechanical and electrical services.
- .2 Mechanical contractor is to consult and co-operate with electrical contractor to identify electrical services which are to be incorporated into interference drawings. Contractor shall perform site survey work to document all existing mechanical and electrical services that are to remain and are to be included in the interference drawings.
- .3 Conduct weekly meetings to discuss and resolve interference issues discovered during interference drawing production.
- .4 Submit drawings to other trades involved in each area and include note in drawing title block as follows;
  - .1 "This drawing was prepared and circulated for review and mark-up to related subcontractors as noted and initialed in the table below. Corrections and concerns identified through this coordination process have been addressed on this drawing. Areas that incorporate significant changes from layouts shown on Contract Drawings have been circled for Consultants' general review"
- .5 Drawing scale to be minimum 1:50 (1/4"=1'-0").
- .6 Produce coordination drawings, preferably in 3D AutoCad MEP or Revit MEP format, and keep a set of drawings on site for Consultant's general review.
- .7 Obtain architectural and consultant's drawing files for background information, pending completion and return of any electronic file waiver forms.

## **2.3 Coordination with Other Trades**

- .1 Lay out and coordinate Work to avoid conflict with work under other sections of this Division and other Divisions.
- .2 When equipment provided under other Sections or Divisions connects with material or equipment supplied under this Section, confirm capacity and ratings of equipment being provided.

## **2.4 Interconnecting Control and Power Wiring**

- .1 Provide wiring block diagrams and detailed termination drawings for controls wiring connections to equipment and instrumentation, for both Building Automation System control and hard-wired interlock wiring. Provide wiring terminal numbers specific for each equipment connection.

## **2.5 Fire Alarm and Building Automation System**

- .1 Provide a wiring coordination interface drawing for termination of fire alarm annunciation circuits to Building Automation System I/O equipment and/or motor starters, adjustable frequency drives, dampers, and motorized fire dampers.
- .2 Drawings to include wiring terminal numbers and description label for FAS annunciation zone.

## **2.6 Owners Equipment and Relocated Equipment**

- .1 The service provisions shown for Owner's supplied equipment and/or relocated equipment is based on the best available information at the time of design. Examine the actual service requirements for this equipment and make adjustments as necessary to connection sizes of service drops to suit. A change (increase or decrease) in one trade size for piping, tubing, electrical conductors and conduit, and a change of up to 25% in duct cross-sectional area will be provided at no change to the construction cost.
- .2 Where actual service requirements (except as described above for size) are different between the Consultant's drawings and Owner's equipment requirements, submit proposal for new or deleted services or capacities to the Consultant for review.

## **3 FABRICATION AND INSTALLATION DRAWINGS**

- .1 On an as-needed basis, prepare fabrication, spooling, and/or installation drawings based on the completed interference coordination drawings. CAD drawing system is in accordance with Contractor's company standards.
- .2 Drawing scale: same as the interference coordination drawings or at larger scale as needed.
- .3 Use information from manufacturer's shop drawings for each trade and figured dimensions from latest Architectural and Structural Drawings.
- .4 Layout equipment and services to provide access for repair and maintenance.

**END OF SECTION**

## **BASIC MATERIALS AND METHODS**

### **20 05 01**

## **1 GENERAL**

### **1.1 Scope**

- .1 Articles that are of a general nature, applicable to each Section of Division 20.

## **2 ACCESS DOORS**

- .1 Provide access doors to be installed at locations where equipment requiring inspection, service, maintenance or adjustment is "built-in" to work of other trades.
- .2 Access is required at;
  - .1 expansion joints,
  - .2 dampers,
  - .3 fire dampers,
  - .4 air valves,
  - .5 air terminal units,
  - .6 isolation and control valves ,
  - .7 pressure reducing valves,
  - .8 heating or cooling coils,
  - .9 control wiring junction boxes.
- .3 Submit shop drawings showing access door size, type and location.
- .4 Construction:
  - .1 constructed of steel, prime coated,.
  - .2 flush mounted with 180° opening door, round safety corners, concealed hinges, plaster lock and anchor straps
  - .3 600 mm x 600 mm (24 in x 24 in) for personnel entry,
  - .4 300 mm x 450 mm (12 in x 18 in) for hand entry, and
  - .5 constructed of stainless steel in areas finished with tile or marble surfaces
  - .6 constructed of stainless steel with neoprene gasketed door in damp and high humidity areas
  - .7 generally fitted with screwdriver operated latches, except in areas subject to security risks (Public Corridors, Psychiatric Patient Areas, Public Washrooms). In these areas doors to be fitted with keyed cylinder locks with similar keys.

#### *Standard of Acceptance*

- Baird - ABCO
- Stelpro - Type 700
- Williams Brothers - GP
- LeHage
- Acudor Acorn
- Mifab

- .5 Installation:

- .1 Supply access doors and make arrangements and pay for installation by Division in whose work they occur.
- .2 Size and locate access doors in applied tile, block or in glazed or unglazed structural tile to suit joint patterns.
- .3 Access doors in ceilings, where acoustic tile is applied to plaster or gypsum board, to be dish type designed to receive tile insert.
- .4 Access doors are not required in removable ceilings. Provide coloured marking devices after completion of ceilings, at four corners of each panel below point requiring access. Colour code markers to show service or device above.
- .5 At time of instruction of owners operating staff, hand-over and obtain signed receipt for 4 sets of each type of key used to lock access doors in secure areas.

### **3 DRAIN VALVES**

- .1 Provide drain points for piping systems with drain valves at low points and at section isolating valves.
- .2 Drain valves: minimum NPS 2 straight pattern bronze with hose end male thread, cap and chain.

### **4 V-BELT DRIVES**

- .1 Provide V-belt drive for each motor driven device which is not direct connected. Keep overhung loads on prime mover shafts within manufacturer's design guidelines.
- .2 Sheaves for motors to 7.5 kW (10 hp) with not more than two belts:
  - .1 cast iron or steel secured to shafts with removable keys.
  - .2 adjustable pitch on motor, fixed pitch on driven device, giving plus or minus 10% speed range,
  - .3 selected to meet specified operating condition at mid position in pitch adjustment.
- .3 Sheaves for motors over 7.5 kW (10 hp) or drives with three or more belts
  - .1 cast iron or steel with split tapered bushing and keyway.
  - .2 fixed pitch.
- .4 Belts:
  - .1 matched sets of 'b' section, selected for service factor of 2.0 based on installed motor horsepower.
  - .2 capable of carrying load with one belt broken.
- .5 Motor slide rails:
  - .1 adjustment plates for centre line alignment
  - .2 belt tension adjusting screws.
- .6 Installation
  - .1 Tension belts to manufacturer's recommendations before start-up and after first 100 hr of operation using calibrated belt tensioning gauge.
  - .2 Provide replacement pulleys and belts during start-up and balancing to suit field operating conditions.

## **5 DRIVE AND COUPLING GUARDS**

- .1 Provide guards to protect belt drives, flywheels, rotating couplings on equipment and fan inlet and outlets.
- .2 Guards:
  - .1 removable for servicing,
  - .2 arranged to permit lubrication with guards in place.
- .3 Guards for belt drives:
  - .1 expanded metal screen welded to steel bar stock or angle frame,
  - .2 minimum 1.2 mm (18 ga) thick galvanized sheet metal tops and bottoms,
  - .3 40 mm (1½") diameter holes at both shaft centres for insertion of tachometer.
- .4 Flexible coupling and flywheel guards:
  - .1 Removable "U" shaped, minimum 1.6 mm (16 ga) thick galvanized mild steel or expanded metal mesh on substantial welded angle iron or round barstock frame.
- .5 Guards on unprotected fan inlets and outlets:
  - .1 Minimum 20 mm (¾ in) galvanized wire mesh or expanded metal screen with net free area of guard not less than 80% of fan opening.
- .6 Installation
  - .1 Belt guards to accommodate movement of motors for belt tension adjustment.
  - .2 Where equipment is installed on resiliently mounted base frame or pad, attach belt guard to this base
  - .3 Belt guards and fan inlet guards may be omitted where fan and motor is installed in plenum less than 1.4 m (4 ft) high and disconnect for fan motor is mounted adjacent to and outside access door to plenum.
  - .4 Fan inlet guards may be omitted where fan is fitted with inlet guide vanes.

## **6 SLEEVES**

### **6.1 General**

- .1 Sleeve pipes, ducts and conduits passing through masonry walls, concrete floors, and fire rated gypsum board ceilings and partitions.
- .2 Maintain fire rating integrity where pipes and ducts pass through fire rated walls, floors and partitions.

### **6.2 Floor and Wall Sleeves**

- .1 Sleeves in fire separations:
  - .1 sized to suit fire stopping methods employed for bare pipes, conduits, insulated pipes, and bare and insulated ducts without fire dampers, and
  - .2 sized to suit conditions of approval given in manufacturers installation instructions for fire and smoke dampers.
- .2 Sleeves in other construction:

- .1 sized to clear insulated pipes and ducts by 13 mm (½ in) all round, and
- .2 sized to clear conduits, bare pipes, and bare ducts by 6 mm (¼ in) all round.
- .3 Sleeves for pipes, conduits and ducts smaller than 0.4 m<sup>2</sup> (4 sq ft) through solid walls and floors:
  - .1 Schedule 40 steel pipe or 1 mm (20 ga) (minimum) sheet metal, lapped and spot welded.
  - .2 Sleeves for pipes, conduits and ducts smaller than 0.4 m<sup>2</sup> (4 sq ft) through gypsum board partitions:
    - (a) 1 mm (20 ga) minimum sheet metal, lapped and spot welded with 20 mm (¾ in) lip flange at one end.
- .4 Sleeves for ducts 0.4 m<sup>2</sup> (4 sq ft) and larger through walls and floors:
  - .1 1.6 mm (16 ga) minimum sheet metal, lapped and spot welded with 20 mm (¾ in) lip flange at one end.

### **6.3 Waterproof sleeves**

- .1 Applications:
  - .1 where pipes and ducts pass through floors in areas subject to water, in mechanical rooms, in kitchens, in washing areas and in slabs over electric and telephone rooms.
- .2 Waterproof sleeves for pipes and conduits:
  - .1 Schedule 40 pipe, with 75 mm (3 in) wide annular fin continuously welded at midpoint, hot dip galvanized after fabrication.
- .3 Waterproof sleeves for ducts less than 0.4 m<sup>2</sup> (4 sq ft):
  - .1 1 mm (20 ga) galvanized steel, with 40 mm (1½ in) flange at midpoint.
- .4 Waterproof sleeves for ducts 0.4 m<sup>2</sup> (4 sq ft) and larger and openings with multiple ducts:
  - .1 1.6 mm (16 ga) galvanized steel, with 40 mm (1½ in) flange at midpoint, or,
  - .2 form opening with wood (removed after concrete is set) and trim opening with welded steel angle frame 75 mm (3 in) high, bolted to slab and caulked, or,
  - .3 trim opening with 75 mm x 75 mm (3 in x 3 in) continuous concrete curb doweled to slab.
- .5 Modifications for existing construction:
  - .1 annular fins and flanges attached to sleeve at point equivalent to surrounding floor level or curb.

### **6.4 Installation**

- .1 Place and secure sleeves in concrete form work.
- .2 Supply sleeves to be set in concrete and masonry walls with installation detail drawings.
- .3 Regular sleeves;
  - .1 terminate flush with surfaces of concrete and masonry walls.
- .4 Waterproof sleeves in new construction;
  - .1 extend 75 mm (3 in) above finished floor.
  - .2 with flange embedded within concrete floor.



- .5 Sleeves in existing concrete and masonry walls and floors;
  - .1 installed in neatly cut or drilled holes in existing construction,
  - .2 cutting and drilling of structural elements, such as floors, slabs, walls, columns, or beams to be carried out in accordance with procedure set out in Article "Cutting and Patching" below.
  - .3 terminate sleeves flush with surfaces of concrete and masonry walls,
  - .4 extend waterproof sleeves 75 mm (3 in) above finished floor with flange, countersunk, and bolted down flush into floor surface,
  - .5 fill opening between sleeve and wall or floor with 2 hour fire rated fire-stopping sealant with water barrier.
- .6 Fill future-use sleeves with weak concrete, gypsum plaster or similar material.
- .7 Coat exposed exterior surfaces of un-galvanized ferrous sleeves with heavy application of zinc rich paint
- .8 At fire separations and smoke separations, pack and seal void between sleeve and pipe, duct without fire damper, conduit, or insulation in accordance with Article "Fire Stopping and Smoke Seals" in this Section.
- .9 At other locations, pack void between sleeve and pipe, conduit, duct or insulation for full depth of sleeve, with mineral wool and seal with silicone-free caulking compound.
- .10 Install fire dampers in accordance with conditions of approval given in manufacturer's instructions.

## **7 FIRE STOPPING AND SMOKE SEALS**

### **7.1 General**

- .1 Provide fire stopping and smoke seals where ducts, pipes or conduits penetrate fire separations. Materials to be supplied, worker training to be arranged, and installation to be supervised, by a specialist firm with an established reputation in this field.
- .2 Fire stop materials to be impervious to water when installed in a horizontal separation, including waterproof service sleeves.

### **7.2 Products**

- .1 Materials to form ULC listed or cUL listed/classified assemblies.
  - Standard of Acceptance*
    - 3M
    - Nelson Firestop Products
    - Hilti Firestop Systems
    - Eastern Wire + Conduit (Royal Quickstop)
- .2 Other manufacturers having products with explicitly similar characteristics, listings or classifications and approvals are acceptable.

### **7.3 Installation**

- .1 Seal space between penetrating service and sleeve or opening in slab with firestop and smoke sealing system in strict accordance with terms and conditions of original ULC or cUL listing and manufacturers recommended procedures.

- .2 Select thickness and arrangement of back-up materials to suit size of service, length of sleeve and anticipated movement.
- .3 Select firestopping system to allow insulation and vapour barrier to pass un-broken through assembly.
- .4 Surfaces to be clean, dry and free from dust, oil, grease, loose or flaking paint and foreign materials at time of application of materials
- .5 Do not apply fire stopping materials to fire or smoke dampers.

## **8 WALL AND FLOOR PLATES**

- .1 Fit pipes passing through walls, floors and ceilings in finished areas with escutcheon, wall or floor plates.
- .2 Plates:
  - .1 at floor; chrome plated two piece split type with hinge.
  - .2 at walls and ceilings; similar to floor plate but with set screw to fasten plate to pipe.

### **8.2 Installation**

- .1 Plates:
  - .1 sized to cover sleeves
  - .2 secured tight against finished surfaces, and
  - .3 fitted to cover sleeve extensions where sleeves extend above finished floor.

## **9 LINK SEALS**

- .1 Fit each pipe passing through floor slab in contact with ground or basement walls below grade with link seal between sleeve and bare pipe.
- .2 Submit manufacturer's literature and schedule showing location, service, inside diameter of wall opening, sleeve length and pipe outside diameter.
- .3 Link seal:
  - .1 Manufactured from modular synthetic rubber links with stainless steel hardware.
  - .2 Loosely assembled with bolts to form continuous rubber belt around pipe, with pressure plate under each bolt head and nut.
  - .3 Constructed to provide electrical insulation between pipe and sleeve.

#### *Standard of Acceptance*

- Power Plant Supply - "Thunderline Linkseal"
- Advance Products & Systems – "Innerlynx"

- .4 Installation
  - .1 Determine inside diameter of each wall opening or sleeve before ordering seal.
  - .2 Position seal in sleeve around pipe and tighten bolts to expand rubber links until watertight seal is obtained.

## **10 PLATFORMS, LADDERS, COVERS, PIPE SUPPORTS, EQUIPMENT SUPPORTS, AND BASES**

### **10.1 Supports for mechanical and electrical work**

- .1 Fabricate platforms, gratings, ladders, piping and equipment supplementary supporting steel, and trench and pit covers, from steel and provided by this Division.
- .2 Concrete housekeeping bases for mechanical and electrical equipment which are in direct contact with floor slab, to be provided by this Division.
- .3 Concrete bases for equipment supported on vibration isolation materials (inertia pads), to be provided by this Division.
- .4 Work to be done by firms specializing in these fields.
- .5 Submit shop drawings for steel and concrete work, prepared by licensed Professional Engineers.

### **10.2 Applicable codes and standards;**

- .1 Ministry of Labour
  - .1 Engineering Data Sheets
  - .2 Health and Safety Guidelines
  - .3 Industrial Alert Bulletins
- .2 Regulations made under the Occupational Health and Safety Act;
  - .1 Regulations for Industrial Establishments
  - .2 Regulations for Health Care and Residential Facilities
- .3 The Ontario Building Code
- .4 American Society for Testing and Materials (ASTM)
  - .1 ASTM A 53/A53M, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
  - .2 ASTM A 269, Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
  - .3 ASTM A 307, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- .5 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-1.40, Anti-corrosive Structural Steel Alkyd Primer.
  - .2 CAN/CGSB-1.108, Bituminous Solvent Type Paint.
  - .3 CAN/CGSB-1.181, Ready-Mixed, Organic Zinc-Rich Coating.
- .6 Canadian Standards Association (CSA)
  - .1 CAN/CSA-G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel.
  - .2 CAN/CSA-G164, Hot Dip Galvanizing of Irregularly Shaped Articles.
  - .3 CAN/CSA-S16.1, Limit States Design of Steel Structures.
  - .4 CSA W59, Welded Steel Construction (Metal Arc Welding).

### 10.3 Supplementary supports and support brackets:

- .1 Fabricated from structural grade steel with anchor bolts and fastenings.
- .2 Designed in consultation with building structural consultant to transfer live loads and dead loads to building structural elements,
- .3 Constructed as frames bracketed from walls, and/or supported from building structure above, and/or floor below.

### 10.4 Concrete bases for housekeeping pads:

- .1 Constructed using plywood form work and 20 Mpa (3000 lb) concrete,
- .2 Doweled to concrete floor slab with not less than 13 mm (½ in) diameter steel rods.
- .3 Plan dimensions:
  - .1 75 mm (3 in) larger all around than base of apparatus for non-seismic applications,
  - .2 200 mm (8 in) larger all around than base of apparatus for seismically restrained equipment, and
  - .3 finished to make smooth, neat surfaces with corners chamfered 25 mm (1 in).
- .4 Height conforming to following table;

Equipment	Floor Type	Vibration Isolation	Thickness of Housekeeping Pad mm (in)
Stationary, not motorized	All	All	100 (4)
Motorized, up to 7.5kW (10 HP)	All	---	150 (6) (max. for fans)
Motorized, 11 to 19kW (15 to 25 HP)	Slab on Grade	No	250 (10)
	Slab on Grade	Yes	150 (6)
	Suspended Slab	Yes	150 (6)

### 10.5 Installation - General

- .1 Locate supporting steel to permit removal of parts for service or repair, and to allow clear access to valves, fittings, and equipment,
- .2 Set equipment on supporting frames and brackets and install hangers, anchor bolts, vibration mountings and snubbers.
- .3 Set equipment base plates on housekeeping pads on minimum 13 mm (½ in) epoxy grout and fill hollow portion of base with concrete.
- .4 Install anchor bolts, vibration mountings and snubbers between equipment and housekeeping pad, or inertia pad and housekeeping pad.

- .5 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.
- .6 Provide anchorage, dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.
- .7 Make field connections with bolts to CAN/CSA-S16.1, or weld.
- .8 Supply items for casting into concrete or building into masonry to appropriate trades together with setting templates.
- .9 Touch-up field welds, bolts and burnt or scratched surfaces after completion of erection with primer.
- .10 Where gratings or trench covers are cut in field or damaged, touch up with zinc rich paint.

**END OF SECTION**

## **INDICATING GAUGES**

### **20 05 19**

#### **1 GENERAL**

##### **1.1 Scope**

- .1 Provide temperature and pressure measuring devices and flow indicators as shown.

##### **1.2 Shop drawings / product data**

- .1 Submit manufacturer's catalogue literature for;
  - .1 Thermometers
  - .2 Pressure gauges
- .2 Include schedule of thermometers, and pressure gauges showing for each instrument:
  - .1 identification number,
  - .2 location,
  - .3 type,
  - .4 range and
  - .5 accessories.

##### **1.3 Applicable codes and standards;**

- .1 ASME B40.200 Thermometers, Direct Reading and Remote Reading
- .2 ASME B40.100 Pressure Gauges and Gauge Attachments
- .3 ASME PTC 19.3 TW – Thermowells
- .4 CSA B51 Boiler and Pressure Vessel Code

#### **2 PRODUCTS**

##### **2.1 Thermometers and Pressure Gauges - Selection Criteria**

- .1 General:
  - .1 normal operating reading to be between half and two thirds of full scale range and
  - .2 expected maximum and minimum readings to be within scale range.
  - .3 thermometers to have both Fahrenheit and Celsius scales.
  - .4 pressure gauges to have both psi and kPa scales.
- .2 Product identification
  - .1 Pressure gauges and thermometers to be selected from manufacturer's standard product line.

##### *Standard of Acceptance*

- Terice
- Dresser - Ashcroft
- Weksler - Baker Instruments
- Winter's Thermogauges

- Weiss
- WIKA

- .3 Model designations from Terice catalogue are used to establish quality standards and construction details to allow assessment of products from other unlisted manufacturers.

## **2.2 Direct reading thermometers**

- .1 Solar powered 178 mm (7 in) industrial, variable angle type, passivated thermistor, cast aluminum epoxy coated case, with solar cell and 11 mm (7/16 in) LCD display.

*Standard of Acceptance*

- Terice SX9

- .2 125 mm (5 in) bi-metal dial type, variable angle, stainless shell case and stem with calibration screw, to CGSB 14.5

*Standard of Acceptance*

- Terice - B85600 Series

## **2.3 Thermometer wells**

- .1 Construction:

- .1 Body material:

- (a) in copper pipe: brass.
- (b) in steel pipe: stainless steel.

- .2 threaded connection, manufactured from bar stock or forged brass with cap and chain, compatible with temperature sensors used.

- .3 pressure rating: 2000 kPa (300 psig) at 121°C (250°F)

- .4 C.R.N. registered

*Standard of Acceptance*

- Terice 5550 Series

## **2.4 Temperature well conversion kits**

- .1 Retrofit kit to convert straight liquid filled thermometer wells to accept bi-metal dial thermometers.

## **2.5 Pressure gauges**

- .1 For direct pressure measurement

- .1 115 mm (4½ in) dial type, silicone-free dampening, black solid front case, ½% accuracy, adjustable pointer to ASME B40.100 Grade 2A.

*Standard of Acceptance*

- Terice - 450B

- .2 For differential pressure measurement

- .1 115 mm (4½ in) dial type, silicone-free dampening, black solid front case, ½% accuracy, adjustable pointer and maximum registering pointer to ASME B40.100 Grade 2A, complete with impulse snubber and 3-way switching valve.

*Standard of Acceptance*

- ° Terice - 450B

.3 Accessories:

- .1 pressure snubbers, brass or T303 stainless steel construction:

*Standard of Acceptance*

- ° Terice - 872

- .2 needle valves, rising stem, brass or T316 stainless steel construction.

*Standard of Acceptance*

- ° Terice - 735 / 740

- .3 coil syphons, 1/4" NPT, welded 304SS Sch.40 body, 180° coil, 2060 kPa (300 psig) and 650°F max

*Standard of Acceptance*

- ° Terice – 885

## **2.6 Test port plugs**

- .1 Piping test port plugs with gauge adaptors for pressure tests or insertion of pocket thermometer probes.

- .1 material: brass or stainless steel T304.with BUNA N diaphragm core,
- .2 size: 1/4" NPT to 1/2" NPT, with probe guard
- .3 performance rating: 7000 kPa (1000 psi) from -40 to 150°C (-40 to 300°F)

*Standard of Acceptance*

- ° Winters – STP series

## **3 EXECUTION**

### **3.1 Thermometer and Pressure Gauges - General installation criteria**

- .1 Install thermometers and gauges not more than 3 m (10 ft) from floor or platform, or install remote reading thermometers and gauges, with dial mounted at eye level, on steel or aluminum plate.
- .2 Provide nameplates for each gauge and thermometer as specified in Section 20 19 00 Identification.

### **3.2 Thermometer installation**

- .1 Install thermometers in wells.
- .2 Install wells with extension necks where piping and equipment to be insulated.
- .3 Install thermometers on inlet and outlet of;
  - .1 heat exchangers.
  - .2 water heating and cooling coils.
  - .3 water boilers.
  - .4 chillers.
  - .5 cooling towers.
  - .6 domestic hot water tanks, and



.7 as shown.

### **3.3 Pressure gauge installation**

- .1 Install pressure gauges on inlet and outlet of;
  - .1 heat exchangers,
  - .2 water heating and cooling coils,
  - .3 steam piping to heating coils
  - .4 water boilers,
  - .5 chillers,
  - .6 cooling towers,
  - .7 domestic hot water tanks,
  - .8 steam boilers,
  - .9 condensate receivers,
  - .10 dearators, and
  - .11 as shown.
- .2 Install needle valves on pressure gauges.
  - .1 For differential pressure gauge, provide needle valve on each sensing line.
- .3 Install pressure snubbers on pressure gauges at;
  - .1 suction and discharge sides of oil pumps, and positive displacement pumps,
  - .2 compressed air; at compressors, dryers and receivers.
- .4 Install coil syphons on steam and condensate pressure gauges.

### **3.4 Test port plugs**

- .1 Install test port plugs in locations as shown. Test port plugs shall not be used in lieu of temperature or pressure gauges specifically shown.

**END OF SECTION**

## **VALVES**

### **20 05 23**

## **1 GENERAL**

### **1.1 Scope**

- .1 Provide valves in piping systems throughout project for shut-off service, manual balancing, and check-stops.
- .2 Refer to relevant specification sections for specialty and control valves.

### **1.2 Applicable Codes and Standards**

- .1 Temperature and pressure ratings, material composition, and manufacturer's testing procedures conforming to latest specifications from:
  - .1 Manufacturers Standardization Society of Valve and Fittings Industry (MSS), and
  - .2 ASTM A216 Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High Temperature Service, or
  - .3 British Standards Institution (BSI) Kitemarks, or
  - .4 supplied by manufacturer operating with ISO 9001 certification.
- .2 Valves subject to registration in pressure piping service to have current Canadian Registration Numbers (CRN) in accordance with:
  - .1 TSSA Act, O.Reg. 220/01,
  - .2 CSA B51 Boiler, Pressure Vessel, and Piping Code.

### **1.3 Quality and Equivalence**

- .1 Valve selections are in general identified by model designations taken from manufacturers catalogues to indicate physical properties and quality standards not otherwise described..
- .2 Companies, and/or trade names listed below are acceptable for various valve types, where products offered are essentially similar to those identified by manufacturer or model number under "Standard of Acceptance" designation.
  - .1 Specific duty valves are specified in each piping service article.
  - .2 for gate, globe, angle, and check valves

#### *Standard of Acceptance*

- Kitz
- Crane
- Newman Hattersley
- Jenkins
- Bonney Forge
- Dahl Bros
- Neo Valves
- Nibco
- Trueline
- Toyo Valves (Red &White)
- S.A. Armstrong
- Velan

- Watts
- A-Chem Valves & Controls
- .3 for double regulating valves
  - S.A. Armstrong
  - Tour & Anderson
  - Preso
  - Newman Hattersley
- .4 for plug valves (with CGA approval when used in gas service)

*Standard of Acceptance*

- Mueller
- Nordstrom
- Newman Hattersley
- .5 for ball valves
- Standard of Acceptance*
  - American Valve
  - Kitz
  - Crane
  - Newman Hattersley
  - Jenkins
  - Apollo
  - Dahl Bros
  - Neo Valves
  - Milwaukee Valve
  - Nibco
  - Canadian Worcester Controls
  - Toyo Valve (Red&White)
  - Watts
  - Velan
  - A-Chem Valves & Controls
  - Trueline
- .6 for grooved piping valve products

*Standard of Acceptance*

- Victaulic
- Nibco
- Golvlok
- Couplox
- Mueller
- Shurjoint

## **2 PRODUCTS**

### **2.1 Selection criteria**

- .1 Valves to be line size, selected as follows
  - .1 for shut-off or isolating service, valves to be
    - (a) Gate
    - (b) Butterfly
    - (c) Ball or

- (d) Plug
- .2 for flow balancing and shut-off service valves to be
  - (a) Double regulating, or
  - (b) Plug and
  - (c) to incorporate adjustable limit stops.
- .3 at discharge of pumps check valves to be silent or spring assisted or combination check and flow control valves.
- .2 On mains and risers, drain valves to be selected as follows
  - .1 On mains NPS 4 and under
    - (a) NPS  $\frac{3}{4}$  brass threaded ball valve of appropriate pressure rating with hose thread, cap and chain.
  - .2 On mains NPS 5 and over
    - (a) NPS 1 brass threaded ball valve of appropriate pressure rating with hose thread, cap and chain.

## 2.2 Domestic water valves

- .1 Gate valves NPS 2 and under, soldered
  - .1 1000 kPa (150 psi), to MSS SP-80, Class 150, bronze body, solid wedge bronze disc, rising stem, screw in, or union bonnet.

### *Standard of Acceptance*

- Kitz 43
- Crane 1334
- Jenkins 813J
- Newman Hattersley T608 with NPT to copper adapters
- Nibco S-131

- .2 Gate valves NPS 2 and under, threaded
  - .1 1000 kPa (150 psi), to MSS SP-80, Class 150, bronze body, solid wedge disc, rising stem, screw in, or union bonnet.

### *Standard of Acceptance*

- Kitz 42
- Crane 431
- Jenkins 281OJ
- Newman Hattersley T608
- Nibco T-131

- .3 Gate valves NPS 2½ and over flanged
  - .1 850 kPa (125 psi), to MSS SP-70, Class 125, cast iron body with flat faced flange, bronze or bronze faced solid wedge disc with bronze seat rings, rising stem, OS & Y, bolted bonnet.

### *Standard of Acceptance*

- Kitz 72
- Crane 465 ½
- Jenkins 454J
- Newman Hattersley #504
- Nibco F-617-O

.4 Globe valves NPS 2 and under, soldered

- .1 850 kPa (125 psi), to MSS SP-80, 300 CWP, bronze body, renewable composition PTFE disc, threaded over bonnet, lock shield handles as indicated.

*Standard of Acceptance*

- Kitz 10
- Crane 1334/1320
- Jenkins 813J
- Newman Hattersley 13 with NPT copper adaptors
- Nibco S-235-Y

.5 Globe valves NPS 2 and under, threaded

- .1 1000 kPa (150 psi), to MSS SP-80, Class 150, bronze body, renewable composition PTFE disc, union bonnet, lock shield handles as indicated.

*Standard of Acceptance*

- Kitz 09
- Crane 7TF
- Jenkins 106BJ
- Newman Hattersley 13
- Nibco T-235-Y

.6 Swing check valves NPS 2 and under, soldered

- .1 850 kPa (125 psi), to MSS SP-80, bronze body, bronze swing disc, regrindable seat, screw-in cap,

*Standard of Acceptance*

- Kitz 23
- Crane 1342
- Jenkins 4093J
- Newman Hattersley 47 with NPT copper adaptors
- Nibco S-413

.7 Swing check valves NPS 2 and under, threaded

- .1 850 kPa (125 psi), to MSS SP-80, Class 125, bronze body, bronze swing disc, regrindable seat, screw-in cap

*Standard of Acceptance*

- Kitz 22
- Crane 37
- Jenkins 4073J
- Newman Hattersley 47
- Nibco T-413

.8 Swing checks NPS 2 ½ and over, flanged

- .1 850 kPa (125 psi), to MSS SP-71, Class 125, cast iron body with flat faced flange, renewable bronze seat rings, bronze faced iron or bronze disc, bolted cap.

*Standard of Acceptance*

- Kitz 78
- Crane 373
- Jenkins 587J

- Newman Hattersley 651
- Nibco F-918

.9 Ball valves up to NPS 2:

- .1 1000 kPa (150 psi), two piece bronze body and chrome plated bronze ball, PTFE seat rings, solder joint or NPT to copper adapters, full port.
- .2 handle extensions suitable to clear 50 mm (2 in) pipe insulation thickness.

*Standard of Acceptance*

- Kitz 59(soldered)
- Kitz 58 (threaded)
- Crane 9322 (soldered)
- Crane 9302 (threaded)
- Jenkins 202J (soldered)
- Jenkins 201J (threaded)
- Newman Hattersley 1999 (soldered)
- Newman Hattersley 1969F (threaded)
- Nibco S-FP-600 (soldered)
- Nibco T-FP-600 (threaded)
- Victaulic 722 (threaded)
- Anvil Fig 171N (threaded)

.10 Double regulating valves (DRV), NPS 2 and under, threaded

- .1 1000 kPa (150 psi) Copper alloy body, plug type stem with flow measurement ports and tamper-proof setting.

*Standard of Acceptance*

- S.A. Armstong CBV
- Tour & Anderson STAD
- Newman Hattersley #1700
- Preso B-PLUS

.11 Double regulating valves (DRV), NPS 2½ and over, flanged

- .1 860 psi (125 psi), cast or ductile iron body, raised face flanges, copper alloy trim, with flow measurement ports, tamper-proof setting.

*Standard of Acceptance*

- S.A. Armstrong CBV II
- Tour & Anderson series 787
- Newman Hattersley #737
- Preso B-PLUS

**2.3 Natural gas, Propane gas valves**

.1 Approvals:

- .1 CSA/CGA

.2 Ball valves NPS 2 and under, threaded

- .1 1000 kPa (150 psi) large port, Class 150 with two piece bronze body stainless steel or chrome plated bronze ball, PTFE seats and seals.

*Standard of Acceptance*

- Kitz 58
- Toyo 5044A
- Crane 9302
- Jenkins 201J
- Grinnell GR 1550
- Newman Hattersley #1969F
- Nibco T-FP-600

.3 Ball valves NPS 2½ to NPS 12, flanged

- .1 1000 kPa (150 psi) standard port, Class 150 with carbon steel body, stainless steel ball and stem, PTFE seats and packing. (lever or gear operator)

*Standard of Acceptance*

- Kitz 150 SCTAM FS-N (150)
- Trueline 715 AIT

.4 Plug Valves NPS 2 and under, threaded

- .1 1200 kPa (175 psi) cast iron body, Class 175 WOG, rectangular port, lubricated plug.

*Standard of Acceptance*

- Nordstrom 142
- Newman Hattersley #171M

.5 Plug Valves NPS 2 ½ to NPS 12, flanged

- .1 1200 kPa (175 psi) cast iron body, Class 200 WOG, rectangular port, full bore, lubricated plug.

*Standard of Acceptance*

- Nordstrom Fig. 143
- Newman Hattersley #201M
- Mueller

.6 Three way cock

*Standard of Acceptance*

- Crane 268
- Nordstrom Fig. 3402
- Newman Hattersley #200L

.7 Test cocks, threaded

- .1 Class 125 bronze

*Standard of Acceptance*

- Crane 254XR

### 3 EXECUTION

#### 3.1 Valve installation

- .1 Install shut off valves at:

- .1 branch take-offs,
- .2 to isolate piping to each piece of equipment, and

- .3 in locations shown.
- .2 Install valves in upright position with stem above horizontal
- .3 Remove internal parts of valves before soldering, welding or brazing pipe to valve body.
- .4 Arrange valve hand wheels and operating levers to be accessible
- .5 In equipment rooms and service spaces provide chain operators for valves mounted more than 2m (6 ft) above floor or access platform. Chains to extend to 1.5m (4 ft-6 in) above floor or platform and to be hooked on clips secured to building structure, clear of walking aisles.
- .6 Install double regulating valves with five pipe diameters of straight pipe on inlet side and two pipe diameters on outlet side.
- .7 Install triple duty or throttling valves where shown in pump discharge piping with ten pipe diameters of straight pipe on the inlet side and two pipe diameters on outlet side.

### 3.2 Double regulating valves

- .1 Consult with double regulating valve manufacturer to ensure correct valve selection. Balancing valves to be sized according to design flow
- .2 Size and select valves for flows as shown at 6 kPa (2 ft) pressure drop across the valve in the fully open position, and in accordance with manufactures recommendation. Table 1 identifies the nominal valve size selection:

Valve Size (in)	Nominal Flow			
	Min. (l/s)	Max. (l/s)	Min. (gpm)	Max. (gpm)
½	0.038	0.177	0.6	2.8
¾	0.126	0.379	2.0	6.0
1	0.246	0.631	3.9	10.0
1¼	0.316	0.947	5.0	15.0
1½	0.416	1.262	6.6	20.0
2	0.795	2.272	12.6	36.0
2½	2.398	6.310	38.0	100.0
3	1.956	8.203	31.0	130.0
4	4.291	12.620	68.0	200.0
5	5.679	20.192	90.0	320.0
6	11.48	28.395	182.0	450.0
8	23.16	51.742	367.0	820.0
10	34.07	82.030	540.0	1300.0
12	60.58	94.650	960.0	1500.0

- .3 Install double regulating valves with five pipe diameters of straight pipe on inlet side, two pipe diameters on outlet side and 10 pipe diameters from any pump.

**END OF SECTION**



## **WELDING 20 05 24**

### **1 GENERAL**

#### **1.1 Scope**

- .1 Weld or braze pipe and fittings for work of Division 20.
- .2 In this section, the term "weld, welder, welding" or similar word or phrase is an expression which includes both welding or brazing.

#### **1.2 Registration and Inspection**

- .1 Before commencing work, make arrangements and pay for registration and inspection by Technical Standards & Safety Authority (TSSA), for the following pressure piping systems:
  - .1 service water piping for building hot water heating systems, at design temperatures above 121°C (250°F) or at design pressures above 1070 kPa (160 psig),
  - .2 chilled water, cooling water, and process water systems, for liquids no more hazardous than water, at design temperatures above 65°C (150°F) or design pressures above 1717 kPa (250 psig), and

#### **1.3 Applicable standards:**

- .1 O.Reg. 220/01 made under the TSSA Act
- .2 CSA B51 Boiler, Pressure Vessel, and Pressure Piping Code
- .3 CSA B52 Mechanical Refrigeration Code
- .4 Piping standards to:
  - .1 ASME B31.9 Code for Building Service Piping.
- .5 ASME Boiler and Pressure Vessel Code, Section VIII Division 1
- .6 ASME Boiler and Pressure Vessel Code, Section IX

### **2 PRODUCTS**

#### **2.1 Not used**

### **3 EXECUTION**

#### **3.1 Welder qualification and welding procedures**

- .1 Welding of piping carrying steam, condensate, hot water, chilled water, or compressed air, at pressures greater than 100 kPa (15 psi) to be carried out using approved procedures by welders certified for pressure piping by TSSA.
- .2 Welding, both shop and field, to be electric arc in accordance with recommendations of Canadian Welding Bureau.

- .3 Welders Certificates and Welding Procedures used on job to be available for inspection during pipe welding operations. Each weld to be stamped with welder's identifying number.

### **3.2 Welded connections to existing pressure piping systems**

- .1 At the commencement of the Work, review with authority-having-jurisdiction inspector to determine their weld testing requirements to validate the proposed welding procedures, including but not limited to:
  - .1 dimensional misalignment between old and new pipe,
  - .2 metallurgical analysis of exiting piping,
  - .3 guided bent test, and
  - .4 fillet weld test.
- .2 After testing requirements are determined, provide a proposed schedule for tie-in connections and required existing service shut-down periods, for approval prior to commencing work.

### **3.3 Weld Quality**

- .1 Welds to be solid homogeneous part of metals joined and free from pits and incorporated slag and scale.
- .2 Weld surfaces to be smooth and regular and weld metal deposition to achieve full penetration with groove filled with weld metal, fused to the base metal throughout joint thickness.
- .3 Conduct visual examination of welds in accordance with the applicable piping standard and submit copy of examination report for review. For registered pressure piping systems, include copies of TSSA field inspection reports.

**END OF SECTION**

## **EXCAVATING AND BACKFILLING**

### **20 05 25**

#### **1 GENERAL**

##### **1.1 Scope**

- .1 Excavation and backfilling for work of Division 20, inside and outside of building.

##### **1.2 Position and extent of existing services**

- .1 Check field conditions and report any discrepancies before commencing work.
- .2 Engage services of water supply, drainage, electric supply, telephone and gas authorities to assist in locating services on and around site.

##### **1.3 Position and extent of new services**

- .1 Retain services of an Ontario Land Surveyor during installation of sanitary sewers, storm sewers, and water mains to confirm that diameter, location, routing, grade, and inverts of piping are in accordance with profile and site services drawing, and that manhole top elevations match finished site grading plan elevations
- .2 Submit survey information and obtain approval before backfilling.

##### **1.4 Applicable codes and standards**

- .1 ASTM D698, Test method for Laboratory compaction characteristic of soil using standard effort.
- .2 Ontario Occupational Health and Safety Act and Regulations for Construction Projects with respect to trench excavation.
- .3 Ontario Provincial Standard Specification 401 Construction Specification for Trenching, Backfilling, and Compacting
- .4 Ontario Provincial Standard Specification 1010 Material Specification for Aggregates - Base, Subbase, Select Subgrade, and Backfill Material
- .5 Ontario Water Resources Act, and Regulations.

#### **2 PRODUCTS**

##### **2.1 Embedment material**

- .1 As defined in OPSS 1010:
  - .1 Granular 'A'
  - .2 Granular 'B', Type I or II, with 100% passing the 26.5 mm sieve.

##### **2.2 Bedding Material**

- .1 As defined in OPSS 1010:
  - .1 Granular 'A'
  - .2 Granular 'B', Type I or II, with 100% passing the 26.5 mm sieve.,

- .3 Unshrinkable fill to OPSS 1359.

## **2.3 Cover material**

- .1 As defined in OPSS 1010:
  - .1 Granular 'A'
  - .2 Granular 'B', Type I or II, with 100% passing the 26.5 mm sieve,
  - .3 Native material.

## **2.4 Backfill materials**

- .1 As defined in OPSS 1010:
  - .1 Granular 'A'
  - .2 Granular 'B', Type I or II, with 100% passing the 26.5 mm sieve,
  - .3 Native material

## **2.5 Native and imported material**

- .1 Select subgrade material:
  - .1 lean coarse granular material containing stones not more than 25 mm (1 in) in size,
  - .2 free from frozen lumps, silt, rubble, clay lumps, cinders, ashes, refuse, vegetable matter or organic matter.

## **2.6 Concrete work:**

- .1 As specified in Division 3, Cast-in-Place Section

# **3 EXECUTION**

## **3.1 Excavation**

- .1 Saw cut pavements, curbs and sidewalks before proceeding with excavation. Layout cuts for approval before commencing work.
- .2 Prepare excavation for underground services of depth and dimensions so that no portion of any pipe bears directly against any rock or other hard surface.
- .3 Cut and trim banks of excavations and shore to prevent caving in. Limit width of excavation from invert up to "crown" of pipe to not more than twice outside diameter of pipe for pipe sizes up to 300 mm (12 in). For larger sizes limit width of excavation to outside diameter of pipe plus 300 mm (12 in).
- .4 Break up and remove rocks and boulders from excavation. Use drilling and wedging to remove rock encountered in trench. Blasting will not be allowed unless approved and authorized in writing.
- .5 Store materials excavated during progress of work to produce minimum of damage or disfigurement of existing ground.
- .6 Keep sides and bottoms of excavations from freezing and protect work from damage due to weather conditions. Excavate in limited lengths to enable protective measures to function efficiently during pipe laying, testing and backfilling.

- .7 Backfill trenches or provide sheeting, sheet piling or bracing to support trench walls and fence perimeter of work area or cover trench opening with steel plates when work area is not supervised.

### **3.2 Pipe laying and support**

- .1 Grade bottom of excavations for pipes to achieve specified slope.
- .2 Unless otherwise specified support piping as follows in accordance with OPSS 401::
  - .1 Flexible pipe on embedment material, and
  - .2 Rigid pipe on bedding material.
- .3 Inside building and up to 1.5 m (5 ft) outside the building:
  - .1 Form bottom of trench in earth so that pipe is supported on solid bed of undisturbed earth free from debris or stones exceeding 25 mm (1 in) in diameter. Shape embedment or bedding as applicable to fit lower one-third segment of pipes and hubs, care being taken to ensure even bearing along barrels.
  - .2 Support piping installed in unstable or filled ground on reinforced 15 Mpa (2500 lb) concrete pad or piers. Shape concrete support to provide bearing for at least lower one-third of circumference of pipe.
  - .3 Support piping installed under framed slabs over unstable or filled ground with mastic-coated clevis hangers and hanger rods or formed hangers tied to slab rebar, arranged as for suspended drainage piping. Support piping temporarily on earth within excavation without backfill and cover trench with plywood. Secure hanger rods to slab reinforcing steel. Use bronze hanger rods in corrosive fill.
- .4 Wall Penetrations:
  - .1 Over-excavate trench for one and half pipe diameters below invert for distance of 600 mm (2 ft) from face of wall.
  - .2 Fit pipe through foundation wall with through a steel sleeve that is sized to suit Link-Seal unit.
  - .3 Fit link seal between sleeve and pipe and tighten.
  - .4 Backfill over excavated area up to invert of pipe with compacted pea gravel, crushed stone, or crushed gravel with grain size of less than 25 mm (1 in).
  - .5 Backfill remainder of trench in accordance with procedures described below.
- .5 Outside building:
  - .1 Form bottom of trench in earth so that pipe is supported on Class "B" bedding or embedment as applicable.
  - .2 Support piping installed in unstable or filled ground on 15 Mpa (2500 lb) engineered concrete bedding/embedment.
  - .3 Place pipe and fittings in trench with invert conforming to elevations, slopes and alignment.
  - .4 On grades exceeding 10 percent, pipe to be laid uphill with compacted fill "collars" at each joint.
  - .5 Support piping, conduits and duct banks passing through backfill at building foundation walls and at manholes and catch basins:
    - (a) on 150 mm (6 in) thick reinforced concrete pads.
    - (b) dowel concrete pads into side of foundation walls, manholes, and catch basins, and
    - (c) extend pads to obtain minimum bearing length of 600 mm (2 ft) on undisturbed ground adjacent to foundation, manholes, and catchbasin backfill.

- .6 Where excavation has been carried to greater depth than required, replace with Granular 'A' material compacted in 150 mm (6 in) lifts to achieve 95% modified Proctor compaction or 10 Mpa (1500 lb) concrete.
- .7 Do not lay pipe in standing or running water. Prevent surface run-off from entering trench.
- .8 When ground water is present in work area, dewater by bailing or pumping to maintain stability of trench and backfilled areas, and control water level below pipe bedding. Maintain control of water in trench before, during and after pipe installation, and until sufficient backfill has been placed to prevent floatation of pipe.
- .9 When pipe laying is interrupted, secure piping against movement and seal open ends to prevent entrance of water, mud, debris or foreign material.

### **3.3 Backfilling**

- .1 Do not commence backfilling over services until testing is complete and approval has been obtained.
- .2 Do not use frozen material for backfilling nor place any backfilling on or against frozen earth.
- .3 Arrange and pay for laboratory testing of samples of backfill material to determine moisture density ratings.
- .4 Test compacted areas using drive tube method or nuclear method.
- .5 Under building floors, roads, curbs, walks, and paved areas;
  - .1 Backfill entire trench with Granular "B" Type I or II material compacted in 150 mm (6 in) lifts to achieve 95% modified Proctor compaction, up to the underside of the element sub-base.
- .6 Under all other areas including soft landscaping:
  - .1 Backfill trench around pipe with Granular "B" type I or II material, compacted in 150 mm (6 in) lifts to achieve 95% standard Proctor compaction, brought up to level 70% of pipe diameter above invert.
  - .2 Then backfill with Backfill material compacted in 150 mm (6 in) lifts to achieve 95% modified Proctor compaction, up to height of at least 600 mm (2 ft) above top of pipes.
  - .3 Fill remainder of trench with Backfill material laid down, compacted, watered, and consolidated in 300 mm (12 in) layers.
- .7 Spaces around manholes and catch basins;
  - .1 Backfill with Granular 'B' type I or II material brought up to height of at least 600 mm (2 ft) above top of pipes.
  - .2 Fill remainder of trench with Backfill material laid down, compacted, watered and consolidated in one foot layers. Consolidate material carefully so that walls are not damaged and support for piping entering or leaving concrete structure is undisturbed.
- .8 Withdraw shoring before backfilling and fill voids left on removal of supports with Granular A.
- .9 Minimize localized loadings and differential settlement wherever pipe crosses other utilities or subsurface structures.
- .10 Provide cushion of Granular 'A' bedding between pipe and any subsurface structure.

### **3.4 Restoration of work area**

- .1 Make up settlement of backfill in roads and walks, as it occurs, and minimize inconvenience to traffic in and around work.
- .2 After period adequate to reveal settlement has passed, fill depressions to restore correct grade.
- .3 Remove and dispose of excess excavated material, and leave site clear and unencumbered.
- .4 Make good damage to roads, curbs, lawns, walks, and paved areas caused by excavation, backfill, settlement and subsequent restoration.
- .5 Support, backfill and restore surface finishes for existing underground piping, conduit or other services uncovered during excavation.

**END OF SECTION**

## **HANGERS AND SUPPORTS**

### **20 05 29**

#### **1 GENERAL**

##### **1.1 Scope**

- .1 Provide hangers and supports for piping and conduits.

##### **1.3 Related Work**

- .1 Ductwork hangers: to section 23 31 13

##### **1.4 Shop drawings**

- .1 Product data to show:
  - .1 upper attachment.
  - .2 hanger rods.
  - .3 pipe attachment.
  - .4 riser clamps.
  - .5 shields and saddles.
  - .6 inserts.
- .2 Submit details for supports, guides, and anchors for glass, fibre-reinforced plastic, and plastic piping systems.
- .3 Submit design drawings for custom fabricated trapeze hangers, sealed by a professional engineer licensed in the project location jurisdiction.
  - .1 Shop drawing details:
    - (a) construction detail drawings for each loading condition,
    - (b) span deflection calculations,
    - (c) building attachment load calculations and type.
  - .2 Provide services of engineer who sealed the custom trapeze hanger shop drawings to conduct a general review of the completed installation on site.

##### **1.5 Applicable Codes and Standards;**

- .1 ASME B31.9 Building Service Piping
- .2 Manufacturers Standardization Society of Valve and Fittings Industry (MSS)
  - .1 MSS SP-58 Pipe Hangers and Supports - Materials Design and Manufacture
  - .2 MSS SP-69 Pipe Hangers and Supports - Selection and Application
  - .3 MSS SP-77 Guidelines for Pipe Support Contractual Relationships
  - .4 MSS SP-90 Guidelines for Terminology for Pipe Hangers and Supports
- .3 The Ontario Building Code



## **2 PRODUCTS**

### **2.1 General**

- .1 Hangers, supports, sway braces, to be made up from stock or production parts, manufactured and fabricated in accordance with ASME B31.1 and MSS SP-58, SP-69, and SP-90.
- .2 Select elements of pipe support systems to provide adequate factors of safety under loads applied by gravity, by temperature induced expansion and contraction, by internal pressure in mechanically jointed plain end pipe, by change of momentum in fluid flow.

### **2.2 Product identification**

- .1 Pipe support products to be selected from manufacturers standard product line

*Standard of Acceptance*

- Anvil
- Unistrut
- Myatt
- Hunt Erico
- Taylor
- National Concrete Accessories - Acrow Richmond
- Pipe Shields
- Portable Pipe Hangers
- Hilti

- .2 Model designations from these manufacturer's catalogue are used to establish quality standards and construction details to permit assessment of products from other manufacturers.

### **2.3 Upper attachments**

- .1 Cast-in-place concrete:

- .1 single or double pipe runs up to and including 300 mm (12 in) diameter:
  - (a) galvanized wedge inserts to MSS SP-58, type 18.
  - (b) ULC listed for pipe NPS  $\frac{3}{4}$  through NPS 8.

*Standard of Acceptance*

- Anvil - Model 281
- Unistrut - Model P-3245

- .2 Surface mount on concrete:

- .1 carbon steel plate with clevis and malleable iron socket and expansion case and bolt with minimum of two expansion cases and bolts for each hanger.

*Standard of Acceptance*

- Anvil plate, Fig. 49 socket, Fig. 290 expansion case, Fig. 117
- Myatt cut plate, double angle clip, Fig. 535 socket, Fig. 480 expansion case, Fig. 485 for existing concrete

- .2 Do not use explosive drive pins in any section of Work without obtaining prior approval.

- .3 Piping or equipment supported from existing concrete construction:

- .1 drill and install threaded inserts.

*Standard of Acceptance*

- Hilti - HDI, Kwick Bolt, HSL

.4 Steel framed construction:

.1 steel beam (bottom flange) and cold piping NPS 2 and under:

- (a) beam clamp to MSS SP-58, type 30, ULC listed.

*Standard of Acceptance*

- Anvil Fig. 218
- Myatt Fig. 500

.2 steel beam (bottom flange) and cold piping NPS 2½ and larger and hot piping:

- (a) heavy beam clamp assembly to MSS SP-58, type 28 or 29, or  
(b) fabricated equivalent, ULC listed.

*Standard of Acceptance*

- Anvil Fig. 228 or 292
- Myatt Fig. 510 X-HEAVY, or 511 X-HEAVY.

.3 steel beam (top flange) and cold piping and hot piping NPS 2 and under:

- (a) steel jaw, hook rod with nut, spring washer and plain washer, to MSS SP-58, type 25, ULC listed.

*Standard of Acceptance*

- Anvil Fig. 227
- Myatt Fig. 506

.4 steel joists and cold piping NPS 2 and under:

- (a) steel washer plate with double locking nuts.

*Standard of Acceptance*

- Anvil Fig. 60
- Myatt Fig. 545

.5 steel joists and cold piping NPS 2½ and larger and hot piping:

- (a) steel washer plates with double locking nut, carbon steel clevis and malleable iron socket.

*Standard of Acceptance*

- Anvil washer plate - Fig. 60, clevis - Fig. 66, socket - Fig. 290.
- Myatt washer plate - Fig. 545, clevis - Fig. 530, socket - Fig. 480.

## **2.4 Hanger rod**

.1 Carbon steel threaded rod;

- .1 electro-galvanized finish in mechanical rooms and outdoors.  
.2 black steel finish in other areas.

*Standard of Acceptance*

- Anvil Fig. 146
- Myatt Fig. 432

## **2.5 Horizontal pipe support - suspended**

- .1 Hot or cold suspended piping, including conduits, where horizontal movement is 25 mm (1 in) or less and hanger rod is longer than 300 mm (12 in).

- .1 steel or cast iron piping:
  - (a) adjustable clevis to MSS SP-58, type 1, ULC listed, sized for outside dimension of pipe and insulation.

*Standard of Acceptance*

- Anvil Fig. 260
- Myatt Fig. 124

- .2 copper piping:
  - (a) adjustable clevis to MSS SP-58, type 1, copper plated.

*Standard of Acceptance*

- Anvil Fig CT-65
- Myatt 151 CT

## **2.6 Horizontal pipe support - bottom supported**

- .1 Hot and cold steel and copper piping:
  - .1 adjustable pipe roller stand to MSS SP-58, type 44.

*Standard of Acceptance*

- Anvil Fig. 177
- Myatt Fig. 262

## **2.7 Trapeze hangers**

- .1 Performance:
  - .1 Manufactured:
    - (a) to product load listings.
  - .2 Custom fabricated:
    - (a) maximum deflection between supports: 1/250 (0.4%) of span
    - (b) minimum factor of safety : 5 times load to ultimate tensile or compressive strength.
- .2 Construction:
  - .1 Carbon steel shapes, to suit load application:
    - (a) hollow steel section,
    - (b) equal leg EI section, or
    - (c) double C channel "strong-back", with welded clips.
  - .2 Hanger rods:
    - (a) as specified above, and
    - (b) minimum two support rods,
    - (c) rods selected for minimum factor of safety of 5 times load to ultimate tensile or compressive strength of rod.
- .3 Pipe restraint:
  - .1 restrain pipes from lateral movement with:
    - (a) bolt-on angle brackets or pipe U-bolts for manufactured hangers,
    - (b) welded-on angles for fabricated hangers.

- .4 Finish:

- .1 electro-galvanized finish in mechanical rooms and outdoors.
- .2 black steel finish in other areas.

*Standard of Acceptance*

- ° Anvil Fig 45, 46, 50

**2.8 Vertical pipe supports:**

.1 Steel or cast iron pipe:

- .1 floor supported galvanized carbon steel riser clamps to MSS SP-58, type 42, ULC listed, field-welded pipe lugs.

*Standard of Acceptance*

- ° Anvil Fig. 261
- ° Myatt Fig. 182 or 183

- .2 suspended, galvanized carbon steel riser clamps to MSS SP-58, type 42, ULC listed, 4 or 6 bolt pattern, field-welded pipe lugs.

*Standard of Acceptance*

- ° Anvil fig. 40
- ° Myatt fig. 190 or 191

.2 Copper pipe:

- .1 carbon steel, copper finished, riser clamps to MSS SP-58, type 8.

*Standard of Acceptance*

- ° Anvil Fig. CT-121
- ° Myatt Fig. 150CT

**2.9 Variable load supports**

.1 Performance:

- .1 Selected for piping loads and estimated travel under service conditions.

.2 Construction:

- .1 carbon steel housing and spring,
- .2 pre-compressed spring,
- .3 load indicator,
- .4 welding to ASME Section IX
- .5 welded attachment points
- .6 finish: semi gloss primer coat.

*Standard of Acceptance*

- ° Anvil – Fig 82, 268, 98

**2.10 Constant load supports**

.1 Performance:

- .1 maintains constant support load under variable hanger displacements.

- .2 selected for piping loads and estimated travel under service conditions, with a minimum safety factor of 25 mm (1 in) extra travel or 20% of total travel, whichever is greater.

.2 Construction:

- .1 to WW-H-171E, ANSI/MSS SP-69 and 58
- .2 carbon steel housing and spring,
- .3 combination hanger moment arm and balancing spring design,
- .4 horizontal and vertical arrangements,
- .5 load adjustment and load indicator scale,
- .6 factory set for load and travel,
- .7 welding to ASME Section IX
- .8 welded attachment points
- .9 finish: semi gloss primer coat.

*Standard of Acceptance*

- Anvil – Fig R 80-V, 81-H

**2.11 Roding for mechanical joint pipe**

- .1 Plain end cast iron and asbestos cement drain waste and vent pipe, NPS 5 and over,
  - .1 bell clamps and rodding at each joint

*Standard of Acceptance*

- Myatt Fig. 175 in configuration Fig. 176
- Anvil Fig. 595 with Fig. 594 washers
- Taylor Fig. 35

- .2 bell clamp and rodding at each tee branch
  - Myatt Fig. 175 in configuration Fig. 180
  - Anvil Fig. 595 with Fig. 594 washers
  - Taylor Fig. 35

**2.12 Saddles and shields at pipe supports**

- .1 Cold piping insulation shields:
  - .1 provided for steel, copper, stainless, glass and plastic piping, all sizes,
  - .2 galvanized steel protection shield.

*Standard of Acceptance*

- Anvil Fig. 167 (up to NPS 24)
- Anvil Fig. 168 - Riblok (up to NPS 8)
- Myatt Fig. 251

- .2 Hot piping insulation shields:
  - .1 provided for steel piping NPS 1-1/4 and smaller,
  - .2 provided for copper tubing, all sizes,
  - .3 galvanized steel protection shield.

*Standard of Acceptance*

- Anvil Fig. 167 (up to NPS 24)
- Anvil Fig. 168 - Riblok (up to NPS 8)
- Myatt Fig. 251

.3 Hot piping saddles:

- .1 provided for steel piping, NPS 1½ and larger:
- .2 protective saddle welded to pipe with insulation inserted between saddle and pipe.

*Standard of Acceptance*

- Anvil Fig. 160 to 166
- Myatt Fig. 210 to 240

### **3 EXECUTION**

#### **3.1 Coordination with concrete work**

- .1 Supply and deliver inserts to site in ample time to be built into work.
- .2 Set and correctly locate inserts for pipes and equipment hangers. Secure inserts firmly to formwork before concrete is poured.

#### **3.2 Hanger installation**

- .1 Support piping and conduit directly from or on structural building elements. Do not support pipe or conduit directly from other services except as described below.
- .2 The hanger rod size and spacing in the following articles is based on supporting a single pipe directly from the structure.
  - .1 If multi-level pipe or conduit supports are proposed, such as trapeze or roller hanger supports, submit shop drawings designed and sealed by a professional engineer licensed as a consulting engineer in the province of the project location and include details for each support system including load calculations.
  - .2 Coordinate with the structural engineer for point load connections to the building structure.
- .3 Install hangers for steel pipe with spacing and hanger rod diameter in accordance with table 1.
  - .1 Exception: fuel oil, natural gas, propane, and medical gas piping.
- .4 Install hangers for copper pipe with spacing and hanger rod diameter in accordance with table 2.
  - .1 Exception: fuel oil, natural gas, propane, and medical gas piping.
- .5 Install hangers for cast iron soil pipe with hanger spacing and hanger rod diameter in accordance with table 3 and as follows:
  - .1 provide at least one pipe hanger for each length of pipe, located at or within 300 mm (12 in) of each hub or mechanical joint,
  - .2 provide a hanger at or adjacent to each fitting hub or mechanical joint except where multiple joints occur within a 1200 mm (4 ft) developed pipe length then;
    - (a) support may be reduced to every other hub or mechanical joint, or
    - (b) where the pipe run is made of multiple fittings connected end-to-end, a 1.6 mm (16 ga) galvanized steel half sleeve may be used underneath the pipe and fittings and supported with a hanger at each end of the sleeve.

.3 for mechanical joints, if the spacing between adjacent joints is 300 mm (12 in) or less, reduce the support spacing to a maximum of 1000 mm (39 in),

.6 Refer to Section 23 11 23 for hanger spacing for Natural Gas and Propane Piping.

**Table 1 : Hanger Spacing for Steel Piping**

Pipe Size NPS	Rod Diameter	Maximum Spacing
½	10 mm (3/8 in)	1.8 m (6 ft)
¾ to 1¼	10 mm (3/8 in)	2.1 m (7 ft)
1½	10 mm (3/8 in)	2.7 m (9 ft)
2	10 mm (3/8 in)	3.0 m (10 ft)
2½	13 mm (½ in)	3.3 m (11 ft)
3	13 mm (½ in)	3.3 m (12 ft)
4	16 mm (5/8 in)	4.2 m (14 ft)
6	16 mm (¾ in)	5.1 m (17 ft)
8	22 mm (¾ in)	5.7 m (19 ft)
10	22 mm (7/8 in)	6.7 m (22 ft)
12	22 mm (7/8 in)	7.0 m (23 ft)
14	25 mm (1 in)	7.5 m (25 ft)
16	25 mm (1 in)	8.0 m (27 ft)
18	25 mm (1 in)	8.4 m (28 ft)
20	30 mm (1-1/4 in)	9.0 m (30 ft)
24	30 mm (1-1/4 in)	9.6 m (32 ft)

**Table 2 : Hanger Spacing for Copper Piping**

Pipe Size NPS	Rod Diameter	Maximum Spacing (Copper)
½	10 mm (3/8 in)	1.5 m (5 ft)
¾ to 1¼	10 mm (3/8 in)	1.8 m (6 ft)
1½	10 mm (3/8 in)	2.4 m (8 ft)
2	10 mm (3/8 in)	2.7 m (9 ft)
2½	13 mm (½ in)	3.0 m (10 ft)
3	13 mm (½ in)	3.0 m (10 ft)
4	16 mm (5/8 in)	3.0 m (10 ft)

**Table 3: Hanger Spacing for Cast Iron Soil Piping**

Pipe Size NPS	Rod Diameter	Maximum Spacing (CI soil pipe)
3	13 mm (½ in)	3 m (9.8 ft)
4	16 mm (5/8 in)	3 m (9.8 ft)
6	16 mm (¾ in)	3 m (9.8 ft)
8	22 mm (¾ in)	3 m (9.8 ft)
10	22 mm (7/8 in)	3 m (9.8 ft)

- .7 Hanger spacing and hanger rod diameter for steel or copper flexible joint roll groove pipe to be as shown in table above for appropriate pipe material with not less than one hanger between joints and with anchors and guides located to maintain piping true to line and grade.
- .8 In steel framed construction, support piping from structural members. Where structural members are not suitably located for upper hanger attachments and inserts of adequate capacity cannot be installed in floor slabs over, provide supplementary steel framing members;
  - .1 fabricate supplementary steel from standard HSS sections, single EL section, double C "strongback" sections, or pipe rolls,
  - .2 size supporting steel to limit span deflection to 1/250 (0.4%) between support points,
  - .3 mechanically fasten supplementary steel to structural steel.
- .9 Offset hangers so that rods are vertical in operating position.
- .10 Provide hanger within 300 mm (12 in) of each horizontal elbow and tee.
- .11 Clamp and rod tees, elbows, and joints, in plain end mechanical joint pipe NPS 5 and over.
- .12 Riser clamps:
  - .1 Weld lugs onto steel piping.



.2 Solder copper pipe to copper riser clamps.

.13 Trapeze hangers

.1 Shim pipes on common trapeze hangers to slope each pipe in required direction.

.2 Mechanical fasten shim plates to hanger. Shim plates and pipe lateral restraints may be fastened as one unit.

**3.3 Variable load supports**

.1 Size, select and install variable load supports for piping in mechanical rooms at first three load points from a shaft penetration.

.2 Provide vibration isolation hangers for other locations in accordance with Section 20 05 48 Vibration Isolation.

**3.4 Saddles and shields**

.1 On cold insulated piping, provide insulation shields between insulation and pipe support.

.2 On hot insulated piping, weld protective saddles to pipe at pipe support locations.

.3 No saddles or shields are required on un-insulated piping.

**3.5 Load nut retention requirements**

.1 Adhere fastening nuts, including top and bottom load nuts, and clevis bolt nuts, to threaded rods or fittings with Loctite 266.

**END OF SECTION**

## **VIBRATION ISOLATION**

### **20 05 48**

#### **1 GENERAL**

##### **1.1 Scope**

- .1 Isolate motor driven mechanical equipment.
- .2 Provide restraints for equipment mounted on vibration isolation to limit movement during start-up and normal operation.
- .3 Isolator and base type designations are taken from appropriate chapter of current ASHRAE Applications Handbook.
- .4 Base type, isolator type and minimum static deflection are shown in equipment schedules and equipment selection sheets.
- .5 Information shown in equipment schedules is to establish minimum standards, vibration isolation equipment to be selected to maintain noise levels in building below RC levels in following schedule.

AREA	NOISE CRITERIA (NC level)
Offices	30 to 35
Public Areas	30 to 35

##### **1.2 Related Sections**

- .1 Piping constant load supports to Section 20 05 29 Hangers and Supports

##### **1.3 Shop drawings**

- .1 Show vibration isolation for each piece of equipment hung from the structure or supported from the floor.
- .2 Submit product data sheets for isolation components.
- .3 Show fabrication details, location and size of anchor bolts.
- .4 Provide vibration isolation equipment by one manufacturer.

##### *Standard of Acceptance*

- Vibron / Kinetics
- BVA
- KorfundMason
- Tecoustics

## **2 PRODUCTS**

### **2.1 Resilient isolator Type 1 (R1)**

- .1 Rubber waffle or ribbed pads:
  - .1 30 durometer natural rubber, minimum of 13 mm (½ in) thick,
  - .2 selected for maximum loading of 350 kPa (50 psi).
- .2 Rubber-steel-rubber pads:
  - .1 two layers of rubber waffle or ribbed pad, 13 mm (½ in) thick, as specified above,
  - .2 bonded to 6 mm (¼ in) steel plate with holes sleeved and fitted with isolation washers.
- .3 Neoprene jacketed pre-compressed moulded fibreglass.

### **2.2 Resilient isolator Type 2 (R2)**

- .1 Elastomer rubber:
  - .1 threaded insert,
  - .2 hold down bolts.
- .2 Neoprene, 50 mm (2 in) free height:
  - .1 natural frequency not to exceed 15 Hz at full load,
  - .2 capable of sustaining load of 110 kg (250 lb) with maximum deflection of 5 mm (3/16 in).

### **2.3 Elastomeric mounts (E1)**

- .1 Construction:
  - .1 colour coded neoprene in shear with
  - .2 maximum durometer of 60,
  - .3 threaded insert,
  - .4 two bolt down holes,
  - .5 ribbed top and bottom surfaces.

### **2.4 General requirements for spring mounts**

- .1 Isolator springs:
  - .1 designed so that ratio of lateral to axial stiffness is equal to or greater than 1.2 times ratio of static deflection to working height,
  - .2 selected for 50% travel beyond rated load,
  - .3 cadmium plated,
  - .4 colour coded.
- .2 Mounts:
  - .1 zinc or cadmium plated hardware,
  - .2 rubber isolation washers,
  - .3 housings coated with rust resistant paint,

- .4 levelling devices, and
- .5 6 mm (¼ in) thick ribbed rubber sound pad bonded to load plate.
- .3 Clearance between metal parts: 6 mm (¼ in) minimum.

## **2.5 Spring isolator Type 1 (S1)**

- .1 Open spring isolators:
  - .1 extra stiff springs with ratio of lateral to axial stiffness of 1.0.

## **2.6 Spring isolator Type 2 (S2)**

- .1 Controlled spring isolators with
  - .1 heavy rigid steel base frames,
  - .2 built-in vertical limit stops,
  - .3 removable spacers, and
  - .4 extra stiff springs with ratio of lateral to axial stiffness of 1.0.

## **2.7 Spring isolator snubber Type 3 (S3)**

- .1 Open spring isolators:
  - .1 horizontal arrangement
  - .2 heavy rigid steel equipment base mount, and structure mount
  - .3 open spring, with 25 mm (1 in) deflection range.
  - .4 isolator bushings.

## **2.8 General requirements for isolation hangers**

- .1 General
  - .1 swivel arrangement to permit hanger box or rod to move through 20° arc without metal to metal contact.

## **2.9 Hanger Type 1 (H1)**

- .1 Spring hanger:
  - .1 welded steel housing with one coat anti-rust paint,
  - .2 colour coded spring,
  - .3 retaining cups,
  - .4 elastomeric washers.

## **2.10 Hanger Type 2 (H2)**

- .1 Rubber isolation hanger:
  - .1 welded steel housing with one coat anti-rust paint,
  - .2 25 mm (1 in) colour coded neoprene in shear with maximum durometer of 60,
  - .3 threaded insert.

### 2.11 Hanger Type 3 (H3)

- .1 Horizontal thrust restraint:
  - .1 spring and elastomeric element
  - .2 housed in box frame with rods and angle brackets to connect unit between isolated equipment and fixed object, and
  - .3 fitted with means to adjust maximum start-stop movement to 9 mm ( $\frac{3}{8}$  in).

### 2.12 Acoustic barriers for anchors and guides

- .1 Manufactured from 25 mm (1 in) thick neoprene isolation with duck reinforcing material.

### 2.13 Equipment base Type A

- .1 Direct isolation:
  - .1 used where equipment is unitary and rigid
  - .2 motor slide rails welded to unit.

### 2.14 Equipment base Type B

- .1 Prefabricated steel base:
  - .1 welded from structural sections and
  - .2 reinforced for drive with;
    - (a) isolation elements attached to base brackets and
    - (b) adjustable motor slide rails.
  - .3 minimum vertical section of base selected on basis of motor size from following;

Motor Size Horsepower	Motor Size kW	Vertical Side mm (in)
up to 3	up to 2.2	75 (3)
7.5	5.5	100 (4)
20	15	150 (6)
50	37	200 (8)
over 50	37	250 (10)

### 2.15 Equipment base Type C

- .1 Concrete filled inertia base:
  - .1 Type B base and,
  - .2 full depth perimeter structural section or formed plate channel frame with;
    - (a) welded in place reinforcing rods running in both directions and
    - (b) 1 mm (20 ga) metal pans,
    - (c) base section filled with concrete, vibrated into place.
  - .3 spring mount units carried by gusseted brackets welded to frame and

- .4 'T' shaped bases to support pump elbows.

## **2.16 Base Type D**

- .1 Roof curb isolation rails:
  - .1 manufactured with structural steel or aluminum upper and lower members, with
    - (a) continuous flexible reinforced water and air tight seal fastened to upper and lower members,
  - .2 protected by removable metal weather shield.
  - .3 supported from lower members by stable steel springs, with
  - .4 maximum deflection 50 mm (2 in) and
  - .5 closed cell neoprene gaskets.
  - .6 constructed with neoprene cushioned restraints to resist wind load in any direction.

## **3 EXECUTION**

### **3.1 General**

- .1 Install vibration isolation equipment in accordance with manufacturer's instructions and locate isolation for equipment to provide stable support under saddles, frames and projections of equipment.

### **3.2 Equipment vibration isolation**

- .1 Provide additional steel in bases and rails to obtain rigidity and uniform load distribution.
- .2 Pumps, fans and motor driven equipment to be mounted on vibration isolation as shown.
- .3 Suspended fans to be supported on
  - .1 Type A or B base with
  - .2 Type H3 hangers.
- .4 Rooftop units to be supported on
  - .1 Type D base.
- .5 Provide Type S3 horizontal thrust restraints for high pressure horizontal discharge fans developing over 1.5 kPa (6 in wg), arranged symmetrically on either side of unit and attached at centre line of thrust.
- .6 Block and shim bases level at correct operating height.
  - .1 Bases to clear housekeeping pads by:
    - (a) 25 mm (1 in) minimum for concrete and
    - (b) 50 mm (2 in) minimum for steel.
- .7 Where isolation is bolted to floor, housekeeping slab or overhead structure:
  - .1 provide vibration isolation rubber washers.
- .8 Where pumps are mounted on vibration isolators
  - .1 provide flanged or grooved coupling steel removable spool pieces on inlet and discharge connections to allow future installation of flexible connectors,

- .2 locate spool pieces between system isolating valve and pump with flange to flange lengths as follows;

Pipe size (inches)	Spool Length (inches)	Pipe Size (mm)	Spool Length (mm)
2	18	50	450
2½ & 3	24¼	65 & 75	616
4 & 5	24¾	100 & 125	625
6 to 12	25	150 to 300	635

- .9 Where ducts attach to resiliently mounted equipment, flexible connections will be provided by ductwork installer.

### 3.3 Service connection vibration isolation

- .1 Make pipe, duct and electrical connections to isolated equipment so as to maintain isolation system flexibility.

### 3.4 Piping vibration isolation

- .1 Piping connected to isolated equipment:
- .1 supported with;
    - (a) spring mounts or spring hangers with static deflection of twice deflection of isolated equipment at first point of support and
    - (b) 25 mm (1 in) minimum static deflection at remaining supports.
  - .2 installed with distance between support points selected as for regular pipe hangers and using spring type for
    - (a) first three supports for piping up to NPS 4.
  - .3 Isolated, with acoustic barrier material, at anchors and guides within pipe shafts, duct shafts, equipment and fan rooms, and up to first anchor outside these rooms or areas.
- .2 Where piping crosses building expansion joint
- .1 provide spring hangers at first two support locations of piping at either side of joint line.

### 3.5 Start-up and set-up

- .1 After installation of connections to resiliently mounted equipment;
- .1 remove shims and blocking and adjust mountings to level equipment,
  - .2 adjust connections, hangers, snubbers, and restraints,
  - .3 ensure that there is no physical contact between isolated equipment and building structure.
- .2 On completion of installation and start-up of equipment;
- .1 make arrangements for manufacturer/supplier of Vibration Isolation equipment to visit site, check performance of systems, inspect installation, adjust seismic restraints, and submit written recommendations,
  - .2 make corrections to installation in accordance with manufacturer/suppliers recommendations,

- .3 provide notice 24 hours in advance of this site visit.

### **3.6 Testing**

- .1 Engage and pay for an experienced sound and vibration professional to take measurements of sound and vibration generated by HVAC systems.
- .2 Co-operate with manufacturer/supplier of Sound Attenuation equipment in this measurement and testing.
- .3 Sound measurements to extend over full audio frequency range and to be taken in areas adjacent to mechanical equipment rooms, duct and pipe shafts, and main electrical rooms.
- .4 Submit outline of tests to be performed, details of instrumentation to be used and floor plans showing test locations prior to commencing work.
- .5 Provide notice one week in advance of commencement of tests.
- .6 Submit complete report of tests addressing noise and vibration levels measured in occupied areas and adequacy of Sound Attenuation and Vibration Isolation equipment.

**END OF SECTION**



## **IDENTIFICATION 20 05 53**

### **1 GENERAL**

#### **1.1 Scope**

- .1 Provide equipment nameplates, piping and duct identification, and valve tags.

#### **1.2 Shop Drawings**

- .1 Submit list of nameplates, with proposed wording, prior to engraving.
- .2 Submit sample board with pipe and duct identification materials.

### **2 PRODUCTS**

#### **2.1 General**

- .1 Manufactured identification systems:
  - .1 laminated vinyl or polyester,
  - .2 resistant to chemical, ultraviolet,
  - .3 minimum operating temperature: -25°C (-12°F)
  - .4 maximum operating temperature: 121°C (250°F)

##### *Standard of Acceptance*

- ° Brady - identification tapes, bands, and markers.
- ° Seton - Setmark Pipe Markers.
- ° Smillie McAdams Summerlin.
- ° Craftmark Identification Systems.

#### **2.2 Equipment Identification Nameplates**

- .1 Identification plates are in addition to manufacturers plates.
- .2 Identification plates:
  - .1 provided for equipment identified with number designations in schedules and equipment selection sheets.
  - .2 marked with equipment ID, service and power source using wording and numbering used in contract documents.
- .3 Fabrication:
  - .1 laminated plastic,
  - .2 black lettering on white background for "Normal" power equipment
  - .3 white lettering on red background for "Emergency" power equipment
  - .4 minimum size 90 mm x 40 mm x 2.5 mm (3 in x 1½ in x ¼ in),
  - .5 engraved with 10 mm (¾ in) high lettering.

## 2.3 Piping Identification

- .1 Flexible coil-wrap manufactured markers:
  - .1 plastic coated markers with integral printing, or plastic cover with field applied self-adhesive markers,
  - .2 applicable WHIMS pictogram for identification of material hazard.
- .2 Self-adhesive manufactured pipe markers and colour bands:
  - .1 50 mm (2 in) wide tape wrapped around pipe or covering with ends overlapping one pipe diameter but not less than 25mm (1 in) for colour bands,
  - .2 minimum 20 mm (¾ in) high lettering,
  - .3 colour band tape with flow direction arrows,
  - .4 waterproof and heat resistant plastic marker tags for pipes and tubing 20 mm (¾ in) nominal and smaller.
  - .5 applicable WHIMS pictogram for identification of material hazard.
  - .6 mellized ribbon, labeled with name of service, at maximum 800 mm intervals.

## 2.4 Ductwork Identification

- .1 Paint stencilled letters 25mm (1 in) high showing;
  - .1 duct service,
  - .2 fan number, and
  - .3 arrows showing direction of flow,

## 2.5 Valve Identification

- .1 Brass valve tags or plastic lamacoid:
  - .1 brass with stamped numbers and letters filled with black enamel,
  - .2 plastic lamacoid with black lettering on a white background,
  - .3 brass or stainless steel chain or S-hook,

# 3 EXECUTION

## 3.1 Equipment Identification

- .1 Locate nameplates to be easily read.
- .2 Do not paint over equipment manufacturer or field installed nameplates.
- .3 Fasten securely with mechanical fasteners.
- .4 Provide standoffs on insulated equipment.
- .5 Examples:
  - .1 at equipment (fan, pump, etc.):

**F-1**  
**Auditorium Supply Fan**

- .2 at motor starter, adjustable frequency drive, and separate local disconnect:

**P-3**  
**Condenser Water Pump**  
**Fed from PDP-12-1**

### **3.2 Piping Identification - Except for Non-Medical Gas Systems**

- .1 Provide manufactured tape markers:
  - .1 self-adhesive type:
    - (a) indoor uninsulated piping,
    - (b) indoor insulated piping with PVC or smooth metal jackets,
  - .2 flexible coil-wrap:
    - (a) outdoor piping,
    - (b) indoor insulated piping with canvas or embossed metal jackets.
  - .3 Install markers on cleaned and prepared surfaces free of dirt and oil.
- .2 Locations:
  - .1 maximum every 15 m (50 ft) along length of pipe, except for medical gas, natural gas and fuel oil,
  - .2 maximum every 6 m (20 ft) along length of pipe for natural gas and fuel oil,
  - .3 within 1 m (3 ft) of each side of barriers, floors and walls,
  - .4 within 1 m (3 ft) of and behind access doors ,
  - .5 within 1 m (3 ft) of piping termination point.

### **3.3 Ductwork identification**

- .1 Paint stencilled letters 25mm (1 in) high showing;
  - .1 duct service,
  - .2 fan number, and
  - .3 arrows showing direction of flow,
- .2 Locations:
  - .1 exposed ducts,
  - .2 concealed ducts next to access doors, and
  - .3 throughout length of ducts at intervals not exceeding 15 m (50 ft).
- .3 Stencil indication on prepared surfaces, and locate on both sides of any penetration.

### **3.4 Valve Identification**

- .1 Provide every valve on job with a numbered tag showing valve type and size, attached to valve stem or wheel handle with non-ferrous chain or S-hook.
  - .1 Valve identification is not required at the following valves:

- (a) inside fire hose cabinets,
- (b) radiation heating units, unit heaters, or fixture stops,
- (c) within site of equipment or apparatus they control provided there is no branch piping between valve and equipment served.

.2 Identification information:

- .1 indicating service, sequential valve number by service or specific equipment ID for control valves, location identifier, purpose of valve, valve type and size.
- .2 valve type designation:
  - (a) **B** (ball valve), **GT** (gate valve), **GL** (globe valve), **CBV** (circuit balancing valve), **BF** (butterfly valve).
- .3 valve size:

**Domestic Cold Water #12  
Riser C-1  
Service Valve - B2**

- (a) for valve size, use NPS designation.
- .4 examples:
  - (a) domestic cold water riser isolating valve, sequence number 12, located near column C-1, NPS 2 ball valve:
  - (b) hot water terminal reheat supply valve, sequence number 57, located in a corridor and not in site of equipment served, circuit balancing valve NPS 3/4:

**Reheat Supply #57  
Room 2-254  
Balancing Valve - CBV 3/4**

- (c) automatic control valve used for pressure balancing the system, with an equipment schedule ID of CV-15, and is globe style NPS 3:

**Constant Pressure Differential Valve  
CV-15  
Automatic Control Valve - GL 3**

- .3 Provide a tag schedule for each system, designating number, service, function, size, and location of each tagged item and normal operating position of each valve.
- .4 Submit two copies of valve tag schedules, encased in clear plastic, bound in vinyl covered, hardbacked 210 mm x 297 mm (8½ in x 11 in) three ring binders

### 3.5 Pipe and Valve Identification Classification

- .1 Colour coding and service identifiers to be in accordance with CGSB-24.3-92 Identification of Piping Systems.

.1 Use colour coding system schedule as follows:

Primary Classification	Secondary Classification	Legend Type and Direction Arrows
Yellow 505-101	Orange 508-102	Black 512-101
Green 503-107	Purple 511-101	White 513-101
Blue 202-101	Black 512-101	
Red 509-102	Yellow 505-101	
White 513-101		

Pipe and Valve Identification				
Pipe Marker Legend	Valve Tag Legend	CGSB Hazard Classification	Background Colour	Legend Colour
City Water	CI.W	Low	Green	White
Cold Water	C.W.	Low	Green	White
Domestic Cold Water Supply	D.C.W.S.	Low	Green	White
Dom Hot Water Supply	D.H.W.S.	Low	Green	White
Dom Hot Water Recirc	D.H.W.R.	Low	Green	White
Waste Water	W.W.	Low	Green	White
Storm Sewer	S.S.	Low	Green	White
Sanitary Sewer	SAN.S.	Low	Green	White
Combination Sanitary Storm Sewer	C.S.S.S.	Low	Green	White
Refrigerant Suction (include refrigerant No.)	REF.S. (No.)	Hazardous	Yellow	Black
Natural Gas	N.G.	Hazardous	Yellow	Black
Fire Protection Water	F.P.W.	Fire Protection	Red	White
Sprinkler Water	S.W.	Fire Protection	Red	White
Vent (plumbing)	V.P.	Low	Green	White
Vent	V.	Hazardous	Yellow	Black

### 3.6 Special Hazards and Warning Labels

- .1 In addition to pipe and duct identification described above, for pipes and ducts containing hazardous materials provide universal warning labels next to the identification label and on associated fans, tanks and pumps etc;
  - .1 standard identification symbols in accordance with WHIMS labeling requirements,
  - .2 minimum 100 mm (4 in) diameter with black symbol on yellow background,
- .2 Provide labeling for systems as follows:

System	Biohazard	Corrosive	Flammable	Explosive	Radioactive		
Isotope drains and exhaust					•		
Fumehood exhaust		•	•	•			
Flammable storage exhaust			•	•			
Isolation Room Exhaust	•						
Decontamination drain and tank	•	•	•	•			

- .3 Provide a list of all systems to be labeled with hazardous warning symbols for review prior to installation.

**END OF SECTION**

## **DUCTWORK INSULATION**

### **20 07 16**

#### **1 GENERAL**

##### **1.1 Scope**

- .1 Insulate and finish ducts, casing, and plenums;
  - .1 provide insulation, sealer coatings, finishes, and mechanical protection.
  - .2 insulation is not required on factory insulated and/or and acoustically lined ductwork except as otherwise shown.

##### **1.2 Quality**

- .1 Manufacturers and products are listed in this Section to establish quality and manufacturing standards. Products from other manufacturers with explicitly similar characteristics may be acceptable but must be submitted as an alternative product submission.

##### **1.3 Qualifications**

- .1 Provide insulation and covering by recognized specialist applicator with an established reputation for this type of work.

##### **1.4 Material test criteria**

- .1 Insulation, adhesives, coatings, finishes, sealers, and tapes:
  - .1 maximum flame spread rating of 25 to CAN/ULC-S102,
  - .2 maximum smoke developed rating of 50 to CAN/ULC-S102.
  - .3 Exception: vapor barrier mastics installed outside of building.

##### **1.5 Applicable codes and standards**

- .1 Material and method of application to comply with or be tested in accordance with following Standards;
  - .1 Thermal Insulation Association of Canada (TIAC) National Insulation Standard, excluding section 12
  - .2 NFPA 90-A Installation of Air-Conditioning and Ventilating Systems
  - .3 ASHRAE/IES 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings
  - .4 NFPA 255 Test of Surface Burning Characteristics of Building Materials
  - .5 CAN/ULC-S102 Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Covering, and Miscellaneous Materials and Assemblies
  - .6 ASTM C411 Standard Test Method for Hot Surface Performance of High Temperature Thermal Insulation
  - .7 ASTM C518 Standard Test Method for Steady State Thermal Transmission Properties by Means of Heat Flo Meter Apparatus
  - .8 ASTM C533 Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation
  - .9 ASTM C534 Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
  - .10 ASTM C552 Standard Specification for Cellular Glass Thermal Insulation

- .11 ASTM C553 Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
- .12 ASTM C612 Standard Specification for Mineral Fiber Block and Board Thermal Insulation
- .13 ASTM C1126 (Gr.1) Standard Specification for Faced and Unfaced Rigid Cellular Phenolic Thermal Insulation
- .14 CGSB 51-GP-52MA Vapour Barrier, Jacket and Facing Material for Pipe, Duct, and Equipment Thermal Insulation.
- .15 CGSB 51.53-95 Poly(Vinyl Chloride) Jacket Sheeting, for Insulated Pipes Vessels and Round Ducts.

## 1.6 Definitions

- .1 In this Section;
  - .1 **"Ambient"**: as applied to temperatures means outdoor design temperature.
  - .2 **"Concealed"**: as applied to mechanical services and equipment located in space above opaque suspended ceilings, and within trenches not in boiler rooms, pipe and/or duct shafts, and non-accessible chases and furred spaces.
  - .3 **"Ductwork"**: as applied to this section includes ducts, fans, supply unit casings, and plenums.
  - .4 **"Exposed"**: as applied to remainder of mechanical services and equipment which are not "concealed" as defined above. For greater certainty, the following locations are Exposed:
    - (a) Services in tunnels,
    - (b) Services in space beneath raised floors,
    - (c) Trenches located in boiler rooms,
    - (d) Outdoors.
  - .5 **"Conditioned air"**: air supplied from air handling units which heats, cools, dehumidifies, or humidifies the air.
  - .6 **"Unconditioned space"**: rooms or spaces that are not supplied with conditioned air, including ceiling spaces which are not part of a ceiling return plenum system
  - .7 **"Outdoor"**: mechanical services and equipment located outside of the building envelope including services located beneath overhangs and soffits, and exposed to any outdoor condition including temperature, sun exposure, or precipitation.
  - .8 **"Mastic"**: heavy-consistency waterproof compound for outdoor applications used in conjunction with reinforcing fabric that remains adhesive and generally pliable with age, to provide either a breathable or vapour barrier finish to insulation.
  - .9 **"Coating"**: light-consistency compound for indoor applications used in conjunction with reinforcing fabric, to provide either a breathable or vapour barrier finish to insulation.
  - .10 **"Finish Jacket"**: final finish protective layer for insulation, including lagging fabric, PVC, metal, and adhesive films; that provides weather-protective finish depending on application.
  - .11 **"Service temperature"**: for purpose of ductwork temperature, is equal to the design operating temperature.

## 2 PRODUCTS

### 2.1 Adhesives, Fasteners, and Tape

- .1 Contact bond cement:
  - .1 for quick setting for metal surfaces.



- .2 Volatile Organic Content: maximum 80 g/L.

*Standard of Acceptance*

- Bakor - No. 220-05
- Foster – Drion 85-75

- .2 Adhesive for flexible closed cell foam insulation:

- .1 Volatile Organic Content: maximum 80 g/L.

*Standard of Acceptance*

- Armaflex 520BLV
- Armaflex Low VOC Spray Contact Adhesive
- Rubatex R-373

- .3 Lap seal adhesive:

- .1 for joints and lap sealing of vapour barriers.  
.2 Volatile Organic Content: maximum 250 g/L.

*Standard of Acceptance*

- Bakor 220-05
- Childers CHIL-STIX FRN CP-82

- .4 Fibrous insulation adhesive:

- .1 Volatile Organic Content: maximum 250 g/L.

*Standard of Acceptance*

- Childers CHIL-STIX FRN CP-82
- Foster No. 85-70

- .5 Vapour barrier tape:

- .1 colour matched and foil faced  
.2 UL 181A listed.

*Standard of Acceptance*

- Johns Manville - Zeston Z-Tape
- MacTac Canada Limited - Vinyl Scrim or Foil Scrim Kraft
- Compac Corp.
- Fattal Canvas Inc. - Insultape

- .6 Weld Pins, Studs and Clips

*Standard of Acceptance*

- Midwest Fasteners
- Continental Studwelding

- .7 Staples

- .1 Monel, flare type, minimum size 12 mm (½ in).

- .8 Tie Wire

- .1 1.6 mm (16 ga) stainless steel with twisted ends.

- .9 Caulking for sheetmetal jackets (outdoor use only)
  - .1 fast-drying, aluminum colour finish, flexible butyl elastomer based vapour barrier sealant.

*Standard of Acceptance.*

- Foster 95-44

## **2.2 Coatings and Membranes**

### **.1 Reinforcing Membrane:**

- .1 synthetic fibre:
  - (a) Leno weave,
  - (b) indoor and outdoor use.

*Standard of Acceptance*

- Foster Mast-A-Fab

- .2 glass-fibre fabric:
  - (a) indoor use.

*Standard of Acceptance*

- Childers Chil-Glas #5/#10

- .3 glass-fibre fabric for use with elastomeric closed cell foam:
  - (a) indoor use.

*Standard of Acceptance*

- Childers Chil-Glass #10

### **.2 Breather Coating - Indoors:**

- .1 for breather coatings and lagging adhesive,
- .2 Volatile Organic Content: maximum 50 g/L.
- .3 white in colour,

*Standard of Acceptance*

- Childers CP-50A HV2
- Foster 30-36

### **.3 Breather Mastic - Outdoors:**

- .1 for breather coatings and lagging adhesive,
- .2 abrasion resistive, flexible,
- .3 UV stabile,
- .4 grey in colour.

*Standard of Acceptance*

- Childers Vi-Cryl CP-10/11
- Foster 35-00 / 45-00
- Bakor 120-10

### **.4 Vapor Barrier Coatings - Indoors:**

- .1 Volatile Organic Content: maximum 50 g/L.

- .2 for vapor barrier coatings and lagging adhesive except for elastomeric closed cell foam,
  - (a) permeance rating 0.02 perms maximum,
  - (b) white in colour

*Standard of Acceptance*

- Childers Chil Perm CP-34/35
- Foster 30-80, 30-90

- .3 for use with elastomeric closed cell foam.

*Standard of Acceptance*

- Childers CHIL-SPRAY WB CP-56 Adhesive

.5 Vapor Barrier Mastic - Outdoors:

- .1 for vapor barrier coatings and lagging adhesive,
- .2 asphalt cutback,
- .3 permeance rating 0.02 perms maximum,
- .4 grey in colour.
- .5 for outdoor use only; not rated to meet fire/smoke rating of 25/50.

*Standard of Acceptance*

- Childers Chil-Pruf CP-22
- Foster 60-25/60-26

## **2.3 Insulation Cement**

- .1 Hydraulic-setting finishing type.

## **2.4 Field Applied Finishes**

.1 PVC (Polyvinyl Chloride) finish jacket:

- .1 minimum 20 mil thickness with permeability not more than 0.09 perms,
- .2 flexible flat-sheet,

*Standard of Acceptance*

- Johns Manville - Manville Zeston 2000
- ACWIL Insulations
- Sure Fit Systems
- Proto PVC - LoSMOKE

- .3 pressure sensitive, colour matching vinyl tape.

.2 Fabric finish jacket:

- .1 ULC listed plain weave cotton fabric at 220 g/m<sup>2</sup> (6 oz/sq yd), treated with fire retardant lagging adhesive, or
- .2 re-wettable fiberglass lagging fabric with water activated self-adhesive.
- .3 suitable for field painting.

*Standard of Acceptance*

- Fattal's Thermocanvas
- Alpha-Maritex 3451-RW
- Clairmont Diplag 60

- Glass-Cell FR
- Newtex - Zetex Rewettable

.3 Metal finish jacket:

.1 equipment:

- (a) stucco embossed aluminum not less than 0.45 mm (0.016 in) thick sheet or,
- (b) corrugated stainless steel not less than 0.25 mm (0.010 in) thick sheet.

.2 fittings:

- (a) Custom made swaged ring or lobster back covers on bends and die shaped fitting covers over fitting, valves, strainers, flanges, and grooved couplings.

.3 bands:

- (a) 12 mm (½ in) wide stainless steel with mechanical fasteners.

*Standard of Acceptance*

- Alcan Canada Products - Thermaclad Type 1
- Childers Products Inc. - Fab Straps

.4 Protective finish for elastomeric cellular foam insulation

.1 indoors and outdoors:

*Standard of Acceptance*

- Armaflex WB Finish

## 2.5 Ductwork Insulation

.1 Type D-1 glass fibre blanket:

- .1 to ASTM C1290
- .2 service temperature: up to 121°C (250°F)
- .3 flexible blanket,
- .4 FSK jacket of kraft bonded to aluminum foil reinforced with glass fibre yarn, maximum 0.02 perms to ASTM E96 Procedure A.
- .5 noncombustible,
- .6 thermal performance:  $R = 0.74 \text{ m}^2 \text{ }^\circ\text{C/W}$  @ 24°C (4.2 btu ft<sup>2</sup> °F /Btu @ 75°F)
- .7 density: 12 kg/m<sup>3</sup> (0.75 pcf)
- .8 vapor transmission : maximum 0.02 perms

*Standard of Acceptance*

- John Manville      Microlite XG Duct Wrap
- Owens Corning      SOFTR Duct Wrap
- Knauf Fibreglass      Friendly Feel Duct Wrap

.2 Type D-2 glass fibre board:

- .1 to ASTM C612,
- .2 service temperature: up to jacket surface temperature (air contact) up to 66°C (150°F) and un-jacketed surface temperature (equipment contact) up to 232°C (450°F).
- .3 rigid for flat surfaces or,
- .4 scored board for curved surfaces 250 mm (10 in) dia and over,

- .5 jacket of kraft bonded to aluminum foil reinforced with glass fibre yarn,
- .6 thermal performance: 0.033 W/m/C @ 24°C (0.23 btu/hr/in/sq ft/F @ 75°F),
- .7 vapor transmission: maximum 0.02 perms
- .8 density: 48 kg/m3 (3.0 lb/cu ft),
- .9 suitable for jacket surface temperature (air contact) up to 66°C (150°F) and un-jacketed surface temperature (equipment contact) up to 232°C (450°F).

*Standard of Acceptance*

- ° Johns Manville - Manville 814 Spin-Glas
- ° Owens Corning - 703 Board
- ° Knauf Fiberglass - Insulating Board

.3 Type D-3 flexible elastomeric closed cell foam:

- .1 to ASTM C534,
- .2 service temperature: up to 82°C (180°F).
- .3 sheet self-adhering, roll type,
- .4 thermal performance: 0.04 W/m/C @ 24°C (0.28 btu/hr/in/sq ft/F @ 75°F),
- .5 manufacturer specific sealer/adhesive.

*Standard of Acceptance*

- ° Armstrong - AP Armaflex Self-Adhering Sheet Insulation
- ° Rubatex

.4 Type D-4 low temperature phenolic board:

- .1 to ASTM C1126 (Gr.1),
- .2 service temperature: -73°C to +121°C (-100°F to 250°F).
- .3 rigid for flat surfaces,
- .4 meeting 25/50 flame spread/smoke development when tested to ASTM E84,
- .5 thermal performance: 0.021 W/m/C @ 10°C (0.145 btu/hr/in/sq ft/F @ 50°F),
- .6 density: 37 kg/m3 (2.3 lb/cuft),

*Standard of Acceptance*

- ° Kingspan - Koolphen K

### **3 EXECUTION**

#### **3.1 Insulation Limits**

.1 Externally insulate air handling system components:

- .1 Conditioned air with cooling coils: supply unit casings and plenums, and free standing supply fans for both recirculating and non-recirculating type systems,
- .2 Conditioned air with heating only: supply unit casing and plenums, free-standing supply fans, and supply air ducts and plenums up to the space served but not in the space itself,
- .3 Conditioned air supply ducts including downstream of reheat coils,
- .4 un-conditioned supply air ducts and plenums that pass through unheated rooms or spaces,
- .5 the first 300 mm (12 in) length of acoustically lined ductwork,
- .6 return air ducts and plenums in unheated spaces,

- .7 exhaust air ducts and plenums in unheated spaces,
  - .8 exhaust air ducts between exhaust air damper and point of discharge to outside of building,
  - .9 outside air intake ducts and plenums;
    - (a) for non-recirculating type ventilation systems without cooling coils, terminate plenum or casing insulation 300 mm (12 in) downstream of final heating coil,
  - .10 mixed air plenums and ducts;
    - (a) for recirculating type ventilation systems without cooling coils, terminate outside air intake insulation 300 mm (12 in) downstream of mixing plenum,
  - .11 sheet metal blank-off plates behind unused sections of air intake louvers.
- .2 Externally insulate ductwork located outdoors:
- .1 supply ducts.
  - .2 conditioned supply ducts.
  - .3 return ducts,
  - .4 exhaust ducts,
    - (a) excluding fan discharge duct,
  - .5 kitchen exhaust ducts with more than 3 m (10 ft) length of duct on roof.
    - (a) excluding fan discharge duct.
- .3 External insulation is not required on:
- .1 casings, ducts or plenums which have been lined with acoustic insulation, except as described above,
  - .2 free standing unconditioned supply fans, supply ducts and plenums,
  - .3 portions of intake ducts or plenums, unit casings and conditioned air plenums which are of double wall insulated construction,
  - .4 pre-insulated flexible ducts.
  - .5 factory insulated air handling units.

### **3.2 General Requirements**

- .1 Insulate ductwork in accordance with Table 1 at the end of this section.
- .2 Store and use adhesives, mastics, and insulation cements at ambient temperatures and conditions recommended by product manufacturers.
- .3 Surfaces to be clean and dry before application of insulation. Apply insulation after pressure and leakage testing is completed and accepted.
- .4 Place insulation with joints staggered and tightly butted, with no visible gaps.
- .5 Neatly finish insulation at supports, protrusions, and interruptions.
- .6 Seal exposed insulation with reinforced vapor barrier or breather coating/mastic as shown.
- .7 Finish ductwork with field installed finish jackets as shown.

### **3.3 Application**

- .1 Rigid insulation - fans, ducts, and casing:
  - .1 overlap horizontal boards over vertical boards, and butt edges tightly together.
  - .2 impale insulation on weld pins, studs, and clips at 300 mm (12 in) centres in both directions, with not less than 2 rows per side and bottom.
  - .3 secure insulation laps with mechanical fasteners (staples).
- .2 Rigid insulation - outside air duct and plenums - glass fibre:
  - .1 as above for fans, ducts, and casings, and;
    - (a) apply first layer of insulation without integral vapour barrier,
    - (b) apply second layer of insulation with integral vapour barrier with staggered joints.
- .3 Rigid insulation - outside air duct and plenum - phenolic board:
  - .1 as above for fans, ducts, and casings, but with only one layer of insulation board.
- .4 Rigid insulation - exhaust air plenums:
  - .1 as above for fans, ducts, and casings.
- .5 Flexible insulation:
  - .1 overlap insulation 50 mm (2 in) on each lap joint, and butt end edges tightly together,
  - .2 on rectangular ducts 600 mm (24 in) and wider, and round ducts 450 mm (18 in) and wider;
    - (a) secure insulation to the underside of duct with weld pins, studs, and clips at 300 mm (12 in) centres in both directions, with not less than 2 rows per side and bottom,
    - (b) secure insulation laps with mechanical fasteners (staples),
    - (c) for round ductwork, the underside of duct is measured as being half the circumference of the duct.
- .6 Flexible elastomeric:
  - .1 wrap tightly onto ductwork and drain pans, and secure with 100% adhesive coverage.
  - .2 on round ducts, overlap insulation 50 mm (2 in) on each lap joint, and butt end edges tightly together,
- .7 Cover angles or standing seams on the outside of plenums, casings and ducts which extend beyond face of applied rigid insulation;
  - .1 with same material and thickness as adjacent ductwork,
  - .2 extend this insulation 75 mm (3 in) on each side of the angle and place tight around the projecting leg of the angle.
  - .3 apply rigid insulation overlapping edge of flexible insulation on angle so that outstanding part of insulated angle projects through work.
- .8 Cut and mitre rigid insulation at elbows and fittings and attach to ductwork with 50% coverage of adhesive, and mechanical fasteners with weld pins, speed clips and washers.
- .9 Attach speed washers when insulation has been placed on metal pins and cut off excess pin length flush with speed washer. Cover washers with vapour barrier tape.
- .10 At junctions between external insulation and acoustic insulation, overlap external insulation 300 mm (12 in) over acoustic lining.

- .11 Outdoor rectangular and flat-oval ductwork:
  - .1 build-up and slope insulation on top of ductwork to provide a 1:100 drainage slope,
  - .2 where width of ductwork exceeds 600 mm (24 in), slope insulation in both directions.

### **3.4 Sealing Insulation**

- .1 Hot ducts, casings, and plenums - Indoors:
  - .1 service temperature: 20°C to 65°C (70°F - 150°F)
  - .2 apply vapour barrier tape to butt joints, overlapping by minimum 50 mm (2 in) each side,
  - .3 do not tape lap joints.
- .2 Cold or dual temperature ducts, casings, and plenums - Indoors:
  - .1 service temperature: Ambient to 20°C (Ambient to 70°F)
  - .2 apply reinforced vapor barrier coating to all corners, lap edges and butt edges, overlapping joint by minimum 50 mm (2 in) each side,
  - .3 cover mechanical fastener (staple) penetrations with reinforced vapour barrier coating,
  - .4 insulate flanges and standing seams with overlapping strips of flexible insulation, and cover with reinforced vapour barrier coating.
- .3 Ducts - Hot ducts - Outdoors:
  - .1 service temperature: 20°C to 65°C (70°F - 150°F)
  - .2 apply reinforced breather mastic to all corners, lap edges and butt edges, overlapping joint by minimum 50 mm (2 in) each side.
  - .3 cover mechanical fastener (staple) penetrations with reinforced breather mastic,
  - .4 insulate flanges and standing seams with overlapping strips of flexible insulation, and cover with reinforced breather mastic.
  - .5 for greater clarity, do not use vapor barrier tape on outdoor applications.
- .4 Ducts - Cold or Dual Temperature - Outdoors:
  - .1 service temperature: Ambient to 20°C (Ambient to 70°F)
  - .2 apply reinforced vapor barrier mastic to all corners, lap edges and butt edges, overlapping joint by minimum 50 mm (2 in) each side,
  - .3 cover mechanical fastener (staple) penetrations with reinforced vapour barrier mastic,
  - .4 insulate flanges and standing seams with overlapping strips of flexible insulation, and cover with reinforced vapour barrier mastic,
  - .5 for greater clarity, do not use vapor barrier tape on outdoor applications.
- .5 Apply mastics and coatings when ambient temperature is above 4°C (40°F), unless manufacturer's instructions permit colder ambient installation conditions.

### **3.5 Insulation Finish**

- .1 Install protective finish on insulation in accordance with Table 2 at the end of this Section, after breather and vapor barrier sealing is completed.



- .2 Install finish jacket materials used for covering to allow 50 mm to 100 mm (2 in to 4 in) overlap on longitudinal and circumferential edges.
- .3 Fabric:
  - .1 Cotton lagging:
    - (a) apply cotton lagging with minimum two coatings of breather or vapor barrier coating adhesive as applicable to the duct system, and finish to provide a smooth surface free of wrinkles and sags.
    - (b) where cotton lagging with appropriate coating is used this satisfies the requirements of a sealer coating for Hot or Cold/Dual temperature ducting systems.
  - .2 Fibreglass lagging:
    - (a) apply re-wettable fibreglass lagging in accordance with manufacturer instructions. Finish to provide a smooth surface free of wrinkles and sags.
    - (b) where re-wettable fiberglass lagging is used this satisfies the requirements of a breather sealer coating for Hot piping systems.
- .4 Metal:
  - .1 use lock-on systems or secure sheeting with bands 450 mm (18 in) apart.
  - .2 joint sealing, indoor:
    - (a) Hot ducts and plenums: do not seal joints.
    - (b) Cold or Dual Temperature ducts and plenums: seal joints with caulking.
  - .3 curved surfaces: custom made swaged ring or lobster back covers,
  - .4 on outdoor hot and cold/dual temperature ductwork, caulk overlapping metal joints to permit expansion of metal jacket.
- .5 Self-Adhesive Weather Barrier (SAWB):
  - .1 apply SAWB in accordance with manufacturer's instructions.
- .6 Flexible elastomeric closed cell foam insulation:
  - .1 apply thin coat of lagging adhesive, and apply glass mesh,
  - .2 when dry apply indoor or outdoor finish at 400 square feet per gallon,
  - .3 apply second coat of same material, at same rate of application, after four hours.

### **3.6 Painted Ductwork**

- .1 Finish ductwork with fabric finish for the following systems:
  - .1 ductwork inside of boiler and refrigeration rooms.
  - .2 ductwork inside of other mechanical service rooms.
  - .3 exposed ductwork in public areas including
- .2 Prime and top-coat painting is provided under separate Division of the Work.

### **3.7 Mechanical Damage Protection - Indoors**

- .1 Protect exposed insulated ductwork from floor level up to 1200 mm (4 ft) above floor with 1.2 mm (18 ga) stainless steel jacket, secured to floor slab.
- .2 Do not overlap fire damper slip joint with protective sheeting.

### 3.8 Field Quality Control

- .1 The Consultant reserves the right to have protective finish coverings removed on up to 5% of all fittings and flanges to review the sealing of the insulation, at no change in cost.
- .2 If insulation sealing is found to be incorrect at any one location, remove the protective finish on all fittings and flanges for review.
- .3 Repair defective sealing and replace protective coverings at no change in cost.

### 3.9 Insulating and Finishes Tables

- .1 Tables 1, and 2 follows.

<b>Table 1 : Ductwork and Plenum Insulation Type and Thickness mm (in)</b>			
<b>Nominal Surface Temperature</b>	<b>Equipment Description</b>	<b>Insulation Type</b>	<b>Insulation Thickness</b>
5°C to 65°C (40F to 150F)	Supply unit casings and plenums	D-2	25 (1)
	Free standing supply fans		
	Rectangular, exposed		
	Rectangular, concealed		
	Rectangular, concealed	D-1	38 (1-1/2) <i>note (1)</i>
	Round and Oval, exposed		
	Round and Oval, concealed		
Ambient to 65°C (Ambient to 150F)	Plenums and Casings - Air Intake	D2	Two layers each 50 (2)
		D4	75 (3)
	Plenums and Casings - Exhaust	D2	50 (2)
		D4	38 (1-1/2)
	Rectangular - Outdoor - Supply	D2	50 (2)
	Rectangular - Outdoor - Return	D2	38 (1-1/2)
	Rectangular - Outdoor - Exhaust		
	Round - Outdoor	D3	Two layers each 25 (1)
	Drain pans	D3	20 (3/4)

Note (1): thickness is “out of box” before installation.

Table 2 : Ductwork Insulation Protective Finishes			
Location	Weather Exposure	System/Space	Finish
Concealed	Indoors	All	None
Exposed	Indoors	Service Rooms	Fabric
	Indoors	Public Spaces	Fabric
	Outdoors	All	Metal

**END OF SECTION**

## **PIPING INSULATION 20 07 19**

### **1 GENERAL**

#### **1.1 Scope**

- .1 Insulate and finish piping, valves, fittings, and pipeline accessories.
  - .1 provide insulation, coatings, finishes, and mechanical protection.
- .2 Provide fire rated insulation on piping as shown, including fire protection standpipes.
  - .1 coordinate with the contractor under Division 21 for location and extent of standpipes to be protected.

#### **1.2 Related Work**

- .1 The following Work is specified in other Section of Division 20:
  - .1 supply of insulation shields for cold and dual temperature piping:
  - .2 provision of welded saddles for hot piping.
- .2 Insulation of underground piping: Section 20 07 21.
- .3 Painting of piping: Division 09.

#### **1.3 Quality**

- .1 Manufacturers and products are listed in this Section to establish quality and manufacturing standards. Products from other manufacturers with explicitly similar characteristics may be acceptable but must be submitted as an alternative product submission.

#### **1.4 Qualifications**

- .1 Provide insulation and covering by recognized specialist applicator with an established reputation for this type of work.

#### **1.5 Material test criteria**

- .1 Insulation, adhesives, coatings, finishes, sealers, and tapes:
  - .1 maximum flame spread rating of 25 to CAN/ULC-S102,
  - .2 maximum smoke developed rating of 50 to CAN/ULC-S102..
- .2 Exception: vapor barrier mastics installed outside of building.

#### **1.6 Applicable codes and standards**

- .1 Material and method of application to comply with or be tested in accordance with following Standards;
  - .1 Thermal Insulation Association of Canada (TIAC) National Insulation Standard, excluding section 12
  - .2 NFPA 90-A Installation of Air-Conditioning and Ventilating Systems
  - .3 ASHRAE/IES 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings

- .4 NFPA 255 Test of Surface Burning Characteristics of Building Materials
- .5 CAN/ULC-S102 Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Covering, and Miscellaneous Materials and Assemblies
- .6 ASTM C411 Standard Test Method for Hot Surface Performance of High Temperature Thermal Insulation
- .7 ASTM C518 Standard Test Method for Steady State Thermal Transmission Properties by Means of Heat Flo Meter Apparatus
- .8 ASTM C533 Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation
- .9 ASTM C534 Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
- .10 ASTM C547 Standard Specification for Mineral Fiber Pipe Insulation
- .11 ASTM C552 Standard Specification for Cellular Glass Thermal Insulation
- .12 ASTM C553 Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
- .13 ASTM C612 Standard Specification for Mineral Fiber Block and Board Thermal Insulation
- .14 ASTM C795 Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel
- .15 ASTM C1126 (Gr.1) Standard Specification for Faced and Unfaced Rigid Cellular Phenolic Thermal Insulation
- .16 CGSB 51-GP-52MA Vapour Barrier, Jacket and Facing Material for Pipe, Duct, and Equipment Thermal Insulation.
- .17 CGSB 51.53-95 Poly(Vinyl Chloride) Jacket Sheeting, for Insulated Pipes Vessels and Round Ducts.

## 1.7 Definitions

- .1 In this Section;
  - .1 **"Ambient"**: as applied to temperatures means outdoor design temperature.
  - .2 **"Concealed"**: as applied to mechanical services and equipment located in space above opaque suspended ceilings, and within trenches not in boiler rooms, pipe and/or duct shafts, and non-accessible chases and furred spaces.
  - .3 **"Exposed"**: as applied to remainder of mechanical services and equipment which are not "concealed" as defined above. For greater certainty, the following locations are Exposed:
    - (a) Services in tunnels,
    - (b) Services in space beneath raised floors.
    - (c) Trenches located in boiler rooms.
  - .4 **"Conditioned air"**: air supplied from air handling units which heats, cools, dehumidifies, or humidifies the air.
  - .5 **"Unconditioned space"**: rooms or spaces that are not supplied with conditioned air, including ceiling spaces which are not part of a ceiling return plenum system
  - .6 **"Outdoor"**: mechanical services and equipment located outside of the building envelope including services located beneath overhangs and soffits, and exposed to any outdoor condition including temperature, sun exposure, or precipitation.
  - .7 **"Mastic"**: heavy-consistency waterproof compound for outdoor applications used in conjunction with reinforcing fabric that remains adhesive and generally pliable with age, to provide either a breathable or vapour barrier finish to insulation.

- .8 **“Coating”**: light-consistency compound for indoor applications used in conjunction with reinforcing fabric, to provide either a breathable or vapour barrier finish to insulation.
- .9 **“Finish Jacket”**: final finish protective layer for insulation, including lagging fabric, PVC, metal, and adhesive films; that provides weather-protective finish depending on application.
- .10 **“Service temperature”**: for purpose of piping temperature, is equal to the gas or vapour design operating temperature, or the liquid supply operating temperature.
- .11 **“Pure water”**: water which has been treated with filtration equipment, including but not limited to reverse osmosis, deionization, ultra-filtration, ultra-violet, distillation or any combination of such or similar equipment, to achieve water quality significantly free of impurities.

## 2 PRODUCTS

### 2.1 Adhesives, Fasteners, and Tape

- .1 Contact bond cement:
  - .1 for quick setting for metal surfaces.
  - .2 Volatile Organic Content: maximum 80 g/L.

*Standard of Acceptance*

- Bakor - No. 220-05
- Foster – Drion 85-75

- .2 Adhesive for flexible closed cell foam insulation:
  - .1 Volatile Organic Content: maximum 80 g/L.

*Standard of Acceptance*

- Armaflex 520 BLV
- Armaflex Low VOC Spray Contact Adhesive
- 

- .3 Lap seal adhesive:
  - .1 for joints and lap sealing of vapour barriers.
  - .2 Volatile Organic Content: maximum 250 g/L.

*Standard of Acceptance*

- Bakor 220-05
- Childers CHIL-STIX FRN CP-82

- .4 Fibrous insulation adhesive:
  - .1 Volatile Organic Content: maximum 250 g/L

*Standard of Acceptance*

- Childers CHIL-STIX FRN CP-82
- Foster No. 85-70

- .5 Vapour barrier tape:
  - .1 colour matched and foil faced
  - .2 UL 181A listed.

*Standard of Acceptance*

- Johns Manville - Zeston Z-Tape

- MacTac Canada Limited - Vinyl Scrim or Foil Scrim Kraft
- Compac Corp.
- Fattal Canvas Inc. - Insultape

.6 Weld Pins, Studs and Clips:

*Standard of Acceptance*

- Midwest Fasteners
- Continental Studwelding

.7 Staples:

- .1 Monel, flare type, minimum size 12 mm (½ in).

.8 Tie Wire:

- .1 1.6 mm (16 ga) stainless steel with twisted ends.

.9 Caulking for sheetmetal jackets (outdoor use only)

- .1 fast-drying, aluminum colour finish, flexible butyl elastomer based vapour barrier sealant.

*Standard of Acceptance.*

- Foster 95-44

## **2.2 Coatings and Membranes**

.1 Reinforcing Membrane:

- .1 synthetic fibre:
- (a) Leno weave,
  - (b) indoor and outdoor use.

*Standard of Acceptance*

- Foster Mast-A-Fab

.2 glass-fibre fabric:

- (a) indoor use.

*Standard of Acceptance*

- Childers Chil-Glas #5/#10

.3 glass-fibre fabric for use with elastomeric closed cell foam:

- (a) indoor use.

*Standard of Acceptance*

- Childers Chil-Glass #10

.2 Breather Coating - Indoors:

- .1 for breather coatings and lagging adhesive,
- .2 Volatile Organic Content: maximum 50 g/L
- .3 white in colour,

*Standard of Acceptance*



- Childers CP-50A HV2
- Foster 30-36

.3 Breather Mastic - Outdoors:

- .1 for breather coatings and lagging adhesive,
- .2 abrasion resistive, flexible,
- .3 UV stabile,
- .4 grey in colour.

*Standard of Acceptance*

- Childers Vi-Cryl CP-10/11
- Foster 35-00 / 45-00
- Bakor 120-10

.4 Vapor Barrier Coatings - Indoors:

- .1 Volatile Organic Content: maximum 50 g/L.
- .2 for vapor barrier coatings and lagging adhesive except for elastomeric closed cell foam,
  - (a) permeance rating 0.02 perms maximum,
  - (b) white in colour

*Standard of Acceptance*

- Childers Chil Perm CP-34/35
- Foster 30-80, 30-90

- .3 for use with elastomeric closed cell foam.

*Standard of Acceptance*

- Childers CHIL-SPRAY WB CP-56 Adhesive
- 

.5 Vapor Barrier Mastic - Outdoors:

- .1 for vapor barrier coatings and lagging adhesive,
- .2 asphalt cutback,
- .3 permeance rating 0.02 perms maximum,
- .4 grey in colour.
- .5 for outdoor use only; not rated to meet fire/smoke rating of 25/50.

*Standard of Acceptance*

- Childers Chil-Pruf CP-22
- Foster 60-25/60-26

## **2.3 Insulation Cement**

- .1 Hydraulic-setting finishing type.

## **2.4 Field Applied Finishes**

- .1 PVC (Polyvinyl Chloride) finish jacket:
  - .1 minimum 20 mil thickness with permeability not more than 0.09 perms,
  - .2 fitting covers, one or two piece, pre moulded,

- .3 glass-fibre insulation inserts for elbows, tees, valves, end-caps, mechanical pipe couplings,
- .4 self sealing longitudinal joints.

*Standard of Acceptance*

- Johns Manville - Manville Zeston 2000
- ACWIL Insulations
- Sure Fit Systems
- Proto PVC - LoSMOKE

- .5 pressure sensitive, colour matching vinyl tape.

.2 Fabric finish jacket:

- .1 ULC listed plain weave cotton fabric at 220 g/m2 (6 oz/sq yd), treated with fire retardant lagging adhesive, or
- .2 re-wettable fiberglass lagging fabric with water activated self-adhesive.
- .3 suitable for field painting.

*Standard of Acceptance*

- Fattal's Thermocanvas
- Alpha-Maritex 3451-RW
- Clairmont Diplag 60
- Glass-Cell FR
- Newtex - Zetex Rewettable

.3 Metal finish jacket:

- .1 straight pipe, duct or plenum:
  - (a) stucco embossed aluminum not less than 0.45 mm (0.016 in) thick sheet or,
  - (b) corrugated stainless steel not less than 0.25 mm (0.010 in) thick sheet.
- .2 fittings:
  - (a) Custom made swaged ring or lobster back covers on bends and die shaped fitting covers over fitting, valves, strainers, flanges, and grooved couplings.
- .3 bands:
  - (a) 12 mm (½ in) wide stainless steel with mechanical fasteners.

*Standard of Acceptance*

- Alcan Canada Products - Thermo clad Type 1
- Childers Products Inc. - Fab Straps

.4 Protective finish for elastomeric cellular foam insulation

- .1 indoors and outdoors:

*Standard of Acceptance*

- Armaflex WB Finish

## 2.5 Pipe Insulation

.1 Type P-1 molded glass fibre:

- .1 to ASTM C547,
- .2 pipe size application: up to and including NPS 24:

- .3 service temperature: -18°C (0°F) to jacket surface temperature (air contact) of 66°C (150°F) and un-jacketed surface temperature (equipment contact) up to 232°C (450°F).
- .4 factory molded rigid pipe insulation,
- .5 ASJ jacket of kraft bonded to aluminum foil reinforced with glass fibre yarn, maximum 0.02 perms to ASTM E96 Procedure A.
- .6 self sealing longitudinal jacket with integral vapour barrier, and matching butt joint sealer strips.
- .7 noncombustible,
- .8 thermal performance: 0.033 W/m/C @ 24°C (0.23 btu/hr/in/sq ft/F @ 75°F)
- .9 vapor transmission : maximum 0.02 perms
- .10 reduced environmental impact feature of either: bio-based binders, 25% minimum recycled glass content, and/or paper-free ASJ jacket material.

*Standard of Acceptance*

- John Manville Micro-Lok HP (25% recycled content)
- Owens Corning Fiberglas Evolution (paper-free ASJ)
- Knauf Fiberglass Redi-Klad 1000 Ecosse (bio-based binders)

.2 Type P-2 glass fibre semi-rigid board:

- .1 to ASTM C795,
- .2 pipe size application: NPS 16 and larger:
- .3 service temperature: up to 454°C (850°F)
- .4 scored and folded board,
- .5 ASJ jacket of kraft bonded to aluminum foil reinforced with glass fibre yarn, maximum 0.02 perms to ASTM E96 Procedure A.
- .6 noncombustible,
- .7 thermal performance: 0.050 W/m/C @ 93°C (0.35 btu/hr/in/sq ft/F @ 200°F)
- .8 vapor transmission : maximum 0.02 perms

*Standard of Acceptance*

- John Manville Spin-Glas 813
- Owens Corning Pipe and Tank
- Knauf Fibreglass Pipe and Tank

.3 Type P-3 flexible elastomeric closed cell foam:

- .1 to ASTM C534,
- .2 pipe size application: up to and including NPS 1-1/2
- .3 service temperature: -183°C (-297°F) to 82°C (183°F)
- .4 tubular with self sealing seams,
- .5 thermal performance: 0.04 W/m/C @ 24°C (0.28 btu/hr/in/sq ft/F @ 75°F),
- .6 manufacturer specific sealer/adhesive.

*Standard of Acceptance*

- ARMACELL - AP Armaflex SS Pipe Insulation
- Rubatex

.4 Type P-4 molded phenolic rigid:

- .1 to ASTM C1126 (Gr.1),
- .2 pipe size application: up to and including NPS 16
- .3 service temperature: -73°C to +121°C (-100°F to 250°F).
- .4 molded pipe, fitting, and hanger supports,
- .5 meeting 25/50 flame spread/smoke developed when tested to ASTM E84,
- .6 thermal performance: 0.019 W/m/C° @ 24°C (0.13 btu/hr/in/sq ft/F° @ 75°F),

*Standard of Acceptance*

- ° Kingspan - Kooltherm K/Kooltherm

.5 Type P-5 cellular glass:

- .1 to ASTM C552,
- .2 pipe size application: up to and including NPS 16
- .3 service temperature: -268°C (-450°F) to 480°C (900°F)
- .4 density 120 kg/m<sup>3</sup> (7.5 lb/cu ft),
- .5 molded or block type,
- .6 thermal performance: 0.043 W/m/C @ 0°C (0.32 btu/hr/in/sq ft/F @ 75°F).

*Standard of Acceptance*

- ° Pittsburgh Corning Foamglas

.6 Type P-6 calcium silicate:

- .1 to ASTM C533,
- .2 pipe size application: up to and including NPS 16
- .3 service temperature: to 649°C (1200°F).
- .4 density 232 kg/m<sup>3</sup> (14.5 lb/cu ft),
- .5 molded or block type,
- .6 asbestos-free,
- .7 thermal performance: 0.058 W/m/C @ 149°C (0.40 btu/hr/in/sq ft/F @ 300°F),

*Standard of Acceptance*

- ° Industrial Insulation Group - Thermo-12/Blue

.7 Type P-7 molded mineral wool fibre:

- .1 to ASTM C547,
- .2 pipe size application: up to and including NPS 30,
- .3 service temperature: up to 650°C (1200°F),
- .4 rigid molded type,
- .5 thermal performance: 0.04 W/m/C @ 50°C (0.25 btu/hr/in/sq ft/F @ 100°F),

*Standard of Acceptance*

- ° Roxul            Tecton 1200
- ° Fibrex         Coreplus 1200 Pipe Insulation

.8 Type P-8 molded mineral wool fibre high temperature:

- .1 to ASTM C547,
- .2 pipe size application: up to and including NPS 30
- .3 service temperature: up to 730°C (1350°F),
- .4 rigid moulded type,
- .5 thermal performance: 0.04 W/m/C @ 50°C (0.25 btu/hr/in/sq ft/F @ 100°F),

*Standard of Acceptance*

- ° Roxul SturdiRock
- ° Fibrex Dura K Pipe Insulation

- .9 Type P-9 removable/reuseable high temperature insulated jackets:
  - .1 custom fabricated, removable insulation covers for hot surfaces,
  - .2 suitable for outdoor use,
  - .3 maximum touch-safe temperature protection : 95°C (203°F) to UL2200.
  - .4 insulation: high density, fire resistant mineral or fibreglass insulation suitable for system operating temperature.
  - .5 cover: silicone impregnated fibreglass cover, for temperatures up to 260°C (500°F).
  - .6 internal liner: silicone impregnated fibreglass fabric, or stainless steel knitted wire mesh.
  - .7 single piece construction
  - .8 metal identification tag, referenced equipment served.
  - .9 tie-straps with D-rings, or Velcro™ closures.

*Standard of Acceptance*

- ° Firwin Corporation
- ° Thermohelp Canada Inc.

- .10 Type P-10 fire-rated pipe insulation:
  - .1 WH, ULC, or UL classified inorganic material, non-combustible, listed for protection of metallic piping,
  - .2 meeting ASTM C518,
  - .3 flexible blanket, 2 hour fire rating,
  - .4 foil encapsulated,
  - .5 suitable for service between: -173°C to 1260°C (-280°F to 2300°F).

*Standard of Acceptance*

- ° Eastern Wire & Conduit (Royal Quickstop Quickwrap)

- .11 Type P-11 molded phenolic rigid pipe support inserts:
  - .1 molded pipe hanger supports on cold and dual temperature piping,
  - .2 to ASTM C1126 (Gr.1),
  - .3 pipe size application: up to NPS 24
  - .4 service temperature: -73°C to +121°C (-100°F to 250°F).
  - .5 meeting 25/50 flame spread/smoke developed when tested to ASTM E84,
  - .6 density: 120 kg/m<sup>3</sup> (7.5 lb/ft<sup>3</sup>)

*Standard of Acceptance*

- Kingspan - Kooltherm K/Kooltherm High Density
- 

### **3 EXECUTION**

#### **3.1 General Requirements**

- .1 Apply insulation after pressure and leakage testing is completed and accepted.
- .2 Surfaces to be clean and dry before application of insulation.
- .3 Store and use adhesives, mastics, and insulation cements at ambient temperatures and conditions recommended by product manufacturers.
- .4 Do not apply insulation on chrome plated surfaces of piping, valves, fittings, and equipment.
- .5 Cut and bevel insulation around nameplates and pressure vessel stamps.
- .6 Neatly finish insulation at supports, protrusions, and interruptions.
- .7 Seal exposed insulation with reinforced vapor barrier or breather coating or mastic.
- .8 Finish piping with field installed finish jackets as specified herein.

#### **3.2 Hot Piping Systems Insulation**

- .1 Insulate hot piping systems including pipe, valves, fittings, and pipeline accessories in accordance with Table 1 at the end of this Section.
- .2 Insulate Condensate piping to the same criteria as its associated steam system.
- .3 Insulate Safety Relief valve piping located between floor or elevated work surface and up to 2400 mm (8 ft) above same, and passing within 1200 mm (4 ft) of a floor or elevated work surface.

#### **3.3 Cold and Dual Temperature Piping Systems Insulation**

- .1 Insulate cold and dual temperature piping systems including pipe, valves, fittings, and pipeline accessories in accordance with Table 2 at the end of this Section.
- .2 Insulate condensate drain piping to the same criteria as its associated cooling system.
- .3 For drainage systems insulate:
  - .1 storm water roof drain body,
  - .2 storm water piping from roof drain body to the floor level of the story below the drain body,
  - .1 sanitary piping in the following locations,
    - (a) horizontal sanitary drainage piping NPS 3 and larger in ceiling spaces,
    - (b) exposed sanitary drainage piping in wet areas including sterile processing, dishwashing, cart-washing
    - (c) exposed sanitary drainage piping in IT/Data rooms,

- .4 For greater clarity, domestic hot water, domestic hot water recirculating, non-potable hot water, and non-potable hot water recirculating piping systems are treated as "cold and dual temperature" for the purpose of application of vapor barriers to both hot and cold domestic and non-potable water piping.

### **3.4 Piping**

- .1 Insulate straight pipe sections by staggering adjacent longitudinal seams 1/4 turn each butt joint.
- .2 Secure insulation at centre of each section, at each end, and at not more than 600 mm (2 ft) intervals with:
  - .1 vapor barrier tape in addition to jackets with self-adhering lap joints for type P1 and P2 insulation on Cold and Dual Temperature piping,
  - .2 mechanical fastened (stapled) or jackets with self adhering lap joints on type P1 and P2 insulation on Hot piping,
  - .3 bands or wire for type P4 to P8 insulation,
  - .4 self-adhered or provide 100% coverage of contact adhesive for type P3 insulation,
  - .5 in accordance with listing requirements for type P10 insulation.

### **3.5 Fittings, Flanges, Couplings, and Strainers**

- .1 Insulate fittings including elbows and tees:
  - .1 NPS 1½ and smaller:
    - (a) mitre cut insulation to create tight fit,
    - (b) for PVC cover, trim backside of insulation on elbows to suit cover but do not reduce total thickness less than that of adjacent pipe insulation.
  - .2 NPS 2 and larger:
    - (a) use matching preformed insulation inserts, or fabricate mitred insulation segments made from same material as pipe insulation,
    - (b) number of mitred segments to be sufficient to maintain thickness of insulation around throat of elbow,
    - (c) secure inserts and fabricated segments with wire prior to application of coatings or finishes.
- .2 Insulate flanges and grooved joint couplings:
  - .1 Insulate with preformed inserts or build-up insulation with same material as on adjacent pipe:
    - (a) butt pipe insulation to each side of flange, coupling, valve, or strainer,
    - (b) build up rigid insulation blocking on each side of fitting, coupling, valve or strainer, with a width dimension same as pipe insulation thickness, and
    - (c) apply insulation layer over outside of flange, coupling, valve or strainer to a thickness equal to pipe insulation thickness.
    - (d) provide removable insulation section on strainer head.
  - .2 Where phenolic insulation is used;
    - (a) same as above except use factory made insulation inserts, or fabricate inserts to suit fixture.
  - .3 Where elastomeric insulation is used;
    - (a) same as above except adhere insulation to flange, coupling, or strainer with full coverage of °C adhesive,
    - (b) do not adhere insulation across bolted connections - insulate on each side of connection and add additional insulation layer across connection and fix in place with bands.

### **3.6 Pipeline Accessories**

- .1 Insulate pipeline accessories:
  - .1 valves
  - .2 strainers
  - .3 pressure reducing valves
  - .4 safety valves
  - .5 meters
  - .6 steam separators
- .2 Insulate accessories for Hot Piping systems with design temperatures greater than 93°C (200°F):
  - .1 with type P-9 removable fitted insulation covers,
  - .2 allow free movement of valve actuator.
- .3 No insulation is required on pipeline accessories for Hot Piping systems with design temperatures of 93°C (200°F) or less.
- .4 Insulate accessories for Cold and Dual Temperature Piping systems for chilled water and liquid refrigerant piping:
  - .1 at locations requiring access, extend insulation to create collar around bolted connection, and install a compression fit piece of insulation to cover equipment.
- .5 Insulate accessories for all other Cold and Dual Temperature Piping systems:
  - .1 insulate with flexible blanket of same material and thickness of adjacent piping and seal with reinforced vapor barrier sealer.
  - .2 at locations requiring access including valve handles, valve actuators, drain valves, etc. cut-back insulation and seal exposed edges.

### **3.7 Drainage Systems - Additional Requirements**

- .1 Insulate underside of roof drain hoppers with flexible blanket insulation of same type as pipe insulation.

### **3.8 Cold and Dual Temperature Pipe Insulation Systems - Additional Requirements**

- .1 Insulate pipe anchor plates and frames with flexible elastomeric closed cell foam insulation blanket of type P-3 insulation and seal with vapour barrier coating.
- .2 Extend insulation along anchor steel a minimum distance of 150 mm (6 in) outside the piping insulation thickness.

### **3.9 Hangers and Supports**

- .1 Provide insulation protection in accordance with Table 3 at the end of this Section, based on pipe size and service process temperature.
- .2 Pipe saddle insulation protection:
  - .1 insulate the interior void spaces of pipe saddles, of same material as adjacent pipe insulation,



- .2 butt insulation up to sides and end of pipe saddle, and leave bottom surface of saddle exposed for direct contact with pipe support.
- .3 Pipe shield insulation protection:
  - .1 install insulation shield between outside of insulation and pipe support; pipe support is sized for outside dimension of insulation.
  - .2 in accordance with pipe size, provide high density insulation insert of same thickness as adjacent pipeline material, fabricated from:
    - (a) cold and dual temperature piping: type P-11 (phenolic),
    - (b) hot piping: type P-11 (phenolic),
    - (c) 300 mm (12 in) long for pipe size up to NPS 3, and
    - (d) 450 mm (18 in) long for pipe sizes NPS 4 and larger.

### **3.10 Floor and Wall Sleeves**

- .1 Extend pipe insulation including coatings and finishes through floor and wall sleeves.
- .2 For penetrations through fire rated separations, provide finishes in accordance with fire stopping manufacturer's listing requirements.
- .3 For outdoor piping passing through exterior walls or roof, terminate mastic lagging at outside face of sleeve and protected by storm flashing, caulked to lagging and to building structure.

### **3.11 Sealing Insulation**

- .1 Apply coatings and mastic in accordance with manufacturer requirements.
  - .1 Hot piping: breather coating/mastic
  - .2 Cold and Dual Temperature piping: vapor barrier coating/mastic
- .2 Only use mastics on outdoor installations.
- .3 Apply mastics and coatings when ambient temperature is above 4°C (40°F), unless manufacturer's instructions permit colder ambient installation conditions.
- .4 Hot Piping;
  - .1 seal lap joints with self-adhesive lap joint, reinforced breather coat, or vapour barrier tape,
  - .2 seal butt joints with matching vapour barrier tape.
- .5 Cold and Dual Temperature Piping;
  - .1 tightly seal insulation with factory applied all-purpose jacket using self-adhering or field applied adhesive on longitudinal laps and butt joint.
    - (a) where sealing strips are damaged, apply secondary layer of colour matched vapor barrier tape.
  - .2 seal insulation without factory applied jackets with 100% coverage of vapor barrier coating/mastic as applicable complete with reinforcing membrane.
  - .3 seal insulation butt ends with vapor barrier coating every four (4) lengths of insulation but not to exceed 2400 mm (8 ft) of pipe length.
- .6 Hanger high-density insulation inserts:

- .1 seal inserts with reinforced breather or vapour barrier coating as applicable, overlapping adjacent insulation a minimum of 50 mm (2 in).
- .7 Elbows, tees, flanges, and fittings;
  - .1 Apply applicable breather or vapor barrier coating/mastic with reinforcing membrane over fitting insulation and overlap 50 mm (2 in) onto adjacent pipe insulation.
    - (a) for greater clarity, use of vapor barrier tape to seal insulation is not permitted.
  - .2 Apply coating/mastic and reinforcing membrane regardless of final finish application.
- .8 Maintain integrity of vapor barrier through sleeves, around fittings and at hangers and supports.

### **3.12 Insulation Finish Coverings**

- .1 Install protective finish coverings on insulation in accordance with Table 4 at the end of this Section, after breather and vapor barrier sealing is completed.
- .2 Cut finish jacket materials used for covering to allow 50 mm to 100 mm (2 in to 4 in) longitudinal overlap and similar circumferential overlap onto adjacent sheets.
  - .1 On vertical pipes arrange circumferential overlap on adjacent sheets outside of sheet below and under sheet above.
- .3 PVC sheeting :
  - .1 Hot piping:
    - (a) overlap longitudinal edges and adjacent sheets by minimum of 50 mm (2 in) and staple fasten the sheets.
    - (b) secure sheeting with colour matched tape around circumference, at least two places per section of sheet, and by stapling longitudinal and circumferential edges.
    - (c) do not seal edges with vapour barrier tape.
    - (d) seal PVC fitting covers at throat and heel seams by stapling and secure over insulation by banding or taping ends to adjacent pipe finish covering with colour matched tape.
  - .2 Cold and Dual Temperature piping:
    - (a) overlap longitudinal edges and adjacent sheets by minimum of 50 mm (2 in) and seal longitudinal edges with vapor barrier coating adhesive for full depth and 100% coverage of overlap,
    - (b) seal circumferential edges of PVC fitting covers with reinforced vapour barrier coating adhesive extending over adjacent pipe insulation section with an overlap of at least 50 mm (2 in).
    - (c) seal PVC fitting covers at throat and heel seams by solvent bonding and secured over insulation with reinforced vapor barrier coating/mastic overlapping adjacent pipe insulation a minimum of 50 mm (2 in).
- .4 Metal:
  - .1 Use lock-on systems or secure sheeting with bands 450 mm (18 in) apart.
  - .2 Joint sealing:
    - (a) Hot pipe: do not seal joints.
    - (b) Cold and dual temperature pipe: seal joints with caulking.
  - .3 Curved surfaces: custom made swaged ring or lobster back covers.
  - .4 On outdoor hot and cold/dual temperature piping, caulk overlapping metal joints to permit expansion of metal jacket.

.5 Fabric:

.1 Cotton lagging:

- (a) apply cotton lagging with minimum two coatings of breather or vapor barrier coating adhesive as applicable to the piping system, and finish to provide a smooth surface free of wrinkles and sags.
- (b) where cotton lagging with appropriate coating is used this satisfies the requirements of a sealer coating for Hot or Cold/Dual temperature piping systems.

.2 Fiberglass lagging:

- (a) apply re-wettable fiberglass lagging in accordance with manufacturer instructions. Finish to provide a smooth surface free of wrinkles and sags.
- (b) where re-wettable fiberglass lagging is used this satisfies the requirements of a sealer coating for Hot piping systems.

**3.13 Painted Piping**

.1 Finish piping with canvas or fiberglass lagging for the following piping systems:

- .1 exposed piping in public areas including

.2 Prime and top-coat painting is provided under separate Division of the Work.

**3.14 Mechanical Damage Protection - Indoors**

- .1 Protect exposed pipe insulation extending up through a floor sleeve at floor line with 1.2 mm (18 ga) stainless steel jacket approximately 100 mm (4 in) high, secured to floor slab. Conceal fastenings by floor plate.
- .2 For piping systems using metal finishes, this protection cover replaces a portion of the specified pipe cover.
- .3 For piping systems using other finishes, this protection cover is in addition to the specified pipe cover.

**3.15 Fire rated pipe Insulation**

- .1 Provide two (2) hour rating of type P-10 insulation on tube or pipe, where shown.
- .2 Install insulation, including pipe hangers, in accordance with fire-rated insulation manufacturer's listing requirements.

**3.16 Field Quality Control**

- .1 The Consultant reserves the right to have protective finish coverings removed on up to 5% of all fittings, flanges, couplings, valves, and pipeline accessories to review the sealing of the insulation, at no change in cost.
- .2 If insulation sealing is found to be incorrect at any one location, remove the protective finish on all fittings, flanges, couplings, valves, and pipeline accessories for review.
- .3 Repair defective sealing and replace protective coverings at no change in cost.

**3.17 Insulating and Finishes Tables**

- .1 Table 1, 2 and 3 follows.

<b>Table 1 : Hot Piping Systems, Insulation Type and Thickness mm (in)</b>							
System	Fluid Nominal Temp. °C (F)	Insulation Type	Nominal Pipe Size (NPS)				
			< 1	1 to 1¼	1½ to 3	4 to <8	≥ 8
			Insulation Thickness, mm (in)				
		P-4	20 (¾ )	20 (¾ )	25 (1 )	38 (1½ )	38 (1½ )
Hot Water Heating	61 to 93 (141 to 200)	P-1	38 (1½ )	38 (1½ )	38 (1½ )	38 (1½ )	38 (1½ )
Glycol Heating		P-7					
Pumped Condensate		P-4	20 (¾ )	25 (1 )	25 (1 )	25 (1 )	25 (1 )
Pure Water (during heat sanitization)	50 to 93 (122 to 200)	P-1 P-7	25 (1 )	25 (1 )	25 (1 )	25 (1 )	25 (1 )
Low Temperature Hot Water Heating	40 to 60 (105 to 140)	P-1	25 (1 )	25 (1 )	25 (1 )	38 (1½ )	38 (1½ )
Low Temperature Glycol Heating		P-4	20 (¾ )	20 (¾ )	20 (¾ )	25 (1 )	25 (1 )
Condenser Water (outdoors)	26 to 39 (80 to 104)	P-1 P-5	25 (1 )	25 (1 )	25 (1 )	38 (1½ )	38 (1½ )

<b>Table 2 : Cold and Dual Temperature Piping Systems, Insulation Type and Thickness mm (in)</b>							
System	Fluid Nominal Temp. °C (F)	Insulation Type	Nominal Pipe Size (NPS)				
			< 1	1 to 1¼	1½ to 3	4 to <8	≥ 8
			Insulation Thickness, mm (in)				
Dual Temperature Heating/Cooling	4.4 to 93 (40 to 200)	P-1	38 (1½ )	38 (1½ )	38 (1½ )	38 (1½ )	38 (1½ )

<b>Table 2 : Cold and Dual Temperature Piping Systems, Insulation Type and Thickness mm (in)</b>							
System	Fluid Nominal Temp. °C (°F)	Insulation Type	Nominal Pipe Size (NPS)				
			< 1	1 to 1¼	1½ to 3	4 to <8	≥ 8
			Insulation Thickness, mm (in)				
Domestic Hot Water Domestic Hot Water Recirculation Not-Potable Hot Water Non-Portable Hot Water Recirculation	40.5 to 60 (105 to 140)	P-1	25 (1)	25 (1)	38 (1 ½)	38 (1 ½)	38 (1 ½)
Domestic Cold Water Non-potable Water Drainage	4.4 to 16 (40 to 60)	P-1	25 (1)	25 (1)	38 (1 ½)	38 (1 ½)	50 (2)
		P-4	---	---	---	25 (1)	25 (1)
Equipment Drains	4.4 to 16 (40 to 60)	P-3	13 (1/2)	20 (3/4)	25 (1)	---	---
Chilled Water Dual Temperature Heating/Cooling	4.4 to 16 (40 to 60)	P-1	25 (1)	25 (1)	38 (1 ½)	38 (1 ½)	50 (2)
		P-4	25 (1)	25 (1)	25 (1)	25 (1)	25 (1)
Refrigerant Suction	< 4.4 (< 40)	P-3	25 (1)	25 (1)	25 (1)	---	---
		P-4	25 (1)	25 (1)	25 (1)	25 (1)	25 (1)

<b>Table 3 : Insulation Hanger Protection</b>				
Process Temperature °C (F)	Pipe Size NPS	Pipe Saddle	Insulation Shield	High-Density Insert
> 93 (200)	$\geq 1-1/2$	•	---	---
	$\leq 1-1/4$		•	---
61 to 93 (141 to 200)	> 6	•	---	---
	$\geq 1-1/2$ and $\leq 6$	---	•	•
	$\leq 1-1/4$	---	•	---
26 to 60 (80 to 140)	$\geq 1-1/2$	---	•	•
	$\leq 1-1/4$	---	•	---
Cold & Dual Temp	$\geq 1-1/2$	---	•	•
	$\leq 1-1/4$	---	•	---

<b>Table 4 : Piping Insulation Protective Finishes</b>			
Location	Weather Exposure	Piping System	Finish
Concealed	Indoors	All	None
Exposed	Indoors	All	PVC
	Indoors - painted pipe	All	Fabric
	Outdoors	All	Metal

**END OF SECTION**

## **START-UP AND PERFORMANCE TESTING REPORTING**

### **20 08 01**

#### **1 GENERAL**

##### **1.1 Scope**

- .1 Performance testing and balancing of heating, ventilating, air conditioning and liquid systems.
- .2 Survey of installed automatic controls and verification of functional performance.
- .3 Rechecking of testing and balancing during the alternate (heating/cooling) season.

##### **1.2 Related work in other sections**

- .1 Air and water balancing: to section 20 08 05

##### **1.3 Coordination**

- .1 Coordinate the work of testing companies:
  - .1 Schedule sufficient time so that testing and balancing can be completed before occupancy begins and coordinate with trades involved.
  - .2 Keep Testing and Balancing firm informed of any major changes made during construction and furnish same with a set of project drawings and reviewed Shop Drawings.
  - .3 Furnish balancing devices, test connections access openings, balancing probe inlets and plugs.
  - .4 Clean and pre-run all equipment, filters, etc. and place all heating, ventilating and air conditioning systems into full operation and continue same during each working day of testing and balancing.
  - .5 Provide immediate labour from pertinent mechanical trades and tools, equipment and materials to make equipment and system alterations and adjustments, as required including control adjustments.
  - .6 Building Management System technical representative to operate the BMS during air and water balancing testing.
  - .7 Refrigeration machine manufacturer service representative conducts performance testing of the refrigeration equipment. Testing and Balancing Firm witnesses and records all test results.
  - .8 Fuel fired heating equipment manufacturer service representative, or other qualified service company technical representative, conducts performance testing of heating equipment. Testing and Balancing Firm witnesses and records all test results.
- .2 Be responsible for systems constructed, installed and adjusted to provide optimum performance as required by design intent. Perform any re-adjusting required as the result of spot checks by the Consultant at no increase in Contract Price.

##### **1.4 Submittals**

- .1 Submit layout drawings and Report Format a minimum 14 days prior to start of air and water balancing on-site.
- .2 Report Format:
  - .1 submit proposed format of initial report,

- .2 include a complete list of instruments and tests for which they are to be used as they relate to this project, including date of last calibration

## **2 PRODUCTS**

### **2.1 Not applicable.**

## **3 REPORT FORMAT**

### **3.1 General**

- .1 Include the following information for each test report:
  - .1 Owner Name
  - .2 Project Name
  - .3 Contractor Name
  - .4 Consultant Name
  - .5 Name of Test Report
  - .6 Name and signature of the person submitting the report
  - .7 Date of report
- .2 Submit two (2) copies of test reports in hardcopy form in 3-“D” ring binders, indexed for each type of report, separately bound from the Operations and Maintenance manuals. Provide two (3) copies of the same reports in Adobe Acrobat version 7 PDF format.

## **4 START-UP AND PERFORMANCE REPORTS**

### **4.1 Required reports**

- .1 Provide the following Start-Up and Performance Testing reports:
  - .1 Equipment start-up report
  - .2 Authorities report
  - .3 Air and water balancing report
  - .4 Acoustic survey report
  - .5 Vibration survey report
  - .6 Controls / BMS operation report
  - .7 Alternate Season test report

### **4.2 Equipment start-up report**

- .1 Provide a test report in spreadsheet format which summarizes the following data for each piece of equipment which is powered or has automatic controls:
  - .1 equipment ID and name,
  - .2 motor insulation megger test - result and initialed by contractor,
  - .3 motor rotation (bump test) - result and initialed by contractor,
  - .4 equipment Start-Up report status - status and initialed by contractor,
  - .5 Manufacturer Start-Up report status – status and initialed by contractor,



- .6 test completion date.
- .2 Provide a test report in spreadsheet format which summarizes the following data for testing of piping systems:
  - .1 system name
  - .2 system limits (if system is not tested in its entirety),
  - .3 type of test (pneumatic, hydrostatic),
  - .4 pressure at start of test,
  - .5 pressure at end of test,
  - .6 duration of test,
  - .7 contractor dated and initialed,
  - .8 expansion tank initial pressure,
  - .9 expansion tank final pressure,
  - .10 backflow preventers have been tested - status and initialed by contractor,
  - .11 pressure relief valves installed – record setpoint and initialed by contractor.
- .3 Equipment/System Start-Up Test Report
  - .1 Provide a separate start-up report for each piece of the following equipment. The SMACNA “Systems Ready to Balance Check List”, where applicable, may be used for this report.
    - (a) HVAC Units
    - (b) Duct Systems
    - (c) Pumps
    - (d) Boilers, and boiler auxiliaries
    - (e) Refrigeration Equipment
    - (f) Hydronic piping systems
    - (g) Sprinkler systems (to NFPA 13)
    - (h) Standpipe systems (to NFPA 14)
- .4 Manufacturer’s Start-Up Test
  - .1 Provide a separate start-up report for each piece of the following equipment, utilizing the manufacturer’s start-up check list. This report may be prepared by the manufacturer’s service representative:
    - (a) chemical water treatment - pipe cleaning,
    - (b) chemical water treatment - passivating and inhibition,
    - (c) refrigeration equipment,
    - (d) packaged AC equipment,
    - (e) heating boilers,
    - (f) domestic hot water heaters,
    - (g) adjustable frequency drives,
    - (h) Building Automation Systems.

#### **4.3 Authorities review**

- .1 Submit copies of authorities-having-jurisdiction inspection and test reports, including:
  - .1 Plumbing and drainage municipal inspector reports
  - .2 TSSA pressure vessel and piping inspection reports
  - .3 ESA field certification reports

#### **4.4 Air and water balancing**

- .1 Provide air and water balancing report : to Section 20 08 05.

#### **4.5 Controls / Building Management System**

- .1 Provide controls test reports: to Section 25 08 00.

### **5 SPECIFIC EQUIPMENT PERFORMANCE TESTS**

#### **5.1 Performance data**

- .1 In addition to tests specified elsewhere, perform the following equipment performance tests. If contractor's standard forms provide for additional data, also submit such additional data.
  - .1 Some equipment tests may need to be performed during the alternate season testing.
  - .2 Include nameplate data and as-tested results.

### **6 REPORT SUBMISSIONS**

#### **6.1 Deficiencies**

- .1 Immediately report to Consultant, any deficiencies in the systems or equipment performance resulting in design requirements being unobtainable.

#### **6.2 Draft report**

- .1 On completion of the start-up, testing, adjusting and balancing of all systems, submit to the Consultant, two (2) typewritten copies of a full report on all tests, adjustments, and balancing performed.
- .2 Attachments including systems schematics with numbered terminals for referring to data above.

#### **6.3 Spot checks**

- .1 After review of the Draft Report by the Consultant and at the Consultants direction, retest up to 30% of all measurements in locations as directed by the Consultant, at no cost extra to the contract.
- .2 If results indicate unusual testing inaccuracy, omissions, or incomplete balancing/adjustment, in the opinion of the Consultant, re-balance entire affected system(s) at no increase in Contract Price.

#### **6.4 Interim report**

- .1 After completion of any retesting described above, submit three (3) typewritten copies of the interim report, in a 3-hole "D" style binder, and two (2) CD or DVD electronic copies in Adobe Acrobat ver.7 PDF format.
- .2 This report is required to obtain Substantial Performance of the Contract.

#### **6.5 Final report**

- .1 Submit to Consultant following completion of alternate season testing and balancing. Submit three (3) typewritten copies, and two (2) CD or DVD Adobe PDF in the same formats as the initial report specified above.

## **6.6 Acceptance**

- .1 The Substantial Performance of the Mechanical Work will be considered reached when the interim Start-Up and Performance Testing report is reviewed by the Consultant and in the opinion of the Consultant all systems have been satisfactorily installed, operated tested, balanced, and adjusted to meet the specified and intended performance.
- .2 The substantial performance is not dependent upon alternate season testing.
- .3 The total performance of the Mechanical Subcontract (Contract) will not be considered reached until the alternate season testing and balancing is completed and the final report submitted and reviewed by the Consultant.

**END OF SECTION**

## **TESTING ADJUSTING AND BALANCING**

### **20 08 05**

#### **1 GENERAL**

##### **1.1 Scope**

- .1 Test, adjust, and balance (TAB) air handling systems and hydronic systems installed, modified or extended as part of this work.

##### **1.2 Qualifications and performance standards**

- .1 Balancing to be performed under supervision of recognized expert with an established reputation in this field.
  - .1 TAB contractor to be a member of AABC or NEBB.
- .2 Perform testing and balancing in accordance with:
  - .1 SMACNA Testing, Adjusting and Balancing guidelines,
  - .2 Associated Air Balancing Council standards for Total System Balance.

##### **1.3 Preparatory work**

- .1 Review design drawings and specifications, shop drawings, interference drawings and other related documentation to become familiar with their intended performance.
- .2 Carry out site visits during later stages of construction to ensure that arrangements for TAB are incorporated.
- .3 Confirm proper placement of thermometer wells, test ports, pressure gauge cocks, balancing valves, balancing dampers and splitter dampers, and access doors.
- .4 Submit TAB schedule, with descriptive data outlining procedures and sample forms showing method of data presentation, three months before start of TAB work on site.
- .5 Provide details of specific procedures to be used for determining test parameters from test measurements and criteria proposed to establish compliance with specification requirements.
- .6 List instruments to be used, method of instrument application (by sketch) and correction factors.
- .7 Calibrate instruments in accordance with recognized standards, and submit calibration curves not more than three months before commencement of TAB.
- .8 TAB measurements to commence when building is "closed in" and work is sufficiently advanced to include;
  - .1 Installation of ceilings, doors and windows.
  - .2 Application of sealing, caulking, and weather stripping.
  - .3 Normal operation of mechanical systems.

##### **1.4 Systems, equipment and related controls requiring TAB**

- .1 Air handling systems.

- .2 Hydronic systems including
  - .1 Heating and cooling equipment and piping systems.
  - .2 Domestic water equipment and cold, hot and recirculation hot water piping systems.

## **2 AIR MOVING SYSTEMS**

### **2.1 Parameters**

- .1 Listed below is an outline of the information to be established in the TAB process:
  - .1 Air flow related;
    - (a) Air velocity
    - (b) Flow cross sectional area.
    - (c) Static pressure.
    - (d) Velocity pressure.
  - .2 Temperature related;
    - (a) Wet bulb.
    - (b) Dry bulb.
  - .3 Equipment related;
    - (a) rotational speed (rpm)
    - (b) Electrical power,
    - (c) Voltage.
    - (d) Current draw.
- .2 Measurement are required at and around equipment to establish air side performance of;
  - .1 Fans.
  - .2 Coils.
  - .3 Filters.
  - .4 Dampers.(fresh, return and relief)
  - .5 Humidifiers.
  - .6 Terminal units
- .3 Measurement are required to characterize system performance;
  - .1 at main ducts.
  - .2 at branch ducts.
  - .3 at sub-branch ducts.
  - .4 at each supply, exhaust and return air inlet and outlet.
  - .5 in each thermostatically controlled zone.

### **2.2 General criteria**

- .1 Balance systems so that fans operate at lowest possible speed and static pressure consistent with delivery of specified air quantity at most remote terminal point.
- .2 Set-up supply fans with sufficient speed to deliver required air quantity when filters are loaded to manufacturers recommended maximum pressure drop. Temporarily block filters to achieve maximum pressure drop at design air flow.

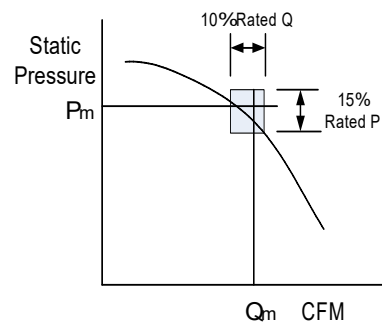
- .3 Air quantities at each exhaust system inlet and supply system outlet are to be measured and throw and pattern is to be adjusted at each supply outlet.
- .4 Balancing to be provided to all air outlets and inlets to airflow rates as indicated on plans.

### 2.3 Fan performance assessment

- .1 Measure air quantity by taking anemometer traverses across a coil or at a filter bank or by pitot tube traverse in a straight section of duct at fan suction or discharge.
- .2 Measure static pressure difference between fan inlet and discharge, motor amperage and fan speed in rpm. Determine motor input power from a curve showing power output as a function of motor amperage for the particular motor.
- .3 Plot results of measurements on fan characteristic curve supplied by fan manufacturer and the air volume, static pressure and fan speed lines should form a triangle enclosed by a rectangle with a dimension of not more than 15% of the rated static pressure by a dimension of not more than 10% of the specified air quantity. Input power taken from the fan characteristic should be within 10% of the power determined from the motor amperage readings.
- .4 If required precision is not obtained, readings to be repeated. If subsequent testing shows that the required precision is unobtainable then fan manufacturer is to submit written report explaining actual fan performance and provide new characteristic curve showing actual performance for fan "as installed".
- .5 Measure static pressure loss across cooling coils, heating coils and individual filter banks and tabulate readings with manufacturers published pressure loss figures for the actual measured air volume.

### 2.4 Variable volume system balancing procedure

- .1 Obtain from Consultant the expected diversity value. Open sufficient boxes to 100%, and close a random selection of boxes, equally distributed throughout the system, to obtain the design fan flow rates.
- .2 Set system to operate with 100% return air, set room thermostats at design indoor temperature, set fan discharge temperature at design point.
- .3 Set thermostat in most remote zone to full cooling and adjust fan inlet guide vane, or AFD speed, static pressure control to supply specified air quantity at most remote zone volume damper, pneumavalve or terminal box.
- .4 Reset most remote zone thermostat to design room temperature and set next most remote zone thermostat to full cooling and adjust branch splitter damper ahead of zone volume damper, pneumavalve or terminal box, to provide design air quantity at outlets.
- .5 If zone air quantity is less than design, increase fan inlet guide vane, or AFD speed, static pressure control setting to achieve design air quantity and rebalance previously checked zones.
- .6 Repeat as required for each zone.



## **2.5 Terminal box supply system balancing procedure**

- .1 Set system to operate with 100% return air, set room thermostats at indoor design temperature and set fan discharge temperature at design value.
- .2 Set thermostat in most remote zone to full cooling and adjust fan inlet guide vane static pressure controller to maintain manufacturer's specified minimum static pressure at box inlet.
- .3 Check air quantity delivered by box and adjust volume regulators to obtain design value.
- .4 Reset room thermostat to full heating and check performance of regulator.
- .5 Reset thermostat to design temperature and repeat procedure for remaining terminal boxes.
- .6 If inlet static pressure at a subsequent box is less than manufacturer's specified minimum, reset inlet guide vane static pressure controller to suit.
- .7 Open balancing dampers and adjust fan inlet static pressure controllers, or fan speed to obtain design air quantity at most remote outlet.
- .8 Balance remaining outlets by adjusting dampers.
- .9 If air quantity at some outlet other than the most remote outlet is less than design, re-adjust fan and rebalance previously adjusted outlets.
- .10 Measure fan performance and adjust fan speeds and inlet guide vane controllers so that return air quantity is equal to supply air quantity less fixed exhaust air quantities, with a 10 percent allowance for pressurization.

## **2.6 Fresh air adjustment procedure**

- .1 After adjustment of supply, return and related exhaust fans, adjust minimum fresh air damper position to obtain design fresh air quantity.
- .2 Damper position to be determined by measurement of outside return and mixed air temperatures and confirming calculations to be included in balance report.
- .3 Where duct space permits, include airflow measurement of supply, and recirculation or outdoor air, to verify results.

## **2.7 Branch air quantity measurement procedure**

- .1 Branch air quantities to be determined using pitot tube traverses in accordance with the procedures outlined in "Testing, Balancing and Adjusting of Environmental Systems" by William G. Eads, P.E., issued by SMACNA.
- .2 Measurements to be taken at each riser as it is connected to fan discharge or suction header and at each floor where branches are taken from the riser. Measurement to be repeated until sum of branch air quantities is within 10% of fan delivery.

### **3 HYDRONIC SYSTEMS**

#### **3.1 Parameters**

- .1 Listed below is an outline of the information to be established in the TAB process;
  - .1 Flow.
  - .2 Pressure.
  - .3 Temperature.
  - .4 Specific gravity.
  - .5 Rotational speed (rpm).
  - .6 Electrical
    - (a) power
    - (b) Voltage.
    - (c) Current draw.
- .2 Measurement are required at and around equipment to establish fluid side performance of;
  - .1 Domestic hot water heaters.

#### **3.2 General criteria**

- .1 Use calibrated venturi tubes, orifices or other metered fittings and pressure gauges in conjunction with permanent and portable type flow meters to determine flow rates for system balance.
- .2 Effect system balancing with automatic control valves open to heat transfer elements and bypasses closed.
- .3 Base flow balance on (in order of preference):
  - .1 double regulating valves, or globe valves associated with flow measuring elements (flow meters),
  - .2 temporary non-invasive flow meters,
  - .3 differential pressure measurement across heat transfer elements, and checked against manufacturer's literature, or
  - .4 temperature difference across various heat transfer elements in the system where flow metering devices are not installed. This method may only be used at design heat transfer conditions.
- .4 Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing.
- .5 Perform balancing by measurement of temperature differential in conjunction with air balancing.
- .6 Adjust water distribution systems by means of double regulating valves, globe valves, balancing cocks, valves and fittings. Do not use shut-off valves for balancing unless indexed.
  - .1 Butterfly valves on discharge side of pumps may be used if they are one trade size smaller than system pipe size. Include Cv values and flow vs valve position curve with balancing report.
- .7 Where available pump capacity is less than total flow requirements of individual system parts, full flow in any part may be simulated by temporary restriction of flow to other parts.



## **4 EQUIPMENT TESTING**

### **4.1 Performance data**

- .1 Submit the following data as a minimum. If contractor's standard forms provide for additional data, also submit such additional data.
  - .1 Some equipment tests may need to be performed during the alternate season testing.
  - .2 Include nameplate data and as-tested results.
- .2 Motors:
  - .1 manufacturer,
  - .2 model or Serial number,
  - .3 amperage and voltage,
  - .4 horsepower,
  - .5 RPM,
  - .6 corrected full load amperage,
  - .7 measured amperage and voltage,
  - .8 calculated BHP (kW).
- .3 Fans:
  - .1 manufacturer,
  - .2 model or Serial number,
  - .3 flow rate
  - .4 RPM,
  - .5 static pressures (suction and discharge),
  - .6 pulley size, type and manufacturer,
  - .7 belt size and quantity.
- .4 Pumps:
  - .1 manufacturer,
  - .2 model or Serial number,
  - .3 flow rate,
  - .4 developed pump head,
  - .5 RPM.

## **5 REPORT PRESENTATION AND VERIFICATION**

### **5.1 Required reports**

- .1 Provide the following reports:
  - .1 Air and water balancing report

### **5.2 Report format**

- .1 Reports to incorporate approved standard forms, with values expressed in SI and (Imperial) units.

- .2 Include "as-built" system schematics showing flow quantities and measurement points. Use as-built drawings and ventilating line diagrams for references.
- .3 Submit four hard copies of TAB reports, with index tabs, in "D" ring binders, for verification.
- .4 Submit two soft copies of TAB reports in Adobe Acrobat V7 PDF format.

### **5.3 Accuracy**

- .1 Adjust systems until operating values within plus or minus 5% of design values are achieved.
- .2 Measurements to be accurate to within plus or minus 2% of actual values.

### **5.4 Spot checks**

- .1 After review of the Draft Report by the Consultant and at the Consultants direction, retest up to 30% of all measurements in locations as directed by the Consultant, at no cost extra to the contract.
- .2 If results indicate unusual testing inaccuracy, omissions, or incomplete balancing/adjustment, in the opinion of the Consultant, re-balance entire affected system(s) at no increase in Contract Price.

### **5.5 Balance position marking**

- .1 Mark the balance position of dampers and valves at the completion of the final testing:
  - .1 Ductwork: indicate with arrow using paint or permanent marker,
  - .2 Exposed ductwork in public areas: self adhesive label, placed adjacent to balancing damper, neatly filled in with % open or degree open value.
  - .3 Valves: self-adhesive label, placed on piping (insulated or not) adjacent to valve, neatly filled in with either % valve open, or number of valve turns to open.
- .2 Additional requirements for Double Regulating Valves:
  - .1 Remove valve handle or other protective device, and set memory stop to limit valve open travel. Replace valve handle or protective cover.

### **5.6 Record keeping**

- .1 Keep records of trial and final balance and submit preliminary report as each system is completed.
- .2 Make spot checks as requested and repeat balancing of system if actual spot check quantities do not agree with preliminary report figures.

### **5.7 Verification**

- .1 Reported measurements will be verified.
- .2 Provide instrumentation and manpower to verify results of up to 30% of reported measurements.
- .3 Number and location of verification measurements to be at discretion of Engineer.
- .4 Where discrepancies are encountered repeat TAB, and resubmit reports.

### **5.8 Completion**

- .1 Continue TAB until reports are approved.

- .2 The Substantial Performance of the Mechanical Work will be considered reached when the initial Start-Up and Performance Testing report is accepted by the Consultant and in the opinion of the Consultant all systems have been satisfactorily installed, operated tested, balanced, and adjusted to meet the specified and intended performance.
- .3 The substantial performance is not dependent upon alternate season testing.
- .4 The total performance of the Mechanical Subcontract (Contract) will not be considered reached until the alternate season testing and balancing is completed and the final report submitted and accepted by the Consultant.

**END OF SECTION**

## **COMMISSIONING OF LIFE SAFETY AND FIRE PROTECTION SYSTEMS - MECHANICAL 20 08 11**

### **1 GENERAL**

#### **1.1 Scope**

- .1 Provide coordinated commissioning of life safety and fire protection systems provided under Division 20 with those provided under Division 26.
- .2 Provide coordinated commissioning for all life safety and fire protection systems provided under Division 20 in accordance with the latest CAN/ULC S1001 requirements and in accordance with section 01 91 11.
- .3 Coordinate and jointly prepare with the Division 26 contractor to conduct complete and thorough testing and documentation of the systems interface and integration between various LSFP systems provided under Division 26 and those provided under Division 20.
- .4 Include all labor and material as required to participate in the life safety and fire protection commissioning process, as outlined in this section, for equipment and systems provided under Division 20.

#### **1.2 Definitions**

- .1 Refer to section 01 91 11.

### **2 PRODUCTS**

#### **2.1 Not Applicable**

### **3 EXECUTION**

#### **3.1 Commissioning requirements**

- .1 Participate in the development and implementation of the coordinated commissioning program for life safety and fire protection systems in compliance with section 01 91 11.

**END OF SECTION**

## **PROJECT CLOSE-OUT MECHANICAL**

### **20 08 19**

#### **1 GENERAL**

##### **1.1 Scope**

- .1 Provide documentation deliverables at completion of the Work.
- .2 Submit all supporting close-out documents by email to [ca.toronto@loringengineers.com](mailto:ca.toronto@loringengineers.com) for review by Consultant.

##### **1.2 Occupancy Permit**

- .1 Submit the reviewed final Life Safety and Fire Protection Commissioning report two weeks prior to application for occupancy permit.

##### **1.3 Substantial Performance**

- .1 Complete the Substantial Performance Checklist and submit with required documentation when applying for Substantial Performance of the Work.
- .2 Where the work is sub-divided into separate scopes of Work, each requiring a separate Substantial Performance application, provide a separate checklist for each application.
- .3 Prepare and submit to the Consultant a comprehensive deficiency list of items to be completed or corrected, as part of the application for a review by the Consultant to establish Substantial Performance of the Work, or for each designated portion of the Work in the case of phased Substantial Performance.
  - .1 Failure to include an item on the list does not alter the Contractor's responsibility to complete the Work.
- .4 Within five working days of the Consultant's review report which indicates that Substantial Performance of the Work has been achieved, provide a detailed schedule for completion and/or correction of the Work of all items described in the Contractors' and the Consultants' deficiency list.

##### **1.4 Total Performance**

- .1 Submit the following documentation with the application for Total Performance. Application for Total Performance cannot be submitted any earlier than the date of Alternate Season testing.
  - .1 Where documentation has already been submitted to the Owner, provide a copy of the transmittal.

SUBSTANTIAL PERFORMANCE APPLICATION CHECKLIST	
Project Name:	
Contract:	
Contract Scope:	
Application Date:	
Signed:	

*The following requirements are completed and included in this application. Where documentation has been issued directly to the Owner, a copy of the transmittal is enclosed.*

- ☐ Contractor has compiled and submitted a detailed deficiency list, identifying work still to be completed, incomplete, or requires correction.
- ☐ Equipment start-up reports (Interim).
- ☐ Building department inspection reports.
- ☐ TSSA pressure piping inspection reports (if applicable)
- ☐ TSSA fuel system field inspection reports (if applicable)
- ☐ ESA field inspection reports.
- ☐ Sprinkler installation certification report to NFPA 13 (if applicable)
- ☐ Standpipe installation certification report to NFPA 14 (if applicable)
- ☐ Air and Water Balancing reports (Interim).
- ☐ Controls / BMS operation report.
- ☐ Equipment, pipeline, and valve identification completed
- ☐ Clean-up completed.
- ☐ Spare parts and replacement parts turned over to Owner; transmittal attached.
- ☐ Warranty certificates
- ☐ Operating and Maintenance Manuals, draft, submitted.
- ☐ As-built drawings submitted
- ☐ Training completed and attendance logs submitted.
- ☐ Commissioning reports submitted and reviewed by Consultant

Consultant Review	
Status:	<input type="checkbox"/> Reviewed <input type="checkbox"/> Incomplete or deficient - resubmit
Signed:	
Date:	

TOTAL PERFORMANCE APPLICATION CHECKLIST	
Project Name:	
Contract:	
Contract Scope:	
Application Date:	
Signed:	

*The following requirements are completed and included in this application. Where documentation has been issued directly to the Owner, a copy of the transmittal is enclosed.*

- ☐ All known deficiencies have been corrected, including latent deficiencies reported by the Owner.
- ☐ Air and water balancing - final versions including alternate season testing completed and submitted.
- ☐ Final commissioning reports submitted and accepted by Owner.
- ☐ Operating and Maintenance manuals - finalized and submitted (if final version was issued at time of Substantial Performance indicate here)
- ☐ As-built drawings final version submitted (if final version was issued at time of Substantial Performance indicate here)

Consultant Review	
Status:	<input type="checkbox"/> Reviewed <input type="checkbox"/> Incomplete or deficient - resubmit
Signed:	
Date:	

**End of Section**

## **FIRE PROTECTION - GENERAL**

### **21 05 01**

#### **1.1 GENERAL**

#### **1.2 Scope**

- .1 Fire protection work includes;
  - .1 Commissioning of fire protection systems,
  - .2 Fire Extinguishers

#### **1.3 Applicable Codes and Standards**

- .1 Fire Protection Work to conform to Standards of National Fire Prevention Association (NFPA) and relevant sections of The Ontario Building Code.

### **2 PRODUCTS**

#### **2.1 Not used.**

### **3 EXECUTION**

#### **3.1 Existing Conditions**

- .1 Contractor shall verify in the field the existing conditions before proceeding with work.
- .2 Contractor shall coordinate the work with all trades and existing conditions.

**END OF SECTION**



## **FIRE EXTINGUISHERS**

### **21 12 29**

## **1 GENERAL**

### **1.1 Scope**

- .1 Provide extinguishers as shown.

### **1.2 Applicable standards**

- .1 National Fire Protection Association (NFPA) 10 Standard for Portable Fire Extinguishers.

## **2 PRODUCTS**

### **2.1 Multipurpose dry chemical extinguishers**

- .1 Stored pressure rechargeable type with hose and shut-off nozzle, ULC labeled for A, B and C class protection, red enamel finish. Sizes 2.25 kg (5 lb), 4.5 kg (10 lb), 9 kg (20 lb), 12.7 kg (27 lb) as indicated.
- .2 Provide 4.5 kg (10 lb) size if not otherwise shown.

#### *Standard of Acceptance*

- ° National Fire Equipment Limited - ABC
- ° Flag Fire Equipment Limited - ABC

### **2.2 Extinguisher brackets**

- .1 Supplied by extinguisher manufacturer.

### **2.3 Identification of extinguishers**

- .1 Include bilingual tag or label attached to extinguishers, in accordance with recommendations of NFPA 10, indicating month and year of installation, with space for service dates.

## **3 EXECUTION**

- .1 Mount cabinets and brackets.
- .2 Install extinguishers at project completion. Confirm location with local building or fire department prior to installation.

**END OF SECTION**

## **PLUMBING GENERAL 22 05 01**

### **1 GENERAL**

#### **1.1 Scope**

- .1 Provide labour, materials and equipment for installation, testing and putting into operation plumbing and drainage systems.

#### **1.2 Qualified tradesmen**

- .1 Work to be done by qualified and recognized firm with an established reputation in this field using tradesmen holding certificates of competency.

#### **1.3 Applicable codes and standards**

- .1 Ontario Building Code
- .2 Regulations of Province, City, or local authority having jurisdiction.
- .3 CSA B272 Pre-Fabricated Self Sealing Roof Vent Flashings
- .4 AWWA C651, Disinfecting Water Mains.
- .5 O.Reg. 212/01 Gaseous Fuels, and related code adoption document.
- .6 O.Reg. 215/01 Fuel Industry Certificates
- .7 CSA B149.1 Natural Gas and Propane Installation Code

#### **1.4 Qualifications**

- .1 Contractors performing work on natural gas or propane systems to be licensed as a gas and propane installer under O.Reg. 215/01, by the Technical Standards and Safety Authority.

### **2 PRODUCTS**

#### **2.1 Water service meter**

- .1 Compound type, to approval of authorities.

*Standard of Acceptance*

- ° Neptune - Trident

- .2 Suitable for future installation of remote reader. Provide conduit for future wiring from meter to remote reader.
- .3 Pay calibration and transportation charges in connection with meter. Water meter to read in cubic meters (m<sup>3</sup>) and U.S. gallons per minute (USGPM).

#### **2.2 Flashing**

- .1 Through-roof penetration flashing, and other waterproofed areas:

- .1 manufactured from composite material,
- .2 minimum dimensions of 500 mm x 500 mm (20 in x 20 in),
- .3 with sleeve extending at least 150 mm (6 in) above roof.

### **3 INSTALLATION**

#### **3.1 Piping**

- .1 Piping system routing is shown diagrammatically. Locate mains, risers and runouts concealed behind furrings or above ceilings except in mechanical equipment rooms and access spaces where piping is to be exposed.
- .2 Determine areas without ceilings from Architectural Drawings and Room Finish Schedules, and in these areas keep piping as high as possible.
- .3 Anchor, guide and support vertical and horizontal runs of piping to resist dead load and absorb thrust.
- .4 Coordinate routing of all piping with ducts and light fixtures.
- .5 Contractor shall verify in field existing conditions before proceeding with work and coordinate the work with all trades and existing conditions.
- .6 Contractor shall coordinate slab penetrations with Building Engineer.
- .7 Cut, patch and paint ceilings and slab as required to meet existing conditions.

#### **3.2 Water service**

- .1 Provide water connection to existing water main service between street main and property line, including shut-off valve, and pay charges and assessments for installation of water service. Extend service from property line into building and provide main shut-off valve and drip in location as shown.
- .2 Install water meter in accordance with Local Authority standards and provide three-valve by-pass arrangement with strainer on street side and drain valve on building side of meter.
- .3 Mount meter;
  - .1 150 mm (6") clear of floor,
  - .2 mount valves in upright position,
  - .3 locate by-pass to provide 500 mm (20 in) clear above top of meter,
  - .4 locate assembly so that meter is at least 600 mm (24 in) from back wall and with 1050 mm (42 in) clear in front.

#### **3.3 Domestic cold water system distribution**

- .1 Provide domestic cold water system with
  - .1 distribution pipe and fittings,
  - .2 valves,
  - .3 premises backflow isolation,
  - .4 zone or equipment backflow protection.

- .2 Minimum water pressure at street level: approximately 500 kPa (70 psi).
- .3 Provide valved connections from supply system, to fixtures and other equipment requiring cold water.

### **3.4 Domestic hot water recirculation system**

- .1 Provide domestic hot water recirculation system with
  - .1 distribution pipe and fittings
  - .2 valves
  - .3 pumps
- .2 Connect ends of hot water risers to recirculation mains and extend to recirculation pump.
- .3 Install recirculation piping as shown.

### **3.5 Natural gas piping**

- .1 Gas connection to existing main and service to meter including pressure regulator, and shut-off valves: provided by local natural gas supply authority.
- .2 Make arrangements and pay charges and assessments for installation of this work.
- .3 Extend service from meter into building and provide distribution piping, valves and connections to equipment as shown.

### **3.6 Drainage**

- .1 Provide roof drains and storm drainage piping system.
- .2 Provide waste and vent connections to plumbing fixtures and equipment.
- .3 Fittings;
  - .1 Do not use double hubs, straight crosses, double T's, or double TY's in soil or waste pipe below any fixture.
  - .2 Do not use branch fittings other than full "Y" or "Y" and an eighth bend, on soil or waste pipe running in horizontal direction.
  - .3 Do not use quarter bend placed on its side.
  - .4 Do not use inverted joints below fixtures.
  - .5 Do not install cleanouts above food preparation or patient treatment areas. In these areas carry rodding connection up to floor cleanout fitted with adjustable gasketed access cover and plug, with cleanout body cast in floor slab above.
  - .6 Drainage fittings to match connected piping for quality and wall thickness.

### **3.7 Connections to Laboratory Furniture**

- .1 Laboratory furniture is to be set in place by Equipment Division 11, with furniture predrilled for service fitments and with sinks fitted with tailpieces. Fitments, (faucets, gas cocks air and vacuum outlets etc.) supplied by Equipment Division 11.
- .2 Install fitments and connect to services providing piping, fittings, valves and traps. Provide shut-off valve on each service branch, except waste, in accessible location above floor, inside furniture as shown.

- .3 Install services concealed in furniture and provide supports and hangers.
- .4 Provide laboratory drainage piping and fittings, up to main drain or sanitary stack as shown. Fit sink traps with cleanouts. Vent piping to be of same material as drainage piping.

### **Flashing**

- .5 Provide flashing for piping penetrations through roofs and other waterproofed areas. Leave flashing ready for Roofing or Waterproofing Trades to make watertight connections.

### **3.8 Vent termination (VTR)**

- .1 Fit vents passing through roof with vent stack sleeve terminating not less than 150 mm (6 in) above roof, above flood level of roof, and 900 mm (3 ft) above or 3500 mm (11.5 ft) horizontally from any air intake, door, or operable window.

### **3.9 Flushing and Disinfecting - Water Service Pipe**

- .1 Complete piping pressure tests prior to flushing and disinfecting operations. Notify Consultant at least two days in advance of date when disinfecting operations are proposed, so that the Consultant may witness the tests.
- .2 Isolate the water service pipe inside the building at the point of entry, from the building water distribution system. Flush water service pipes for a minimum of 10 minutes to produce a water velocity of 1.5 m/s (5 fps) and discharge water to drain or other acceptable area.
  - .1 Minimum flushing flow rates:

Pipe size	Minimum Flow	
NPS	L/s	usgpm
2	3.3	52
2 1/2	4.7	75
3	7.3	115
4	12.6	200
6	23.4	450
8	49	780
10	76	1200
12	110	1750

### **3.10 Flushing and Cleaning - Building Water Distribution Piping**

- .1 Conduct first fill and pressure testing of building distribution piping only after completion of flushing and disinfection of water service pipe.
- .2 Complete piping pressure tests prior to flushing and cleaning operations.

.3 Flush water distribution piping through available outlets with sufficient flow to produce velocity of 1.5 m/s, within pipe for 10 minutes, or until foreign materials have been removed and flushed water is clear.

.4 Minimum flushing flowrates:

Pipe size	Minimum Flow	
NPS	L/s	usgpm
2	3.3	52
2 1/2	4.7	75
3	7.3	115
4	12.6	200

.5 Open and close valves, hydrants and service connections to ensure thorough flushing.

**END OF SECTION**

## **PLUMBING SPECIALTIES & ACCESSORIES**

### **22 05 23**

#### **1 GENERAL**

##### **1.1 Scope**

- .1 Provide plumbing specialties and accessories.

##### **1.2 Product data**

- .1 Submit product data sheets for;
  - .1 Floor drains, roof drains, cleanouts, wall hydrants, water hammer arresters, back flow preventers, back water valves, hose bibbs, water make-up assembly, pressure reducing stations, pressure reducing valves, strainers and traps.

##### **1.3 Applicable codes and standards**

- .1 CSA-B125 Plumbing Fittings.
- .2 CSA B.64.1.1 Vacuum Breakers, Atmospheric Type
- .3 CSA B.64.4 Backflow Preventers, Reduced Pressure Principle Type
- .4 CSA B64.10 Manual for the Selection and Installation of Backflow Prevention Devices/Manual for the Maintenance and Field Testing of Backflow Prevention Devices
- .5 CSA B79 Floor, Area, and Shower Drains and Cleanouts for Residential Construction
- .6 Plumbing and Drainage Institute (PDI) Standard PDI-WH201.Water Hammer Arresters
- .7 PDI-G101 Testing and Rating Procedure for Grease Interceptors with Appendix of Sizing and Installation Data.

#### **2 PRODUCTS**

##### **2.1 General**

- .1 Floor, area, combination and roof drains and cleanouts to conform to CSA B79 and to be products of one manufacturer.

##### *Standard of Acceptance*

- ° Jay R. Smith
- ° Mifab
- ° Zurn

##### **2.2 Floor drains**

- .1 Construction:
  - .1 cast iron body
  - .2 integral double drainage openings, flashing ring and clamping device.
  - .3 polished nickel bronze adjustable strainer.
  - .4 integral flange to receive the floor finish.

- .5 adjustable galvanized ductile iron tractor grates in mechanical equipment rooms and fan rooms.

*Standard of Acceptance*

- Jay R. Smith 2005 series
- Mifab F1100 series
- Zurn Z-415 series

## **2.3 Roof drains**

.1 Construction:

- .1 cast iron body
- .2 removable cast/ductile iron dome
- .3 bearing pan, gravel stop, and deck clamp.
- .4 flashing clamp with extension

*Standard of Acceptance*

- Jay R. Smith 1010 series
- Mifab R1200 series
- Zurn Z-100 series

## **2.4 Scupper drains**

.1 Construction:

- .1 cast iron body
- .2 flashing clamp
- .3 bronze strainer.

*Standard of Acceptance*

- Jay R. Smith 1510 series
- Mifab R1300 series
- Zurn Z-180 series

## **2.5 Cleanouts**

.1 In floors:

- .1 line size for NPS 2, NPS 3 and NPS 4 and NPS 4 in larger lines.
- .2 seal and test plug
- .3 cast iron body with clamp and collar,
- .4 in unfinished floor areas,
  - (a) cast iron frame heavy duty scoriated cast iron round or square tractor cover and internal plug, and
- .5 in finished floor areas,
  - (a) nickel bronze frame and round or square nickel bronze adjustable access cover,
  - (b) recessed for tile infill in tiled areas,
  - (c) recessed for carpet infill in carpeted areas,
  - (d) deeply recessed for terrazzo infill in terrazzo finished areas, and with
  - (e) extended flange around frame in areas with monolithic floor finishes.

*Standard of Acceptance*



- Jay R. Smith 4000 series
- Mifab C1100 series
- Zurn Z-1400 series

- .2 In exposed areas, ceiling spaces and accessible pipe chases,
  - .1 cast iron caulking ferrule with neoprene jacket and plug secured to body with cap screws.

## **2.6 Wall hydrants**

- .1 Concealed key operated non-freeze type with;
  - .1 vacuum breaker,
  - .2 stainless steel or bronze box,
  - .3 hinged locking door,
  - .4 galvanized casing, and
  - .5 adjustable wall flange.

### *Standard of Acceptance*

- Jay R. Smith 5509QT
- Mifab MHY-26
- Zurn Z-1320

## **2.7 Non-Freeze Roof Hydrant "NFRH-1"**

- .1 Exposed, non-freeze roof hydrant, with Dura-Coated cast iron head and lift handle with lock option, bronze interior parts, galvanized steel casing, and bronze valve housing with 1/8" [3 mm] IP drain port in housing. Complete with Dura-Coated cast iron roof support sleeve with wide anchoring flange and clamp collar.

### *Standard of Acceptance*

- Zurn Z1388

## **2.8 Water hammer arresters**

- .1 Stainless steel construction with precharged air chamber of nesting bellows.
- .2 Selected in accordance with Plumbing and Drainage Institute Standard PD1-WH201.

### *Standard of Acceptance*

- Jay R. Smith Hydrotrol 5000 series
- Mifab WHB series
- Zurn Shocktrol Z-1700 series

## **2.9 Trap seal primers**

- .1 Serving 1 or 2 drains:
  - .1 diaphragm operated primer with distribution unit,
  - .2 automatically operated by a pressure drop of 35 to 70 kPa (5 to 10 psi) in supply line to fixture.

### *Standard of Acceptance*

- Precision Plumbing Products Model PO-500
- Mifab M-500 with MI-DU

- .2 Serving 3 to 30 drains:
  - .1 electric, manifolded units,
  - .2 components factory assembled in 1.5 mm (16 ga) recessed metal cabinet with hinged stainless steel lockable access door,
  - .3 atmospheric vacuum breaker,
  - .4 preset 24 hr clock,
  - .5 manual over ride switch,
  - .6 120 Volt solenoid valve,
  - .7 NPS ¾ or NPS ½ valved inlet water connection,
  - .8 calibrated water distribution manifold,
  - .9 NPS ½ outlet compression fittings.

*Standard of Acceptance*

- ° Precision Plumbing Products Model PT-3 thru PT-30
- ° Mifab MI-100

**2.10 Back-flow preventers - Reduced Pressure Principle (RP)**

- .1 Conforming to CSA B.64.4
- .2 NPS 3/4 and larger:
  - .1 two independent check valves with intermediate relief valve,
  - .2 OS&Y ULC listed resilient seated gate valves,
  - .3 ball test cocks, and
  - .4 air gap drain.

*Standard of Acceptance*

- ° Watts No.909 series
- ° Cla-val Company Model RP-1
- ° Conbraco 40200 & 40100 Series

**2.11 Vacuum breakers**

- .1 Conforming to CSA B.64.2
  - .1 NPS ¾,
    - (a) Hose connection type (HCVB) with non-removable single check, and
    - (b) atmospheric vent vacuum breaker.

*Standard of Acceptance*

- ° Watts No.8A
- ° A.W.Cash Valve Type V-3

**2.12 Pressure reducing valves**

- .1 Self-contained type with;
  - .1 bronze body,
  - .2 single renewable nickel alloy seat and resilient disc,

- .3 diaphragm suitable for 90°C (200°F) service,
- .4 close coupled bronze strainer with stainless steel screen.

*Standard of Acceptance*

- Watts
- A.W.Cash Valve
- Singer Valve
- Leslie
- Fisher Controls
- Spence ED Series
- Conbraco

## **2.13 Diaphragm expansion tanks**

- .1 Construction:
  - .1 carbon steel body
  - .2 polypropylene liner
  - .3 stainless steel pipe connections
  - .4 fixed diaphragm, FDA approved Butyl
- .2 Ratings:
  - .1 Maximum working pressure: 1034 kPa (150 psig)
  - .2 Maximum working temperature: 115°C (240°F)

*Standard of Acceptance*

- Armtrol - Therm-X-Trol
- S.A. Armstrong
- Watts
- Bell & Gossett
- Taco

## **3 EXECUTION**

### **3.1 Installation general**

- .1 Install to conform with Canadian Plumbing Code, provincial codes, and local authority having jurisdiction.

### **3.2 Cleanouts**

- .1 Install at base of soil and waste stacks, and rainwater leaders and at changes in direction.
- .2 Extend cleanouts flush to wall or finished floor unless serviceable from below floor.
- .3 Install cleanouts located in floors clear of obstructions.

### **3.3 Wall hydrants**

- .1 Install 600 mm (24 in) above finished grade.

### **3.4 Water Hammer Arresters**

- .1 Select and install in accordance with PDI-WH 201 on branch supplies to each fixture or group of fixtures.

### **3.5 Trap seal primers**

- .1 Select and install to prime floor and funnel drain traps.
- .2 120V 1ph 60 Hz supply will be brought to electric manifolded units under Division 26 and connected under Division 22.

### **3.6 Back-flow preventers and vacuum breakers**

- .1 Install in accordance with CSA B64.10.
- .2 Install backflow preventers horizontally, in accordance with manufacturer's recommendations, but not less than 300 mm (12") and not greater than 1500 mm (60") above the floor.
- .3 Pipe discharge from backflow preventer, with air gap, to nearest drain or service sink.

### **3.7 Pressure reducing valves**

- .1 Install with shut-off valve upstream and 115 mm (4½ in) pressure gauge downstream.

### **3.8 Water system expansion tank**

- .1 Provide lockshield shut-off valve and pressure gauge on water line to expansion tank.
- .2 Check and adjust pressure charge in accordance with manufacturer's instructions.
  - .1 Set minimum pressure on tank before domestic hot water piping is warmed up.

**END OF SECTION**

## **DOMESTIC WATER SUPPLY PIPING - COPPER**

### **22 11 16**

## **1 GENERAL**

### **1.1 Scope**

- .1 Provide copper pipe and fittings for potable domestic water piping, above and below ground.

### **1.2 Applicable codes and standards**

- .1 ASTM B88 Standard Specification for Seamless Copper Water Tube
- .2 ASME B16.15 Cast Bronze Threaded Fittings, Classes 125 and 250
- .3 ASME B16.18 Cast Copper Alloy Solder Joint Pressure Fittings
- .4 ASME B16.22 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
- .5 ASME B16.24 Cast Copper Alloy Pipe Flanges and Flanged Fittings; Class 150, 300, 400, 600, 900, 1500, & 2500.
- .6 ASTM B828 Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.
- .7 CSA B242 Groove and Shouldered Type Mechanical Couplings
- .8 AWS A5.8 Brazing Filler Metal.
- .9 AWWA C606 Grooved and Shouldered Joints
- .10 AWWA C111/ ANSI A21.11 Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
- .11 ASTM A307 Standard Specification for Carbon Steel Bolts and Studs 60,000PSI Tensile Strength
- .12 ASTM A563 Standard Specification for Carbon and Alloy Steel Nuts
- .13 ASTM B-32 Specification for Solder Metal

## **2 PRODUCTS**

### **2.1 Domestic hot, cold and recirculating piping, within building**

- .1 Copper tube: to ASTM B88.
  - .1 Hard drawn, type L above ground.
  - .2 Soft annealed, type K below ground.
- .2 Tube to have certification markings made by testing agency accredited by Standards Council of Canada.

### **2.2 Fittings**

- .1 Brass or bronze flanges and flanged fittings: to ASME B16.24.
- .2 Brass or bronze threaded fittings: to ASME B16.15.
- .3 Solder/brazed fittings: cast bronze to ASME B16.18, or wrought copper and bronze to ASME B16.22.
- .4 Roll groove full flow standard radius cast bronze fittings for sizes NPS 2 1/2 and larger: to AWWA C606.

## **2.3 Joints**

- .1 Flanged joints:
  - .1 made up with rubber gaskets 1.6 mm ( $1/16$  in) thick to AWWA C111 and
  - .2 heavy series bolts, hexagonal head pattern to ASTM A307, nuts to ASTM 563, and washers.
- .2 Solder: tin antimony solder, 95:5 to ASTM B-32.
- .3 Silver brazing alloy AWS Classification BCUP-5
  - Standard of Acceptance*
    - Handy Harman "SIL-FOS"
    - All-State Welding Alloys "SILFLO 15"
- .4 Roll grooved piping:
  - .1 made up with roll groove positive clamp gasketed couplings or roll groove flange adapters for copper piping to CSA B242 or AWWA C606.

- Standard of Acceptance*
  - Victaulic
  - Gruvlock
  - Couplox
  - Shurjoint

## **2.4 Valves**

- .1 Valves: to Section 20 05 23 Valves.

# **3 EXECUTION**

## **3.1 Installation**

- .1 Isolate equipment, fixtures and branches with gate, ball or butterfly valves.
- .2 Use globe, DRVs, ball or butterfly valves for throttling service.
- .3 Install piping close to building structure to minimize furring and conserve headroom. Group piping and run parallel to walls and ceilings.
- .4 Cut tube square, ream tube ends and clean tubing and tube ends before joint assembly.
- .5 Prepare roll groove joints in shop or field using groove rolling machine.
- .6 Assemble roll groove joints using dry lubricated gaskets.
- .7 Anchors, guide and support roll grooved piping in accordance with coupling manufacturer's instructions.
- .8 Before assembling solder or brazed joints, remove working parts of valves, clean inside of solder fittings and outside of mating pipe with emery paper and coat with flux.
- .9 Solder or braze joints with blow torch or oxy-acetylene flame.

.10 Joint construction, buried:

.1 All sizes: brazed.

.11 Joint construction, above ground:

.1 Up to NPS 2½: soldered in all locations

.2 NPS 3 and larger: brazed in all locations

.3 NPS 3 and larger: grooved joint in exposed areas only.

(a) for greater clarity, "exposed areas" include inside service rooms and above lay-in tile ceilings, but excludes vertical and horizontal service shafts, above any other ceiling construction, and inside walls and partitions.

### **3.2 Testing and Balancing**

.1 Pressure test piping before insulation is applied. Cut-out and replace leaking soldered or brazed fittings and retest.

.2 Balance supply systems and recirculation systems using lock shield globe valves or DVR.

**END OF SECTION**

## **PUMPS - PLUMBING**

### **22 11 23**

## **1 GENERAL**

### **1.1 Scope**

- .1 Provide pumps for plumbing systems.

### **1.2 Related Section**

- .1 20 05 12 Electric Motors
- .2 20 05 13 Motor Starters and Wiring

### **1.3 Shop drawings**

- .1 Submit shop drawings for each pump showing model number, outline dimensions, motor mounting details, inlet and outlet connection details and pump starting and control characteristics.
- .2 Submit certified performance curves for each pump showing efficiency, pressure, net positive suction head (NPSH), and power input in kW (brake horsepower) against flow, from shut-off to free delivery through scheduled point of rating.

### **1.4 Quality Control**

- .1 Factory Testing – Pump Performance:
  - .1 conduct manufacturer's factory acceptance test of completed unit before shipping to site. Submit characteristic pump Flow-Head curves plotted from test results.

### **1.5 Applicable Codes and Standards**

- .1 CSA C820 - Energy Efficiency Test Methods for Small Pumps

## **2 PRODUCTS**

### **2.1 General characteristics**

- .1 Construction:
  - .1 pump casings: close grained cast iron or cast bronze fitted with casing or impeller wear rings, or both.
  - .2 impellers: enclosed bronze or duralloy, dynamically balanced, mounted on carbon steel shaft fitted with stainless steel or bronze sleeves.
  - .3 maximum impeller diameter: 90% of catalogued diameter for selected pump casing size.
  - .4 seals: mechanical type, except use balanced type where stuffing box pressure exceeds 690 kPa (100 psi).
  - .5 pump motors:
    - (a) to Section 20 05 12 *Electric Motors*, and
    - (b) to suit impeller rotational speed and dimensions and to be sized for continuous operation at runout condition without going into the motor service factor..
- .2 Performance:



- .1 Head, power and efficiency test data for small pumps to be determined in accordance with CSA C820.
  - .2 Performance characteristic curve, plotting head against flow, to be continuously rising from run-out to shut-off.
  - .3 Select pump to operate with flow in range from 30% below flow value at point of maximum efficiency to 10% above that flow value, for impeller diameter chosen.
- .3 Pumps to be standard units from regular production stock.

*Standard of Acceptance*

- S. A. Armstrong
- ITT Bell & Gossett
- Taco
- Paco

## **2.2 In-line circulators**

- .1 Construction:
  - .1 bronze fitted or bronze construction suitable for working pressure of 1200 kPa (175 psi),
  - .2 shaft with integral thrust collar, mechanical seal, supported by two oil lubricated bronze sleeve bearings,
  - .3 resiliently mounted motor.

## **3 EXECUTION**

### **3.1 General**

- .1 Make piping and electrical connections to pumps.
- .2 Arrange piping of multiple pumps in a pumpset to permit removal of either pump without disturbing remaining unit.
- .3 Check pump rotation.
- .4 Set up and adjust controls.

### **3.2 Gauges**

- .1 Provide one pressure gauge for each water circulating pump and connect with piping and isolating valves to pump suction and discharge. Where suction pressure is 70 kPa (10 psi) or less, gauge to be compound type.

**END OF SECTION**

## **DRAINAGE AND VENT PIPING – CAST IRON AND COPPER**

### **22 13 16**

## **1 GENERAL**

### **1.1 Scope**

- .1 Provide cast iron pipe and fittings and/or copper tube and fittings for drain, waste and vent services.
  - .1 For aboveground and buried services.
  - .2 For drainage piping serving mechanical service rooms.

### **1.2 Related Sections**

- .1 22 13 21: Drainage Piping - Pumped

### **1.3 Applicable codes and standards**

- .1 Standards:
  - .1 CSA B70 Cast Iron Soil Pipe, Fittings, and Means of Joining
  - .2 CSA-B125 Plumbing Fittings.
  - .3 CSA B158.1 Cast Brass Solder Joint Drainage, Waste, and Vent Fittings
  - .4 CSA B602 Mechanical Couplings for Drain, Waste, and Vent Pipe and Sewer Pipe.
  - .5 ASTM A74 Standard Specification for Cast Iron Soil Pipe and Fittings
  - .6 ASTM A888 Standard Specification for Hubless Cast Iron Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications
  - .7 ASME B16.29 Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV
  - .8 ASTM B32 Specification for Solder Metal
  - .9 ASTM B306 Standard Specification for Copper Drainage Tube (DWV)
  - .10 ASTM C564- Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
  - .11 ASTM C1540 Standard Specification for Heavy Duty Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings.
  - .12 ASTM B828 Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.
  - .13 Canadian Pipe Institute Standard Specification
  - .14 Cast Iron Soil Pipe Institute (CISPI) Technical Manual
  - .15 CISPI 301 Standard Specification for Hubless Cast Iron Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications
  - .16 CISPI 310 Specification for Couplings for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications

## **2 PRODUCTS**

### **2.1 Copper drain waste and vent pipe and fittings, within building**

- .1 Pipe:
  - .1 Copper DWV tube, to ASTM B306

.2 Certification markings made by testing agency accredited by Standards Council of Canada.

.2 Fittings

.1 Cast brass to CSA B158.1

.2 Wrought copper to ANSI B16.29

.3 Solder

.1 Tin-antimony 95/5, to ASTM B32 alloy Sb5.

## **2.2 Cast iron pipe and fittings for drain waste and vent services**

.1 Pipe and fittings:

.1 Cast to CSA B70, ASTM A74 or ASTM A888

.2 with heavy bituminous coating for buried service.

.2 Joints below grade:

.1 Hub and spigot made up neoprene gasket to ASTM C564 and lubricating compound.

.3 Joints above ground:

.1 Hub and spigot made up neoprene gasket to ASTM C564 and lubricating compound.

.4 Tie-rods:

.1 fabricated by double bolted riser clamps and 10mm (3/8 in) carbon steel rods, with riser clamp placed on each side of joint.

## **3 EXECUTION**

### **3.1 Installation General**

.1 Install suspended piping to grade, parallel and close to walls and ceilings to conserve headroom and space.

.2 Install piping close to building structure to minimize furring. Group piping and run parallel to walls and ceilings.

### **3.2 Cast Iron Piping**

.1 Install cast iron drainage piping in accordance with Cast Iron Soil Pipe and Fittings (CISPF) Technical Manual.

.2 Lay buried piping in bedding prepared in accordance with Canadian Pipe Institute Standard Specification, on 150 mm (6 in) bed of clean sand, shaped to accommodate hubs and fittings, to line and grade as shown. Backfill with clean sand to 300 mm above top of pipe or to underside of floor slab whichever is less.

.3 For suspended piping, provide hangers within 450 mm (18 in) of each joint, at each change of direction, and within 450 mm (18 in) of the terminal end of each pipe run.

.4 Assemble and tighten mechanical sleeve joints to coupling manufacturers recommended torque value with torque wrench.

- .5 Provide braces or tie-rods on horizontal piping NPS 5 and larger:
  - .1 at each branch opening or change of direction,
  - .2 at each pipe run coupling.
- .6 Provide sway bracing on all horizontal piping where the hanger length is greater than 450 mm (18 in) from the top of the pipe to the connecting point on the structure.
- .7 Install cast iron hub-and-spigot joints with neoprene compression gasket and lubrication in accordance with manufacturer requirements.

### **3.3 Copper Tubing**

- .1 Cut copper tube square, ream tube ends and clean tubing and tube ends before joint assembly.
- .2 Before assembling solder joints, clean inside of solder fittings and outside of mating pipe with emery paper and coat with flux.
- .3 Solder joints in copper pipe with blow torch or oxy-acetylene flame.

### **3.4 Testing**

- .1 Test before piping is concealed.
- .2 Cut-out and replace leaking soldered fittings, remake joints in cast iron piping, and retest.

**END OF SECTION**

## **DOMESTIC WATER HEATERS**

### **22 33 13**

## **1 GENERAL**

### **1.1 Scope**

- .1 Provide domestic hot water heaters as shown

### **1.2 Shop drawings**

- .1 Submit shop drawings for each heater with model number, outline dimensions, fuel or power requirements, inlet and outlet connection details and capacity.

### **1.3 Applicable codes and standards**

- .1 CSA C22.2 No. 110 Construction and Test of Electric Storage-Tank Water Heaters
- .2 CSA C191 Performance of Electric Storage Tank Water Heaters for Household Service
- .3 CSA 4.1 Gas Water Heaters - Volume I Storage Water Heaters with Input Ratings Below 75,000 Btu Per Hour or Less
- .4 CSA 4.3 Gas Water Heaters - Volume III Storage Water Heaters with Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous.
- .5 CSA B-51 Part 1 Boiler, Pressure Vessel and Pressure Piping Code
- .6 CSA B140.12 Oil-Fired Service Water Heaters for Domestic Hot Water and Space Heating Use

## **2 PRODUCTS**

### **2.1 General**

- .1 Design conditions:
  - .1 design pressure: 860 kPa (125 psi)
  - .2 design temperature: 60°C (180°F).
- .2 Piping connections:
  - .1 Up to NPS 3: threaded
  - .2 NPS 3 and over: flanged.
- .3 Fittings, all heaters:
  - .1 replaceable magnesium anode,
  - .2 50 mm (2 in) mineral wool insulation,
  - .3 enamelled steel jacket,
  - .4 hose threaded drain valve,
  - .5 ASME rated temperature and pressure relief valve

## **2.2 Electric hot water heaters**

- .1 Conform to CSA C22.2 No. 110 and CSA C191
- .2 Factory assembled and tested, glass lined steel tank units, with;
  - .1 copper sheathed immersion elements arranged for flip-flop operation
  - .2 close tolerance positive snap action thermostats
  - .3 manual reset high temperature limit switch.
  - .4 built-in and factory pre-wired controls including contactors.

### *Standard of Acceptance*

- Rheem
- John Wood
- PVI

## **3 EXECUTION**

### **3.1 Installation**

- .1 Provide supporting structural steel for horizontal mounted tanks and for instantaneous heaters. Set anchor bolts through feet of vertical tanks.
- .2 Isolate tanks from ground. For horizontal tanks provide dielectric pads between tank and saddles, and for vertical tanks with legs, provide dielectric pads under feet, and isolation washers and sleeves at each anchor bolt.
- .3 Connect up to cold water supply lines and domestic hot water distribution piping with 300mm (12 in) long, line size flexible connections.
- .4 Instruments with external electric wiring to be isolated from heaters and tanks with dielectric bushings or dielectric unions
- .5 Provide temperature and pressure relief valve for water side of each heater piped to nearest funnel or hub drain.
- .6 Provide valved drain from each tank piped to nearest funnel or hub drain.
- .7 At each hot water heater requiring electric power provide suitably sized fused disconnect switch and wire from switch to heater.

**END OF SECTION**

## **PLUMBING FIXTURES & TRIM**

### **22 42 13**

#### **1 GENERAL**

##### **1.1 Scope**

- .1 Provide plumbing fixtures and trim.

##### **1.2 Applicable codes and standards**

- .1 CSA-B45 Series, Plumbing Fixtures.
- .2 CSA-B125 Plumbing Fittings.
- .3 UL 1951 Electrical Plumbing Accessories
- .4 ASME A112.6.1 Supports for Off-the-Floor Plumbing Fixtures for Public Use

##### **1.3 Fixture count**

- .1 Determine number and location of fixtures from Architectural drawings. In the absence of architectural drawings, refer to Mechanical drawings.

##### **1.4 Fixture quality standards**

- .1 Fixtures and trim of same type to be product of one manufacturer.
- .2 Finished surfaces to be clear, smooth and bright, and guaranteed not to craze, discolour or scale.
- .3 Visible parts of faucets, escutcheons, wastes, strainers, traps, shower heads, supplies and stops: chrome plated.
- .4 Water supply faucet spouts fitted with aerators.
- .5 Floor mounted water closets fitted with china bolt caps.
- .6 Where fixtures and trim are identified by manufacturers' catalogue designation these references are to establish quality standards. For the purposes of this section of the specification, fixtures or trim from manufacturers listed below are equally acceptable when conforming to the same level of quality.

##### *Standard of Acceptance*

- American Standard
- Kohler
- Delta Commercial
- Centoco
- Kindred

## **2 PRODUCTS**

### **2.1 Water Closet Type "WC-1"**

- .1 Combination toilet and flush valve, Wall-hung with wall outlet, Vitreous china, elongated front, Hardwired, Exposed chrome plated flush valve with vacuum breaker, 1.28 gpf, NPS 1½ top spud connection.

*Standard of Acceptance.*

- American Standard "AFWALL MILLENIUM FloWise" 2257.528

- .2 Open front seat, less cover with check hinges, for elongated bowl, extra heavy duty (white).

*Standard of Acceptance*

- Centoco - 1500cc

### **2.2 Water Closet Type "WC-2" (Wheelchair Application)**

- .1 Combination toilet and flush valve, Wall-hung with wall outlet, Vitreous china, elongated front, Hardwired, Exposed chrome plated flush valve with vacuum breaker, 1.28 gpf, NPS 1½ top spud connection.

*Standard of Acceptance*

- American Standard "AFWALL MILLENIUM FloWise" 2257.528

- .2 Solid plastic, open front elongated seat, with cover (white).

*Standard of Acceptance*

- Eljer 124-0355

### **2.3 Lavatory Type "LAV-1/2/3"**

- .1 Single Bowl wall-mount Bathroom Sink. Sink is manufactured from vitreous china with, Center drain placement.

*Standard of Acceptance*

- Kohler "BRENHAM" K-1997-4-0

- .2 Deck-Mount, Sensor- operated Faucet and soap dispenser, 0.35 gpm, Multi-Laminar Spray, w/ hardwire kit.

*Standard of Acceptance*

- Sloan "ESD-601"

- .3 NPS 1¼ diameter cast brass chrome plated tailpiece with open grid strainer

*Standard of Acceptance*

- Cambridge Brass 33T260

- .4 Chrome plated NPS 3/8 rigid angle or flexible supplies with lockshield stops.

*Standard of Acceptance*

- Cambridge Brass 47T312



- .5 Chrome plated cast brass swivel "P" trap with cleanout and wall nipple threaded both ends, CP wall flange and set screw.

*Standard of Acceptance*

- ° Eljer - trap 804-1100, wall nipple 804-1150

## **2.4 Sink Type "SK-1" (Staff Lounge)**

- .1 Single Bowl Undermount Sink, with rear center drain placement. "mocha" finish

*Standard of Acceptance*

- ° Elkay Quartz Classic - ELGU2522

- .2 Single Handle Pull-Down Kitchen Faucet. Black Stainless swivel spout and two function spray head, metal body and ADA metal lever handle. With Hard wire kit.

*Standard of Acceptance*

- ° Delta "TRINSIC" 9159TLV-KS-DST

- .3 NPS 1¼ chrome plated cast tailpiece with plug and open grid strainer

*Standard of Acceptance*

- ° Cambridge Brass 33T290

- .4 Chrome plated NPS 3/8 rigid angle or flexible supplies with lockshield stops.

*Standard of Acceptance*

- ° Cambridge Brass 47T312

- .5 Chrome plated cast brass swivel "P" trap with cleanout and wall nipple threaded both ends, chrome plated wall flange and set screw.

*Standard of Acceptance*

- ° Eljer - trap 804-1100, wall nipple 804-1150

## **2.5 Sink Type "SK-2" (Programme Room)**

- .1 Single Bowl Drop-in Sink, with rear center drain placement. "mocha" finish

*Standard of Acceptance*

- ° Elkay Quartz Classic - ELGUAD2519PD

- .2 Single Handle Pull-Down Kitchen Faucet. Black Stainless swivel spout and two function spray head, metal body and ADA metal lever handle. With Hard wire kit.

*Standard of Acceptance*

- ° Delta "TRINSIC" 9159TLV-KS-DST

- .3 NPS 1¼ chrome plated cast tailpiece with plug and open grid strainer

*Standard of Acceptance*

- ° Cambridge Brass 33T290

- .4 Chrome plated NPS 3/8 rigid angle or flexible supplies with lockshield stops.

*Standard of Acceptance*

- Cambridge Brass 47T312

- .5 Chrome plated cast brass swivel "P" trap with cleanout and wall nipple threaded both ends, chrome plated wall flange and set screw.

*Standard of Acceptance*

- Eljer - trap 804-1100, wall nipple 804-1150

## **2.6 Janitor's Sink Type "MS-1"**

- .1 Wall Hung Service Sink Kit. Sink is manufactured from 14 gauge 304 Stainless Steel with a Buffed Satin finish, Center drain placement.

*Standard of Acceptance*

- Elkay- ESSW2520C

- .2 Wall mounted supply fitting over back of sink with top brace, pail hook, vacuum breaker, hose end and integral stops

*Standard of Acceptance*

- Cambridge Brass 28T2356

- .3 NPS 2 cast iron "S" trap

*Standard of Acceptance*

- Eljer 804-1040

## **2.7 Funnel Drain "FND"**

- .1 75 mm (3") funnel drain with 100 mm (4") rim.

*Standard of Acceptance*

- Zurn Z326

- .2 NPS 1½ chrome plated brass "P" trap with cleanout, brass nuts and deep escutcheon

*Standard of Acceptance*

- Zurn Z8702-PC

## **2.8 Floor Drain "FD"**

- .1 75 mm (3") Floor drain with 100 mm (4") rim.

*Standard of Acceptance*

- ZURN zn415-b
- MIFAB
- watts

- .2 NPS 1½ chrome plated brass "P" trap with cleanout, brass nuts and deep escutcheon

*Standard of Acceptance*

- Zurn Z8702-PC

## **2.9 Temperature Mixing Valve "TMV"**

- .1 Self contained thermostatic water mixing valves;
  - .1 one small for 1/3 rated flow,
  - .2 one large for 2/3 rated flow,
  - .3 sized for not more than 100 kPa (15 psi) pressure drop at rated flow.
- .2 Construction:
  - .1 bronze, brass, copper and stainless steel construction,
  - .2 mounted on strut frame with integral return piping, circulator, aquastat, check valves, bypass piping and balancing valves,
  - .3 outlet test connection, ball valve shut off on each mixing valve outlet, cold water inlet and hot water inlet,
  - .4 dial thermometers on hot, cold, mixed and return piping,
  - .5 adjustable high temperature limit stops set for 50°C (120°F),
  - .6 pressure gauge on tempered water piping,
  - .7 pre-assembled in accordance with schematic detail, and factory tested.

### *Standard of Acceptance*

- ° Leonard - Megatron
- ° Bradley - S59
- ° Cash - with Type TA control
- ° Towle & Whitney - Simplicity
- ° Powers - with 1430 valves
- ° Watts - with N-170 - M2 Valves

## **2.10 Drinking Fountain Type "DF-1"**

- .1 Stainless steel wall mounted bottle filler & drinking fountain:

### *Standard of Acceptance*

- ° Elkay EZWS-WDFPBM114K

- .2 NPS 1¼ "P" trap.
- .3 Rough brass NPS ½ stop on supply

## **2.11 Sealant between fixture and wall finish:**

- .1 One part acetoxy silicone sealant
- .2 White or clear colour
- .3 Formulated with fungicide

### *Standard of Acceptance*

- ° Tremco Tremsil 200
- ° Dow Corning
- ° GE

### **3 EXECUTION**

#### **3.1 Fixture installation**

- .1 Support fixtures level and square and connect with supplies, drains, traps and vents.
- .2 Hot water faucets to be on left.
- .3 Fixtures on outside walls to have water supplies from floor, other fixtures to be served from walls.
- .4 Mounting heights for wall hung fixtures and showers to be measured from finished floor.
- .5 Provide field installed in-line brass bodied swing check valves on the hot and cold water supplies to each TMV unit. For greater certainty, if the TMV unit is supplied with integral check valves they are deemed not to meet this requirement.

#### **3.2 Protection**

- .1 Plumbing fixtures and trim to be covered with plywood, cardboard or heavy paper and kept protected before, during and after installation and until work is completed and accepted.
- .2 Clean fixtures, and trim immediately prior to building completion.

#### **3.3 Fixture supports**

- .1 Provide plates, brackets, wall carriers, cleats, and supports to secure fixtures in place.
- .2 Fasten wall brackets with bolts attached to double steel supporting plates.
- .3 Bolt fixture to wall through cored holes under lavatory wall flange, using chrome plated carriage bolts with integral washers, and expansion shields.
- .4 Install extra heavy chair carriers for fixtures not directly supported from floor.
- .5 Conceal vertical supports and baseplates in wall construction.
- .6 Apply sealant bead between wall mounted fixture and finished wall.
- .7 Floor mounted water closet bowls to be set in mastic.

#### **3.4 Hot Water Temperature Limits**

- .1 Test, adjust and set high temperature limit stops on shower fixtures to supply a maximum water temperature of 49°C (120°F).
- .2 Test, adjust and set temperature control on thermostatic mixing valves to supply a maximum water temperature of:
  - .1 49°C (120°F) for group showers, and
  - .2 29°C (85°F) for emergency showers.
- .3 Provide a report of this testing and include:
  - .1 fixture reference,

- .2 measured maximum temperature,'
  - .3 date of test(s),
  - .4 signature of person(s) conducting test.
- .4 The above tests are subject to a demonstration test audit of up to 10% of the total fixture count to verify compliance. If audit tests are not satisfactory to the Consultant, additional testing and verification will be conducted by the Contractor until such time as a demonstration audit provides satisfactory results to the Consultant.

END OF SECTION

## **NATURAL GAS SYSTEMS**

### **23 11 23**

## **1 GENERAL**

### **1.1 Scope**

- .1 Provide gas service, piping system and connect to appliances as shown.

### **1.2 Definitions**

- .1 In this section,
  - .1 *Concealed* (as it applies to piping or tubing): piping or tubing that, when in place in a wall, floor, or ceiling of a finished building, is hidden from view and can only be exposed by use of a tool. The term does not apply to piping or tubing that passes directly through a wall or partition ref. CSA B149.1
  - .2 *Exposed* (as it applies to piping or tubing): piping or tubing that is not concealed, and includes piping or tubing installed above a false ceiling space as defined in CSA B149.1

### **1.3 Shop drawings**

- .1 Submit manufacturer's data sheets for valves. Submit shop drawings where pipe assemblies with fittings, elbows and flanges are shop prefabricated.

### **1.4 Applicable codes and standards**

- .1 Legislation:
  - .1 Technical Standards and Safety Act, Ontario Regulation 212/01 for Gaseous Fuels
- .2 Installation standards, codes and guidelines:
  - .1 CSA-B149.1. Natural Gas and Propane Installation Code
- .3 Product standards:
  - .1 ASTM A53                      Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc-Coated, Welded and Seamless.
  - .2 ASTM A106                    Standard Specification for Seamless Carbon Steel Pipe for High Temperature Service
  - .3 ASME B16.3                   Malleable Iron Threaded Fittings
  - .4 ASME B16.5                   Pipe Flanges and Flanged Fittings
  - .5 ASME B16.9                   Factory Made Wrought Steel Buttwelding Fittings
  - .6 ASME B16.11                  Forged Fittings, Socket-Welding and Threaded
  - .7 ASME B16.20                  Metallic Gaskets for Pipe Flange: Ring-Joint Spiral Wound and Jacketed
  - .8 ASME B16.21                  Non-Metallic Flat Gaskets for Pipe Flanges
  - .9 ASME B16.39                  Malleable Iron Threaded Pipe Unions; Class 150, 250 and 300
  - .10 ASME B18.2.1                Square and Hex Bolts and Screws
  - .11 ASME B18.2.2                Square and Hex Nuts
  - .12 ASTM A307                   Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

- .13 ASTM A563 Standard Specification for Carbon and Alloy Steel Nuts
- .14 ASTM A194 Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both
- .15 CAN/ULC-S642 Standard for Compounds and Tapes for Threaded Pipe Joints
- .16 CSA-B137.4 Polyethylene Piping Systems for Gas Services,
- .17 CSA-B137.4.1 Electrofusion-Type Polyethylene Fittings for Gas Services
- .18 ANSI Z21.21/CSA 6.5 Automatic Valves for Gas Appliances
- .19 ANSI Z21.80/CSA 6.22 Line pressure regulators

## **1.5 Permits and charges**

- .1 Make arrangements and pay charges for;
  - .1 Relocation of gas service into building,
  - .2 gas meter installation, including regulators and service valves,
  - .3 inspection of installation and appliances.

## **2 PRODUCTS**

### **2.1 Steel pipe for natural gas or propane gas - Aboveground**

- .1 Pipe for design pressures less than 860 kPa (125 psig):
  - .1 NPS 10 and under:
    - (a) ASTM A106 Gr B, schedule 40 Seamless,
    - (b) ASTM A53 Gr B, schedule 40 Electric Resistance Weld (ERW) or seamless (S)
  - .2 Joints and fittings:
    - .1 NPS 2 and under:
      - (a) socket weld fittings: Class 3000 forged steel to ASME B 16.11,
      - (b) threaded fittings: Class 150 malleable iron to ASME B16.3,
      - (c) unions: Class 150 malleable iron threaded unions to ASME B16.39

#### *Standard of Acceptance*

- ° Anvil
- ° Bonney Forge

- .2 Flanges, NPS 2 and over:
  - (a) forged steel, Class 150 to ASME B16.5, weld neck with wall thickness to match pipe or slip on type, with raised face.
- .3 Gaskets:
  - (a) to ASME B16.21 of heavy duty neoprene compressed sheet minimum 1.6 mm (1/16 in) thick

#### *Standard of Acceptance*

- ° Chesterton 122NN

- .4 Studs, bolts and nuts:
  - (a) "high strength" type to ASME B18.2.1 with ASME 18.2.2 or ASTM A307 with ASTM A563 or ASTM A194.

- .5 Thread compound and tape:
  - (a) to CAN/ULC-S642, double density PTFE tape (pink) or PTFE pipe dope.

## **2.2 Line Pressure Regulators**

- .1 Regulator valve:
  - .1 Listed to ANSI Z21.80/CSA 6.22,
  - .2 Class I or Class II based on outlet gas pressure as shown,
  - .3 body pressure rating: 860 kPa (125 psig),
  - .4 vent limiting device where;
    - (a) inlet gas pressure is 14 kPa (2 psig) or less.
    - (b) Inlet gas pressure is greater than 14 kPa (2psig) and monitoring regulator or overpressure shut-off device is shown.
- .2 Overpressure protection:
  - .1 Full internal relief, except where monitoring regulator, line relief valve or overpressure shut-off valve is shown.
  - .2 Monitoring regulator or overpressure shut-off device provided as part of a factory assembled unit with the pressure regulator where shown.
- .3 Line pressure relief valves:
  - .1 adjustable pressure relief setpoint, set in accordance with CSA B149.1,
  - .2 body pressure rating: 860 kPa (125 psig).

## **3 EXECUTION**

### **3.1 Gas service**

- .1 Meter and service regulator installation provided by gas utility company in accordance with the requirements of the local authority having jurisdiction.
- .2 Clearly indicate gas service with permanent marking at or on outside of building.
- .3 Extend service piping from meter installation as shown.

### **3.2 Piping joints and fittings**

- .1 Exposed piping:
  - .1 NPS 2 and smaller: threaded fittings and joints, or socket welded.
  - .2 NPS 2½ and larger: welded with butt weld fittings, welded outlet fittings, or flanged.
- .2 Concealed piping:
  - .1 NPS 2 and smaller: socket weld fittings,
  - .2 NPS 2½ and larger: butt weld fittings or welded outlet fittings.

### **3.3 Connections to appliances**

- .1 Connect to appliances with threaded unions up to NPS 2 and flanges NPS 2½ and above.



- .2 Provide dirt trap and service valve at each appliance.

### 3.4 Piping installation

- .1 Provide clearance and access for maintenance of appliances, valves and fittings.
- .2 Ream pipe after cutting to length and clean off scale and dirt both inside and outside before assembly.
- .3 Cap ends during construction to prevent entry of foreign matter.
- .4 Make up threaded pipe with;
  - .1 couplings,
  - .2 caps and plugs,
  - .3 90° and 45° elbows, and
  - .4 tee fittings.
- .5 Make up welded pipe with;
  - .1 long radius elbows,
  - .2 tee fittings where branch connections are same size as main or smaller,
  - .3 welded outlet fittings where branch connections are smaller than main and where main is NPS 3 and larger,
  - .4 branches may be welded directly onto main provided main is NPS 6 and larger and branch is at least 2 pipe sizes smaller than main.
  - .5 where branch fitting is welded onto main;
    - (a) cut opening in main true and bevelled,
    - (b) hole saw or drill and ream main to maintain full inside diameter of branch line,
    - (c) opening to be sized to prevent branch pipe from projecting inside main, and
    - (d) to inhibit entry of welding metal and slag into pipes.

### 3.5 Hanger installation

- .1 To section 20 05 29.
- .2 Install hangers for steel pipe with spacing and hanger rod diameter in accordance with table 1.

**Table 1 : Hanger Spacing for Steel Piping**

Pipe Size NPS	Rod Diameter	Maximum Spacing
1/2	10 mm (3/8 in)	1.8 m (6 ft)
3/4 to 1-1/4	10 mm (3/8 in)	2.1 m (7 ft)
1-1/2	10 mm (3/8 in)	2.7 m (9 ft)
2	10 mm (3/8 in)	3.0 m (10 ft)
2-1/2	13 mm (½ in)	3.0 m (10 ft)

- .3 Support vertical riser piping at each floor level.

### **3.6 Valves**

- .1 To section 20 05 23.
- .2 Install valves with stems upright or horizontal.
- .3 Install valves at branch take-offs and to isolate each piece of appliances, and to isolate each pressure regulating valve.

### **3.7 Line pressure regulating valves**

- .1 Provide line pressure regulating valves with full internal relief except where monitoring regulator or overpressure shut-off device is shown, in which case provide line pressure regulator with vent limiting device.
- .2 Install regulators in accessible and ventilated location.
- .3 Set regulation control pressure in accordance with downstream pressure requirements.

### **3.8 Pressure control venting**

- .1 Pipe vents for pipeline pressure control devices and appliances pressure devices to the outdoors.
- .2 Provide bleed vents and relief vents in accordance with manufacturer requirements or in their absence in accordance with CSA B149.1. Minimum tubing size for bleed vents to be 8 mm OD (NPS 3/8).
- .3 Bleed vents may be combined where the common vent is sized in accordance with CSA B149.1 for vent size, length and inlet gas pressure.
- .4 Relief vents for line pressure relief valves may be combined where the common vent is sized in accordance with CSA B149.1 for vent size, length and relief valve inlet and discharge gas pressures.
  - .1 For clarity, do not combine vents from line pressure regulators with internal relief with any other vent – run each regulator vent separately to the outdoors.

Terminate vents outdoors with a 180° gooseneck and finish with

### **3.9 Identification**

- .1 To section 20 05 53.

### **3.10 Coordination of Inspection/Service Connection**

- .1 Submit to Gas Supply Authority list of natural gas appliances being installed showing type, quantity and rating.
- .2 Make appliance fuel and vent connections before scheduling inspection, meter installation, and activation of service.

**END OF SECTION**

## **AIR DISTRIBUTION - GENERAL**

### **23 31 01**

#### **1 GENERAL**

##### **1.1 Scope**

- .1 Provide labour, materials and equipment for installation, testing and putting into operation ventilating and air conditioning systems

##### **1.2 Qualified tradesmen**

- .1 Work to be done by qualified tradesmen holding certificates of competency.

##### **1.3 Applicable standards**

- .1 The Ontario Building Code
- .2 Regulations of Province, or local authority having jurisdiction.

#### **2 PRODUCTS**

##### **2.1 Not Used**

#### **3 EXECUTION**

##### **3.1 Ductwork**

- .1 Ductwork system routing is shown diagrammatically. Drawings are not considered to be fabrication or installation drawings.
- .2 Locate mains, risers and runouts to be concealed behind furrings or above ceilings except in mechanical equipment rooms and access spaces where ductwork is to be exposed.
- .3 Determine areas without ceilings from Architectural Drawings and Room Finish Schedules, and in these areas keep ductwork as high as possible.
- .4 Anchor, guide and support vertical and horizontal runs of ductwork to resist dead load and absorb thrust.

##### **3.2 Air supply equipment**

- .1 Install and connect air handling units, and air conditioning units, and build casing and plenums.

##### **3.3 Air exhaust equipment**

- .1 Install and connect exhaust fans, roof and wall exhausters and dust and fume collectors.

##### **3.4 Terminals devices**

- .1 Locate and install terminal boxes, registers, diffusers, and grilles

### **3.5 Life safety**

- .1 Install fire dampers, smoke dampers, and combination smoke and fire dampers to protect openings in fire separations.
- .2 Provide smoke stopping around unprotected ducts passing through smoke separations.

### **3.6 Air balancing**

- .1 Co-operate with air balancing agency; install supplementary dampers, access openings and access doors to facilitate testing and adjustment.

**END OF SECTION**

## **DUCTWORK 23 31 13**

### **1 GENERAL**

#### **1.1 Scope**

- .1 Provide metal ductwork systems as shown.

#### **1.2 Related sections**

- .1 23 31 21 Protected Ductwork

#### **1.3 Applicable Codes and Standards**

- .1 Installation standards and codes
  - .1 NFPA 90A Installation of air conditioning and ventilating systems.
  - .2 NFPA 90B Installation of warm air heating and air conditioning systems.
  - .3 ASHRAE Letter and number designations, shown as "CR3-16" etc., are taken from ASHRAE Duct Fitting Data Base.(DFDB)
  - .4 ANSI/SMACNA HVAC Duct Construction Standards - Metal and Flexible (2005 edition)
- .2 Product standards:
  - .1 ASTM A90/M Standard Test Method for Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings
  - .2 ASTM A653/M Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process
  - .3 ASTM A924/M Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
  - .4 ASTM A1011/M Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
  - .5 ASTM A283/M Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
  - .6 ASTM A36/M Standard Specification for Carbon Structural Steel
  - .7 ASTM A480/M Specification for General requirements for Flat Rolled Plate, Sheet, and Strip
  - .8 ASTM A463/M Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process
  - .9 ASTM B209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

#### **1.4 Shop Drawings and Application Details**

- .1 Submit manufacturer's catalogue literature for;
  - .1 Proprietary joints,
  - .2 Hardware.
- .2 Submit schedules and details to show;

- .1 fabrication details of
  - (a) connections to risers in duct shafts
  - (b) balancing damper construction,
  - (c) fittings where geometry contemplated is different from that specified.
- .2 in chart form
  - (a) duct system pressure class,
  - (b) duct sheet gauges,
  - (c) joint types and application criteria,
  - (d) location criteria and dimensions for bracing, stiffeners and balancing dampers
  - (e) duct leakage class, and
  - (f) extent of sealing.

## **1.5 Record Drawings**

- .1 As work progresses, mark-up field drawings and submit as part of record of "As-Built" conditions.

## **1.6 Qualifications**

- .1 Ductwork systems to be provided by firm having an established reputation in this field.

# **2 PRODUCTS**

## **2.1 Basic material**

- .1 Galvanized steel:
  - .1 Ducts and connectors: lock forming quality to ASTM A653 or ASTM A924,
    - (a) Z180 (G60) for indoor ductwork,
    - (b) Z275 (G90) zinc coating for outdoor ductwork.
  - .2 Miscellaneous pipe, angles, strips and threaded rod in contact with ductwork: galvanized with a minimum thickness equal to ASTM A653 - Z180 (G60).
- .2 Stainless steel:
  - .1 To ASTM A480, Type 304L
- .3 Aluminum:
  - .1 To ASTM B209;
    - (a) alloy 3003-H14 or 5052-H32 for sheet material.
    - (b) alloy 6061-T6 for plate material
    - (c) alloy 6061-T4 or T6 for shapes material.
- .4 Plain mild carbon steel:
  - .1 To ASTM A1011, A283, A572 and A36 as applicable.

## **2.2 Joints**

- .1 Flanged duct joints:
  - .1 proprietary roll-formed flanges, corner pieces, integral edge seals, gaskets and cleats.
  - .2 material to match that of ductwork being joined.

*Standard of Acceptance*

- ° Ductmate – System 25/35/45
- ° Carlisle Canada - Nexus

**2.3 Sealant and tape**

- .1 To section 23 33 05 Duct Accessories.

**2.4 Hangers and supports**

- .1 Upper hanger attachments;  
.1 in new concrete: manufactured concrete inserts.

*Standard of Acceptance*

- ° Myatt Fig. 485

- .2 for steel joist: galvanized joist clamps or steel plate washer.

*Standard of Acceptance*

- ° Anvil Fig. 61 or 86
- ° Anvil Fig. 60 for plate washer

- .3 for steel beams: galvanized beam clamps.

*Standard of Acceptance*

- ° Anvil Fig. 60

- .2 Seismic supports and restraints to Section 20 05 49 Seismic Restraint

**2.5 Duct access doors**

- .1 To section 23 33 05 Duct Accessories.

**3 EXECUTION**

**3.1 Construction**

- .1 Construction details, sheet gauges, reinforcing, and bracing to be taken from SMACNA HVAC Duct Construction Standards - Metal and Flexible except as otherwise shown.
- .2 Rectangular ductwork:
- .1 longitudinal seams: Pittsburgh Lock, with specified sealant applied prior to hammering of joint,
  - .2 transverse joints: to SMACNA HVAC standards based on pressure class and reinforcement used and sealing requirements.
- .3 Round ductwork, 500 Pa (2 in wg) pressure class and higher:
- .1 spiral flat type longitudinal seam, button punched.
- .4 All exposed ductwork shall be rigid duct with internal acoustic lining. Exposed ductwork shall not have external insulation.
- .5 All exposed ductwork shall be rigid, round spiral seam ducts.

- .6 All exposed ductwork shall be prepared for painting by Others. Ductwork shall be cleaned and all tags and stickers shall be removed prior to painting.

### 3.2 Pressure classification and seal class

- .1 Low pressure ductwork construction classification:

<b>Table 1: Duct Pressure Classification</b>			
Pressure class Pa (in wg)	Operating pressure Pa (in wg)	Velocity m/s (fpm)	Leakage Test Pressure Pa (in wg)
125 (½)	up to 125 (½)	10.0 (2000)	125 (½)
250 (1)	125 to 250 (½ to 1)	12.5 (2500)	250 (1)
500 (2)	250 to 500 (1 to 2)	12.5 (2500)	500 (2)
750 (3)	500 to 750 (2 to 3)	15.0 (3000)	750 (3)
Greater than 750 (3)	High Pressure Ductwork		Not less than 1000 (4)

- .2 Assemble ductwork seams and joints with joint sealant as shown in table 2.
- .3 Sealant application:
- .1 store duct sealant at room temperature for 24 hours before use,
  - .2 apply sealant on seams as noted in table 1, and brush or extrude sealant to cover fasteners,
  - .3 on bell and spigot style joints apply sealant on male section with caulking gun and spread sealant evenly on mating surface with brush,
    - (a) insert fitting and secure with sheet metal screws
    - (b) brush sealant onto outside of assembled joint in 50 mm (2 in) wide band covering fastener heads,
  - .4 allow 40 hours curing time before pressure testing.

**Table 2: Duct System Pressure and Seal Class**

No.	Ductwork System	Static pressure construction class Pa (in.wg.)	Seal class	Sealing requirements (1)(2)(3)(4)
1	Induction unit supply from fan discharge to unit plenum box inlet.	+1000 (4) and up	A	Transverse joints, longitudinal seams, ductwall penetrations, and other connections



**Table 2: Duct System Pressure and Seal Class**

No.	Ductwork System	Static pressure construction class Pa (in.wg.)	Seal class	Sealing requirements (1)(2)(3)(4)
2	Supply risers in vertical service space (duct shafts).	+1000 (4)	B	Transverse joints, longitudinal seams, and other connections
3	Supply air ductwork from discharge side of fan to inlet of terminal box or reheat coil in healthcare and laboratory facilities.	+1000 (4)		
4	Return/exhaust air ductwork between HEPA filters and suction side of fan.	-1000 (4)		
5	Return/exhaust air ductwork between a Heat Recovery Wheel and suction side of fan.	-1000 (4)		
6	Autopsy exhaust ductwork.	-1000 (4)		
7	Supply air ductwork from discharge side of fan to inlet of terminal box or reheat coil;  Return air ductwork on discharge side of fan.	+750 (3)		
8	Return/Exhaust risers in mechanical rooms and vertical service spaces (duct shafts).	-750 (3)		
9	Supply air ductwork upstream of HEPA filters, including diffusers with integral HEPA filters. <sup>(5)</sup>	+750 (3)	C	Transverse joints and other connections
10	Return and/or exhaust air ductwork on suction side of fans <u>other than</u> in mechanical rooms and vertical service spaces.	-500 (2)		
11	Supply air ductwork on downstream side of terminal units or reheat coil;  Exhaust air ductwork on discharge side of fan;  Fan coil units, suction and discharge.	250 (1)	C	Transverse joints only
12	Supply air and return air ductwork from roof top air conditioning units, 5 tons or less	125 (½)	D	No sealing

**Notes for table 2:**

- (1) *Transverse joints* are connections of two duct or fitting elements oriented perpendicular to flow,
- (2) *Longitudinal seams* are joints oriented in direction of flow,
- (3) *Duct wall penetrations* are openings made by screws, non-self-sealing fasteners, pipe, tubing, rod and wire,
- (4) *Other connections* such as spin-ins taps and other branch fittings inserted into cut openings in duct, access door frames, insertion type control elements and duct joints at equipment are to be treated as *transverse joints*.
- (5) *This pressure class also applies to supply ductwork downstream of a terminal box or reheat coil which serve diffusers with integral HEPA filters.*

**3.3 Fittings - Rectangular Ductwork**

- .1 Refer to Annex A at the end of this Section for illustrations of referenced fitting types.
- .2 Elbows:
  - .1 Elbows are to be installed as shown, or if not shown, in descending order as listed in table 3.
    - (a) for clarity, elbows types are to be selected based on the highest order number (where 1 is the highest) which will fit the available space.

**Table 3: Rectangular Duct, Elbows**

Order No.	ASHRAE Fitting No.	Description	Throat Radius Ratio R/W	Duct Width Limit mm (in)	Minimum Throat Radius mm (in)	Remarks
1	CR3-1	Smooth radius Unvaned elbow	1.5	≤ 300 (12)	---	Default
			1.0	> 300 (12)	---	
2	CR3-3	Smooth radius Vaned elbow	0.75	≤ 900 (36)	150 (6)	One full radius single thickness splitter vane
	CR3-4	Smooth radius Vaned elbow	0.75	> 900 (36) ≤ 1500 (60)	150 (6)	Two full radius single thickness splitter vane
	CR3-5	Smooth radius Vaned elbow	0.75	> 1500 (60)	150 (6)	Three full radius single thickness splitter vane
3	CR3-15	Square Mitred Vaned elbow	Square throat; Square heel.	--	---	Double thickness turning vanes;  50 (2) heel radius vane;  54 mm (2.125 in) vane spacing.
4	CR3-2	Radius Heel Sharp Throat	0.5	---	---	Double thickness turning vanes as per CR3-3, 4 or 5 depending on duct width

- .2 First elbow on discharge side of fan:
  - (a) fitting CR3-1, unvaned elbow with throat radius 1.0 times duct width, with the required upstream effective length  $L_e$  of straight length of duct in accordance with fitting type SR7-5 or SR7-9 as applicable.
- .3 Wye and tee branch fittings - Supply air systems:
  - .1 Wye and tee branch fittings are to be installed as shown, or if not shown, as selected from table 4.

<b>Table 4 : Rectangular Duct, Wye and Tee Branch Fittings - Supply Air Systems</b>			
Ref. No.	Supply Ductwork System	Fitting Type	ASHRAE Fitting No
1	For 750 Pa (3 in.w.g) pressure class and above: branch take-off from ducts in shafts, and ducts upstream of terminal boxes, filters and reheat coils	Smooth radius wye; diverging	SR5-1
		Dovetail wye	SR5-14
		Divided flow fittings	(SMACNA) 4A or 4B
		45° entry branch diverging	SR5-13
2	Supply ducts downstream of terminal boxes, fan coil units, reheat coils or heat pumps	Tee, rectangular main to round conical tap	SR5-12
		Tee, 45° entry branch diverging	SR5-13
		Smooth radius wye; diverging	SR5-1

.4 Wye and tee branches - Return/Exhaust air systems:

.1 Wye and tee branch fittings are to be installed as shown, or if not shown, as selected from table 5.

<b>Table 5 : Rectangular Duct, Wye and Tee Branch Fittings - Return/Exhaust Air Systems</b>			
Ref. No.	Return/Exhaust Ductwork System	Fitting Type	ASHRAE Fitting No
1	All pressure classes including branch connections at duct shafts	Smooth radius wye; converging	ER5-1
		Dovetail wye	ER5-4
		Divided flow fittings	(SMACNA) 4A or 4B
		45° entry branch diverging, where shown on drawings	ER5-3

.5 Transitions (Rectangular and Round):

.1 converging: maximum 20° angle between ductside and direction of flow,

.2 diverging: maximum 15° angle between ductside and direction of flow.

.6 Fabricate duct offsets using elbows selected in accordance with table 2 and as follows:

.1 single offset in single plane, less than duct height: made up with two 45° elbows,

.2 single offset, of greater displacement, made up with 90° elbows,

.3 double offset in single plane, less than duct height, made up with four 45° elbows,

.4 double offset in single plane, of greater displacement than duct height, made up with 90° elbows.

.7 Obstructions passing through duct:

.1 covered by round nosed streamline enclosure where free area of duct is reduced by less than 15%,

.2 fitted in round nosed streamline enclosure with duct width increase, SMACNA HVAC FIG 2-10, Detail E , with converging and diverging transition angle requirements as specified above.

### 3.4 Fittings - Round Ductwork

.1 Refer to Annex A at the end of this Section for illustrations of referenced fitting types.

.2 Elbows:

.1 Elbows are to be installed as shown, or if not shown, in order of available space as listed in table 6.

<b>Table 6 : Round Duct, Elbows</b>					
Ref. No.	Description	ASHRAE Fitting No.	Throat Radius Ratio R/W	Duct Width Limit mm (in)	Remarks
1	30° elbow	CD3-3*	1.5	≤ 300 (12)	Die stamped
		CD3-14*	1.5	> 300 (12)	2-Gore
2	45° elbow	CD3-3	1.5	≤ 300 (12)	Die stamped
		CD3-14	1.5	> 300 (12)	3-Gore
3	60° elbow	CD3-3*	1.5	≤ 300 (12)	Die stamped
		CD3-14*	1.5	> 300 (12)	4-Gore
4	90° elbow	CD3-1	1.5	≤ 200 (8)	Die stamped
		CD3-9	1.5	>200 (8) and ≤ 350 (14)	5-Gore
		CD3-10	1.5	>350 (14) and ≤ 900 (36)	7-Gore
			2.5	> 900 (36)	7-Gore

.3 Wye branches:

.1 Wye and tee branch fittings are to be installed as shown, or if not shown, as selected from table 7.

<b>Table 7 : Round Duct, Wye and Tee Branch Fittings</b>			
Ref. No.	Supply Ductwork System	Fitting Type	ASHRAE Fitting No
1	Downstream of supply fan.	Wye branch plus 45° elbow	SD5-2
		Tee, tapering	SD5-12
2	Downstream of terminal boxes.	Wye branch plus 45° elbow	SD5-1
		Tee, tapering	SD5-10
3	Return or exhaust duct branches.	Wye branch plus 45° elbow	ED5-2
4	Return or exhaust duct branches; equal main and branch duct size.	Tee, tapering, with 45° elbow	SD5-2

**Table 7 : Round Duct, Wye and Tee Branch Fittings**

Ref. No.	Supply Ductwork System	Fitting Type	ASHRAE Fitting No
5	Return or exhaust duct branches; smaller branch size.	Tee, tapering, with 45° elbow	SD5-12

**3.5 Balancing dampers**

- .1 Provide splitter dampers where branch connections are taken from supply mains.
- .2 Provide single blade dampers on each branch of supply air systems downstream of terminal boxes.
- .3 Provide Opposed Blade Dampers (OBD) at branch and main connection on exhaust and return air systems.

**3.6 Finishing, fastening and supports**

- .1 Hammer edges and slips to leave smooth finished surface inside duct.
- .2 Support vertical ducts with angles riveted to duct and bearing on building structure.
- .3 Hangers;
  - .1 Duct side up to maximum 500 mm (20 in) supported with strap hangers of same material as duct but one sheet metal thickness heavier.
  - .2 Extend strap hangers down duct side and turn under 50 mm (2 in) fastening securely to side and underside of duct.
  - .3 Duct side greater than 500 mm (20 in) supported with trapeze hangers constructed from galvanized steel angle with steel rods in accordance with table 8;

**Table 8 : Duct Hangers**

Duct size mm (in)	Angle size mm (in)	Rod size mm (in)
up to 750 (up to 30)	25x25x3 (1x1x $\frac{1}{8}$ )	6 ( $\frac{1}{4}$ )
750 to 1050 (30 to 40)	40x40x3 (1 $\frac{1}{2}$ x1 $\frac{1}{2}$ x $\frac{1}{8}$ )	6 ( $\frac{1}{4}$ )
1050 to 1500 (40 to 60)	40x40x3 (1 $\frac{1}{2}$ x1 $\frac{1}{2}$ x $\frac{1}{8}$ )	10 ( $\frac{3}{8}$ )
1500 to 2400 (60 to 90)	50x50x3 (2x2x $\frac{1}{8}$ )	10 ( $\frac{3}{8}$ )
2400 and over (90 and over)	50x50x6 (2x2x $\frac{1}{4}$ )	10 ( $\frac{3}{8}$ )

- .4 Maximum hanger spacing: 2.4 m (8 ft) on centre.

**3.7 Sheet metal plenums:**

- .1 50 mm (2 in) thick thermally insulated double wall construction,

- .2 inner (cold side) wall of galvanized steel,
- .3 outer (room side) wall of galvanized steel,
- .4 50 mm (2 in) thick, 72 kg/m<sup>3</sup> (4 lb/ft<sup>3</sup>) density, glass fibre insulation, foil backed with vapour barrier on inner wall side,
- .5 watertight, welded stainless steel type 304 floor panels, with upturned 50 mm (2 in) perimeter lip,
- .6 thermal break; between adjacent wall panels, between wall panels and plenum roof panels, and between wall/roof panels and building structure.

### 3.8 Protection of duct openings

- .1 Cap off ends of unfinished ducts while plastering, drywall and other finishing operations are in progress,
- .2 Cover open ends or registers of active exhaust/return ducts with 25 mm (1 in) thick filter media secured with tape. Maintain media until dust producing finishing operations are completed.

### 3.9 Duct access doors

- .1 Provide for inspection and servicing of duct mounted components and cleaning of duct system;
  - .1 located such that any section of duct is not more than 15 m (50 ft) from point of access,
  - .2 at base of each accessible duct riser,
  - .3 in front of and behind duct mounted coils,
  - .4 at activation side of fire, smoke, and combination fire/smoke dampers,
  - .5 and motorized dampers where damper actuator is located inside of duct or plenum.
- .2 Door size:
  - .1 Select access door sizes based on smallest duct dimension in accordance with table 9.

<b>Table 9 : Access Door Sizes</b>			
Smallest Duct Dimension mm (in)	Bottom of duct height above floor m (ft)	Location	Door Size mm (in)
≤ 350 (14)	Any	Side or bottom	300 x 150 (12x6)
>350 and ≤500 (>14 and ≤20)	Any	Side or bottom	450 x 250 (18x10)
>500 (>20)	≤3.6 (12)	Side or bottom	530x350 (21x14)
	>3.6 (12)	Bottom	635x430 (25x17)

**3.10 Leak testing**

- .1 Test air duct systems for leaks at 1.00 times pressure specified for class as follows;
  - .1 between supply air handling units and terminal units
  - .2 between supply air handling units and air supply outlets on supply systems without terminal units
  - .3 between inlet grilles and exhaust/return fan inlet, and fan outlet and exhaust or mixing plenum, on return/exhaust systems,
  - .4 following parts of system are exempt from pressure testing;
    - (a) short duct runs of 15 metres (45 feet) or less, operating at 37 Pa (1/8 in) SP or less.
    - (b) ductwork installed downstream of terminal boxes and fan coil units.
- .2 Conduct test in accordance with Associated Air Balance Council (AABC) recommended procedures.
- .3 Where audible air noise is detected during test, remove test, pressure apply sealant to leaking joints and seams, and retest after 48 hours. Continue testing and sealing until leaks are inaudible.
- .4 Allowable ductwork leakage to be lesser of,
  - .1 1% of system airflow, or
  - .2 value calculated from following formula;

$$F = K \times C_L \times P^{0.65}$$

$$L = (A \times F) / 100, \text{ or}$$

$$L = (A \times K \times C_L \times P^{0.65}) / 100$$

<b>Table 10: Flow Measurement Units</b>				
	Term	Flow Measurement		
		m <sup>3</sup> /s	l/s	CFM
F	leakage coefficient	m <sup>3</sup> /s per 100m <sup>2</sup>	l/s per m <sup>2</sup>	CFM per 100 ft <sup>2</sup>
C <sub>L</sub>	leakage coefficient	Refer to table 11 below		
P	test pressure	kPa	kPa	in.wc.
L	Allowable leakage	m <sup>3</sup> /s	L/s	CFM
A	Duct surface area	m <sup>2</sup>	m <sup>2</sup>	ft <sup>2</sup>
K	unit conversion	1.24 x 10 <sup>-2</sup>	1	1

<b>Table 11: Leakage Coefficient, C<sub>L</sub></b>			
Duct Type	Seal Class		
	C	B	A
Rectangular metal	24	12	6



<b>Table 11: Leakage Coefficient, <math>C_L</math></b>			
Duct Type	Seal Class		
	C	B	A
Round Metal	12	6	3
Unsealed rectangular metal duct	48	48	48
Unsealed round or oval metal duct	30	30	30

- .5 Calculate duct surface area for each test section and determine allowable leakage in accordance with formulae above. Test duct at pressure for specified class for 15 minutes. If leakage rate exceeds allowable value, caulk and seal joints, and repeat testing caulking and sealing process until measured leakage rate is less than calculated allowable value for section under test.
- .6 Maintain set of drawings on site, coloured each day during testing to indicate extent of duct satisfying leakage criteria under test.
- .7 Submit a written report, verified by TAB Agent, identifying each segment of duct system tested, showing calculation of allowable leakage, test pressure and leakage value measured under test, and certifying that leakage testing has been satisfactorily completed.

### **3.11 Duct cleaning**

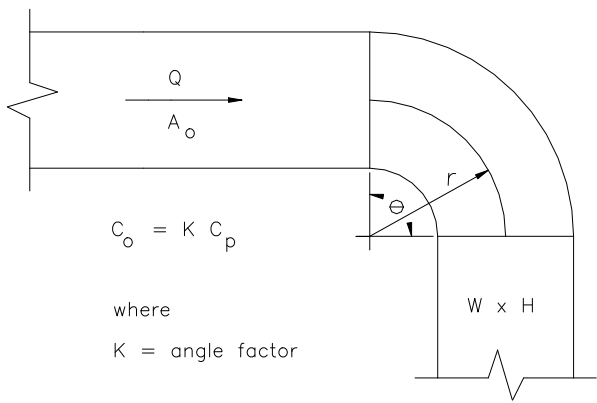
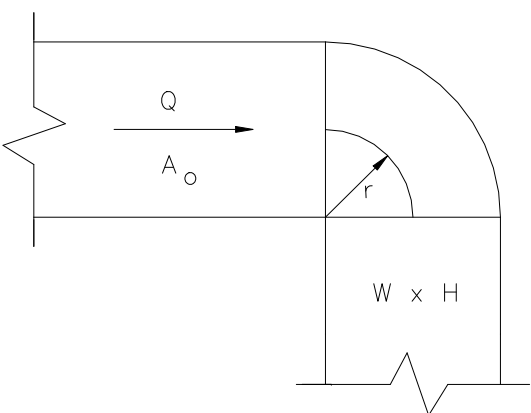
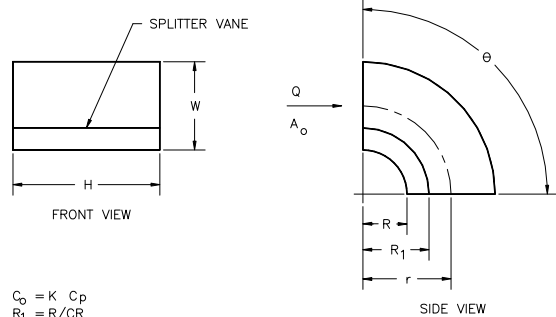
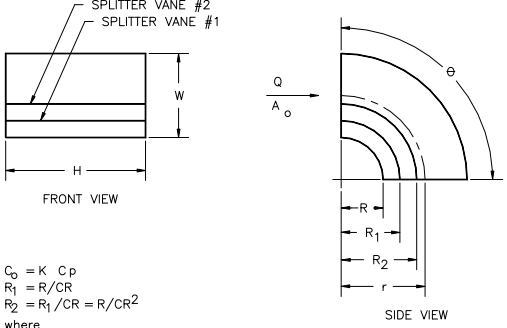
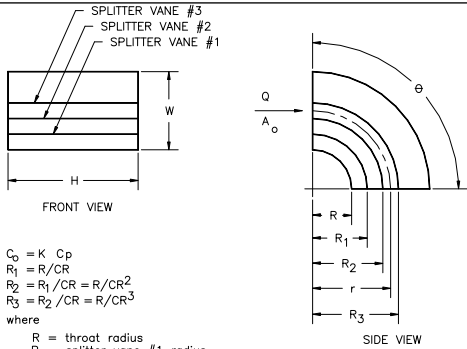
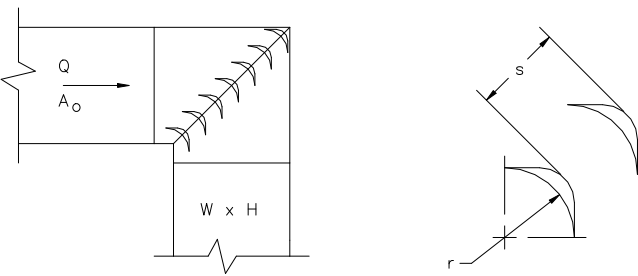
- .1 Cleaning to be performed by agent specializing in this field of work, be a member in good standing with National Air Duct Cleaners Association (NADCA), and to comply with NADCA standards.
- .2 Clean new horizontal and vertical ducts (supply, return, exhaust, transfer), as well as, existing supply and return ductwork connected to new fan systems.
- .3 Clean ductwork using high powered vacuum system, hand tools and mechanical brushing systems such that metal surfaces are visibly clean.
- .4 Reset balancing dampers to original settings if moved during work. Have TAB Agent confirm damper settings.
- .5 Maintain set of drawings on site, coloured each day during cleaning to indicate extent of duct cleaning completed.
- .6 Submit a written report, verified by TAB Agent, identifying extent of duct system cleaning and certifying that NADCA standards have been met.

### **3.12 Fitting Illustrations**

- .1 Illustrations of fitting referenced in this specification follows in Annex A.

Annex A – Illustration of Referenced Fittings

Rectangular Elbows (see Table 3)

<div>  <div> <math>C_o = K C_p</math>   where  <math>K = \text{angle factor}</math> </div> </div>		<div>  </div>	
CR3-1	CR3-2		
<div>  <div> <math>C_o = K C_p</math>  <math>R_1 = R/CR</math>  where  <math>R = \text{throat radius}</math>  <math>R_1 = \text{splitter vane radius}</math>  <math>CR = \text{'CURVE RATIO'}</math>  <math>K = \text{angle factor}</math> </div> </div>		<div>  <div> <math>C_o = K C_p</math>  <math>R_1 = R/CR</math>  <math>R_2 = R_1/CR = R/CR^2</math>  where  <math>R = \text{throat radius}</math>  <math>R_1 = \text{splitter vane \#1 radius}</math>  <math>R_2 = \text{splitter vane \#2 radius}</math>  <math>CR = \text{'CURVE RATIO'}</math>  <math>K = \text{angle factor}</math> </div> </div>	
CR3-3	CR3-4		
<div>  <div> <math>C_o = K C_p</math>  <math>R_1 = R/CR</math>  <math>R_2 = R_1/CR = R/CR^2</math>  <math>R_3 = R_2/CR = R/CR^3</math>  where  <math>R = \text{throat radius}</math>  <math>R_1 = \text{splitter vane \#1 radius}</math>  <math>R_2 = \text{splitter vane \#2 radius}</math>  <math>R_3 = \text{splitter vane \#3 radius}</math>  <math>CR = \text{'CURVE RATIO'}</math>  <math>K = \text{angle factor}</math> </div> </div>		<div>  <div> <math>r = 2.0 \text{ (50)}, s = 2.125 \text{ (60) in.(mm)}</math> </div> </div>	
CR3-5	CR3-15		

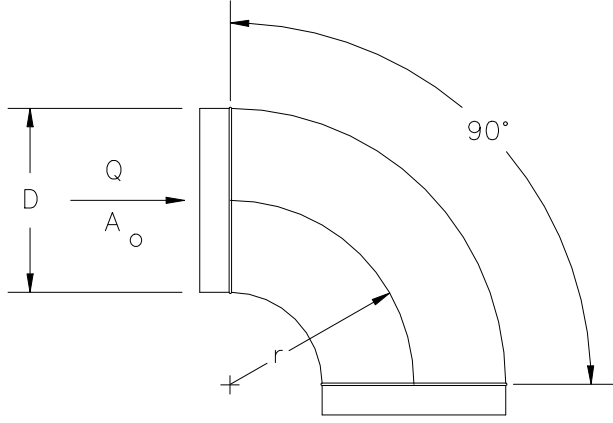
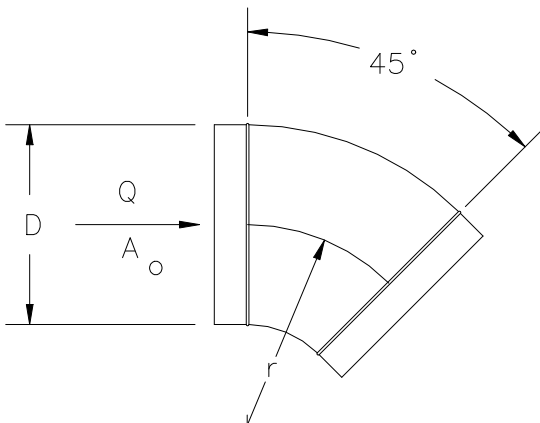
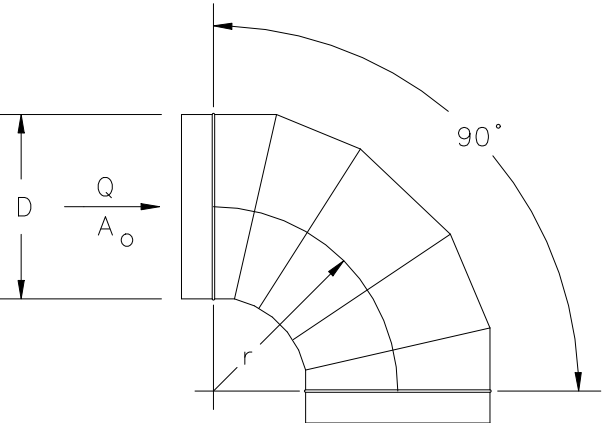
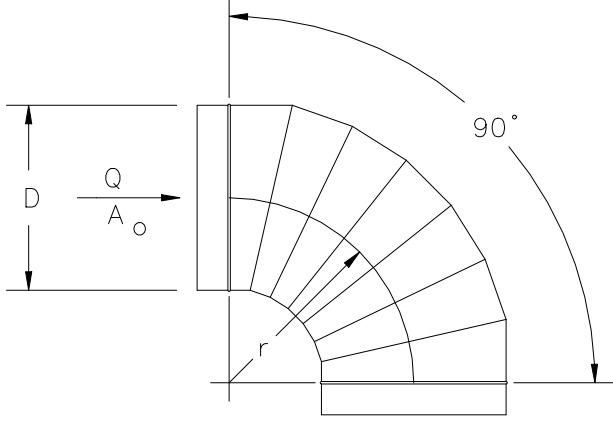
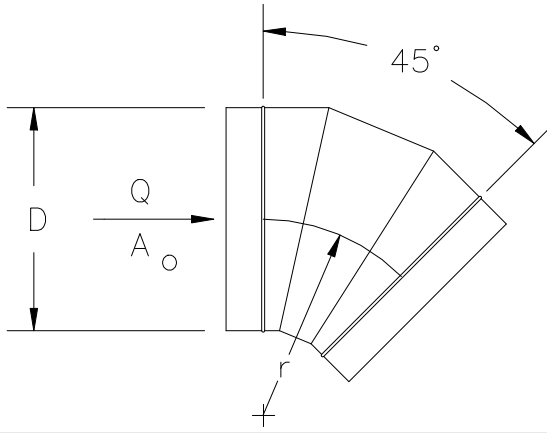
**Rectangular Wyes and Tee's – Supply Ductwork** (see Table 4)

<p><math>A_s = A_b \geq A_c</math> <math>r/W_b = 1.0</math></p>	<p><math>L = 4 \text{ in. (100mm)}</math></p>
<p><b>SR5-1</b></p> <p><math>L = 0.25W_b, 3 \text{ in. (75mm) min.}</math></p>	<p><b>SR5-12</b></p> <p><math>r/W_c = 1.5</math> <math>Q_{b1}/Q_c = Q_{b2}/Q_c = 0.5</math> <math>W_{b1} = W_{b2} = W_b</math></p>
<p><b>SR5-13</b></p> <p><b>SMACNA Fig. 4A/4B</b></p>	<p><b>SR5-14</b></p>

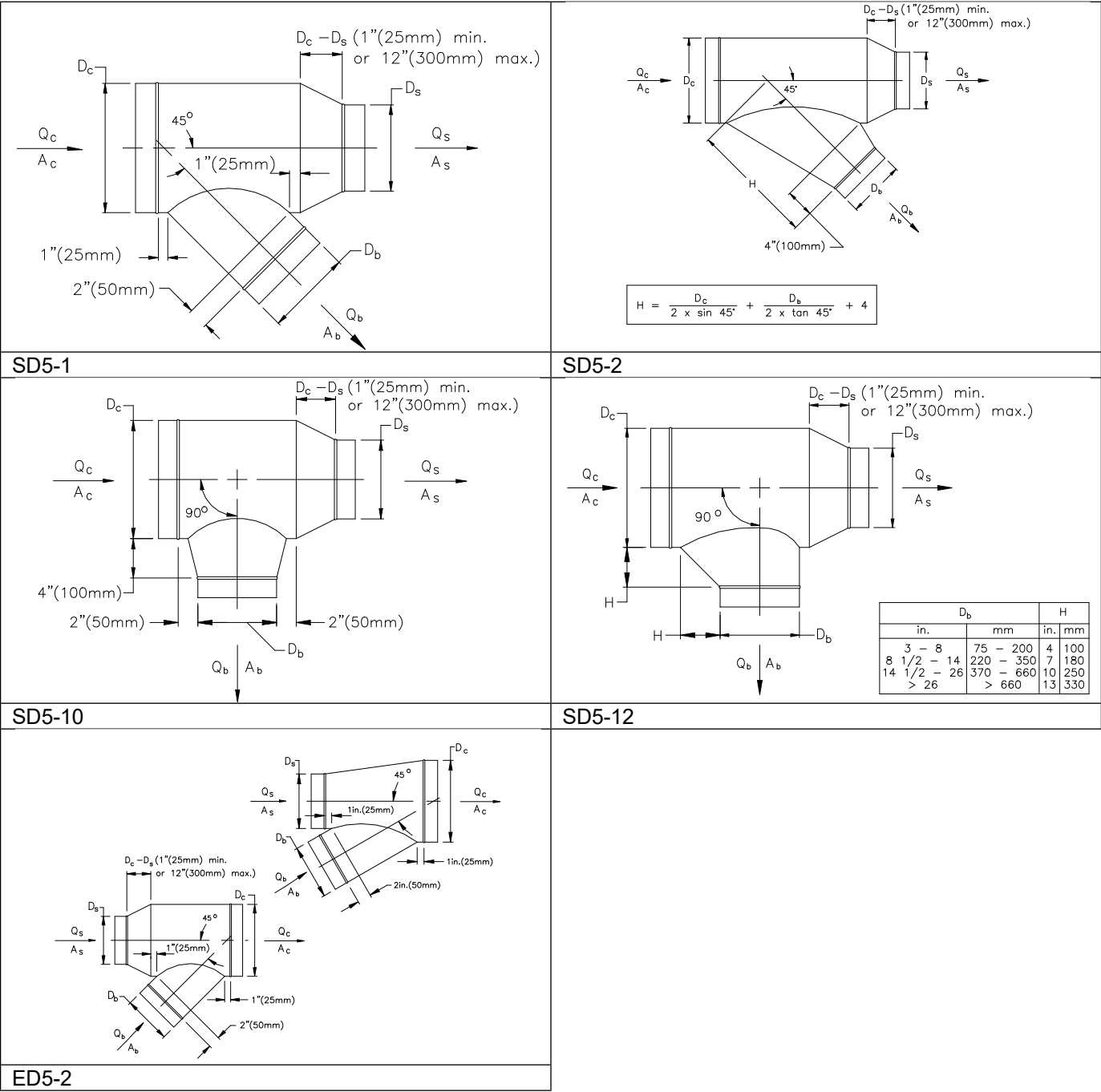
Rectangular Wyes and Tee's – Return/Exhaust Ductwork (see Table 5)

<div> <div> <math>A_s + A_b \geq A_c</math>  <math>r/W_b = 1</math> </div> </div>	<div> <div> <math>L = 0.25 W, 3 \text{ in. (75 mm) min.}</math>  <math>A_s = A_c</math>  <math>A_b/A_c = 0.5</math> </div> </div>
<div> <div>ER5-1</div> <div> <math>r/W_c = 1.5</math>  <math>Q_{b1}/Q_c = Q_{b2}/Q_c = 0.5</math>  <math>W_{b1} = W_{b2} = W_b</math> </div> </div> <div>ER5-4</div>	<div> <div>ER5-3</div> </div>

**Round Elbows (see Table 6)**

	
CD3-1	CD3-3
	
CD3-9	CD3-10
	
CD3-14	

Round Wyes and Tees (see Table 7)



END OF SECTION

## **ACOUSTIC LINING (DUCTWORK & PLENUMS)**

### **23 32 48**

## **1 GENERAL**

### **1.1 Scope**

- .1 Provide acoustic lining for
  - .1 all transfer ducts,
  - .2 all ductwork 15' upstream and downstream of all fans,
  - .3 all ductwork 15' downstream of VAV boxes,
  - .4 and as shown.

## **2 PRODUCTS**

### **2.1 Duct liner - Elastomeric**

- .1 flexible, closed cell elastomeric insulation in sheet form with self-adhering backing or flexible polyimide foam insulation
- .2 flame spread rating not to exceed 25, smoke development rating not to exceed 50.
- .3 for rectangular ductwork, plenums and casings use 25 mm (1 in) insulation,
- .4 for round or oval ductwork and curved surfaces use 25 mm (1 in) insulation.

#### *Standard of Acceptance*

- ° Armacell AP Armaflex SA
- ° Manville - Polycoustic.

### **2.2 Adhesive**

- .1 flame spread rating not to exceed 25, smoke developed rating not to exceed 50,
- .2 temperature range- 40°C to 82°C (- 40°F to 180°F),
- .3 meet requirements of NFPA 90A.

#### *Standard of Acceptance*

- ° Armacell 520 Adhesive
- ° DuroDyne 1A-22
- ° Foster
- ° S.M. Adhesives
- ° Goodloe & Moore - Tuff Bond

### **2.3 Fasteners**

- .1 2.0 mm (1/16 in) diameter weld pins,
- .2 Length selected to suit thickness of insulation,
- .3 32 mm (1¼ in) square Nylon retaining clips.

*Standard of Acceptance*

- DuroDyne PN series with NC series clips
- Goodloe & Moore - Gemco

**2.4 Sealer and tape**

- .1 Armstrong WB Armaflex Finish, Manville SuperSeal coating, OR Childers CHILSPRAY WB CP-56 Adhesive, and
- .2 Polyvinyl treated open weave fibreglass membrane 50mm (2 in) wide.

*Standard of Acceptance*

- Duro Dyne FT-2

**2.5 Metal liner**

- .1 0.5 mm (26 ga) galvanized perforated metal liner for ducts where air velocity exceeds 10 m/sec (2000 fpm).
- .2 1.6 mm (16 ga), 20 mm x 10 mm (¾ in x ⅝ in) flattened expanded metal lath for plenums and casings.

**3 EXECUTION****3.1 Installation**

- .1 Duct size indicated to be size as measured inside liner
- .2 Fasten liner to interior sheet metal surface of duct with 100% coverage of adhesive, and install weld pins at 1 pin per 0.5m<sup>2</sup> (5 sq ft) but not less than 1 row on each duct side.
- .3 Position and adhere sheets to overlap previously installed sheets by 4 mm (1/8 in). After bonding of sheets spread butt joints and brush apply adhesive to both butt edges and apply pressure to joint.
- .4 Apply tape to joints, exposed edges, weld pins and clip penetrations and damaged areas of liner.
- .5 Bed tape in sealer and apply 2 coats of sealer over tape.
- .6 Over acoustic insulation in round or oval ductwork where air velocity exceeds 10 m/sec (2000 fpm) apply perforated metal liner and secure with weld pins and speed washers.
- .7 Lining in plenums and casings:
  - .1 adhered and pinned as for ductwork,
  - .2 in addition apply flattened expanded metal lath secured with weld pins and speed-washers over liner and fasten 50 mm (2 in) edge nosings crimped from 1 mm (20 ga) galvanized corner angles at leading and trailing edges of liner.
- .8 Provide expanded metal mesh over acoustic lining in accessible ductwork and on casing and plenum roofs walls and floors.

**END OF SECTION**



## **DUCT ACCESSORIES**

### **23 33 05**

## **1 GENERAL**

### **1.1 Scope**

- .1 Provide duct accessories as shown.

### **1.2 Shop drawings**

- .1 Submit product data sheets for:
  - .1 flexible connections
  - .2 sealants
  - .3 tapes
  - .4 duct access doors and hardware
  - .5 instrument test ports

## **2 PRODUCTS**

### **2.1 Flexible connections**

- .1 Neoprene:
  - .1 galvanized 0.66 mm (24 ga) sheet metal frame, with fabric clenched with double locked seams,
  - .2 fire resistant, self-extinguishing, neoprene coated glass fabric,
  - .3 operating temperature: -40°C to 90°C (-40°F to 194°F),
  - .4 density: 0.653 kg/m<sup>2</sup> (0.13 lb/sq ft) in conventional systems.

#### *Standard of Acceptance*

- ° Duro-Dyne - Durolon
- ° Ventfabric - Ventglas
- ° Elgin - Neoprene

- .2 Vinyl coated, insulated:
  - .1 flame resistant, 0.56 mm (0.022 in) thick vinyl coated fabric envelope, enclosing 32mm (1¼ in), 12kg/m<sup>3</sup> (0.75 lb/cu ft) fiberglass insulation,
  - .2 operating temperature: 82°C (180°F) continuous and 93°C (200°F) intermittent,
  - .3 installed;
    - (a) in connections for insulated duct systems,
    - (b) in circular duct connections subject to negative pressure with diameter less than 250mm (10 in), and
    - (c) in rectangular duct connections subject to negative pressure with smallest side less than 300mm (12 in)

#### *Standard of Acceptance*

- ° Duro-Dyne - Insulflex

## **2.2 Sealant**

- .1 water based polymer emulsion type flame resistant duct sealing compound.
- .2 operating temperature range: -29°C to 93°C (-20°F to 200°F).

### *Standard of Acceptance*

- Bakor 530 - 14
- RCD #6
- 3M Fastbond 900
- Childers CP-145a & CP-146
- United Duct Sealer (water based)
- Duro Dyne DWN (water based)

## **2.3 Tape**

- .1 polyvinyl treated open weave glass fibre tape, 50mm (2") wide.

### *Standard of Acceptance*

- Duro-Dyne FT-2

## **2.4 Duct access doors**

- .1 Construction - uninsulated duct or plenum:
  - .1 shop or field fabricated from same material as duct, one sheet metal thickness heavier but not less than 0.6mm (26ga.) thick,
  - .2 with gasketed sheet metal angle frame.
- .2 Construction - insulated duct or plenum:
  - .1 shop fabricated as double wall insulated sandwich, of same material as duct, one sheet metal thickness heavier but not less than 0.6mm (26ga) thick,
  - .2 with gasketed sheet metal angle frame and 25 mm (1 in) thick rigid glass fibre insulation.
- .3 gasketed with neoprene or foam rubber.
- .4 fitted with hardware as follows: two sash locks for doors up to 300 mm x 300 mm (12 in x 12 in).
  - .1 four sash locks for doors up to 301 mm x 450 mm (13 in x 18 in).
  - .2 piano hinge and minimum 2 sash locks for doors up to 451 mm x 1000 mm (19 in x 40 in)
  - .3 piano hinge and 2 handles operable from both sides for doors over 1000 mm (40 in) in height.

### *Standard of Acceptance*

- Duro-Dyne SP-21 for door handles

## **2.5 Instrument test ports**

- .1 Construction:
  - .1 1.6 mm (16 ga.) thick steel body zinc plated after manufacture,
  - .2 chain secured neoprene expansion plug with cam lock handle,
  - .3 28 mm (1 in) minimum inside diameter, length to suit insulation thickness,
  - .4 Neoprene mounting gasket: flat for rectangular duct and moulded for round duct.

*Standard of Acceptance*  
° Duro-Dyne IP1 or IP2

### **3 EXECUTION**

#### **3.1 Flexible connections**

- .1 Provide to isolate air handling equipment, fans, ductwork, and as shown.
- .2 Minimum length: 75 mm (3 in) length of fabric measured in direction of air flow,
- .3 Minimum distance between metal parts when system is in operation: 25 mm (1 in).
- .4 Anchored on static side of connection.

#### **3.2 Sealant and tape**

- .1 Apply to ductwork joints and seams as detailed in other sections.

#### **3.3 Access doors**

- .1 Install in ductwork;
  - .1 before and after reheat coils, and at
  - .2 fire dampers,
  - .3 duct smoke detectors,
  - .4 volume control devices, and
  - .5 control elements.
- .2 Weld door frames in place for plenums, casings, and high velocity ductwork.
- .3 Door sizes:
  - .1 as large as possible, with 1:1.5 aspect ratio, for duct sides up to and including 360 mm (14 in),
  - .2 300 mm x 380 mm (12 in x 15 in) for duct sides 380 mm (15 in) and larger,
  - .3 1500 mm (60 in) high by 450 mm (18 in) wide in casings and plenums.

#### **3.4 Instrument test ports**

- .1 Install for duct velocity traverse readings and for duct air temperature readings.
- .2 Locate across duct or plenum at right angles to flow, at not more than 250 mm (10 in) intervals for traverses and at not more than 500 mm (20 in) for temperature measurements.
- .3 Install for velocity traverses;
  - .1 at ducted inlets to roof and wall exhausters,
  - .2 at inlet to and outlet from other fan systems, and
  - .3 at main and branch where branch serves more than one outlet. Ports in main to be upstream of branch in both diverging and converging flow.
- .4 Install for temperature measurement;
  - .1 at outside air intakes,

- .2 at inlet and outlet of coils, and
- .3 downstream of intersection of converging air streams of different temperatures.

**END OF SECTION**

## **DAMPERS - BALANCING**

### **22 33 13**

## **1 GENERAL**

### **1.1 Scope**

- .1 Provide balancing dampers as shown.

## **2 PRODUCTS**

### **2.1 Splitter dampers**

- .1 Construction:
  - .1 single thickness construction, of same material as duct but one sheet metal thickness heavier where both dimensions of damper blade are less than 300 mm (12 in),
  - .2 double thickness construction, one metal thickness lighter than duct, where either dimension of damper blade is 300 mm (12 in) or larger,
  - .3 of height equal to full depth of branch duct and length 1½ times branch duct width.
  - .4 fitted with piano hinge pivot, control rod, and locking device accessible from outside fitting.

### **2.2 Single blade dampers in rectangular ductwork**

- .1 Construction:
  - .1 shop fabricated of same material and sheet metal thickness as duct, stiffened with longitudinal V-grooves.
  - .2 maximum aspect ratio: 3:1,
  - .3 maximum blade height: 250 mm (10 in).
  - .4 fitted with locking quadrant and inside and outside bearings.

### **2.3 Multi-blade dampers in rectangular ductwork**

- .1 Construction:
  - .1 shop fabricated of same material and sheet metal thickness as duct, stiffened with longitudinal V-grooves.
  - .2 opposed blade configuration
  - .3 channel frame with angle blade stop,
  - .4 maximum blade height: 100 mm (4 in),
  - .5 maximum blade length: 1200 mm (48 in).
  - .6 bearings with bronze bushings.
  - .7 shaft extension with locking quadrant.

### **2.4 Single blade dampers in round ductwork**

- .1 Construction:
  - .1 shop fabricated butterfly type with round edged 3.5 mm (10 ga) disk set in round sheet metal housing, fitting snugly when closed, 10 degrees from vertical,

- .2 fitted with rubber packing glands, shaft extension, wing nuts, and indexing device to indicate disk position.

### **3 EXECUTION**

#### **3.1 Manual dampers**

- .1 Install dampers:
  - .1 where branch serving more than two outlets is taken from main supply duct, use splitter damper in take-off fitting, or single or multiple blade damper in branch.
  - .2 where branch joins main return or exhaust duct use single or multiple blade damper in branch.
- .2 Install splitter dampers and single or multiple blade dampers where branches are taken from or feed into main ducts as specified above.
- .3 Provide other manual dampers as shown.

#### **3.2 Access for adjustment**

- .1 Locate dampers to allow adjustment of blade position and locking of quadrant and for servicing damper actuators on motorized dampers.

**END OF SECTION**

## **DAMPERS - OPERATING**

### **23 33 14**

## **1 GENERAL**

### **1.1 Scope**

- .1 Provide motorized dampers as shown.

### **1.2 Related sections**

- .1 Dampers complying with this section:
  - .1 25 35 01: B.A.S. Instrumentation and Actuators

### **1.3 Shop drawings and product data**

- .1 Submit manufacturer's catalogue literature with:
  - .1 performance charts, pressure drop vs approach velocity for range of blade angles from 0 to 90°
  - .2 torque requirements.
  - .3 construction details.

## **2 PRODUCTS**

### **2.1 Multi-leaf dampers**

- .1 Parallel blade type:
  - .1 for two position, OPEN/CLOSED, service
  - .2 for modulating fresh and return service in air handling units.
- .2 Opposed blade type
  - .1 for other modulating service.
- .3 Performance:
  - .1 leakage in closed position: maximum 2% of rated air flow at 500Pa (2 in wg) differential across assembly,
  - .2 pressure drop in open position: maximum 50 Pa (0.2 in wg) differential at 5 m/s (1000 fpm).
- .4 Construction:
  - .1 blades, non-insulated: extruded aluminum interlocking blades,
  - .2 frame, non-insulated: extruded aluminum,
  - .3 blades, insulated: extruded aluminum interlocking double thickness insulated blades,
  - .4 frame, insulated: extruded aluminum, thermally broken,
  - .5 seals: extruded vinyl seals, and spring stainless steel side seals,
  - .6 maximum blade width: 125 mm (5 in),
  - .7 maximum blade length: 1200 mm (4 ft).
  - .8 self-lubricated bronze bearings.
  - .9 blade linkage with steel tie rods, brass pivots and steel brackets.

.5 Actuator:

- .1 24 Volt electric actuator with spring return stroking damper from closed to open with 4 -20 mA signal.

*Standard of Acceptance*

- ° Belimo - electric actuators

### **3 EXECUTION**

#### **3.1 Installation**

- .1 Secure dampers within ductwork, air handling units and at air inlets an exhaust outlets, and as shown.
- .2 Caulk around frames and between multiple damper modules with UL listed silicone-free sealant.

**END OF SECTION**



## **FLEXIBLE DUCTWORK**

### **23 33 46**

## **1 GENERAL**

### **1.1 Scope**

- .1 Provide flexible ductwork as shown.

### **1.2 Reference standards**

- .1 Conform to;
  - .1 ULC S110 Fire tests for air ducts.
  - .2 ULC 181 Factory made air ducts and connections.
  - .3 NFPA 90A Installation of air conditioning and ventilating systems.
  - .4 NFPA 90B Installation of warm air heating and air conditioning systems.
  - .5 SMACNA Flexible duct installation standards

### **1.3 Product data**

- .1 Submit manufacturer's data sheets for each product showing;
  - .1 Thermal properties.
  - .2 Friction loss characteristics,
  - .3 Acoustical loss factors,
  - .4 Leakage rates,

## **2 PRODUCTS**

### **2.1 Flexible ductwork**

- .1 General requirements:
  - .1 maximum working pressure: 1.5 kPa (6 in wg),
  - .2 maximum negative working pressure: 1.25 kPa (5 in.wg.)
  - .3 pressure drop coefficients as listed below based on sheet metal duct pressure drop coefficient of 1.00,
  - .4 flame spread rating not to exceed 25 and smoke developed rating not to exceed 50.
  - .5 Listed to ULC-S110 as a Class 1 product.

#### *Standard of Acceptance*

- Flexmaster
- Peppertree Air Solutions Inc
- Trans Continental Equipment

### **2.2 Nonmetallic flexible ductwork**

- .1 Construction:
  - .1 coated mineral base fabric type helically supported by steel wire,
  - .2 maximum pressure drop coefficient: 3,

.3 airtight.

### **2.3 Nonmetallic insulated flexible ductwork**

.1 Construction:

- .1 coated mineral base fabric type helically supported by steel wire with factory applied flexible glass fibre thermal insulation with vapour barrier and vinyl or aluminum jacket, maximum "U" value of 1.25 W/m<sup>2</sup>/K (0.22 Btu/hr/sq.ft/°F),
- .2 maximum pressure drop coefficient:3,
- .3 airtight.

### **2.4 Sealing compound**

*Standard of Acceptance*

- Durodyne
- Transcontinental Equipment
- Dyn Air

## **3 EXECUTION**

### **3.1 Duct installation**

- .1 Length of flexible duct feeding ceiling outlet: 1.5 to 2 m (5 to 6 ft)
- .2 Do not install flexible duct on exhaust grilles serving high humidity spaces including shower rooms, bathing rooms, pools, equipment process rooms, cold rooms with temperatures below 15°C (60°F), kitchens including clean-up areas, and central sterile processing areas.
- .3 Provide flexible duct and make connections to supply diffusers and grilles as shown. Do not use flexible duct connectors on return or exhaust air grilles unless shown.
- .4 Use sealing compound and tape at connection points between sheet metal and flexible duct. Make a further mechanical connection using sheet metal screws.
- .5 Centre-line radius of bends in flexible ductwork to be greater than one duct diameter.
- .6 Do not install flexible ductwork through floors, partitions or masonry walls.

**END OF SECTION**

## **FANS** **23 34 05**

### **1 GENERAL**

#### **1.1 Scope**

- .1 Provide fans of type, size and performance as shown.

#### **1.2 Shop drawings and product data**

- .1 Submit shop drawings showing outline dimensions, motor mounting details, inlet and outlet connection details, motor characteristics, drive arrangement and weight.
- .2 Submit certified performance curves for each fan showing efficiency, static pressure and power input as KW (brake horsepower) from shut-off to free delivery through scheduled point of rating.

#### **1.3 Reference standards**

- .1 Fan ratings:
  - .1 established by tests performed in accordance with AMCA 210, (ASHRAE 51) Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
- .2 Sound ratings;
  - .1 taken from tests performed in accordance with
    - (a) AMCA 300, Reverberant Room Method for Sound Testing of Fans,
    - (b) AMCA 320, Laboratory Methods of Sound Testing Fans Using Sound Intensity, or
    - (c) AMCA 330, Laboratory Method of Testing to determine Sound Power in a Duct,
  - .2 and presented using
    - (a) AMCA 301, Methods of Calculating Fan Sound Ratings from Laboratory Test Data.
- .3 Construct fans to conform to AMCA 99, Standards Handbook.
- .4 Fan class to conform with AMCA 99-2408, Operating Limits for Centrifugal Fans.

### **2 PRODUCTS**

#### **2.1 General**

- .1 Space allocation, motor sizes, base details, connection arrangements and performance are based on fan equipment by manufacturers as shown in schedules.
- .2 Fans:
  - .1 labelled with Air Performance, or Sound and Air Performance AMCA Certified Rating Seals
  - .2 of same manufacture for similar applications, but may be chosen from other manufacturers' product lines for other different applications.
  - .3 selected from manufacturer's catalogued range of standard products.

*Standard of Acceptance)*  
° Barry Blower

- Penn
- Greenheck
- Loren Cook
- Twin City

## **2.2 Selection criteria**

- .1 Select fan size, operating rpm and rating point on stable part of head flow curve with smooth characteristics.

## **2.3 Construction details**

- .1 Fans:
  - .1 statically and dynamically balanced
  - .2 running at least 20% below first critical speed when operating at maximum speed for class of construction, interior and exterior surfaces manufactured from steel factory cleaned and primed to CGBS 1-GP-181M+ Amdt-Mar-78
  - .3 surfaces contacting airstream zinc-coated
- .2 Fan bearings:
  - .1 grease lubricated self aligning ball or roller type with oil retaining, dust excluding seals,
  - .2 cartridge type for shafts less than 37 mm (1 - 7/16 in) diameter,
  - .3 shaft adapter sleeves with horizontally split pillow blocks and mechanical flinger type grease valves for shafts 37 mm (1 - 7/16 in) diameter or larger,
  - .4 interference fit rather than adapter sleeve type on shafts 56 mm (2 - 3/16 in) and larger
  - .5 furnished with drain plugs,
  - .6 fitted with extended grease lubricating lines where access is restricted,
  - .7 packed with grease at factory,
- .3 Fan motors:
  - .1 not less than motor kW (horsepower) shown in schedule.
  - .2 sized in accordance with criteria specified under "Motors".
  - .3 capable of satisfactory operation over range of performance from shut-off to run-out at 115% of rotational speed at point of selection.

## **2.4 Centrifugal fans**

- .1 Arrangement:
  - .1 rotation, discharge and motor position to be as shown,
  - .2 fan classification to be established to permit operation at 125% of rotational speed at point of selection.
- .2 Fan wheels:
  - .1 backward curved or backward inclined blades for fan wheel diameters less than 686 mm (27 in), backward curved air foil blades for fan wheel diameters 686 mm (27 in) and larger.
- .3 Accessories:

- .1 38 mm (1 - ½ in) casing drains where fans discharge vertically,
- .2 quick opening access doors in scroll casing when equipped with variable inlet guide vanes,
- .3 stuffing box style shaft seals on single inlet single width fans and utility sets.

## **2.5 Cabinet fans**

- .1 Construction:
  - .1 single or multiple wheel DWDI centrifugal fans with motor and V-belt drive, selected in accordance with requirements for centrifugal fans,
  - .2 arranged with not less than 0.75 wheel diameter clearance between fan inlet and plenum wall,
  - .3 factory fabricated casing of zinc coated or phosphate treated steel of 1.6 mm (16 ga) thickness, reinforced and braced for rigidity,
  - .4 removable panels for access to internal parts,
  - .5 internally lined cabinet with 50 mm (2 in) thick rigid acoustic insulation,
  - .6 expanded metal mesh over insulation on floor.

## **3 EXECUTION**

### **3.1 Fan installation**

- .1 Mount fans as shown, with vibration isolation, restraining snubbers, flexible electrical leads, and flexible connections to inlet and discharge ductwork.
- .2 Align shafts, belt drive and motor.
- .3 Adjust belt tension.
- .4 Check motor rotation before start-up.

### **3.2 Protection**

- .1 Provide temporary enclosures for open drip proof motors.
- .2 Cover fan inlet and discharge openings during construction.
- .3 Rotate fans, by hand, every month between delivery and acceptance of building.

### **3.3 Commissioning**

- .1 During balancing adjust sheaves on variable pitch belt drives, adjust blade pitch of axial flow fans, and change pulleys and belts on fixed pitch belt drives, to achieve specified air quantities.

**END OF SECTION**

## **PACKAGED ROOF AND WALL EXHAUSTERS**

### **23 34 23**

## **1 GENERAL**

### **1.1 Scope**

- .1 Provide package roof exhausters as shown.

### **1.2 Shop drawings and product data sheets**

- .1 Submit manufacturer's data sheets for:
  - .1 roof exhausters,
- .2 Provide equipment model numbers, performance and design data, outline dimensions, power requirements, prefabricated curb details, support and connection details and unit weights.

## **2 PRODUCTS**

### **2.1 General**

- .1 Roof and wall exhausters, sound curbs and air intake cowls to be products from current catalogue of one manufacturer.

#### *Standard of Acceptance*

- ° Penn
- ° Greenheck
- ° Carnes
- ° Loren Cook

### **2.2 Roof and wall exhausters**

- .1 Construction:
  - .1 centrifugal belt driven type with spun aluminum housing, insulated aluminum curb, continuous curb gasket and stainless steel fastenings,
  - .2 non overloading, statically and dynamically balanced aluminum fan wheels,
  - .3 lubricated ball bearing shaft and motor mounted in compartment isolated from air stream,
  - .4 motor disconnect switch mounted in motor compartment,
  - .5 adjustable pitch drive with automatic spring loaded belt tensioner,
  - .6 vibration isolation between static and rotating components,
  - .7 bird screen and gravity backdraft dampers

### **2.3 Sound curbs**

- .1 Construction:
  - .1 supplied to match roof exhauster base dimensions,
  - .2 double baffle prefabricated self-flashing type,
  - .3 pressure loss at rated air flow of not more than 37 Pa (0.15 in wg).
- .2 Performance:

.1 constructed and selected to meet sound attenuation spectrum as follows;

Octave band	1st	2nd	3rd	4th	5th	6th	7th	8th
Attenuation in dB	3	5	11	16	22	20	17	13

### **3 EXECUTION**

#### **3.1 Installation**

- .1 Install fans and curbs.
- .2 Supply curbs to roofer with location details and counter flash before installation of fans.

#### **3.2 Commissioning**

- .1 Check direction of fan rotation and adjust variable pitch drives during balancing.

**END OF SECTION**

## **TERMINAL BOXES**

### **23 36 13**

## **1 GENERAL**

### **1.1 Scope**

- .1 Provide terminal boxes as shown.

### **1.2 Shop drawings**

- .1 Submit manufacturer's data sheets with equipment model numbers, performance and design data, outline dimensions, enclosure details, support and connection arrangements and electrical power requirements where applicable.

### **1.3 Applicable codes and standards**

- .1 ARI Standard 880 Standard for Air Terminals
- .2 ARI Standard 885 Standard for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets.
- .3 ASHRAE Standard 180 Methods of Testing for Rating Ducted Air Terminal Units

## **2 PRODUCTS**

### **2.1 General**

- .1 Selection of units to meet air quantities shown to be based on;
  - .1 maximum Inlet Air Pressure; 750 Pa (3 in wg),
  - .2 minimum Inlet Air Pressure; 75 Pa (0.3 in wg),
  - .3 maximum room NC sound pressure level (  $2 \times 10^{-4}$  microbar reference) at maximum inlet pressure to be less than 40 at discharge and 42 radiated for box with attenuator mounted exposed (without ceiling).
- .2 Where sizes, model numbers and unit types are indicated, selections are taken from E.H. Price catalogue.

#### *Standard of Acceptance*

- ° E.H. Price
- ° Titus
- ° Environmental Technologies
- ° Nailor Industries.
- ° Carnes
- ° Metalaire

### **2.2 Terminal box**

- .1 Construction:
  - .1 pressure independent type with pneumatic velocity sensor, damper assembly, factory calibrated controller and actuator with adjustable minimum stop
  - .2 damper arranged "normally open" for morning warm-up.



- .3 controller capable of maintaining air quantity within  $\pm 5\%$  of set value, between zero and stipulated rated air flow,
  - .4 sound level below specified values when operating from minimum to maximum inlet static pressure.
- .2 Silencer/attenuator:
- .1 on box discharge, acoustically treated open end or multiple outlet attenuator 900mm (30 in) long on boxes up to Size 10 and 1.5 m (5 ft) long on boxes Size 12 and larger
  - .2 acoustic lining - fibreglass:
    - (a) 20 mm (13/16 in) thick, 64kg/m<sup>3</sup> (4 lb/sq ft) density, rigid fibreglass with fire resistive reinforced aluminum foil-scrim-kraft (FSK) facing,
    - (b) flame spread rating not to exceed 25, smoke development rating not to exceed 50,
    - (c) fastened to interior sheet metal surface with 100% coverage of adhesive, and fasteners at 1 pin per 0.2m<sup>2</sup> (2 sq ft) but not less than 1 row on each duct side.
    - (d) edges concealed by metal nosings at inlet and discharge, with notch and tuck fabrication and seams protected by Z strips
- Standard of Acceptance*
- ° Steri-Liner
- .3 duct liner fasteners:
- (a) 2.0 mm (1/16 in) diameter pins,
  - (b) length selected to suit thickness of insulation,
  - (c) 32 mm (1¼ in) square Nylon retaining clips.

## **2.3 Controllers**

- .1 Direct Digital Controllers (DDC) including actuators to be supplied by Section 25 14 00, B.A.S. Equipment Controllers,
- .2 Air flow sensor to be provided by Terminal Box Manufacturer.
- .3 120 VAC to 24 VAC transformer for DDC controller to be supplied by Section 25 14 00, B.A.S. Equipment Controllers.

## **3 EXECUTION**

### **3.1 Box installation**

- .1 Support terminal boxes from building structure with angles, hangers and supplementary steel before installation of piping and connecting ductwork.
- .2 Provide access door in ductwork downstream of reheat coil.

### **3.2 Ductwork connections**

- .1 Connect inlet ductwork with spiral flat seam round duct of same diameter as terminal box inlet
- .2 Support outlet ductwork independent from box.
- .3 Seal openings in box and attenuator for reheat coil and connections, control, and power wiring.

### **3.3 Electrical connections**

- .1 Electrical Division 26 will provided 208 Volt, single phase power supply with a junction box for each group of terminal boxes with maximum of 12 terminal box controls fed from one junction box
- .2 Extend power supply from these junction boxes and connect to terminal units.

### **3.4 Leakage testing**

- .1 Terminal boxes and attenuators to be included in ductwork leakage testing.

**END OF SECTION**

## **GRILLES, REGISTERS AND DIFFUSERS**

### **23 37 13**

#### **1 GENERAL**

##### **1.1 Scope**

- .1 Provide grilles, registers, and diffusers as shown.

##### **1.2 Shop drawings**

- .1 Submit manufacturer's data sheets with equipment model numbers, performance and design data, outline dimensions, support recommendations and connection details.

##### **1.3 Samples**

- .1 Submit examples of each type and style of register, diffuser and grille with sample finishes when requested.

#### **2 PRODUCTS**

##### **2.1 General**

- .1 Grilles, registers and diffusers:
  - .1 product of one manufacturer where same model or type identification is used.
  - .2 standard catalogue products selected to meet capacity, throw, and noise level.
  - .3 prime coated, stamped or cold rolled steel material with mitred corners and exposed joints welded and ground smooth.
  - .4 extruded satin finish, clear anodized aluminum material with mitred corners and mechanical fasteners.
  - .5 Frames with full perimeter gaskets, plaster stops where set into plaster or gypsum board, and concealed fasteners.

##### **2.2 Type designations**

- .1 Diffuser, register and grille schedule identifies model or type identifiers used on floor plans with model numbers taken from listed manufacturer's catalogue.
- .2 Where several manufacturer's model numbers are given, these are acceptable alternatives.
- .3 Where only one manufacturer's model number is given, provide designated item.

##### *Standard of Acceptance*

- E.H. Price
- Titus
- Carnes
- Nailor
- MetalAire

##### **2.3 Return and exhaust grilles**

- .1 single deflection type, with horizontal face bars, 20° maximum turn up,

- .2 perimeter border with gasket,
- .3 opposed blade damper with concealed operator,
- .4 of steel or aluminum material.

## **2.4 Diffusers**

- .1 circular or square multiple cone or perforated face type, with adjustable pattern control,
- .2 of steel or aluminum material.

## **2.5 Linear diffusers**

- .1 Type: Extruded aluminum, continuous linear slot with extruded aluminum pattern controller.
- .2 Frame: To match ceiling construction.
  - .1 All linear diffusers installed in gypsum ceilings shall have concealed frames.
- .3 Fabrication: Aluminum extrusions .062 inch thick with end-caps, mitered corner and blank-offs for a continuous appearance.
- .4 Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.

# **3 EXECUTION**

## **3.1 Layout**

- .1 Drawings showing position of air distribution outlets are essentially diagrammatic. Coordinate exact location of diffusers with other elements in ceiling and shown on reflected ceiling drawings and select trim to suit ceiling materials listed in Finish Schedules.
- .2 Cut tiles, provide new tiles and tee-bar for installation of air inlets/outlets.

## **3.2 Installation of grilles and registers**

- .1 Install supply registers with face bars vertical and exhaust and return registers with face bars horizontal.
- .2 Install registers and grilles with oval head cadmium plated screws in countersunk holes where fastenings are visible.
- .3 Ducted exhaust/return registers shall be provided with a minimum 4" high plenum with transition/duct collar for duct connection.

## **3.3 Installation of diffusers**

- .1 Diffusers to be installed with concealed fastenings.
- .2 Round, square and rectangular diffusers to be provided with equalizing deflectors, mounted in neck, accessible from diffuser face, with blades oriented at right angles to direction from which air is flowing.

- .3 Except for last diffuser on branch, each diffuser installed in underside of supply duct to have extract volume control damper.
- .4 Provide cord operated volume damper for all linear diffusers located in gypsum board, luminaire, woodslats and all inaccessible ceilings. Provide damper adjustment through face of air outlet. Provide all hardware and extensions.

**END OF SECTION**

## **ROOFTOP PACKAGE UNITS**

### **23 74 13**

#### **1 GENERAL**

##### **1.1 Scope**

- .1 Provide roof top package units as shown.

##### **1.2 Shop drawings**

- .1 Submit shop drawings for each roof top package unit with;
  - .1 equipment model number,
  - .2 outline dimensions,
  - .3 enclosure details,
  - .4 space requirements for service and maintenance,
  - .5 support arrangements.
- .2 Provide rating information showing capacity and power input requirements for heating and cooling at full load.
- .3 Provide diagrams showing;
  - .1 requirements for field assembly with air flows, connection pipe sizes and external pressure drop at rated air flow,
  - .2 unit internal and external electrical power and control wiring with motors, starters, relays and interlocks identified, and with terminal and wire numbers marked.
- .4 Submit sound power data for supply, relief, or return fans rated at more than 2.0 m<sup>3</sup>/s (4000 cfm) and for condenser section where unit capacity exceeds 40 kW (11.4 tons).

##### **1.3 Reference standards**

- .1 Sound ratings to AMCA (Air Moving and Air Conditioning Association) 301 when tested to AMCA 300 and soundproofing to ARI 270.
- .2 Fans to AMCA 99
- .3 Fan ratings to AMCA 210, and ASHRAE 51.
- .4 Weatherproofing to AGA rain test standards.
- .5 Salt spray test to ASTM B117.
- .6 Units larger than 40 KW (11.4 tons) to ARI 210 Standard for Unitary Air Conditioning Equipment.

##### **1.4 Warranty**

- .1 Compressors to be warranted against failure for three (3) years and warranty to include for labour and materials used in replacing compressors, and in cleaning, dehydrating and charging refrigeration system.

## **2 PRODUCTS**

### **2.1 General**

- .1 Performance as shown.
- .2 Hermetic reciprocating or scroll compressor, evaporator, air cooled condenser, condenser fans, evaporator fan, heater section, filter box, economizer section, power exhaust fans, motor starters, and controls,
- .3 Roof curb mounting frame for down discharge supply and up-flow return
- .4 Factory assembled and tested with refrigeration piping, refrigerant and oil charge.
- .5 Ready for connection to ductwork, gas and electric power source.

#### *Standard of Acceptance*

- ° Trane
- ° Carrier
- ° York

### **2.2 Cabinet**

- .1 Construction:
  - .1 assembled on galvanized steel base with lifting lugs and curb flashings,
  - .2 constructed with angle or folded plate frame of galvanized steel, minimum 22 mm (14 ga), and panels of 1.0 mm (20 ga),
  - .3 configured for bottom or side air supply and return connections
  - .4 weathertight casing with removable gasketed panels for access to motorized equipment, electrical control panel and filter changing,
  - .5 primed and enameled to withstand 1000 hr salt spray test.
- .2 Insulation:
  - .1 insulation on panel surfaces in contact with conditioned air: 13 mm (½ in), 24 kg/m³ (1.5 lb/ft³) density foil faced or neoprene coated glass fibre.

### **2.3 Evaporator**

- .1 Direct expansion type, arranged with counter flow between air and refrigerant,
  - .1 minimum of two circuits for units with capacities of 6 tons or larger,
  - .2 aluminum fins on copper tubes mounted in zinc coated steel casing,
  - .3 maximum face velocity of 2.6 m/s (500 fpm), minimum 3 rows,
- .2 Condensate pan:
  - .1 galvanized steel welded condensate pan draining to 20 mm (¾ in) side outlet connection.

### **2.4 Evaporator fan**

- .1 Double width, double inlet centrifugal type;
  - .1 statically and dynamically balanced,

- .2 arrangement 3 belt driven, with adjustable pitch sheave and belt tensioning arrangement, sized for 150% of fan motor horsepower for units with capacities of 6 tons or larger.
- .3 multi-speed direct driven , with fan mounted on motor shaft for units with capacities of 5 tons or smaller,
- .4 mounted with motor on isolation base separated from unit casing with flexible connections and rubber in shear isolators.

## **2.5 Air filters**

- .1 50 mm (2 in) thick throwaway filters.
- .2 Mounted ahead of evaporator coil, in filter box with access panel.

## **2.6 Refrigerant circuit**

- .1 Piping, valves, fittings and related parts to CSA B52 with;
  - .1 thermal expansion valve or capillary refrigerant metering device
  - .2 high side pressure relief device, and
  - .3 charging valve.
- .2 Insulation:
  - .1 19 mm (¾ in) thick flexible elastomeric insulation on suction line.

## **2.7 Condenser section**

- .1 Fans:
  - .1 direct drive, slow speed, multiple propeller fans.
  - .2 variable speed, ball bearing, permanently lubricated fan motors, fitted with electronic head pressure control, for stable operation down to outside temperature of -29°C (-20°F)
- .2 Condenser coil:
  - .1 aluminum fins on copper tube, integral subcooling circuits,
  - .2 separate refrigeration circuits for each compressor,
  - .3 sized for outdoor air entering temperature of 38 C (100 F).

## **2.8 Refrigeration controls**

- .1 Microprocessor based DDC control system with;
  - .1 external unit stop switch,
  - .2 high and low refrigerant pressure switches,
  - .3 oil pressure safety switch,

## **2.9 Gas fired heating section**

- .1 CGA certified heating section with modulating gas heating.
- .2 Electronic spark ignition, electronic flame failure sensor, limit controls and gas train,
- .3 Control system located in sheet metal weatherproof enclosure.



## **2.10 Economizer section**

- .1 Motorized fresh air and recirculation dampers,
- .2 Gravity relief dampers with direct drive propeller type power exhaust fans

## **2.11 Temperature control system**

- .1 Microprocessor based, Direct Digital Control (DDC) processor, BACnet.
- .2 Electronic thermostat and DDC control module to operate heating, economizer dampers and power exhaust fans, and cooling in sequence in response to thermostat sensed temperature.
- .3 Remote status panel with indicating lights showing heat mode, cool mode, compressor operation, no heat, filter and touch sensitive key pad to allow hour/day operating program and adjustment of thermostat set point.

## **2.12 Electrical panel**

- .1 Single point power supply with;
  - .1 power connection,
  - .2 control interlock terminals,
  - .3 unit control system located in sheet metal weatherproof enclosure.
- .2 Circuit protection for;
  - .1 compressors and starters,
  - .2 fans and control circuit,
  - .3 solid state sequence timer,
  - .4 compressor motor overload protection with current sensing in three passes,
  - .5 control transformer.

# **3 EXECUTION**

## **3.1 Installation**

- .1 Install roof curb and place unit on curb with adequate clearance for service and maintenance.
- .2 Connect ductwork, and gas piping.
- .3 Provide un-fused weatherproof disconnect on or adjacent unit and run electric power and control wiring.

## **3.2 Start-up service**

- .1 Arrange for manufacturers' field representative to supervise installation, start-up unit and instruct Owners operations and maintenance personnel.

**END OF SECTION**

## **UNIT HEATERS**

### **23 82 39**

## **1 GENERAL**

### **1.1 Scope**

- .1 Provide heaters as shown.

### **1.2 Shop drawings**

- .1 Submit manufacturer's data sheets for unit heaters with:
  - .1 equipment model numbers,
  - .2 performance and design data,
  - .3 outline dimensions,
  - .4 power requirements,
  - .5 support and connection details,
  - .6 equipment weights.

## **2 PRODUCTS**

### **2.1 General**

- .1 Heating equipment capacities as shown.
- .2 Manufacturers:

#### *Standard of Acceptance*

- Rosemex
- Sterling
- Rosemex
- Rittling
- Dunham Bush
- Reznor
- Engineered Air
- Slant/Fin
- Sigma
- Airtherm

### **2.2 Cabinet unit heaters**

- .1 Casings:
  - .1 surface mounted, recessed or semi-recessed type,
  - .2 1.6 mm (16 ga) steel finished with factory applied baked primer with internal glass fibre insulation,
  - .3 integral air outlet and inlet grilles,
  - .4 removable access panels allowing service of fans, coils and controls,
  - .5 removable 25 mm (1 in) fibrous glass media replaceable filters
- .2 Electric coils:

- .1 nickel-chrome electric resistance wire embedded in refractory material and enclosed in steel sheathing with low watt density extended fins,
  - .2 arranged for two stage heating with magnetic contactors, high temperature limit switch, and fan override switch built into cabinet,
  - .3 heating elements and fan to be controlled by two stage thermostat and common On/Off control switch.
- .3 Fan:
- .1 statically and dynamically balanced, double width centrifugal fans with sleeve bearings, direct connected to resiliently mounted three speed single phase motor.
  - .2 speed controller and single phase motor starting switch factory wired to motor and mounted inside cabinet behind access door
- .4 Accessories:
- .1 supplied with line voltage thermostat for remote mounting.

### **2.3 Baseboard**

- .1 Casings:
- .1 22-gauge steel, with prime coat finish and angle brackets for connection of hanger rods.
  - .2 20-gauge steel front panel.
- .2 Heating element:
- .1 Stainless steel tubular heating element with aluminum fins.
  - .2 Floating heating element on high-temperature nylon bushings reducing expansion noises.
- .3 Accessories:
- .1 supplied with line voltage thermostat for remote mounting.

## **3 EXECUTION**

### **3.1 Heater support**

- .1 Attach heaters to building structure with angles, hanger rods and supplementary suspension steel.

### **3.2 Connections**

- .1 Connect piping with swing joints.
- .2 Install electric on/off automatic control valve, interlocked with fan motor, on supply to each cabinet unit heater.
- .3 Install remote thermostats, multi-speed controllers, motor starter switches and other controls and provide interconnecting wiring.

### **3.3 Cabinets and enclosures**

- .1 Install cabinets tight against furrings, columns, or wall surfaces.

- .2 enclosure lengths to be job measured at site where enclosure extends between walls, furrings or similar fixed objects.
- .3 Provide elements, hangers, hanger brackets and piping connections where enclosures are provided under another Division.

### **3.4 Completion**

- .1 Clean coils and comb fins on finned elements.
- .2 Set dampers and isolating valves open.
- .3 Re-finish units damaged during installation.

**END OF SECTION**

## **BUILDING AUTOMATION SYSTEMS GENERAL**

### **25 05 01**

#### **1 GENERAL**

##### **1.1 Scope**

- .1 Provide Building Automation System (BAS) with Direct Digital Control (DDC), and Energy Management for building mechanical and electrical systems.
  - .1 System to be Tridium Niagara framework
- .2 Integrate BAS into Toronto Public Library Johnson Controls Facility Explorer server for remote monitoring and control.
- .3 Integrate BAS into the TPL IT Network.

##### **1.2 Related Sections**

- .1 Building Automation System includes Sections:
  - .1 25 00 88 Commissioning - BAS
  - .2 25 13 01 B.A.S. Building Controllers
  - .3 25 14 01 B.A.S. Equipment Controllers
  - .4 25 35 01 B.A.S. Instrumentation and Actuators
  - .5 25 90 01 B.A.S. Sequence of Operations

##### **1.3 Equipment Supplied for installation under Other Sections**

- .1 Supply the following equipment for installation under other Sections of Division 20;
  - .1 automatic control valves,
  - .2 temperature wells for controllers and sensors provided under this Section,
  - .3 terminal unit controllers, actuators for volume dampers and velocity pressure sensors including transformers. Arrange and pay for shipping to terminal unit manufacturer's facility for factory installation.
  - .4 actuators for motorized dampers and smoke dampers including associated end switches and relays.

##### **1.4 Equipment Provided under Other Sections**

- .1 The following equipment is provided under other Sections of Division 20;
  - .1 liquid flow measuring devices
  - .2 steam humidifiers with automatic control valves
  - .3 unit heater and cabinet unit heater line voltage thermostats
  - .4 manual dampers, fire dampers, gravity dampers, and smoke dampers
  - .5 motorized dampers

##### **1.5 Applicable standards**

- .1 ANSI/ASHRAE standard 135-2004      BACnet

- .2 Interfacing Standard:
  - .1 Input/output devices to use ASCII (American Standard for Communication and Information Interchange) code and standard EI (Electronic Industry Association) interfaces.
  - .2 CSA T530: Building Facilities, Design Guidelines for Telecommunications (same as EIA/TIA 569).
  - .3 IEEE 802.3 Ethernet 10Base-T LAN.

## **1.6 Abbreviations and definitions**

- .1 The following definitions, abbreviations, and acronyms apply:
  - .1 AI Analog Input: continuously variable value, usually a sensor, referenced to a controller
  - .2 AO Analog Output: continuously variable value, usually a control signal to an actuator device, referenced to a controller.
  - .3 BI Binary (digital) Input: a two-state (On-Off) value, usually associated with a switch or state, referenced to a controller.
  - .4 BO Binary (digital) Output: a two-state (On-Off) value, usually associated with starting or stopping equipment or generating an alarm, referenced to a controller.
  - .5 BCU Building Control Unit
  - .6 ECU Equipment Control Unit
  - .7 FAS Fire Alarm System
  - .8 GUI Graphic User Interface: an LED, LCD or monitor display
  - .9 I/O Input/Output
  - .10 LAN Local Area Network
  - .11 NC Normally Closed: position of device in a de-energized state.
  - .12 NO Normally Open: position of device in a de-energized state.
  - .13 OWS Operator workstation: a PC based server or computer
  - .14 Tier 1 High level network providing communication between BCU's and workstations.
  - .15 Tier 2 Lower level network providing communications between ECU's and BCU's
  - .16 WAN Wide Area Network

## **1.7 Manufacturers and Installers**

- .1 Provide BAS with DDC and Energy management for mechanical and electrical systems by an organization:
  - .1 specializing in design, installation, commissioning and service of open protocol Tridium Niagara Framework systems,
  - .2 having completed five (5) projects of similar size and complexity within the preceding five (5) years,
  - .3 employing certified journeymen experienced in this type of work.

## **1.8 Continuity of Staff and Subcontractors**

- .1 Project Manager is to be nominated at time of shop drawing submission and is to remain involved with project, from shop drawing preparation through to Acceptance, unless request for change is submitted and approved.

- .2 Subcontractors listed in preliminary design submission are to execute work defined as sublet in preliminary design document, unless request for change is submitted and approved.
- .3 Requests for changes in staff, subcontractors, or extent of work subcontracted are to be submitted for approval and such approval is not to be unreasonably withheld.

#### **1.9 Identification of non-conforming materials and equipment.**

- .1 Submit documentation at time of bid, identifying nature and extent of non-conformance and variances from specifications or referenced standards.
- .2 Failure to submit this documentation at time of bid will be interpreted as confirmation that materials, workmanship, hardware and software will be in strict accordance with specifications and standards.

#### **1.10 Licences and Ownership**

- .1 Ownership of, and licences for, hardware and software supplied or used for this project or for ongoing system operation, maintenance and modification to be registered, without restrictions, in Owner's name.
- .2 This is applicable to System Software, Workstation Application Editors, and Controller Software.
  - .1 Licensing to permit an unlimited number of users to access system without additional fees.
  - .2 As of last day of warranty period, software is to be upgraded to current version or release.
  - .3 Project-developed software and resulting documentation to be treated as part of system and subject to these same requirements for ownership and licensing. This material includes;
    - (a) Project graphic images
    - (b) CAD generated record drawings
    - (c) Project database
    - (d) Project-specific application programming code and documentation.

#### **1.11 Shop Drawings**

- .1 Submit one completely engineered and coordinated shop drawing package. Partial or incomplete submission of data and/or drawings will be returned without review.
- .2 Submit shop drawings for designed elements;
  - .1 list of materials of equipment to be used indicating manufacturer, model number, and other relevant technical data.
  - .2 BAS riser diagram showing system controllers, operator workstations, network repeaters, and network wiring.
  - .3 single-line schematics and system flow diagrams showing location of control devices.
  - .4 detailed analysis of each Sequence of Operation from design documents, ready for development of actual programming code.
  - .5 Sequence of Operations to cover normal operation and operation under various alarm conditions applicable to that system.
- .3 Submit shop drawings schedules for;
  - .1 control damper; spreadsheet type, to include separate line for each damper and columns for damper attributes.
  - .2 control valve; spreadsheet type, to include separate line for each valve and separate columns for valve attributes.

- .4 Submit catalogue cut-sheets for;
  - .1 manufacturer's description and technical data, such as performance curves, product specification sheets, and installation/maintenance instructions for equipment and hardware items as follows;
    - (a) Controllers (BCU's and ECU'S)
    - (b) Transducers/Transmitters and Sensors with
      - accuracy data, range and scale information,
      - one sheet for each device marked with applicable options. (Where several devices of same type are to be used, submit one sheet for each device, individually marked.)
    - (c) Actuators
    - (d) Valves
    - (e) Relays/Switches
    - (f) Panels
    - (g) Power Supplies
    - (h) Batteries
    - (i) Operator Interface
    - (j) Wiring and wiring accessories
  - .2 hardware data sheets for Operator Interfaces, local panels, and portable operator terminals.
  - .3 Software manuals for applications programs for Operator Interface, portable operator terminals, and programming devices.
  - .4 Protocol Implementation Conformance (PIC) statement for BACnet devices.
  - .5 Where interfaces occur with control or wiring diagrams of other sections, obtain reproducible copies of these diagrams and revise to show terminal numbers at interface and include diagrams as part of interconnection schematic shop drawings.

#### **1.12 Graphics**

- .1 Submit supporting documentation:
  - .1 examples of graphics for Operator Interface to include;
    - (a) BAS network schematics
    - (b) typical terminal unit floor plan graphic that shows conditions on occupied floor
    - (c) typical equipment room floor plan graphic
    - (d) typical graphics for each system and terminal unit at least one sample graphic for each type of equipment,
  - .2 New BAS graphics shall be design consistent with the existing Toronto Public Library graphics.
    - .1 Upon request by contractor, Toronto Public Library can provide a sample building station, so graphics objects are consistent across all facilities.

#### **1.13 Project schedules**

- .1 At time of shop drawing submission provide Gantt type Schedule of Work with;
  - .1 project broken down into discrete work items
  - .2 start date of each work item
  - .3 duration of each work item
  - .4 relationships between work items and showing constraints on work flow.
  - .5 planned delivery dates for ordered material and equipment with expected lead times.
  - .6 procedures.



- .2 During design, installation and start-up of installation provide monthly written status reports indicating work completed and revisions to expected delivery dates. Include updated Schedule of Work with each report.

#### **1.14 Warranty**

- .1 At completion of Work, submit written guarantee undertaking to remedy defects in work for period of two (2) years from date of acceptance, which includes:
  - .1 rectification of control system failures attributable to defects in workmanship, materials, hardware, and software,
  - .2 Service Technician to arrive on site within 24 hours of warranty service request, to install and de-bug software patches, to replace defective parts, materials or equipment, and to provide incidental supplies, and labour for remedial work,
  - .3 Technician to remain in attendance until system is returned to operating condition.
- .2 Submit similar guarantee for any part of work accepted by Owner, before completion of whole work.

## **2 PRODUCTS**

### **2.1 General**

- .1 Provide equipment which functions and meets detailed performance criteria when operating in following minimum ambient condition ranges:
  - .1 Temperature - 0°C to 32.2°C (32°F to 90°F)
  - .2 Relative Humidity 10% to 90% non-condensing
  - .3 Electrical power service of single phase, 120 VAC +/- 10%, 60 Hz nominal.
- .2 Components installed within motor control devices to be designed to operate with transient electrical fields occurring within these devices.

### **2.2 Licensing**

- .1 Supervisory controllers shall be installed with open licenses for full access from Toronto Public Library's Facility Explorer server.
- .2 All licenses shall be provided to and in the name of Toronto Public Library.
- .3 Licenses shall be perpetual, transferrable, assignable and royalty-free

### **2.3 Equipment standard**

- .1 Products and software: manufacturer/developer/supplier's catalogued current stock.
- .2 This installation is not to be used as test site for newly developed product or software, without explicit written approval.
- .3 Equipment and systems installed under this Contract to meet;
  - .1 performance specifications when subjected to VHF, UHF, FM, AM or background RFI as generated by commercial or private, portable or fixed transmitters that meet regulatory codes.
  - .2 Federal Communication Commission (FCC) Rules and Regulations, Part 15, Subpart J for computing devices.

## **2.4 BAS Systems Integration**

- .1 All controls systems must be integrated to Toronto Public Library's Johnson Controls Facility Explorer® (FX) server to monitor and control HVAC equipment.

## **2.5 General BAS architecture**

- .1 Control system:
  - .1 All new building automation system (BAS) shall be based on the open environment Tridium Niagara framework, compatible with the existing FX server, and shall be integrated within the FX server over the TPL IT network. No PC hardware shall be installed. Parameters for TPL IT network connection will be provided by TPL IT.
    - (a) Installer must be a licensed Tridium systems integrator.
  - .2 each mechanical system, building floor plan, and control device to be displayed through point-and-click graphics,
  - .3 Web server with network interface card to gather data from this system and generate web pages that can be accessed through conventional web browser on any PC connected to network,
  - .4 Operators to access this system through web browser, and browser interface to perform normal operator functions.
- .2 Open protocol:
  - .1 Provide an integrated, open protocol building automation system, either/ or in combination:
    - (a) BACnet to ANSI/ASHRAE Standard 135-2001,
- .3 BAS network architecture - Dedicated LAN for BAS:
  - .1 BAS communication architecture to consist of at least two tiers with each tier using local area networks.
  - .2 Tier 1: Building Controller network;
    - (a) Ethernet communications (ISO 8802-3/IEEE 802-3), using high speed local area network communications. TCP/IP to be used as communication protocol on first tier network.
  - .3 Tier 2: Equipment Controller network;
    - (a) open, peer-to-peer control networks to interconnect BAS controllers (BCU's and/or ECU's) on ring or star topology bus.
    - (b) Peer-to-peer configuration means units exist and speak equally on same bus.
    - (c) Controllers in peer-to-peer configuration can share data without assistance from Operator Interface.

## **2.6 General functional requirements**

- .1 Control mechanical and electrical equipment as specified in Control Sequences, shown on Control Schematics, and described in Equipment Schedules.
- .2 System architecture to be modular, permitting stepped expansion of application software, system peripherals, and field hardware.
- .3 Each controller;
  - .1 operates with local closed loop programming, independent from server, if peer-to-peer communication is interrupted;
  - .2 performs resident control routines;

- (a) receiving information from field mounted sensors and switches and
  - (b) transmitting instructions to actuators to perform control sequences.
- .3 manages local hardware and software alarms;
  - (a) to collect historical data,
  - (b) to facilitate operator input and output and
  - (c) to communicate with Central BAS web server and operator interface.

## **2.7 Performance**

- .1 General:
  - .1 information transmission and display times are based upon network, rather than modem, connections.
  - .2 test systems using manufacturer's recommended hardware and software for operator interface.
- .2 Performance criteria:
  - .1 Graphic Display;
    - (a) display graphic with 20 dynamic points with current data within 10 seconds.
  - .2 Graphic Refresh;
    - (a) update graphic with 20 dynamic points with current data within 10 seconds and
    - (b) automatically refresh every 15 seconds.
  - .3 Configuration and Tuning Screens;
    - (a) special screens used for configuring, calibrating, or tuning points, PID loops, and similar control logic to refresh every 5 seconds.
  - .4 Object Command response;
    - (a) time between command of binary object at Operator Interface (OI) and reaction by device to be less than 5 seconds.
    - (b) time between command of analog object at Operator Interface (OI) and start of adjustment to be less than 5 seconds.
  - .5 Alarm Response Time;
    - (a) time between when an object goes into alarm and when it is annunciated at Operator Interface (OI) to be less than 15 seconds.
  - .6 Program Execution Frequency;
    - (a) execution repeat frequency to be selected in manner consistent with mechanical process under control.
    - (b) custom and standard applications to be capable of executing as often as once every 5 seconds.
    - (c) programmable controllers to be able to perform PID control loop routines at selectable frequency, adjustable at Operator Interface (OI) down to once every second.
    - (d) workstations connected to network to receive alarms with not more than 5 seconds spread between first and last annunciation.
  - .7 Reporting Accuracy;

- (a) system to report values with an end-to-end accuracy equal to or better than those listed below.
- (b) control loops to maintain measured variable at set point value within tolerances equal to or better than those listed below.

## **2.8 Capacity for Future Expansion**

### **.1 Supervisory Controller**

- .1 Each BAS shall have a supervisory controller sized to handle the points and sequences of operation, plus a 25% additional spare capacity for future expansion. Supervisory controllers shall be installed with open licenses for full access from the existing FX server.

## **3 EXECUTION**

### **3.1 Examination**

- .1 Inspect site and thoroughly examine documents to establish locations for control devices and equipment and report discrepancies, conflicts, or omissions for resolution before starting rough-in work.
- .2 Be responsible for correction of defects caused through neglect of inspections and examinations or failure to report and resolve discrepancies.

### **3.2 Protection**

- .1 Protect work and material against damage during construction and be responsible for work and equipment until inspected, tested, and accepted.
- .2 Protect material not immediately installed and close open ends with temporary covers or plugs during storage and construction to prevent entry of foreign objects.
- .3 Protect electronic equipment from elements during construction.

### **3.3 Coordination**

- .1 Coordinate and schedule control work with other work in same area to ensure orderly progress.
- .2 Testing and balancing:
  - .1 Supply set of tools for Testing and Balancing Technicians to interface to control system, train these technicians in use of tools and provide qualified Control Technician to assist with testing and balancing first 10 terminal units.
  - .2 Tools to be turned over to Owners on completion of testing and balancing.
- .3 Controls work by others:
  - .1 Integrate and coordinate this control work with controls and control devices provided or installed by others.
  - .2 Each supplier of control product to configure, program, start up, and test that product to satisfy requirements of Sequence of Operation regardless of where within contract documents product is specified or described.
  - .3 Resolve compatibility issues between control products provided under this section and those provided under other sections or divisions of this specification.

### **3.4 General Workmanship**

- .1 Installation to be performed by skilled and certified technicians.
- .2 Install equipment, piping, and wiring or raceways horizontally, vertically, and parallel to building lines.
- .3 Provide sufficient slack and flexibility in connections to allow for vibration isolation between conduit, raceways, piping and equipment.
- .4 Verify wiring integrity to ensure continuity and freedom from shorts and ground faults.
- .5 Install instrumentation and devices in locations providing adequate ambient conditions.
- .6 Protect components placed in areas of potentially high humidity.
- .7 All thermostats installed on perimeter wall shall be mounted on insulated backing.

### **3.5 Cleaning**

- .1 Clean up debris, remove packaging material, collect waste and place in designated location, on a daily basis.
- .2 Keep work areas free from dust, dirt, and debris.
- .3 On completion of work, check finish of equipment provided under this section for damage and repair damaged factory-finished paint, replace deformed cabinets and enclosures with new material, and repaint to match original.

### **3.6 Field Quality Control**

- .1 Ensure work, materials, and equipment comply with this specification and approved shop drawings.
- .2 Monitor field installation for code compliance and workmanship quality.
- .3 Arrange and pay for inspections by local or provincial authorities having jurisdiction.

### **3.7 Wiring**

- .1 Electrical materials, equipment and installation procedures under to conform to Ontario Electrical Safety Code as amended to date and standards established in Division 26.
- .2 Conduit:
  - .1 thin wall (EMT) conduit up to and including 32mm (1 1/4 in) size for exposed wiring up to 3 m (10 ft) above floor level,
  - .2 rigid galvanized steel conduit in locations accessible to public, subject to mechanical injury, or outdoors; and for conduit 40mm (1 1/2 in) size and larger,
  - .3 watertight compression fittings in exterior locations.
- .3 Run conduit and raceways parallel to building lines and be secured to building structure.
- .4 Wiring not to be installed in conduit to be installed parallel to building lines and be secured to building structure with clips at minimum 3m (6 ft) centres. Where possible, wiring to run above corridors and in service spaces.

- .5 Wiring in return air ceiling spaces to be plenum rated.
- .6 Where conduit leaves heated areas and enters unheated areas, seal conduit.
- .7 Provide interposing and motor control relays at local item of equipment or at associated MCC as applicable.
- .8 Provide 120 VAC wiring as needed to support operation of system networking hardware, field panels, and controllers. Refer to Section 20 05 13 for description of division of work and responsibility.
- .9 Provide control transformers for system components requiring power supply that do not have integral control transformers.
- .10 Where point schematics and specifications indicate auxiliary contact provision, provide instrumentation, wiring, conduit, power supplies and services as to integrate these points into BAS.
- .11 Mount transformers in enclosures.

### **3.8 Identification of Equipment**

- .1 Identify discrete items of equipment with plastic nameplates, identifying equipment and function.
- .2 Identification plates are in addition to manufacturers plates.
- .3 Manufacturers' nameplates and UL or CSA labels to be visible and legible after equipment is installed.
- .4 Identification plates:
  - .1 provided for equipment identified with number designations in schedules and equipment shop drawings.
  - .2 marked with equipment type, number and service following wording and numbering used in contract documents and shop drawings
  - .3 laminated plastic
  - .4 white face and black centre
  - .5 minimum size 75 mm x 40 mm x 3 mm (3 in x 1½ in x ⅜ in),
  - .6 engraved with 6.5 mm (¼ in) high lettering.
  - .7 securely attached to equipment.
- .5 Label wiring and cabling, including that within factory-fabricated panels, with control system address or termination number at each end within 50 mm (2 in) of termination.
- .6 Permanently label or code each point of field terminal strips to show instrument or item served.
- .7 Label each control component with permanent label. Label plug-in components so that label remains stationary during component replacement.
- .8 Label room sensors related to terminal boxes or valves with nameplates. Place labels on back of sensors.
- .9 Identify starters that are interfaced to BAS system with self-adhesive labels, white letters on red background as follows;

<p style="text-align: center;"><b>W A R N I N G</b></p> <p><b>THIS EQUIPMENT IS OPERATING UNDER AUTOMATIC CONTROL AND MAY START OR STOP AT ANY TIME WITHOUT WARNING. SWITCH DISCONNECT TO "OFF" POSITION BEFORE SERVICING.</b></p>
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- .10 Submit samples of labels and nameplates for review prior to installation.

### **3.9 Acceptance**

- .1 After tests described in this specification are performed satisfactorily and checklists and reports are submitted and approved, certify acceptance of control system including:
  - .1 Control system checkout and testing
  - .2 Control system demonstration
  - .3 Training
  - .4 As-built documentation
- .2 Certification document may identify tests that cannot be performed due to extenuating circumstances such as weather conditions. Append program to certification document for rectification and completing these tests during warranty period.

### **3.10 Control System Checkout and Testing**

- .1 Provide schedule for start-up testing.
- .2 Calibrate and prepare for service; equipment, instruments, controls, and accessories.
- .3 Start-up testing to verify substantial completion of control system before system demonstrations begin.
  - .1 Verify that control wiring is connected and free of shorts and ground faults. Verify that terminations are tight.
  - .2 Enable control systems and verify input device calibration.
  - .3 Verify that binary output devices operate and that normal positions are correct.
  - .4 Check control valves and automatic dampers for proper action and closure and adjust valve stem and damper blade travel.
  - .5 Verify that analog output devices are functional, that start and span are correct, and that direction and normal positions are correct.
  - .6 Verify that system operates according to Sequences of Operation. Simulate changes in variables by overriding and varying inputs and schedules and observe and record each operational mode response.
  - .7 Tune PID loops and control routines.
  - .8 Check each alarm with an appropriate signal at value that will trip alarm.
  - .9 Trip interlocks using field contacts to check logic and to ensure that actuators fail in proper direction.
  - .10 Test interlock actions by simulating alarm conditions to check initiating value of variable and interlock action.

- .4 Prepare and submit log documenting start-up testing of each input and output device and each control routine, with technician's initials certifying each device and each routine is functioning correctly and sensors have been calibrated. Include list of deficiencies, if any, and schedule setting out rectification program with time lines.

### **3.11 Control System Demonstration**

- .1 Obtain approval of start-up testing log and rectification program before scheduling demonstrations.
- .2 Provide notification not less than 10 days before system demonstration begins.
- .3 Demonstration to follow previously submitted and approved procedures;
  - .1 submit checklists and report forms for each system as part of demonstration,
  - .2 lists and forms to have initials of technicians conducting demonstrations,
  - .3 date of each demonstration and signatures of Owner's representatives witnessing each demonstration section.
- .4 Prior to acceptance, perform following tests to demonstrate system operation and compliance with specification after and in addition to tests specified above in Control System Checkout and Testing.
- .5 Show field operation of;
  - .1 each Sequence of Operation.
  - .2 Operator Interface
  - .3 DDC loop response with graphical trend data output showing
    - (a) Each DDC loop response to set point change producing an actuator position change of at least 25% of full range.
    - (b) Trend sampling rate to be from 10 seconds to 3 minutes, depending on loop speed.
    - (c) Loop trend data to show set point, actuator position, and controlled variable values.
    - (d) Documentation of further tuning of any loop that displays significantly under- or over-damped control
  - .4 Demand limiting routine with trend data output showing demand-limiting algorithm action;
    - (a) trend data to document action sampled each minute over at least 30-minute period and to show building kW, demand-limiting set point, and status of set-points and other affected equipment parameters.
  - .5 Building fire alarm system interface.
  - .6 Trend logs for each system point with;
    - (a) trend data to indicate set-points, operating points, valve positions, and other data as specified in points list provided with each Sequence of Operation,
    - (b) each log to cover three 48-hour periods and to have sample frequency not less than 10 minutes,
    - (c) show that Logs are accessible through operator interface and can be retrieved for use in other software programs.
  - .7 Substantiate calibration and response of any input and output points requested.
  - .8 Provide at least two technicians equipped with two-way communication.
  - .9 Provide and operate test equipment to establish calibration and prove system operation.
- .6 Tests that fail to demonstrate system operation to be repeated after repairs and/or revisions to hardware or software is completed.



- .7 Project record Submittals.
  - .1 Submit three copies of project record documents and obtain approval during acceptance procedures.
  - .2 Submit inspection certificates.
  - .3 Certificate of Acceptance to be withheld until Submittals are approved.

### **3.12 Training**

- .1 Materials:
  - .1 Provide course outline and materials for each class at least six weeks before first class.
  - .2 Provide training through instructor-led sessions, with computer-based, or web-based techniques.
  - .3 Instructors to be factory-trained and experienced in presenting this material.
  - .4 Perform classroom training using network of working controllers representative of installed hardware
- .2 Operating staff training:
  - .1 Provide training for Owners operating staff using abovementioned training materials in self-paced mode, web-based or computer-based mode, classroom mode, or combination of these methods.
  - .2 Allow for 1 repeat sessions for each category to cover operator shift rotation.
- .3 Training to enable students to accomplish following objectives.
  - .1 Group 1:
    - (a) Proficiently operate system
    - (b) Understand control system architecture and configuration
    - (c) Understand BAS system components
    - (d) Understand system operation, including BAS system control and optimizing routines (algorithms)
    - (e) Operate workstation and peripherals
    - (f) Log on and off system
    - (g) Access graphics, point reports, and logs
    - (h) Adjust and change system set-points, time schedules, and holiday schedules
    - (i) Recognize common HVAC system malfunctions by observing system graphics, trend graphs, and other system tools
    - (j) Understand system drawings and Operation and Maintenance manual
    - (k) Understand project layout and location of control components
    - (l) Access data from BAS controllers
    - (m) Operate portable operator's terminals
  - .2 Group 2:
    - (a) Create and change system graphics
    - (b) Create, delete, and modify alarms, including configuring alarm reactions
    - (c) Create, delete, and modify point trend logs (graphs) and multi-point trend graphs
    - (d) Configure and run reports
    - (e) Add, remove, and modify system's physical points
    - (f) Create, modify, and delete application programming
    - (g) Add operator interface stations
    - (h) Add new controller to system
    - (i) Download firmware and advanced applications programming to controller
    - (j) Configure and calibrate I/O points

- .3 Group 3:
  - (a) Maintain software and prepare backups
  - (b) Interface with job-specific, third-party operator software
  - (c) Add new users and understand password security procedures
- .4 Divide presentation of objectives into three sessions:
  - .1 Group 1: Day-to-day Operators.
  - .2 Group 2: Advanced Operators
  - .3 Group 3: System Managers and Administrator
  - .4 Participants will attend one or more of sessions, depending on knowledge and expertise level required.
  - .5 Provide each student with one copy of training material.

### **3.13 Submittals for Acceptance**

- .1 Provide system documentation at time of acceptance.
- .2 As-built drawings;
  - .1 As-built interconnection wiring diagrams, or wire lists of field installed system with identified, ordering number of each system component and service.
  - .2 Floor plans with accurate depiction of location of system devices, controllers, and trunk wiring. Drawings to be constructed using Architectural backgrounds provided.
  - .3 Provide 2 copies on CD-ROM of above drawings in AutoCAD Release 2000 format without compression.
  - .4 Provide 5 full size hard copies of floor plan drawings.
- .3 Operation and Maintenance (O&M) Manuals:
  - .1 Provide two paper copies of material and five copies on CD-ROM in Adobe PDF format.
  - .2 Describe operation, maintenance and servicing requirements of system and associated equipment.
  - .3 Provide following information in separate sections, each with an index.
    - (a) Service and parts;
      - Names, addresses, and telephone numbers of installing contractors and service representatives for equipment and control systems.
      - List of recommended spare parts with part numbers and suppliers.
    - (b) System description;
      - English language outline of BAS system and system architecture
      - As-built versions of shop drawing product data.
      - Reduced size (11 in x 17 in) copies of record drawings
      - Graphic files, programs, and database on magnetic or optical media.
      - Licenses, guarantees, and warranty documents for equipment and systems.
    - (c) Technical literature for equipment, including;
      - catalogue sheets,
      - calibration, adjustments and operation instructions,
      - installation instructions,
      - hardware and software manuals, with information supplied by original product developer, on application programs and on computers and controllers supplied

- Operator's manual with procedures for operating control systems; logging on and off, handling alarms, producing point reports, trending data, overriding computer control, and changing set-points and variables.
  - Engineering, installation, and maintenance manual or set of manuals that explains how to design and install new points, panels, and other hardware; how to perform preventive maintenance and calibration; how to debug hardware problems; and how to repair or replace hardware.
  - Original-issue documentation with installation and maintenance information for third-party hardware including computer equipment and sensors.
  - Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.
  - Programming manual or set of manuals with description of programming language and syntax, explanation of statements for algorithms and calculations used, procedures for point database creation and modification, documentation of techniques for program creation and modification, and instructions for use of editor.
  - Documentation of programs created using custom programming language including set-points, tuning parameters, and object database. Electronic copies of programs to modify and create control logic, set-points, tuning parameters, and objects that can be viewed using programming tools.
- .4 Original Software:
- .1 Furnish one original set of application and system software on original media. Disks to bear manufacturer's label. Field copies are not acceptable.
  - .2 Original-issue copies of software to include operating systems, custom programming language, application generation, graphic support, maintenance support, operator workstation or web server software, and other utilities provided in support of installed system.
- .5 On-line record documentation:
- .1 After completion of testing and adjustment, install the following additional information on the server OWS.
    - (a) As-built record drawing files,
    - (b) detailed catalog data on all installed system components, with supplier contact information for purchasing and factory authorized repair service.

### **3.14 Correction After Completion**

- .1 After start-up, testing, and commissioning phase when satisfactory and reliable operation of equipment and systems has been demonstrated, acceptance to be certified. Guarantee period to begin on date established on certificate of acceptance.
- .2 Provide (supply, install, de-bug and commission) updates and patches to resolve software deficiencies in operator workstation or web server software, project-specific software, graphic software, database software, and firmware during guarantee period.
- .3 Provide (supply, install, de-bug and commission) upgrades that improve routines and procedures of operator workstation software, web server software, project-specific software, graphic software, or database software, free of charge, during guarantee period .
- .4 Provide details of proposed changes and obtain written authorization before installation of updates, patches, or upgrades.
- .5 Include preventative maintenance, with allowance for spare parts, labour, and emergency (24 hour) service for system and equipment during guarantee period.

- .6 Equipment manufacturers to submit written undertakings to make circuit board repairs and provide spare parts, software support and patches, and technical assistance for at least five years after acceptance is certified.

**END OF SECTION**

## **B.A.S. BUILDING CONTROLLERS**

### **25 13 01**

#### **1 GENERAL**

##### **1.1 Scope**

- .1 Provide Building Controllers ("BCU") for Building Automation System.

#### **2 PRODUCTS**

##### **2.1 General**

- .1 Provide equipment which functions and meets detailed performance criteria when operating in following minimum ambient condition ranges:
  - .1 Temperature - 0°C to 32.2°C (32°F to 90°F),
  - .2 Relative Humidity 10% to 90% non -condensing,
  - .3 Electrical power service of single phase, 120 VAC +/- 10%, 60 Hz nominal,
  - .4 Operating voltage: operate at 90% to 110% of nominal voltage rating and to perform an orderly shutdown below 80% nominal voltage,
  - .5 Operation to be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft).
- .2 Components installed within motor control devices to be designed to operate with transient electrical fields occurring within these devices..

##### **2.2 Building Controllers**

- .1 General:
  - .1 stand-alone, multi-tasking, multi-user, real time digital processors with hardware, software, and communications interfaces, power supplies, and input/output modular devices.
  - .2 Based on the open environment Tridium Niagara framework
  - .3 Compatible with Toronto Public Library's Johnson Controls Facility Explorer server
  - .4 removable (hot swappable) without disconnection of terminals and wiring,
  - .5 have access to data within network to accomplish global control strategies.
  - .6 support firmware upgrades without need to replace hardware and to have spare capacity for I/O.
  - .7 continuously perform self-diagnostics, communication diagnosis, and provide both local and remote annunciation of any detected component failures, low battery condition; and upon failure to assume predetermined failure mode.
  - .8 monitor status of overrides and inform operator if automatic control has been inhibited, and allow operator to manually override automatic or centrally executed inhibit command.
- .2 Input/ Output points:
  - .1 hardwired inputs and outputs to tie into system through various Building Control Units (BCU's).
  - .2 protected such that shorting of point to itself, shorting of point to another point, or shorting of point to ground will not damage controller.
  - .3 protected such that voltage spikes of up to 24 V, of any duration, and any polarity will not damage controller.

- .4 Analog input: compatible with, and field configurable to commonly available sensing devices using low voltage signals (0 -10 VDC), current signals (4 -20 ma), or resistance signals from thermistors or RTD.
  - .5 Analog output: in form of modulating electronic signal, either voltage mode (0 -10VDC) or current mode (4 -20mA).
  - .6 Digital inputs: allow monitoring of on/off signals from remote devices. Digital inputs to provide wetting current of at least 12 ma and to be compatible with commonly available control devices.
  - .7 Digital outputs: provide on/off operation, or pulsed low voltage signal for pulse width modulation control. Digital outputs to be relays, 24 Volts AC or DC maximum, having 3 Amp maximum current. Each relay to be configured as normally open or normally closed, and either dry contact or bussed.
  - .8 Universal inputs: Thermistor Precon Type II, dry contacts, or 0 -5VDC with 0 -10K Ohm input impedance.
- .3 Spare I/O capacity, each BCU:
- .1 minimum of 25% spare I/O point capacity for each point type found at each location.
  - .2 25% of each type if input points are not universal,
  - .3 25% of each type if outputs are not universal,
  - .4 Minimum of one spare is for each type of point used.
  - .5 Future use of spare capacity to involve provision of field device, field wiring, point database definition, and custom software. These spare points to be configurable without additional controller boards or point modules. Wiring connections to be made to field-removable, through modular terminal strips or termination cards connected by ribbon cable.
- .4 Time Clock:
- .1 Controllers that perform scheduling operations to have on board real-time clock.
- .5 Communications:
- .1 communication port (RS-232 DB-9, RJ-11 or RJ-45) for connection to laptop computer or operator interface device to allow memory downloads and other commissioning and troubleshooting operations.
  - .2 communication services over BAS networks to support operator interface performance, and value passing as follows;
    - (a) connection of an operator interface device to any one controller on network to allow operator to interface with other controllers as if that interface were directly connected to those other controllers.
    - (b) data, status information, control algorithms, inputs, outputs, etc., from any controller on network is to be available for viewing and editing through operator interface device that is connected to any controller on network.
    - (c) links to execute control strategies to be programmed and tested so that an operator with appropriate password privileges is able to edit these links either by typing in standard object addresses, or by using simple point and click commands.
    - (d) daily routine automatically synchronize time clocks in controllers. An operator initiated change to master time clock setting to be automatically broadcast to other controllers on network.
    - (e) minimum baud rate for peer-to-peer communication between controllers in system LAN to be at 10 Mbps and communication with low level controllers, to be at 76 Kbps.
- .6 GUI:

- .1 face mounted LED type annunciation to display operational mode, and power and communication status.
- .7 Tier 1 LAN:
  - .1 BCU's reside on Ethernet (ISO 8802-3) first tier Building Systems LAN, on same high-speed network as Server, and provide Read (Initiate) and Write (Execute) services to communicate with BACnet objects or LON SNVT's.
- .8 BACnet devices, Tier 1 network;
  - .1 Conformance Class 6,
  - .2 meet all the requirements for all of the lowered numbered classes as specified herein for Class 3, and
  - .3 in accordance with the requirements of ANSI BACnet 135-1995 for Classes 4 and 5, support the BACnet functional groups for;
    - (a) Clock,
    - (b) Time Master,
    - (c) Reinitialize,
    - (d) PCWS (Personal Computer Workstation),
    - (e) Event Initiation,
    - (f) Event Response and Files,
  - .4 support the standard BACnet object types of;
    - (a) Calendar,
    - (b) Command,
    - (c) Event Enrollment,
    - (d) File and Schedule, and
    - (e) support the Local\_Time, Local-Date, UTC\_Offset, Daylight\_Savings\_Status and Time\_Synchronization\_Recipient properties of the Device Object.
- .9 Power interruption:
  - .1 In event of normal power loss;
    - (a) provide orderly shut down of controllers to prevent loss of database or software programming,
    - (b) incorporate non-volatile memory for critical configuration data,
    - (c) battery backup to be provided to support real time clock and volatile memory for minimum of 72 hours.
- .10 Memory:
  - .1 sufficient memory to support operating system, program, and database requirements including;
    - (a) device and network management.
    - (b) data sharing.
    - (c) alarm and event management including custom alarm messages for each alarm level for each point noted in I/O Schedule.
    - (d) energy management.
    - (e) collection of historical trend data for operator selected points.
    - (f) maintenance support.
    - (g) scheduling.
    - (h) dial up communications.
    - (i) manual override monitoring.

## **2.3 Building Controller Software**

### **.1 General**

- .1 Applications software for building systems operation and monitoring and energy management to reside and operate in system controllers (BCU's).
- .2 Using and editing of applications to be available to an operator with appropriate authorization, through operator workstation/browser interface or at other engineering workstations.
- .3 Software to support concurrent operation of multiple standard and non-standard protocols including but not limited to:
  - (a) BACnet
  - (b) LonTalk
  - (c) MODBUS
  - (d) OPC
  - (e) SNMP

### **.2 Software application programs:**

#### **.1 Scheduling**

- (a) capable of scheduling each object or group of objects,
- (b) separate schedules for each day of week with up to five start/stop pairs. (10 events)
- (c) exception schedules defined up to year in advance and once events on exception schedule day have been executed, definition of the exception schedule day will be discarded and replaced by standard schedule for that day of week.
- (d) up to 24 holiday schedules may be placed on scheduling calendar and will be repeated each year.
- (e) ability to override programmed start/stop based on outside temperature reaching or exceeding an adjustable value, operator initiated, individual for each system,
- (f) temporary scheduler, ability to alter current schedule on a one time basis.

#### **.2 Optimal Start/Stop**

- (a) Delay startup of each HVAC system to latest possible time which will allow building space to reach target conditions occupancy time
- (b) Also advance shutdown of each system to earliest possible time.
- (c) Include modeling techniques using building mass temperature and outdoor air temperature to predict building warm up and cool down times under different outdoor and indoor conditions.
- (d) Generate reports to show current value of variables, inputs and outputs involved and estimates of energy savings.

#### **.3 Temperature based load control**

- (a) Provide temperature setback or set up according to programmed occupancy schedules with capability to assign separate schedules to each control zone.
- (b) Control of setback or set up achieved through setpoint adjustment, cycling of systems or cooling plant temperature conditions occupancy time
- (c) Generate reports to show current value of variables, inputs and outputs involved and estimates of energy savings.

#### **.4 Supply air reset**

- (a) Monitor heating and cooling loads in building spaces and adjust HVAC discharge sensors to most energy efficient levels which will still satisfy measured load zone.
- (b) Generate reports to show current value of variables, inputs and outputs involved and estimates of energy savings.

#### **.5 Enthalpy Economizer:**



- (a) Program to control outside and return and exhaust air dampers during the cooling season based on inside and outside enthalpy comparisons.
  - (b) modulate dampers to mix outside and return air for free cooling whenever outside temperature is less than the supply air temperature setpoint
  - (c) Use either return or outdoor air to effect smallest enthalpy change across the cooling coil whenever outside temperature is above the supply air setpoint.
- .6 Grouping of objects
- (a) able to group together objects associated with equipment based on function and location so that group may be used for scheduling, logging, assigning global commands and other applications.
  - (b) at a minimum, assemble the following groups
    - each air handling unit and objects from all terminal units controllers associated with the specific air handling unit
  - (c) assemble other groups as directed by the Consultant, Commissioning Agent and Client
- .7 Alarms
- (a) each binary input and binary value object capable of generating an alarm based on an operator-specified state and to have capability to enable or disable this alarm.
  - (b) each analog object capable of generating an alarm based on an operator-specified high and low alarm limit and to have capability to enable or disable this alarm.
  - (c) delivered with alarms enabled as listed in Sequences of Operation.
- .8 Electrical demand management
- (a) capable of managing electrical demand by monitoring power consumption from signals received from pulse generator provided by others mounted at building power meter or from watt transducer or current transformers attached to building electrical feeder lines.
  - (b) If power consumption exceeds operator definable levels, system to be capable of automatically adjusting set-points, de-energizing low priority equipment, and taking other pre-programmed actions as described in Sequences of Operation to reduce demand.
  - (c) If demand drops below operator defined levels, action will be taken to restore loads in predetermined order.
- .9 Maintenance Management.
- (a) able to monitor equipment status and generate maintenance alarms based upon user-designated run-time, starts, or performance limits.
  - (b) configured to deliver maintenance alarms based upon Sequences of Operation.
- .10 Sequencing.
- (a) able to sequence chillers, boilers, and pumps with lead, lag, standby, priority assignment based upon run time,
  - (b) configured as specified in Sequences of Operation.
- .11 PID Control.
- (a) PID (proportional-integral-derivative) algorithm with direct or reverse action, controlled variable, set point, and PID gains user-selectable.
  - (b) this algorithm to calculate time-varying analog value that is used to position an output object or stage series of output objects.
  - (c) integral windup protection as a fundamental part of PID algorithm.
- .12 Staggered Start.
- (a) able to prevent controlled equipment from restarting simultaneously on power restoration after power outage.
  - (b) user-selectable sequence to establish order in which equipment (or groups of equipment) is started, and time delay between starts.

.13 Duty Cycling

- (a) Periodically cycles run and stand-by equipment to equalize usage, on a calendar basis.

.14 Power Interruption Restart

- (a) automatic system restart after a power failure,
- (b) on resumption of power (normal or emergency transfer), command all equipment and devices to a de-energized state (system stop program).
- (c) provide field verified time delay to permit all associated rotating equipment to come to a stop.
- (d) initiate restart of systems in accordance with current operating schedule requirements, and Staggered Start program.

.15 Smoke Management

- (a) Provide smoke management, smoke venting and pressurization control and communication integration with Fire Alarm System.

.16 Energy Calculations.

- (a) calculation routines to establish and accumulate instantaneous power demand in kW, flow rates in L/s temperature differences in C° and convert information to energy usage data.
- (b) two algorithms;
  - first one calculates sliding window average with operator specified window intervals.
  - second one calculates fixed-window average with digital input signal to define start of window period and synchronize fixed-window average calculation with start time used by utility.

.17 Anti-Short Cycling.

- (a) routines to protect binary output objects from short cycling with operator selected on-time and off-time minimums.

.18 On/Off Control with Differential.

- (a) direct-acting or reverse-acting algorithm that cycles binary output object based on operator selected controlled variable, set point and differential.

.19 Run-Time Totalization.

- (a) calculation routine that totalizes run-times for any binary input or object with operator selected high runtime alarms.
- (b) delivered with run time totalization and alarms configured as specified in Sequences of Operation.

### **3 EXECUTION**

#### **3.1 Equipment mounting**

- .1 Install equipment in accordance with manufacturer's recommendations.
- .2 Mount units on modular channel frames (Unistrut or equivalent) adjacent to equipment being controlled.
  - .1 for free-standing frames, provide cross bracing and spread footing to withstand a horizontal seismic force equal to 150% of weight of BCU and support frame.
  - .2 BCU's may be mounted directly to fixed building elements, including columns and walls.
  - .3 Do not mount or attach BCU or mounting frames to any equipment subject to vibration.
- .3 Install piping securely anchored to structure or equipment.
- .4 Make power connections to controller units and sensors.

### **3.2 Configuration**

- .1 Total number of devices on each Building LAN Bus not to exceed 80% of maximum device limitations (with the use of repeater devices).

**END OF SECTION**

## **B.A.S. EQUIPMENT CONTROLLERS**

### **24 14 01**

## **1 GENERAL**

### **1.1 Scope**

- .1 Provide Equipment Controllers ("ECU") for Building Automation System.
- .2 Connect Field Controllers to Building Controller via a BAS on a dedicated BACnet network.

## **2 PRODUCTS**

### **2.1 General**

- .1 Provide equipment which functions and meets detailed performance criteria when operating in following minimum ambient condition ranges:
  - .1 Temperature - 0°C to 32.2°C (32°F to 90°F)
  - .2 Relative Humidity 10% to 90% non -condensing
  - .3 Electrical power service of single phase, 120 VAC +/- 10%, 60 Hz nominal,
  - .4 Operating voltage: operate at 90% to 110% of nominal voltage rating and to perform an orderly shutdown below 80% nominal voltage,
  - .5 Operation to be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft).
- .2 Components installed within motor control devices to be designed to operate with transient electrical fields occurring within these devices.

### **2.2 Equipment Controllers - General**

- .1 ECU's separated into two types: Programmable, and Configurable.
- .2 General:
  - .1 stand-alone, multi-tasking, multi-user, real time digital processors with hardware, software, and communications interfaces, power supplies, and input/output modular devices.
  - .2 removable (hot swappable ) without disconnection of terminals and wiring,
  - .3 have access to data within network to accomplish global control strategies.
  - .4 support firmware upgrades without need to replace hardware and to have spare capacity for I/O.
  - .5 continuously perform self-diagnostics, communication diagnosis, and provide both local and remote annunciation of any detected component failures, low battery condition; and upon failure to assume predetermined failure mode.
  - .6 monitor status of overrides and inform operator if automatic control has been inhibited, and allow operator to manually override automatic or centrally executed inhibit command.
- .3 Input/Output points:
  - .1 hardwired inputs and outputs to tie into system through various Equipment Control Units (ECU's).
  - .2 protected such that shorting of point to itself, shorting of point to another point, or shorting of point to ground will not damage controller.

- .3 protected such that voltage spikes of up to 24 V, of any duration, and any polarity will not damage controller.
  - .4 Analog input: compatible with, and field configurable to commonly available sensing devices using low voltage signals (0 -10 VDC), current signals (4 -20 ma), or resistance signals from thermistors or RTD.
  - .5 Analog output: in form of modulating electronic signal, either voltage mode (0 -10VDC) or current mode (4 -20mA).
  - .6 Digital inputs: allow monitoring of on/off signals from remote devices. Digital inputs to provide wetting current of at least 12 ma and to be compatible with commonly available control devices.
  - .7 Digital outputs: provide on/off operation, or pulsed low voltage signal for pulse width modulation control. Digital outputs to be relays, 24 Volts AC or DC maximum, having 3 Amp maximum current. Each relay to be configured as normally open or normally closed, and either dry contact or bussed.
  - .8 Universal inputs: Thermistor Precon Type II, dry contacts, or 0 -5VDC with 0 -10K Ohm input impedance.
- .4 Spare I/O capacity, each ECU:
- .1 minimum of 15% spare I/O point capacity for each point type found at each location.
  - .2 15% of each type if input points are not universal,
  - .3 15% of each type if outputs are not universal,
  - .4 Minimum of one spare is for each type of point used.
  - .5 Future use of spare capacity to involve provision of field device, field wiring, point database definition, and custom software. These spare points to be configurable without additional controller boards or point modules. Wiring connections to be made to field-removable, through modular terminal strips or termination cards connected by ribbon cable.
- .5 Time Clock:
- .1 Controllers that perform scheduling operations to have on board real-time clock.
  - .2 In network application, time clock synced to associated BCU.
- .6 Communications:
- .1 communication port (RS-232 DB-9, RJ-11 or RJ-45) for connection to laptop computer or operator interface device to allow memory downloads and other commissioning and troubleshooting operations.
  - .2 communication services over BAS networks to support operator interface performance, and value passing as follows:
    - (a) connection of an operator interface device to any one controller on network to allow operator to interface with other controllers as if that interface were directly connected to those other controllers.
    - (b) data, status information, control algorithms, inputs, outputs, etc., from any controller on network is to be available for viewing and editing through operator interface device that is connected to any controller on network.
    - (c) links to execute control strategies to be programmed and tested so that an operator with appropriate password privileges is able to edit these links either by typing in standard object addresses, or by using simple point and click commands.
    - (d) daily routine automatically synchronize time clocks in controllers. An operator initiated change to master time clock setting to be automatically broadcast to other controllers on network.

- (e) minimum baud rate for peer-to-peer communication between controllers in system LAN to be at 10 Mbps and communication with low level controllers, to be at 76 Kbps.

.7 Power interruption:

- .1 continue to provide control functions in event of network communication failures.
- .2 incorporate sufficient non-volatile memory to store critical configuration data in event of loss of normal power, and sufficient battery backup to support real time clock and volatile memory for minimum of 72 hours.

.8 Memory:

- .1 sufficient memory to support its own operating system, including data sharing.

.9 GUI:

- .1 face mounted LED type annunciation to display operational mode, and power and communication status.

.10 Tier 2 LAN:

- .1 ECU's reside on either ARCNET or MS/TP physical data link layer protocol to provide BACnet internetworking and

.11 BACNet devices, Tier 2 Network;

- .1 Conformance Class 3,
- .2 support the BACnet functional groups for
  - (a) Change-of-Value (COV) Event Initiation,
  - (b) Change-of-Value (COV) Event Response,
  - (c) Event Initiation,
  - (d) Event Response,
- .3 support the BACnet standard application services of;
  - (a) Read Property,
  - (b) Write Property.
- .4 support the standard BACnet object types of;
  - (a) Device,
  - (b) Analog Input,
  - (c) Analog Output,
  - (d) Analog Value,
  - (e) Binary Input,
  - (f) Binary Output and Binary Value,
  - (g) Loop,
  - (h) Multi-State Input,
  - (i) Multi-State Output,
  - (j) Notification Class at a minimum.
- .5 The described functionality provides reading and writing of all analog or digital inputs and outputs between BACnet devices on the network and provides for change-of-value initiation and reporting.

## **2.3 Equipment Control Unit (ECU) - Programmable**

.1 General:

- .1 capable of stand-alone, microprocessor-based operation.

- .2 fully programmable controller for larger equipment and small systems such as hydronic air handling system, simple chiller or boiler plants, cooling towers and pumps.
- .3 support firmware upgrades without need to replace hardware and to have minimum of 15 percent spare capacity of I/O functions.
  - (a) type of spares to be in same proportion as implemented functions on controller, but in no case there to be less than one point of each implemented I/O type.
- .4 continuously perform self-diagnostics, communication diagnosis, and provide both local and remote annunciation of any detected component failures, low battery condition; and upon failure to assume predetermined failure mode.

## **2.4 Equipment Control Units (ECU) - Configurable**

- .1 General:
  - .1 capable of stand-alone, microprocessor-based operation.
  - .2 purpose-built for specific application to which they are applied, including;
    - (a) terminal unit (VAV, CAV, FPVAV) box,
    - (b) unit heaters,
    - (c) fan coils,
    - (d) rooftop unit
    - (e) heat pumps
    - (f) local reheat zones
    - (g) perimeter heating control
    - (h) free-standing fans
  - .3 Optically isolated from other controllers on communication loop.
  - .4 Memory: maintain all BIOS and programming information in the event of a power loss for at least 90 days.
- .2 Local zone control:
  - .1 wired to wall mounted temperature sensor with jack-style communications wiring.

## **2.5 Equipment Controller Software**

- .1 General:
  - .1 applications software for building systems operation and monitoring and energy management to reside and operate in system controllers (ECU's),
  - .2 using and editing of applications to be available to an operator with appropriate authorization, through operator workstation/browser interface or at other engineering workstations,
  - .3 software to support concurrent operation of multiple standard and non-standard protocols including but not limited to:
    - (a) BACnet
    - (b) LonTalk
    - (c) MODBUS
    - (d) OPC
    - (e) SNMP
  - .4 Memory resident and available to the programs a full library of DDC algorithms, intrinsic control operators, arithmetic, logic, and relational operators for implementation of control sequences.
  - .5 Proportional Control, Proportional plus Integral (PI), Proportional plus Integral plus Derivative (PID), and Adaptive Control (self learning).

- .6 Adaptive Control algorithm used on control loops, as indicated in the I/O summary, where the controlled medium flow rate is variable (such as VAV units and variable flow pumping loops).
  - .7 Adaptive control algorithm monitor the loop response characteristics in accordance with the time constant changes imposed by variable flow rates. The algorithm operates in a continuous self learning manner and retains in memory a stored record of the system dynamics so that on system shutdown and restart, the learning process starts from where it left off and not from ground zero.
  - .8 Standard PID algorithms are not acceptable substitutes for variable flow applications since they will provide satisfactory control at only one flow rate and will require continued manual fine tuning.
  - .9 Make available DDC setpoints, gains and time constants associated with DDC programs to the operator for display and modification via the central operator interface and portable operators terminal.
  - .10 Adjustable execution interval of each DDC loop from two to 120 seconds in one second increments.
  - .11 Assignment of initialization values to all outputs to assure that controlled devices assume a fail safe position on initial system start up.
- .2 Configurable ECU programming:
- .1 Series of user selectable and configurable pre-programmed control functions.
  - .2 Control parameters field adjustable during balancing to compensate for variations in terminal unit installation, type and size.
- .3 Software application programs:
- .1 Scheduling
    - (a) capable of scheduling each object or group of objects.
    - (b) separate schedules for each day of week with up to five start/stop pairs. (10 events)
    - (c) exception schedules defined up to year in advance and once events on exception schedule day have been executed, definition of the exception schedule day will be discarded and replaced by standard schedule for that day of week.
    - (d) up to 24 holiday schedules may be placed on scheduling calendar and will be repeated each year.
    - (e) ability to override programmed start/stop based on outside temperature reaching or exceeding an adjustable value, operator initiated, individual for each system
  - .2 Optimal Start/Stop
    - (a) Delay startup of each HVAC system to latest possible time which will allow building space to reach target conditions occupancy time
    - (b) Also advance shutdown of each system to earliest possible time.
    - (c) Include modeling techniques using building mass temperature and outdoor air temperature to predict building warm up and cool down times under different outdoor and indoor conditions.
    - (d) Generate reports to show current value of variables, inputs and outputs involved and estimates of energy savings.
  - .3 Temperature based load control
    - (a) Provide temperature setback or set up according to programmed occupancy schedules with capability to assign separate schedules to each control zone.
    - (b) Control of setback or set up achieved through setpoint adjustment, cycling of systems or cooling plant temperature conditions occupancy time
    - (c) Generate reports to show current value of variables, inputs and outputs involved and estimates of energy savings.
  - .4 Supply air reset



- (a) Monitor heating and cooling loads in building spaces and adjust HVAC discharge sensors to most energy efficient levels which will still satisfy measured load zone.
  - (b) Generate reports to show current value of variables, inputs and outputs involved and estimates of energy savings.
- .5 Enthalpy Economizer:
- (a) Program to control outside and return and exhaust air dampers during the cooling season based on inside and outside enthalpy comparisons.
  - (b) modulate dampers to mix outside and return air for free cooling whenever outside temperature is less than the supply air temperature setpoint
  - (c) Use either return or outdoor air to effect smallest enthalpy change across the cooling coil whenever outside temperature is above the supply air setpoint.
- .6 Grouping of objects
- (a) able to group together objects associated with equipment based on function and location so that group may be used for scheduling, logging, assigning global commands and other applications.
  - (b) at a minimum, assemble the following groups;
    - each air handling unit and objects from all terminal units controllers associated with the specific air handling unit
  - (c) assemble other groups as directed by the Consultant, Commissioning Agent and Client
- .7 Alarms
- (a) each binary input and binary value object capable of generating an alarm based on an operator-specified state and to have capability to enable or disable this alarm.
  - (b) each analog object capable of generating an alarm based on an operator-specified high and low alarm limit and to have capability to enable or disable this alarm.
  - (c) delivered with alarms enabled as listed in Sequences of Operation.
- .8 Electrical demand management
- (a) capable of managing electrical demand by monitoring power consumption from signals received from pulse generator provided by others mounted at building power meter or from watt transducer or current transformers attached to building electrical feeder lines.
  - (b) If power consumption exceeds operator definable levels, system to be capable of automatically adjusting set-points, de-energizing low priority equipment, and taking other pre-programmed actions as described in Sequences of Operation to reduce demand.
  - (c) If demand drops below operator defined levels, action will be taken to restore loads in predetermined order.
- .9 Maintenance Management.
- (a) able to monitor equipment status and generate maintenance alarms based upon user-designated run-time, starts, or performance limits.
  - (b) configured to deliver maintenance alarms based upon Sequences of Operation.
- .10 Sequencing.
- (a) able to sequence chillers, boilers, and pumps with lead, lag, standby, priority assignment based upon run time,
  - (b) configured as specified in Sequences of Operation.
- .11 PID Control.
- (a) PID (proportional-integral-derivative) algorithm with direct or reverse action, controlled variable, set point, and PID gains user-selectable.
  - (b) this algorithm to calculate time-varying analog value that is used to position an output object or stage series of output objects.
  - (c) integral windup protection as a fundamental part of PID algorithm.

.12 Staggered Start.

- (a) able to prevent controlled equipment from restarting simultaneously on power restoration after power outage.
- (b) user-selectable sequence to establish order in which equipment (or groups of equipment) is started, and time delay between starts.

.13 Energy Calculations.

- (a) calculation routines to establish and accumulate instantaneous power demand in kW, flow rates in L/s temperature differences in C° and convert information to energy usage data.
- (b) two algorithms;
  - first one calculates sliding window average with operator specified window intervals.
  - second one calculates fixed-window average with digital input signal to define start of window period and synchronize fixed-window average calculation with start time used by utility.

.14 Anti-Short Cycling.

- (a) routines to protect binary output objects from short cycling with operator selected on-time and off-time minimums.

.15 On/Off Control with Differential.

- (a) direct-acting or reverse-acting algorithm that cycles binary output object based on operator selected controlled variable, set point and differential.

.16 Run-Time Totalization.

- (a) calculation routine that totalizes run-times for any binary input or object with operator selected high runtime alarms.
- (b) delivered with run time totalization and alarms configured as specified in Sequences of Operation.

### **3 EXECUTION**

#### **3.1 General**

- .1 Provide ECU's for control and instrumentation strategies as detailed in sequence of operation, and as shown.
- .2 Provide custom programming to meet the control strategies as called for in the sequence of operation sections.
- .3 Install equipment in accordance with manufacturer's recommendations.
- .4 Mount units on modular channel frames (Unistrut or equivalent) adjacent to equipment being controlled.
  - .1 for free-standing frames, provide cross bracing and spread footing to withstand a horizontal seismic force equal to 150% of weight of ECU and support frame.
  - .2 ECU's may be mounted directly to fixed building elements, including columns and walls.
  - .3 Do not mount or attach ECU or mounting frames to any equipment subject to vibration.
- .5 Install piping securely anchored to structure or equipment.
- .6 Make power connections to controller units and sensors.

### **3.2 Tier 2 LAN device density**

- .1 Total number of devices on each Tier 2 LAN not to exceed 80% of maximum device limitations (with the use of repeater devices).

### **3.3 ECU database**

- .1 Configure each ECU and provide database to include:
  - .1 Terminal unit box type,
  - .2 Terminal unit box size,
  - .3 minimum and maximum air flows,
  - .4 reheat air flow: minimum turndown air flow prior to use of reheat,
  - .5 current air flow,
  - .6 calibration factor: for field calibration determines by air balancing,
  - .7 room temperature setpoint,
  - .8 maximum room temperature setpoint: occupant selectable,
  - .9 minimum room temperature setpoint: occupant selectable,
  - .10 cooling setpoint,
  - .11 heating setpoint,
  - .12 unoccupied cooling setpoint,
  - .13 unoccupied heating setpoint,
  - .14 afterhours maximum Timer: maximum time occupant may override unoccupied cycle,
  - .15 internal cooling Signal: used to reset supply air temperature if more cooling is required,
  - .16 internal Heating Signal: used to reset supply air temperature is less cooling is required

**END OF SECTION**

## **B.A.S. INSTRUMENTATION AND ACTUATORS**

### **25 35 01**

#### **1 GENERAL**

##### **1.1 Scope**

- .1 Provide Instrumentation, dampers, control valves, and Actuators for Building Automation System.
- .2 Provide actuators for operating dampers provided as part of factory built air handling units.

#### **2 PRODUCTS**

##### **2.1 General**

- .1 Provide equipment which functions and meets detailed performance criteria when operating in following minimum ambient condition ranges:
  - .1 Temperature - 0°C to 32.2°C (32°F to 90°F)
  - .2 Relative Humidity 10% to 90% non -condensing
  - .3 Electrical power service of single phase, 120 VAC +/- 10%, 60 Hz nominal.
- .2 Components installed within motor control devices to be designed to operate with transient electrical fields occurring within these devices.

##### **2.2 Power Supplies and Line Filtering**

- .1 Power Supplies:
  - .1 control transformers to be UL listed,
  - .2 line voltage units to be CSA listed,
  - .3 provide over-current protection in primary and secondary circuits,
  - .4 limit connected loads to 80% of rated capacity.
- .2 DC power supplies:
  - .1 output to match equipment current and voltage requirements,
  - .2 units to be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation to be 1.0% line and load combined, with 100-microsecond response time for 50% load changes,
  - .3 units to have built-in over-voltage and over-current protection and to be able to withstand 150% current overload for at least three seconds without trip-out or failure,
  - .4 units to operate between 0°C and 50°C (32°F and 120°F). EM/RF to meet FCC Class B and VDE 0871 for Class B and MILSTD 810C for shock and vibration.
- .3 Power Line Filtering:
  - .1 provide internal or external transient voltage and surge suppression for workstations and control modules,
  - .2 surge protection:
    - (a) dielectric strength of 1000 V minimum,
    - (b) response time of 10 nanoseconds or less,
    - (c) transverse mode noise attenuation of 65 dB or greater,
    - (d) common mode noise attenuation of 150 dB or greater at 40-100 Hz.

## 2.3 Motorized Control Dampers

- .1 Construction:
  - .1 in accordance with section 23 33 14 - Dampers - Operating.

## 2.4 Electric/electronic actuators – air dampers

- .1 Actuators for Air Handling Units dampers and general purpose plenum/duct mounted dampers:
  - .1 electric/electronic type for two position or proportional operation as shown,
  - .2 enclosure:
    - (a) general purpose, drip proof enclosure for indoor applications,
    - (b) NEMA 4 enclosure for outdoor use and where dampers are exposed to the airstream inside an air intake plenum.
  - .3 gear type mechanism with spring-return to failed position as shown,
  - .4 mounted over damper shaft or with connecting linkage and with fastening clamp assembly,
  - .5 sized and selected in accordance with manufacturer's instructions,
  - .6 electronic overload or digital rotation sensing circuitry to protect damper operator through entire range of rotation,
  - .7 angle of rotation adjustable between 0° to 90°,
  - .8 control signals:
    - (a) 0 - 10VDC or 0 - 20ma for proportional control,
    - (b) power On-Off for two position service,
  - .9 feedback signals:
    - (a) proportional service: 2 - 10 VDC position feedback signal.
    - (b) two position service: two SPDT auxiliary switches for end stop position indication.
  - .10 suitable for operation down to -35°C when installed outdoors.
- .2 Actuators for dampers serving fuel-fired appliances and stationary engines – equipment and rooms:
  - .1 as above for general purpose duct mounted dampers and as follows.
  - .2 spring return to fail position on loss of power supply:
    - (a) combustion air dampers : fail-to-open
    - (b) ventilation inlet air dampers: fail-to-open
    - (c) recirculation air dampers: fail-to-close
    - (d) exhaust air dampers: fail-to-open.
  - .3 spring operating cycle time: <20 seconds at -20°C to 50°C (-4°F to 122°F)
  - .4 operating control:
    - (a) combustion air dampers: two position open/closed
    - (b) all other dampers: modulating with 0-10VDC or 4-20 mA input signal

### *Standard of Acceptance*

- ° Belimo – EFB24-S N4/EFB120-S N4 series for two position dampers
- ° Belimo – EFB24-SR-S N4 series for modulating dampers

- .3 Actuators for Terminal unit dampers:
  - .1 integrated DDC controller and damper actuator,

- .2 sized and selected in accordance with terminal box damper manufacturer's specifications,
- .3 gear drive, direct coupled type operators mounted to shaft with universal V-bolt clamp,
- .4 proportional type control,
- .5 selectable / reversible rotation direction,
- .6 input type and range as suitable for interfacing to output of terminal unit controller,
- .7 angle of rotation adjustable between 30 to 90° with mechanical limit stops,
- .8 damper position indication visible without cover removal,
- .9 manual override to set damper position without power applied to actuator,
- .10 electronic stall protection,
- .11 general purpose dust proof enclosure,
- .12 actuator running time of not more than 100 seconds,
- .13 delivered to terminal unit manufacturer's factory for installation.

## **2.5 Control Valves**

- .1 General:
  - .1 Body and trim materials selected in accordance with specification for globe valves, ball valves, or high performance butterfly valves, and in accordance with manufacturer's recommendations for design conditions and service.
  - .2 Size control valves for pressure drops and heating and cooling loads as scheduled with same pressure rating as globe valves under same service and pressure conditions.
  - .3 Size valves for two port and three port, two position service;
    - (a) line size,
    - (b) ball valves, sizes NPS 1 ½ and smaller,
    - (c) butterfly valves, sizes NPS 2 and larger.
  - .4 For two port and three port modulating service;
    - (a) use globe valves for CV rating 160 and smaller,
  - .5 Control valve type selections and sizes are shown on drawings, schematics and schedules.
- .2 Water and glycol valves:
  - .1 two position service;
    - (a) straight through two port type, single seated, with replaceable disc or ball,
    - (b) quick opening linear or equal percentage flow characteristics.
  - .2 modulating service;
    - (a) straight through two port type, single seated,
    - (b) equal percentage flow characteristics.
  - .3 modulating diverting service; three port mixing valves,
    - (a) linear for each port to give constant total flow or,
    - (b) equal percentage flow characteristics with 25% valve authority (valve pressure drop equal to 33% pressure drop through load at full flow).
  - .4 actuator and trim selected for close-off pressure ratings as follows;
    - (a) two-way modulating or two position service; 150% of pump shut off head.
    - (b) three-way modulating service; 300% of pressure differential between ports A and B at design flow or 100% of pump shut off head.
    - (c) shut off head to be based on maximum rpm when pump is fitted with VFD

- .5 sized as follows;
  - (a) for two-position service; line size.
  - (b) for two-way modulating service unless otherwise shown; pressure drop at design flow equal to greatest of;
    - 200% of pressure drop through heat exchanger,
    - 100% of pressure drop through coil,
    - 50% of pressure difference between supply and return mains, or
    - 35 kPa (5 psi).
  - (c) for three-way modulating service; pressure drop equal to smaller of;
    - twice pressure drop through coil or heat exchanger, or
    - 35 kPa (5 psi).
  - (d) for valves for radiation, terminal units and reheat coils;
    - pressure drop of 7kPa (1 psig)
- .6 failed position on isolation from control signal as follows;\_\_
  - (a) Heating water and glycol zone valves; normally open.
  - (b) Heating coil valves in AHU; normally open.
  - (c) Chilled water control valves; normally closed.
  - (d) Chilled water differential pressure by-pass control valves; normally open.
  - (e) Hot water and glycol differential pressure by-pass control valves; normally closed.

## **2.6 Electric/electronic actuators - valves**

- .1 Valve actuators for service other than radiation, radiant panel and reheat coil valve applications:
  - .1 sized and selected in accordance with manufacturer's specifications,
  - .2 electric/electronic for two position, or proportional control action, coupled to valves with linkage,
  - .3 electronic interface control board, solid state drive, reversible motor, oil immersed gear train,
  - .4 electronic overload or digital rotation sensing circuitry to protect damper operator through entire range of rotation,
  - .5 span and zero travel adjustment,
  - .6 position feedback signal on actuators used for proportional control,
  - .7 provision for manual positioning of valve when actuator is not powered,
  - .8 spring return mechanism to return valve to "normal" position on power failure (i.e. Normally Open (NO), or Normally Closed (NC)),
  - .9 control signals:
    - (a) 0 to 10VDC or 0 to 20ma,
    - (b) modulate damper position with 2 to 10VDC or 4 to 20ma input signal operating range when in proportional service.
    - (c) input type and range as suitable for interfacing to output of BAS controller
  - .10 feedback signals:
    - (a) two independent adjustable travel limit switches and wiring to BAS for indication of valve position.
  - .11 general purpose, drip proof NEMA 2 die-cast housing with corrosion resistant steel cover for indoor applications, watertight NEMA 4 enclosure for outdoor use,
  - .12 electric actuators suitable for operation down to -35°C where installed outdoors.
- .2 Valve actuators for service on radiation, radiant panel, and reheat coil valve applications:

- .1 output shaft driven by gear train mechanism.
- .2 reversible motor with automatic load limit,
- .3 input type and range as suitable for interfacing to output of BAS controllers,
- .4 adjustable span and offset travel ,
- .5 position feedback signal on actuators used for proportional control,
- .6 general purpose, dustproof, die-cast aluminum housing,
- .7 actuator rotation limit.

## **2.7 Temperature switches**

- .1 Low temperature limit thermostat (freezestat):
  - .1 6m (20 ft) of sensing capillary sensitive to freezing air over any 400mm (15 in) section,
  - .2 manual reset switch
  - .3 installed in multiples with one unit serving not more than 5 m<sup>2</sup> (40 sq ft) of duct area.
  - .4 single pole single throw (SPST) contacts or single pole double throw (SPDT) contacts where used as digital input to BAS
  - .5 1.7°C to 7.2°C (35°F to 45°F) operating temperature range
  - .6 adjustable set point within specified range
  - .7 protective enclosure.
- .2 Temperature switches:
  - .1 sensing element of liquid, vapour or bimetallic type,
  - .2 adjustable set-point and differential of at least 0.22°C to 1.7°C ( 0.4°F to 3.0°F),
  - .3 snap action type rated at 120 volts, 15 amps or 24 volts DC,
  - .4 automatic in operation and automatically reset when condition returns to normal.
  - .5 suitable for wall mounting on standard electrical box with protective guard, or suitable for insertion into air ducts with insertion length of 450 mm (18 in), or
  - .6 thermowell type with compression fitting for 20 mm (0.8 in) NPT well, mounting length of 100 mm ( 4 in), and immersion wells of type 316 stainless steel, or
  - .7 Strap-on-type with helical screw stainless steel clamps.
  - .8 23°C to 57°C (75°F to 138°F) operating temperature range
  - .9 adjustable set point within specified range
  - .10 single pole single throw (SPST) contacts or single pole double throw (SPDT) contacts where used as digital input to BAS
  - .11 protective enclosure.

## **2.8 Temperature sensors/transmitters**

- .1 Sensor alternative technologies:
  - .1 Resistance temperature device (RTD) of precision thin film platinum element type;
    - (a) linear characteristics over sensor range,
    - (b) 1000 ohm, ±20 ohms (2%) reference resistance at 0°C (32°F),
    - (c) 0/.0385ohms/ohm/°C (0.0212 ohms/ohm/°F) temperature coefficient of resistance and
    - (d) ±0.36°C at 21°C (±0.65°F at 70°F) accuracy



- .2 Resistance temperature device (RTD) of precision thin film nickel element type, with
  - (a) linear characteristics over sensor range,
  - (b) 1000 ohm,  $\pm 20$  ohms (2%) reference resistance at 21°C (70°F),
  - (c) 5.4 ohm/°C (3.0 ohm/°F) temperature coefficient of resistance and
  - (d)  $\pm 0.18^\circ\text{C}$  at 21°C ( $\pm 0.34^\circ\text{F}$  at 70°F) accuracy
- .3 Thermistor with
  - (a) non-linear negative temperature coefficient of resistance,
  - (b) 10,000 ohms reference resistance at 25°C (77°F),
  - (c) curve matched to  $\pm 0.2^\circ\text{C}$  ( $\pm 0.36^\circ\text{F}$ ) temperature accuracy over 0°C to 70°C (32°F to 158°F), and
  - (d) long term stability of 0.025°C (0.045°F) drift per year
- .2 Each sensor:
  - .1 2 integral anchored lead wires
  - .2 waterproof sensor to sheath seal
  - .3 strain minimizing construction
  - .4 standard conduit box termination with cover
  - .5 pig-tail wire leads with wire nuts or screwed terminal connector block
  - .6 factory calibrated and capable of end to end (sensing element to BAS) accuracy of  $\pm 0.25^\circ\text{C}$  ( $\pm 0.5^\circ\text{F}$ ) over full range of measured variable.
  - .7 transducing circuit to convert output to signal compatible with equipment controller
  - .8 concealed USB or serial communications port for portable PC or hand held commissioning equipment.
- .3 Averaging element type temperature sensors:
  - .1 average style element for ducts of greater cross section than 0.4 m<sup>2</sup> (4 sq ft).
  - .2 sensor operating temperature range from -40°C to 121°C (-40°F to 250°F)
  - .3 copper sheathed construction
  - .4 non-condensing 5 to 95% RH
  - .5 minimum immersion length of 4000 mm (13 feet)
  - .6 probe field formable to minimum radius of 100mm (4 in) at any point along probe length, other than with 200 mm (8 in) of connector box, without degradation of specified performance
  - .7 provided as multiple sensors where single averaging element cannot be located to provide proper duct or plenum temperature sampling.
- .4 Duct mount probe type temperature sensors:
  - .1 provided for ducts of cross section less than 0.4 m<sup>2</sup> (4 sq ft)
  - .2 sensor operating temperature range from -40°C to 121°C (-40°F to 250°F)
  - .3 copper or brass or stainless steel sheathed construction
  - .4 non-condensing 5 to 95% RH
  - .5 metal mounting plate
  - .6 length such that sensing element is no less than a of duct width or diameter from duct wall greater

- .7 provided as multiple sensors where single element cannot be located to provide proper duct or plenum temperature sampling.
- .5 Thermowell mount type temperature sensors:
  - .1 insertion elements for measurement of fluid temperatures with stainless steel sheath
  - .2 sensor operating temperature range from  $-40^{\circ}\text{C}$  to  $121^{\circ}\text{C}$  ( $-40^{\circ}\text{F}$  to  $250^{\circ}\text{F}$ )
  - .3 spring loaded construction with compression fitting for 20mm (NPS  $\frac{3}{4}$ ) well mounting
  - .4 length suitable for application
  - .5 stainless steel or chrome plated brass thermowells of size and material to suit relevant sensor, pipe and service
- .6 Outside air temperature sensors:
  - .1 insertion type for through-the-wall installation with stainless steel sheath
  - .2 sensor operating temperature range from  $-25^{\circ}\text{C}$  to  $60^{\circ}\text{C}$  ( $-13^{\circ}\text{F}$  to  $140^{\circ}\text{F}$ )
  - .3 waterproof seal at wall
  - .4 non-condensing 5 to 95% RH
  - .5 total active probe length of 100 mm to 150 mm (4 in to 6 in)
  - .6 with non-corroding outdoor shield to minimize solar heating effect and
  - .7 inert section passing through wall to allow precise measurement of outdoor temperature.
- .7 Space temperature sensors, Type 1:
  - .1 for measurement of space temperatures throughout facility
  - .2 sensor operating temperature range from  $4^{\circ}\text{C}$  to  $60^{\circ}\text{C}$  ( $40^{\circ}\text{F}$  to  $140^{\circ}\text{F}$ )
  - .3 surface mounted plastic mono-chromatic guard with surface mounting plate and wall anchors.
  - .4 guard secured to mounting plate by screws.
  - .5 no display

## **2.9 Humidity sensors - electronic**

- .1 Each humidity sensor:
  - .1 suitable for operating ranges of 10 to 100% R.H.
  - .2 sensor operating temperature range from  $-40^{\circ}\text{C}$  to  $121^{\circ}\text{C}$  ( $-40^{\circ}\text{F}$  to  $250^{\circ}\text{F}$ )
  - .3 solid state sensing element,
  - .4 accuracy of  $\pm 3\%$  over range of 5 to 95% R.H.
  - .5 independent, non-interactive span and zero adjustments
  - .6 0-100% linear proportional output signal indicating relative humidity, 4-20 mA, 0-5 Vdc or 0-10 Vdc
  - .7 strain minimizing construction
  - .8 dust proof enclosure
  - .9 screwed terminal connector block.
- .2 Duct mount probe type humidity sensors:
  - .1 metal mounting plate
  - .2 constructed with 304 stainless steel element enclosure

- .3 length such that sensing element is not less than  $\frac{1}{4}$  of duct width or diameter from duct wall.
- .3 Outside air type humidity sensors:
  - .1 weatherproof enclosure with cover
  - .2 waterproof seal.
- .4 Space humidity sensors:
  - .1 surface mounted plastic guard with surface mounting plate and wall anchors
  - .2 guard secured to mounting plate by screws
  - .3 analogue LCD humidity display.

## **2.10 Pressure sensors/transmitters and pressure switches**

- .1 General:
  - .1 Rating of chilled and condenser water units: 1000 kPa (125 psi).
  - .2 Rating of hot water units: 1000 kPa (125 psi).
  - .3 Rating of steam units: 1200 kPa (150 psi).
  - .4 Rating of high temperature water units: 2700 kPa (400 psi)
  - .5 Pressure sensors monitoring fan operation to have set point adjustable from 0 to 3600 Pa (0 to 10 in wg.) and adjustable differential between 10 to 300 Pa (0.03 to 1 in wg).
- .2 Static pressure and differential pressure sensors for air or inert gas - electronic:
  - .1 diaphragm driven, capacitance change type, 0-100% linear proportional output signal indicating static pressure or differential pressure at station, 4-20 mA, 0-5 Vdc or 0-10 Vdc
  - .2 field adjustable zero and span
  - .3 selected with span of not greater than twice maximum static pressure and not less than twice differential pressure at shut-off.
  - .4 accuracy, including non-linearity, hysteresis and non-repeatability;  $\pm 1\%$  full scale
  - .5 operating temperature range; -18°C to 80°C (0°F to 175°F)
  - .6 operating humidity range; 10 to 90% non-condensing
  - .7 high and low pressure ports, brass hose barbed pressure fittings suitable for 8 mm ( $\frac{1}{4}$  in) tubing
  - .8 mounting bracket, suitable for duct mounting
  - .9 dust proof enclosure, and
  - .10 screw terminal connector block.
- .3 Pressure transducers - electronic:
  - .1 suitable for use in water, glycol, steam, ammonia and non-corrosive refrigerants,
  - .2 series 300 stainless steel construction, stainless steel diaphragm
  - .3 sealed electronics
  - .4 0-100% linear proportional output signal indicating pressure at station, 4-20 mA, 0-5 Vdc or 0-10 Vdc
  - .5 designed for 3 times rated range over pressure without damage
  - .6 low pressure range 1 to 700 kPa (0 to 100 psig)

- .7 high pressure range 1 to 3400 kPa (0 to 500 psig)
  - .8 accuracy including non-linearity, hysteresis, and non-repeatability;  $\pm 1\%$  full range span
  - .9 operating temperature range;  $-40^{\circ}\text{C}$  to  $100^{\circ}\text{C}$  ( $-40^{\circ}\text{F}$  to  $212^{\circ}\text{F}$ )
  - .10 operating humidity range; 10 to 90% non-condensing
  - .11 suitable for direct mounting to pressure port
  - .12 dust proof enclosure, and
  - .13 screw terminal connector block.
- .4 Differential pressure transmitters for terminal units:
- .1 suitable for use in air with pressure independent terminal units (constant volume, variable volume or fan powered)
  - .2 capacitive sensor technology
  - .3 pressure range 0 Pa to 373 Pa (0 to 15 in.w.g.)
  - .4 linear output proportional to velocity pressure of unit inlet air stream, and suitable as analog input to terminal unit controller
  - .5 accuracy including non-linearity, hysteresis, and non-repeatability;  $\pm 1\%$  full scale
  - .6 operating temperature range;  $0^{\circ}\text{C}$  to  $50^{\circ}\text{C}$  ( $32^{\circ}\text{F}$  to  $122^{\circ}\text{F}$ )
  - .7 operating humidity range; 10 to 90% non-condensing
  - .8 high and low pressure ports, barbed pressure fittings suitable for 8 mm ( $\frac{1}{4}$  in) tubing for connection to air flow pick up device provided with terminal box
  - .9 mounting kit, suitable for installation within terminal unit controller enclosure
  - .10 coded screw terminals
- .5 Differential pressure switches:
- .1 spring loaded diaphragm type
  - .2 suitable for use with air or inert gas,
  - .3 adjustable set-point and differential,
  - .4 snap acting SPDT contacts suitable for use as digital input to BAS
  - .5 switch mounted with diaphragm in vertical plane
  - .6 automatic in operation and automatically reset when condition returns to normal.
  - .7 operating temperature range;  $0^{\circ}\text{C}$  to  $60^{\circ}\text{C}$  ( $35^{\circ}\text{F}$  to  $140^{\circ}\text{F}$ )
  - .8 operating humidity; 10 to 90% RH non-condensing
  - .9 high and low pressure ports, brass hose barbed pressure fittings suitable for 8 mm ( $\frac{1}{4}$  in) tubing
  - .10 mounting bracket suitable for duct mounting,
  - .11 dust proof enclosure, and
  - .12 screw terminal block

## **2.11 Electrical devices**

- .1 Current sensing relays:
  - .1 metering transformer ranged to match load being metered,
  - .2 plug in base and shorting shunt to protect current transformer when relay is removed from socket,

- .3 current transformer for single or three phase metering connected into single relay,
  - .4 adjustable latch level, adjustable delay on latch and minimum differential of 10% of latch setting between latch level and release level,
  - .5 discrimination between phases in three phase applications to allow worst case selection,
  - .6 mounted in motor starter enclosure and fed from starter control transformer,
  - .7 relay contacts capable of handling 10 amps at 240 volts.
- .2 Current transducer:
- .1 output signal proportional to measured line current,
  - .2 output signal in one of following ranges; 4-20 mA, 0-5 Vdc or 0-10 Vdc
- .3 Control Relays:
- .1 plug-in type, UL listed, with dust cover and LED "energized" indicator.
  - .2 contact rating, configuration, and coil voltage suitable for application.
  - .3 NEMA 1 enclosure for relays not installed in local control panels.
- .4 Time Delay Relays:
- .1 solid-state plug-in type, UL listed, with adjustable time delay adjustable  $\pm 100\%$  from set point shown.
  - .2 contact rating, configuration, and coil voltage suitable for application.
  - .3 NEMA 1 enclosure for relays not installed in local control panels.
- .5 Override Timers:
- .1 spring-wound line voltage, UL Listed, with contact rating and configuration by application unless implemented in control software.
  - .2 0-6 hour calibrated dial.
  - .3 flush mounted on local control panel face.
- .6 AC Current Transmitters:
- .1 self-powered, combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 4-20 mA two-wire output.
  - .2 full-scale unit ranges of 10 A, 20 A, 50 A, 100 A, 150 A, and 200 A, with internal zero and span adjustment.
  - .3  $\pm 1\%$  full-scale accuracy at 500 ohm maximum burden.
  - .4 UL/CSA listed and meet or exceed ANSI/ISSA 50.1 requirements.
- .7 AC Current Transformers:
- .1 UL/CSA listed
  - .2 completely encased (except for terminals) in approved plastic material.
  - .3 selected for appropriate current ratios with  $\pm 1\%$  accuracy at full-scale output.
  - .4 fixed-core transformers for new wiring installation
- .8 AC Voltage Transmitters:
- .1 self-powered single-loop (two-wire) type, 4-20 mA output with zero and span adjustment.

- .2 adjustable full-scale unit ranges; 100-130 Vac, 200-250 Vac, 250-330 Vac, and 400-600 Vac.
- .3  $\pm 1\%$  full-scale accuracy at 500 ohm maximum burden.
- .4 UL/CSA listed, 600 Vac rated and conforming to ANSI/ISSA 50.1.
- .9 AC Voltage Transformers:
  - .1 UL/CSA listed, 600 Vac rated with built-in fuse protection.
  - .2 suitable for ambient temperatures of 4°C to 55°C (40°F to 130°F) and
  - .3  $\pm 0.5\%$  accuracy at 24 Vac and 5 Vac load.
  - .4 windings (except for terminals) enclosed with metal or plastic.
- .10 Power Monitors:
  - .1 three-phase type with three-phase disconnect and shorting switch assembly,
  - .2 UL listed voltage transformers, and
  - .3 UL listed split-core current transformers.
  - .4 selectable output either rate pulse for kWh reading or 4-20 mA for kW reading.
  - .5 maximum error of  $\pm 2\%$  at 1.0 power factor or  $\pm 2.5\%$  at 0.5 power factor.
- .11 Current Switches:
  - .1 self-powered, solid-state type with adjustable trip current
  - .2 integral current transformers and relays to indicate motor status
  - .3 SPDT output relay suitable for use as digital input
  - .4 field adjustable output relay trip setting, over 0-100% of range. Deadband adjustment to maximum of 10% of range
  - .5 integral zero-leakage LED's indicating sensor power and switch status
  - .6 long term setting drift of current transformer and relay combination not more than 5% full range over 6 months
  - .7 over current and over voltage protection for current transformer and relay
  - .8 operating temperature range; -10°C to 50°C (14°F to 122°F)
  - .9 operating humidity range; 5% to 90% RH non condensing
- .12 Electronic signal isolation transducers:
  - .1 provided whenever;
    - (a) an analog output signal from BAS is connected to an external control system as an input (such as chiller control panel) or
    - (b) BAS is to receive an analog input signal from an external remote system.
  - .2 designed for ground plane isolation between systems.

## **2.12 Local equipment panels**

- .1 General:
  - .1 NEMA 2 sheet metal cubicles with vertically hinged lockable doors,
  - .2 sensors, transducers, BAS controllers, and relays mounted on backing board and/or DIN rails within inner section,
  - .3 enclosures sized to house controllers and associated transformers, control relays, wiring, conduits and other auxiliary equipment.

- .4 engraved lamaroid labels with white lettering indicating function of each sensor, transducer, controller, gauge and instrument.
- .5 wiring terminations labelled
- .6 EMT conduit openings and adapters in sufficient quantities and sizes to accommodate wiring terminating within enclosure
- .7 wiring within enclosure installed in neat and protected manner, enclosed in wireways or plastic conduit.
- .8 inside each panel, one set of as built, plasticized control Shop Drawings for equipment served by that panel permanently affixed to cabinet frame.

## **2.13 Wiring and Raceways**

- .1 Wiring, conduit, and raceways to Section 20 05 13.
- .2 Wire used for power and control:
  - .1 insulated copper conductors,
  - .2 UL listed for minimum 90°C (200°F) service.
  - .3 Power wiring minimum 12 gauge.
  - .4 Control wiring for digital functions: 18 AWG minimum with 300 Volt insulation.
  - .5 Control wiring for analog functions: 18 AWG minimum with 300 Volt insulation, twisted and shielded, 2 or 3 wire to match analog function hardware.
  - .6 Transformer current wiring: 16 AWG minimum.
  - .7 Sensor wiring: 22 AWG minimum twisted and shielded, 2 or 3 wire to match analog function hardware. Provide additional conductors as to support supplemental features of sensor (i.e. set-point adjustment, override, etc.)

## **3 EXECUTION**

### **3.1 Installation of Sensors**

- .1 General:
  - .1 Mount sensor assemblies and elements;
    - (a) in clean areas wherever possible,
    - (b) accessible to allow for replacement and servicing without interfering with access for adjacent equipment and personnel traffic in surrounding space,
    - (c) provide access doors where assemblies and elements are concealed.
  - .2 Install transmitters, transducers, controllers, solenoid air valves and relays in NEMA2 enclosures;
    - (a) install wiring and tubing within enclosures in trays or individually clipped to back of panel with identification tags and terminal numbers visible.
  - .3 Rigidly support field mounted transmitters, transducers, and sensors on pipe stands or channel brackets.
  - .4 Orient sensing elements to correctly sense measured variable and to be isolated from vibrations and environmental conditions that could affect measurement or calibration.
  - .5 Identify each cable and wire at every termination point.
  - .6 Air seal wires attached to sensors at entry into junction box.

- .2 Temperature sensors:
  - .1 Install room temperature sensors on concealed junction boxes supported by wall framing.
  - .2 Use averaging sensors in mixing plenums and hot and cold decks. Install averaging sensors in serpentine manner vertically across duct. Support each bend with capillary clip.
  - .3 Install mixing plenum low-limit sensors in serpentine manner horizontally across duct. Support each bend with capillary clip. Provide sensor element length to coil area ratio of 3 m per 1 m<sup>2</sup> (1 ft per 1 sq ft).
  - .4 Install pipe-mounted liquid temperature sensors in wells with heat-conducting material. Where thermowell installation necessitates shutting down of pumps or draining of pumps, coordinate with Consultant and Owner.
  - .5 Cut and recover piping insulation to one foot either way for installation of strap-on temperature sensors. Provide removable insulation box over sensor and patch insulation to match existing.
  - .6 Install outdoor air temperature sensors on north facing wall with sun shield.
  - .7 Mount space temperature and humidity sensors 1200 mm (4 ft) above finished floor.
- .3 Pressure sensors:
  - .1 Mount gauge tees adjacent to water differential pressure taps. Install shut-off valves before tee for water gauges.
- .4 Differential air static pressure sensor installations:
  - .1 Supply duct static pressure;
    - (a) pipe high-pressure tap to duct using pitot tube,
    - (b) make pressure tap connections according to manufacturer's recommendations.
  - .2 Return duct static pressure;
    - (a) pipe high-pressure tap to duct using pitot tube,
    - (b) make pressure tap connections according to manufacturer's recommendations.
  - .3 Building static pressure;
    - (a) pipe pressure sensor's low-pressure port to static pressure port located on outside of building through high-volume accumulator,
    - (b) pipe high-pressure port to location behind thermostat cover.
  - .4 Piping to air pressure transducer pressure taps to contain capped test port adjacent to transducer.
  - .5 Locate air pressure transducers, except those controlling terminal unit boxes;
    - (a) in control panels, not on monitored equipment or on ductwork,
    - (b) mount transducers in vibration-free location accessible for service without use of ladders or special equipment.
- .5 Flow Switch Installation
  - .1 Fit correct length paddle for diameter of pipe.
  - .2 Adjust switch for specified flow condition in accordance with manufacturer's instructions

### **3.2 Actuators**

- .1 General:
  - .1 Mount actuators and adapters according to manufacturer's recommendations.
- .2 Electric and Electronic Damper Actuators:



- .1 Mount damper actuators directly on damper shaft or jackshaft
  - .2 Mount valve actuator directly on shaft or with linkages according to manufacturer's recommendations.
  - .3 For low-leakage dampers with seals, mount actuator with minimum 5° travel available for damper seal tightening.
  - .4 To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close damper, then tighten linkage.
  - .5 Provide mounting hardware and linkages for actuator installation.
- .3 Valve Actuators:
- .1 Connect actuators to valves with adapters approved by actuator manufacturer.

**END OF SECTION**

## **B.A.S. SEQUENCE OF OPERATIONS**

### **25 90 01**

## **1 GENERAL**

### **1.1 Definitions**

- .1 System Start: actions required at system start-up under schedule control or on re-start after power failure.
- .2 Normal Operation: normal control sequence after initial start-up requirements are satisfied.
- .3 Demand Limiting: special operation parameters during normal utility power outages (emergency generator operation)
- .4 System Stop: shut-down of system under schedule control and fail-safe position of system in event of loss of normal power.
- .5 Fire Alarm: action required in the event of a signal from the fire alarm system (FA).
- .6 Schedule: scheduled operation of system
- .7 Alarm: minimum alarm points required.
- .8 Emergency Power: control system elements to be fed from emergency power, refer to electrical drawings.

## **2 PRODUCTS**

### **2.1 Refer to Sections of Division 25 00 00 BUILDING AUTOMATION SYSTEM**

## **3 EXECUTION**

### **3.1 Sequence of operation and control drawings**

- .1 Control sequences that follow describe and detail suggested method of control of systems.
- .2 Control drawings listed for each control sequence illustrate required inputs and outputs for the control and monitoring of systems.
- .3 Review sequence of operation described for each system and allow for additional input and output points to achieve method of control described. Review documents to determine quantity of each piece of equipment or system.

.4 Sequences of Operation

- .1 CS 001 Rooftop Units
- .2 CS 002 Transfer and Exhaust Fans
- .3 CS 003 EF-2
- .4 CS 004 VAV Boxes

**END OF SECTION**

## CS001 – Roof Top Units (RTU)

Reference: Drawing M-601

Sequence:

RTUs shall be monitored and controlled by the Building Automation System (BAS). All setpoints shall be adjustable.

1. System Control:
  - 1.1. Schedule:
    - 1.1.1. The system operates via pre-programmed occupancy time schedule. Coordinate final occupancy schedule with Owner.
  - 1.2. Manual Override:
    - 1.2.1. Override On:
      - 1.2.1.1. The operator's command on BAS shall override the time schedule and revert the system into occupied mode.
    - 1.2.2. Override Off:
      - 1.2.2.1. The operator's command on BAS shall override the time schedule and revert the system into unoccupied mode.
2. Unoccupied Mode:
  - 2.1. RTU fans shall be de-energized and OA damper closed.
  - 2.2. Unoccupied mode:
    - 2.2.1. If there is a call for heating/cooling from the associated VAV zones, the RTU fan shall be enabled. The OA damper shall remain closed.
    - 2.2.2. The supply fan VFD shall modulate to maintain the supply air static pressure setpoint.
    - 2.2.3. The RTU shall enable heating or cooling mode maintain the supply air temperature setpoint.
    - 2.2.4. The system shall revert to unoccupied mode once the unoccupied space temperature setpoint has been met.
3. Occupied Mode:
  - 3.1. Fan Control
    - 3.1.1. RTU fan shall be enabled and run continuously.
    - 3.1.2. The OA damper shall open to it's minimum position.
    - 3.1.3. The supply fan VFD shall modulate to maintain the supply air static pressure setpoint.
  - 3.2. Temperature Control
    - 3.2.1. The system heating mode shall be disabled when the outdoor air temperature rises above 15.5°C.
    - 3.2.2. The system cooling mode shall be disabled when the outdoor air temperature drops below 12.8°C. as set by the global seasonal setpoint.
    - 3.2.3. The system shall modulate the gas heating or stage the DX cooling to maintain the supply air temperature setpoint.
    - 3.2.4. The supply air temperature setpoint shall be as follows:

Return Air Temp (°C)	Supply Air Temp (°C)
24	12.8
18	20
  - 3.3. Economizer Mode
    - 3.3.1. Economizer mode shall be enabled when the OA temperature is below 21°C and the OA enthalpy is less than the RA enthalpy.

- 3.3.2. In economizer mode, the OA damper shall modulate to maintain the supply air temperature setpoint.
- 3.3.3. If the supply air temperature setpoint cannot be achieved via economizer, the DX cooling shall stage on to supplement the cooling.

4. Alarms:

- 1.1. The following points shall alarm at the operator workstation (alarm limits including delays shall be adjustable at OWS web graphics):

Description	Low	High	Time Delay	Action
Mismatch of unit command and fan status feedback	-	-	2 min	Notification
Space temperature	15	25	5 min	Notification
Leak detection	-	-	0 sec	Shut down unit, close CHW valve and notification

## CS002 – Exhaust/ Transfer Fans

Reference: Drawing M-601

Sequence:

Exhaust fans shall be monitored and controlled by the Building Automation System (BAS).

1. System Control:
  - 1.1. Schedule:
    - 1.1.1. The system operates via pre-programmed occupancy time schedule. Coordinate final occupancy schedule with Owner.
  - 1.2. Manual Override:
    - 1.2.1. Override On:
      - 1.2.1.1. The operator's command on BAS shall override the time schedule and revert the system into occupied mode.
    - 1.2.2. Override Off:
      - 1.2.2.1. The operator's command on BAS shall override the time schedule and revert the system into unoccupied mode.
2. Unoccupied Mode
  - 2.1. Exhaust fan shall be off and associated damper shall be closed
3. Occupied Mode
  - 3.1. Exhaust fan shall energize and run continuously and associated damper shall be open.
4. Alarms:
  - 1.1. The following points shall alarm at the operator workstation (alarm limits including delays shall be adjustable at OWS web graphics):

Description	Low	High	Time Delay	Action
Mismatch of unit command and fan status feedback	-	-	2 min	Notification

## CS002 – Exhaust/ Transfer Fans

Reference: Drawing M-601

Sequence:

Exhaust fans shall be monitored and controlled by the Building Automation System (BAS).

1. System Control:
  - 1.1. Schedule:
    - 1.1.1. The system operates via a manually operated switch.
  - 1.2. Manual Override:
    - 1.2.1. Override On:
      - 1.2.1.1. The operator's command on BAS shall override the time schedule and revert the system into occupied mode.
    - 1.2.2. Override Off:
      - 1.2.2.1. The operator's command on BAS shall override the time schedule and revert the system into unoccupied mode.
2. System Disabled
  - 2.1. Exhaust fan shall be off and associated exhaust fan damper shall be closed. Return air damper to RTU-2 shall be open.
3. System enabled.
  - 3.1. Exhaust fan shall be on and associated exhaust fan damper shall be open. Return air damper to RTU-2 shall be closed.
4. Alarms:
  - 1.1. The following points shall alarm at the operator workstation (alarm limits including delays shall be adjustable at OWS web graphics):

Description	Low	High	Time Delay	Action
Mismatch of unit command and fan status feedback	-	-	2 min	Notification

## CS-004 – VAV Boxes

Reference: Drawing M-603

Applicable  
System: VAV Boxes

Sequence:

VAV boxes shall be monitored and controlled by the Building Automation System (BAS). All setpoints shall be adjustable.

1. System Control:

1.1. Schedule:

1.1.1. The system operates via pre-programmed occupancy time schedule. Coordinate final occupancy schedule with Owner.

1.2. Manual Override:

1.2.1. Override On:

1.2.1.1. The operator's command on BAS shall override the time schedule and revert the system into occupied mode.

1.2.2. Override Off:

1.2.2.1. The operator's command on BAS shall override the time schedule and revert the system into unoccupied mode.

2. Temperature Control:

2.1. The VAV terminal box controller monitors the space temperature sensor and velocity sensor. The controller shall modulate the cold supply air damper and modulate the electric reheat to maintain the desired room temperature.

2.2. If the space temperature is below its adjustable setpoint, the VAV damper shall modulate to its minimum position.

2.3. On further drop in space temperature below the setpoint, the electric reheat shall modulate to maintain the space temperature setpoint and the VAV damper shall modulate open.

2.4. As the space temperature rises above its setpoint, the electric reheat shall be disabled and the primary damper shall modulate to maintain the space temperature setpoint.

2.5. The supply air volume will be limited by its minimum and maximum supply air volume settings.

2.6. All VAV terminal units shall be addressable from the standalone controllers.

3. Temperature Setpoints:

3.1. Unoccupied Space Temperature set point :

Operation Mode	Set Point
Heating	16°C
Cooling	26°C

3.2. Occupied Space Temperature set point :

Operation Mode	Set Point
Heating	22°C
Cooling	24 °C

4. Alarms:

4.1. The following points shall alarm at the operator workstation:

Description	Low	High	Time Delay
Space temperature	15°C	30.0°C	15 min



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## **ELECTRICAL GENERAL REQUIREMENTS 26 01 01**

### **1 REQUIREMENTS**

#### **1.1 General Contract Documents**

- .1 Comply with General Conditions of Contract, Supplementary Conditions and Division 01 - General Requirements.

#### **1.2 Work Included**

- .1 Work to be done under this section to include furnishing of labour, materials, equipment and services required for installation, testing and putting into proper operation complete Electrical systems as shown, as specified, as intended, and as otherwise required. Complete systems to be left ready for continuous and efficient satisfactory operation.

#### **1.3 Document organization**

- .1 Applicable Divisions for Electrical Work:
  - .1 Division 26 – Electrical
  - .2 Division 27 – Communications
  - .3 Division 28 – Electronic Safety and Security
- .2 For clarity, any reference in the Contract Documents to Division 26 includes Division 27 and 28.
- .3 The Specifications for these Divisions are arranged in Sections for convenience. It is not intended to recognize, set, or define limits to any subcontract or to restrict Contractor in letting subcontracts.
- .4 Contractor is responsible for completion of the Work whether or not portions are sublet.

#### **1.4 Division 26, as it applies to Division 27 and 28**

- .1 Division 26 contains common work requirements that are applicable to the Work of Division 27 and 28 and apply as if written in full within Division 27 and 28.

#### **1.5 Definitions**

- .1 The words "indicated", "shown", "noted", "listed" or similar words or phrases used in these Specifications, mean that the material or item referred to as "indicated", "shown", "listed" or "noted" on the Drawings or in the Specifications.
- .2 The words "approved", "satisfactory", "as directed", "submit", "permitted", "inspected", or similar words or phrases used in these Specifications, mean that the material or item referred to, is to be "approved by", "satisfactory to", "as directed by", "submitted to", "permitted by", "inspected by" the Consultant.
- .3 Instructions using any form of the word "provide", require the Contractor to furnish labour, materials and services as necessary to supply and install the referenced item.
- .4 The term "building code" means the current edition of the "Ontario Building Code".
- .5 The terms "electrical code" and "electrical safety code" mean the current edition of the "Ontario Electrical Safety Code".

- .6 The terms “electrical authority” and “electrical safety authority” mean the “Electrical Safety Authority, ESA” The term “AHJ” means the “Authority Having Jurisdiction” and can include the local building inspector, the local fire department and the electrical safety inspector or their agents.

## **1.6 Language**

- .1 Specifications are written as a series of instructions addressed to the Contractor, and by implication to subcontractors and to suppliers. For clarity and brevity, use is made of numbered lists and bulleted lists. Where the list follows a semi-colon (;) punctuation is for clarity, where the list follows a colon (:) punctuation is to be read as short-hand form of verb “to be” or “to have” as context requires.
- .2 It is not intended to debate with the Contractor reasons for these instructions, and words associated with justification for an instruction or restatement of anticipated performance have been omitted to avoid possible ambiguities.

## **1.7 Examination**

- .1 Examine any existing buildings and services, local conditions, building site, Specifications, and Drawings and report any condition, defect or interference that would prevent execution of the Work.
- .2 Examine work of other Divisions before commencing the Work and report any defect or interference.
- .3 No allowance will be made for any expense incurred through failure to make these examinations of the site and documents prior to Tender or on account of any conditions on site or any growth or item existing there which was visible or known to exist at the time of Tender.

## **1.8 Design Services**

- .1 Provide design services for elements of the Work where specified. Instruments of this service to be sealed by a professional engineer licensed in the applicable jurisdiction.

## **1.9 Standard of Material and Equipment**

- .1 Materials and equipment:
  - .1 new and of uniform pattern throughout the Work,
  - .2 of Canadian manufacture where obtainable,
  - .3 labelled or listed by Code and/or Inspection Authorities, CSA certified and CMB listed; where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Safety Authority,
  - .4 standard products of approved manufacture,
  - .5 in compliance with Standards and Regulations with respect to;
    - (a) chemical and physical properties of materials,
    - (b) design,
    - (c) performance characteristics, and
    - (d) methods of construction and installation,
  - .6 identical units of equipment to be of same manufacture,
  - .7 within any unit of equipment, identical component parts to be of same manufacture, but various component parts comprising the unit need not be from one manufacturer.
- .2 Materials and equipment are described to establish standards of construction and workmanship.

- .1 Where manufacturers or manufacturers' products are identified in lists with phrase "Standard of Acceptance", these are manufacturers and/or products which meet standards with regard to performance, quality of material and workmanship.
- .2 Manufacturers and/or products used are to be chosen from these lists.
- .3 Include items of material and equipment not specifically noted on Drawings or mentioned in Specifications but which are required to make a complete and operating system.
- .4 Confirm capacity or ratings of equipment being provided, when based on ratings of equipment being provided under other trade Sections, before such items are purchased.
- .5 Provide equipment marked for use with 75°C wiring or with a higher temperature rating. If equipment is not marked with a temperature rating or if the only rating available is less than 75°C, increase the associated conductor sizes accordingly, to the satisfaction of the consultant.
- .6 Factory fabricate control panels and component assemblies.
- .7 Select materials and equipment in accordance with manufacturer's recommendations and install in accordance with manufacturer's instructions.
- .8 Materials and equipment not satisfying these selection criteria will be condemned.
  - .1 Remove condemned materials from job site and provide properly selected and approved materials.

#### **1.10 Substitutions**

- .1 The use of a substitute article or material which the manufacturer represents to be of at least equal quality and of the required characteristics for the purpose intended may be permitted, subject to the following provisions;
  - .1 a substitution will not be considered for reasons of meeting the construction schedule unless the Contractor can demonstrate to the satisfaction of the Consultant that all reasonable efforts have been made to procure the specified product or material in a timely fashion,
  - .2 the manufacturer to advise the Consultant of the intention to use an alternative article or material before doing so,
  - .3 the burden of proof as to the quality and suitability of alternatives to be upon the manufacturer, the manufacturer to supply all information necessary, as required by the Consultant, at no additional costs to the contract,
  - .4 the Consultant to be the sole judge as to the quality and suitability of alternative materials and the Consultant's decision to be final,
  - .5 where use of an alternative material involves redesign or changes to other parts of the Work, the costs and the time required to effect such redesign or changes will be considered in evaluating the suitability of the alternative materials,
  - .6 no test or action relating to the approval of substitute materials to be made until the request for substitution has been made in writing by the manufacturer and has been accompanied by complete data as to the quality of the materials proposed, such request to be made in ample time to permit appropriate review without delaying the Work, taking into consideration that such a substitution request may be rejected requiring that the product or material as originally specified be provided,
  - .7 whenever classification, listing, or other certification by a recognized standards body is a part of the specifications for any material, proposals for use of substitute materials to be accompanied by reports from the equivalent body indicating compliance with the requirements of the specifications,

- .8 the costs of testing required to prove equality of the material proposed to be borne by the manufacturer.

### **1.11 Owner's Special Requirements**

- .1 Contractor to provide a written list of names of employees and sub-trades employees entering the building.
- .2 Park vehicles in designated areas.
- .3 Do not block driveways.
- .4 Trades-people to supply and use their own tools. No tools, ladders or equipment, etc. will be loaned.
- .5 "No Smoking" – this is a smoke free building; violators will be denied entry. Smoking is not allowed on the roof.
- .6 For any open flame work, a fire extinguisher and security fire watch are required.
- .7 Perform a daily cleanup prior to leaving the site.

## **2 SUBMITTALS**

### **2.1 Requests for Information (RFIs)**

- .1 Submit requests for information (RFIs) in accordance with Division 01 specification:
  - .1 Submit to the Prime Consultant for distribution and tracking with the design team;
  - .2 Include relevant and applicable Drawing and/or Specification reference for the RFI;
  - .3 Provide photos, hand sketches or other material to support and clarify the intent of the RFI.

### **2.2 Shop Drawings and Product Data**

- .1 Submit shop drawings, manufacturers and product data and samples;
  - .1 Submit for each item of equipment.
  - .2 Submit shop drawings in the same unit of measure as used on the drawings. Both metric and imperial measures may be included.
  - .3 Submit shop drawings to the Prime Consultant for distribution.
- .2 Include a shop drawing cover sheet, for each shop drawing include the information listed below:
  - .1 Provide the following information on each submission;
    - (a) Client/Architect name
    - (b) Project Name
    - (c) Loring project number
    - (d) Date
    - (e) Contractor name
    - (f) Contractor reference No.
    - (g) Manufacturer's name
    - (h) Product type
    - (i) Specification section number
    - (j) Contractor trade: mechanical, electrical, elevators, or general trades
    - (k) If a re-submission, the Loring reference number from the previous submission.

- .3 Submit shop drawings in PDF format;
- .4 Manufacturers' printed product data sheets for standard items are acceptable in place of shop drawings provided that physical characteristics are identified and are related to specification references.
- .5 Submit manufacturers' data sheets with typed schedules listing manufacturers' and suppliers' name and catalogue model numbers for such items as fire alarm system components, etc.
- .6 For luminaires, submit bound sets of luminaire cut sheets with manufacturers' names and catalogue numbers for all luminaires to be used on the project. Identify and arrange the luminaire cut sheets and catalogue numbers in the same sequence as the Specification Luminaire List.
- .7 Shop drawings and product data to show;
  - .1 CSA or equivalent approval,
  - .2 dimensioned outlines of equipment,
  - .3 dimensioned details showing service connection points.
- .8 Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.
- .9 Where applicable, include;
  - .1 wiring, single line and schematic diagrams,
  - .2 diagrams showing interconnection with work of other Sections,
  - .3 equipment elevations,
  - .4 component assemblies,
  - .5 trip settings,
  - .6 description of operation.
- .10 Each shop drawing to be checked and stamped as being correct, by trade purchasing item, before drawing is submitted. If above requirements are not complied with, shop drawings will be rejected and returned forthwith.

## **2.3 Field, Fabrication, or Installation Drawings**

- .1 Contractor's field, fabrication, installation, and/or sleeving drawings will not be reviewed as shop drawings. If submitted as a shop drawing, a transmittal will be returned identifying that the submitted drawings have not been reviewed.
- .2 Maintain a copy on site of such drawings for reference by the Consultant.
- .3 Upon request, provide a copy of such drawings to the Consultant for general information purposes.

## **2.4 Change Order Quotation Review**

- .1 Submit change order quotations in accordance with general conditions and as specified herein:
  - .1 Submit to the Prime Consultant for distribution and tracking with the design team;

## **2.5 Progress Draw Certification**

- .1 For all trades applicable to the Division 26 scope of work inclusive of Division 27 and 28, the Contractor is to submit to the Prime Consultant for distribution and tracking with the design team for review and recommendation;
  - .1 Include relevant invoice breakdowns that show itemized contract value, percent complete to date, and percent complete applicable to the current invoice;
  - .2 Itemize all approved Change Orders in similar fashion separate from the Base Bid breakdown.

## **3 APPLICABLE CODES AND STANDARDS**

- .1 Install electrical systems in accordance with the Ontario Electrical Safety Code (OESC).
- .2 Install underground systems in accordance with the latest edition of CSA C22.3 No.7 except where specified otherwise.
- .3 Abbreviations for electrical terms: to the latest edition of CSA Z85.
- .4 Comply with CSA Certification Standards and Ontario Electrical Safety Code Bulletins in force at time of Tender submission.
- .5 Where requirements of this specification exceed those of the above-mentioned standards, this specification to govern.
- .6 In the event of a conflict between codes, regulations, or standards, or where work shown is in conflict with these documents, obtain interpretation before proceeding. Failure to clarify any ambiguity will result in an interpretation requiring the application of the most demanding requirements.

## **4 CONFINED SPACES**

- .1 Unless otherwise prescribed by the Constructor's/Owner's workplace safety program, treat spaces not designed and constructed for continuous human occupancy as "confined spaces", including but not limited to;
  - .1 horizontal and vertical service spaces, shafts, and tunnels,
  - .2 inside of equipment which permits entry of the head and/or whole body, and
  - .3 ceiling spaces which are identified as containing a hazardous substance.

## **5 PERMITS, FEES AND INSPECTIONS**

- .1 Submit to Electrical Safety Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.
- .2 Pay associated fees.
- .3 Consultant will provide drawings and specifications required by Electrical Safety Authority at no cost.
- .4 Notify Consultant of changes required by Electrical Safety Authority prior to making changes.
- .5 Furnish to Consultant, Certificates of Acceptance from Electrical Safety Authority and authorities having jurisdiction, upon completion of the Work.



## **6 EQUIPMENT**

### **6.1 Manufacturers Nameplates**

- .1 Metal nameplate with raised or recessed lettering, mounted on each piece of equipment.
- .2 Manufacturer's nameplate to indicate equipment size, capacity, model designation, manufacturer's name, serial number, voltage, cycle, phase and power rating, and approval listings.

### **6.2 Finishes**

- .1 Primary and final painting for Work, other than items specified as factory primed or finished, to be done under Finish Division 9.
- .2 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
- .3 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .4 Leave a quart can, as used with panelboards, with Owner for touch-up purposes.
- .5 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.
- .6 Store electrical materials and equipment such as switchboards, panels, transformers, bus ducts, fire alarm devices, luminaires, etc., in a dry, clean location and cover with polyethylene plastic to preserve factory finish.
- .7 Protect exposed or free-standing equipment with plastic to minimize entry of dust and dirt and marring of finished surfaces during progress of work.
- .8 Schedule luminaires, lamps, diffusers and fire detectors for installation as late as possible during construction in order to minimize accumulation of dust and/or dirt on them. Clean luminaires and diffusers, not acceptable because of dust and dirt, in an approved manner in accordance with the manufacturer's instructions. Wrap surface mounted and suspended luminaires and fire detectors, installed prior to painting or dusty construction being completed in the area, in plastic to prevent dirt or paint from settling on them.

## **7 OFFICE, STORAGE & TOOLS**

### **7.1 Office and Storage**

- .1 Provide temporary office and lunchroom facilities, workshop, tools and material storage space. Facilities may be site trailers or as otherwise approved by the General Contractor/Construction Manager.
- .2 Assume responsibility for these facilities.
- .3 Provide power, heat, light, telephone and internet services.
- .4 Owner's cafeteria is off limits.

## **7.2 Appliances and Tools**

- .1 Provide tools, equipment, scaffolding, extension cords, lamps and miscellaneous consumable materials, as required to carry out the Work.

## **8 COORDINATION**

### **8.1 General**

- .1 Consultant's drawings are diagrammatic and illustrate the general location of equipment, and intended routing of conduits, feeders, etc. and do not show every structural detail. In congested areas drawings at greater scale may be provided to improve interpretation of the Work. Where equipment or systems are shown as "double line", they are done so either to improve understanding of the Work, or simply as a result of the use of a CAD drawing tool, and in either case such drawings are not represented as fabrication or installation drawings.
- .2 Lay out and coordinate the Work to avoid conflict with work under other Divisions.
- .3 Make good damage to Owner's property or to other trade's work caused by inaccurate layout or careless performance of the Work.
- .4 Where equipment provided under other Divisions connects with material or equipment supplied under this Division, confirm capacity and ratings of equipment being provided.
- .5 Take information involving accurate measurements from dimensioned Architectural Drawings or at the building.
- .6 Install services and equipment which are to be concealed, close to the building structure so that furring is kept to minimum dimensions.
- .7 Location of conduit, bus duct, raceways and equipment may be altered without extra cost provided instruction is given or approval is obtained, in advance of installation of items involved. Changes will be authorized by site instructions and are to be shown on Record Drawings.
- .8 Include incidental material and equipment not specifically noted on Drawings or mentioned in Specifications but which is needed to complete the Work as an operating installation.

### **8.2 Field, Fabrication, and Installation Drawings**

- .1 Prepare field, fabrication, and/or installation drawings to show location of equipment and relative position of services and to demonstrate coordination with work of other trades.
  - .1 Drawing scale: minimum 1:50 (1/4"=1'-0")
- .2 Use information from manufacturer's shop drawings for each trade and figured dimensions from latest Architectural and Structural Drawings.
- .3 Layout equipment and services to provide access for repair and maintenance.
- .4 Submit drawings to other trades involved in each area and include note in drawing title block as follows;
  - .1 "This drawing was prepared and circulated for review and mark-up to related subcontractors as noted and initialed in the table below. Corrections and concerns identified through this

coordination process have been addressed on this drawing. Areas that incorporate significant changes from layouts shown on Contract Drawings have been circled for Consultants' review."

### **8.3 Cutting and Remedial Work**

- .1 For details of cutting and patching and division of Work refer to Division 1.
- .2 Assume responsibility for prompt installation of work in advance of concrete pouring, masonry, roofing, finishing and similar work. Should any cutting or repairing of either unfinished or finished work be required because such installation was not done, employ the particular trade, whose work is involved, to do such cutting and patching. Pay for any resulting costs.
- .3 Neatly cut or drill holes required in existing construction to accommodate equipment such as cables, raceways, etc.
- .4 Arrange and pay for cutting and patching as required for the Work. Before cutting, drilling, or sleeving structural load bearing elements, obtain the Consultant's approval of location and methods in writing. For weather exposed or moisture resistant elements or sight exposed surfaces, employ the original installer or an expert in finishing of the material, to perform cutting or patching.
- .5 Layout cutting of structural elements, such as floor slabs, walls, columns or beams and obtain approval before starting work. Conduct an electromagnetic scan for reinforcing rods, such as Hilti PS200 Ferrosan, and review with the Structural Engineer.
- .6 Arrange and pay for supplemental x-ray examination to locate concrete reinforcement, conduits and other embedments. Submit x-ray results and obtain approval before starting work.
- .7 Relocate core drilling location if steel or conduit is found in the proposed location and repeat procedure. Repair and reroute any circuits damaged by core drilling.

### **8.4 Voltage Ratings**

- .1 Operating voltages: to latest edition of 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. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

### **8.5 Wiring of Mechanical Trades Motors**

- .1 To limit responsibility and to specifically define the Work under this Division, use the following procedure with regard to motors provided under Mechanical Division 20.
- .2 The Contractor under Mechanical Division 20 will be responsible for installing equipment which he supplies including motors, starters, disconnect switch, Motor Control Centres, "mechanical" panelboards and miscellaneous controls of the type specified.
- .3 In every instance whether pertaining to Plumbing, Air Conditioning, Refrigeration, Heating or Ventilating equipment, wire to line side of the Motor Control Centre, panelboard, disconnect switch, or starter provided by these trades, in reasonable proximity to equipment being controlled.
- .4 From this point, unless otherwise noted, the cost of electrical material and labour will be borne by the particular trade whose work is involved. That trade will mount starter and wire from it to motor being controlled, together with control wiring, remote switches, and pilot lights.

- .5 Where individual starters and controls are grouped together, the Contractor under Mechanical Division 20 will provide a panel for mounting his equipment. Provide a feeder, main fused disconnect switch, a splitter of adequate size and capacity, individual fused disconnect switches, and wire to line side of the Division 20 starters.
- .6 In the case of unit heaters, reheat coils, electrical control devices, and cabinet unit heaters, terminate wiring in an outlet immediately adjacent to motor or device being electrically powered. Wiring from this point to starter, thermostat, or other devices will be done under Mechanical Division 20.
- .7 Provide branch circuit wiring and an outlet for each motorized damper or heating control.
- .8 Ascertain exact locations of starters, Motor Control Centres, "mechanical" panelboards and motors, from Mechanical Drawings.
- .9 Motors up to and including 0.25 kW (1/3 HP) to be 120 volt, 60 Hz, single phase.
- .10 Motors 0.37 kW (½ HP) and above to be 3 phase, 60 Hz, voltage as noted.

## **9 PROTECTION OF PERSONNEL, WORK, AND PROPERTY**

### **9.1 Personnel Protection**

- .1 Protect exposed live equipment during construction for personnel safety.
- .2 Shield and mark live parts "LIVE 120 VOLTS", or with appropriate voltage.
- .3 Arrange for installation of temporary doors for rooms containing electrical distribution equipment. Keep these doors locked except when under direct supervision of electrician.
- .4 Do not leave conduit, wires, cables, tools, equipment or materials in such a way that they constitute a hazard.
- .5 Provide guards around openings in the roof or floor to prevent stock or scrap from dropping down.
- .6 Remove loose equipment and tools from overhead areas before leaving each day.
- .7 Do not leave boards with protruding nails on the floor.
- .8 Cut off bolts at floor level to eliminate a possible tripping hazard.

### **9.2 Protection During Construction**

- .1 Take the necessary precautions to protect equipment, existing building and service from damage during the Work. Accept responsibility for any damage and make good without cost to the Owner.
- .2 It is of vital importance, during work of this Contract, that all existing surfaces and items that are to remain are not damaged in any way whatsoever by the work of all trades. Take precautions as necessary to prevent damage to walls, floors, ceilings, windows, doors, door frames, mouldings, finishes, piping, etc. Provide protection, hoarding, tarpaulins, dust sleeves etc., as required. Any damage caused because of lack of adequate protection to be made good at no cost to the Owner.
- .3 Take care to eliminate dust in equipment areas.

- .4 Protect switchgear fronts from accidental breaker trips when working around or above them. Provide an extended shield constructed of 12 mm (½") fire retardant plywood a minimum of 450 mm (18") from board front to allow access to board.

### **9.3 Protection of Floors During Equipment Installation**

- .1 Provide protection of floor finishes during installation or removal of equipment, and at any other time when moving or installing heavy equipment.
- .2 Install 19mm (¾") plywood over 6 mil plastic over finished floor areas when moving heavy equipment that could damage floor finish.
- .3 Repaint or re-tile any floors or walls damaged or scratched during construction.

### **9.4 Housekeeping**

- .1 Maintain a high level of cleanliness.
- .2 Remove scrap and refuse from the work area daily.
- .3 Whenever possible, clean up immediately following completion of work.
- .4 Deposit oily and waste solvent rags in approved containers to minimize the fire hazard.
- .5 Sweep and damp mop daily.

## **10 WORK IN EXISTING BUILDING**

### **10.1 General**

- .1 During the tender period, perform a site inspection of the place of work and surroundings including the accessible ceiling spaces and other areas where access could be considered reasonable. Make a thorough investigation of the as built conditions to determine the scope of renovation and demolition work required prior to submitting a tender.
- .2 The Work includes changes to the existing building and changes at junction of old and new construction. Route cabling, ducts, conduits and other services to avoid interference with existing installation.
- .3 Relocate existing pipes, ducts, conduits, bus ducts and any other equipment or services as necessary to accommodate the Work.
- .4 Remove existing lighting fixtures, wiring, devices and equipment to suit new construction. Cut back and cap conduits and electrical outlets not being used, so that finished work presents a neat and clean appearance. Disconnect at point of electrical supply, remove obsolete wiring and conduits, and make existing systems safe.
- .5 Unless noted otherwise removed materials and equipment become the property of the Contractor and are to be taken from the site and disposed of appropriately.
- .6 Review removed luminaires and equipment with the Owner's representative, and if the Owner instructs they wish to keep any items, move them to a designated location on the site. Luminaires and equipment that the Owner does not want become the property of the Contractor and are to be taken from the site and disposed of appropriately.

- .7 Revise panelboard directories accordingly if affected by the Work.
- .8 Co-ordinate work affecting fire alarm system, fire safety, or protection systems with the Owner, Consultant, fire alarm system manufacturer and authorities having jurisdiction prior to commencing work. Provide temporary fire protection and/or a fire watch in all areas affected by the demolition and as required by authorities having jurisdiction.

## **10.2 Continuity of Services**

- .1 Repair any damage caused to existing systems when making connections.

## **11 MOVING AND SETTING IN PLACE OWNER'S EQUIPMENT**

### **11.1 S.B.O. (Supplied by Owner)**

- .1 Items marked SBO on drawings will be;
  - .1 purchased by Owner,
  - .2 received, checked, stored, unpacked, uncrated, assembled and located by the Contractor under Division 1
- .2 Connect electrical services to this equipment.

### **11.2 E.R. or Ex. Rel. (Existing Relocated) or otherwise so identified**

- .1 Except as indicated below, items so marked on drawings will be moved from their present location and reinstalled by the Contractor under Division 1. Disconnect and reconnect electrical services to accommodate the relocation of this equipment.
- .2 Disconnect, remove, store as necessary, move into place, reinstall, clean and reconnect electrical items so marked, such as;
  - .1 luminaires,
  - .2 fire detectors,
  - .3 speakers,
  - .4 switches,
  - .5 receptacles,
  - .6 disconnects,
  - .7 splitters,
  - .8 panelboards,
  - .9 switchgear,
  - .10 transformers,
  - .11 etc.

## **12 FINAL CLEANING**

### **12.1 General**

- .1 Do final cleaning.
- .2 Perform final cleaning after construction activities, that create dust, have been completed.

- .3 Clean electrical equipment and devices installed as part of this project.
- .4 Clean lighting reflectors, lenses, and other lighting surfaces that have been exposed to construction dust and dirt, including the top surface, whether exposed or in the ceiling space.
- .5 Clean switch, receptacle, and communications outlets, cover plates, and exposed surfaces.
- .6 Clean and vacuum any smoke detectors exposed to construction dust, do not use compressed air.
- .7 Electrical rooms, and electrical or communication closets:
  - .1 Thoroughly vacuum and clean interiors and bus work of switchboards, panels, cabinets and other electrical equipment of construction debris and dust prior to energization using a HEPA vacuum cleaner. Final clean using clean lint free cloths with a cleaning liquid as recommended by the manufacturer for the purpose.
  - .2 HEPA vacuum the top of switchboards, panels, cabinets, bus ducts, cable trays and conduits, and mechanical duct work in the room, followed by a thorough HEPA vacuuming of the floors. Thoroughly wash floors with wet mop and clean water. Control access to the room after cleaning. Provide temporary filter media on air supply ducts to these rooms to prevent re-contamination from other areas of construction.
  - .3 Thoroughly re-clean as necessary prior to final turn over.
  - .4 Do not lay permanent switchboard matting in electrical rooms until rooms are thoroughly re-cleaned, and floors wet mopped and dried, immediately prior to final turn over.

### **13 RECORD DRAWINGS**

- .1 Provide record drawings as specified herein.
- .2 A set of design drawings in Revit will be provided by the Consultant. Make sets of white prints for each phase of the Work, and as the Work progresses and changes occur, mark white prints in coloured inks to show revisions. Dimension locations of ductbanks, conduits, maintenance holes, buried cables and similar buried items. Within the building, provide dimensions with respect to building column centres. Outside the building provide dimensions to the building foundation or to the centerline of paved roadways or provide GPS co-ordinates. Mark level with respect to an elevation which will be provided.
- .3 Survey information from excavation and backfill of site services to be kept on site after approval and to be similarly transferred to white prints.
- .4 Retain these drawings and make available to Consultant for periodic review.
- .5 At 50%, 75% and 90% of project completion, scan marked-up drawings to Adobe .pdf format and submit a copy to the Consultant, or to the project document portal if one is in use.

#### **13.2 As-built Drawings**

- .1 Prior to testing, balancing and adjusting, transfer site record drawing information to Revit (RVT) files, to record final as-built condition. Obtain a current set of Revit files from the Consultant.
  - .1 Follow the Consultants Revit Standards. Do not alter drawing scales, X-refs, colours, layers or text styles.
  - .2 The Consultant's Revit files might not reflect all or any construction changes.
- .2 Where items have been deleted, moved, renumbered or otherwise changed from contract drawings, revise the Revit files to record these changes. "Bubble" these revisions.

- .3 Show on electrical as-built drawings final locations of conduit, outlets, panels, branch wiring, system wiring, pull boxes, bus ducts, and equipment.
- .4 Show on site services as-built drawings survey information provided by the Ontario Land Surveyor (OLS) monitoring the services installation.
- .5 Identify each drawing in lower right hand corner in letters at least 12 mm (½") high as follows "AS-BUILT DRAWINGS. This drawing has been revised to show systems as installed" (Signature of Contractor) (Date). The site services drawings are to include signature and stamp of OLS attached to note.
- .6 Submit one (1) set of PDF prints of the draft as-built Revit files for the Consultant's review.
- .7 Once "AS BUILT DRAWINGS" white prints are reviewed, transfer Consultant's comments to the Revit files. Return Revit files modified to "As Built" condition to Consultants.
- .8 Submit one (1) sets of pdf prints and three (3) copies of Revit files with Operating and Maintenance Manuals.

## **14 OPERATING AND MAINTENANCE INSTRUCTIONS**

### **14.1 Operating and Maintenance Data**

- .1 Provide operation and maintenance data bound in 210 mm x 300 mm x 50mm thick (8½ in x 11 in x 2 in thick) size, vinyl covered, hard back, three-ring covers.
  - .1 Organize material in volumes generally grouped by Division Section;
    - (a) Site services,
    - (b) Power,
    - (c) Lighting,
    - (d) Low Voltage Systems,
    - (e) Fire Alarm and Security.
  - .2 Title sheet in each volume to be labeled "Operating and Maintenance Manual" and to bear;
    - (a) Project Name,
    - (b) Project Number,
    - (c) Date,
    - (d) Trade Section, and
    - (e) List of Contents.
  - .3 Provide three hard-copies to Owner.
- .2 In addition, provide Adobe PDF files for each document, produced from original direct-to-digital file creations.
  - .1 Organize documents into separate PDF files for each Division Section identified above, and apply Adobe Bookmarks to create Table of Contents.
- .3 Include in operations and maintenance data;
  - .1 details of design elements, construction features, component function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension and expansion of any portion or feature of installation,
  - .2 technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items, and parts lists; advertising or sales literature not acceptable,
  - .3 wiring and schematic diagrams and performance curves,



- .4 names and addresses of local suppliers for items included in maintenance manuals,
  - .5 reviewed shop drawings,
  - .6 operating characteristics of the equipment supplied such as calibration curves and coordination data to allow proper co-ordination with Owner's equipment,
  - .7 description of operation of the controls and protective devices used,
  - .8 maintenance and adjustment procedures,
  - .9 lifting and jacking instructions,
  - .10 fault locating guide,
  - .11 spare parts list and an itemized price list,
  - .12 name and telephone numbers of service organization and technical staff that will provide warranty service on the various items of equipment.
- .4 Approval procedure;
- .1 submit one set of first draft of Operating and Maintenance Manuals for approval,
  - .2 make corrections and resubmit as directed,
  - .3 review contents of Operating and Maintenance Manuals with Owner's operating staff or representative to ensure thorough understanding of each item of equipment and its operation,
  - .4 hand-over an additional two copies of Operating and Maintenance Manuals to Owner's operating staff and obtain written confirmation of delivery.

## **14.2 Operating and Maintenance Instructions**

- .1 Provide instructions to Owner's operations staff to thoroughly explain operation and maintenance of each system, incorporating specialized instruction by manufacturers as described under other Sections. Include classroom instruction and hands-on instruction, delivered by competent instructors.
- .2 Develop the proposed training plan, submit an outline of the training program for review and adjustment by the Owner. Obtain approval from the Owner before commencing training.
- .3 Structure each session to start with the classroom instruction for the overall system, followed by hands-on instruction for each item of equipment, utilizing the services of the manufacturers' representative as required.
- .4 Organize and schedule each training session to deliver the required instruction in an efficient and effective manner on a schedule agreed upon with the Owner. Repeat each training session approximately one week after the original session.
- .5 Organize each pair of training sessions as follows:
  - .1 Power Distribution - Normal Power and Lighting Control - Division 26
  - .2 Communications – Division 27
  - .3 Electronic Safety and Security – Fire Alarm – Division 28
  - .4 Electronic Safety and Security – Security – Division 28
- .6 Complete the training as close to Substantial Performance as possible, so that the operations staff are prepared to operate the systems after Substantial Performance is certified.
- .7 Keep a record of date and duration of each instruction period together with names of persons attending. Submit signed records at completion of instruction.

- .8 For each training session, include the following topics;
  - .1 general purpose of the system (design intent),
  - .2 use of O & M manuals,
  - .3 review of single line drawings and control schematics,
  - .4 start-up, normal operation, shutdown, unoccupied operation, seasonal changeover, manual operation, control set-up and programming, troubleshooting and alarms,
  - .5 interaction with other systems,
  - .6 adjustments and optimizing methods for energy conservation,
  - .7 maintenance requirements,
  - .8 special maintenance and replacement sources,
  - .9 health and safety issues,
  - .10 occupancy interaction issues, and
  - .11 system response to different operating conditions.
- .9 Develop and provide training material, including printed documents and electronic presentation aids (e.g. MS PowerPoint) for each session. Submit three (3) copies of materials in both hardcopy and electronic format, in accordance with article on Operating and Maintenance Manuals.
- .10 Sessions may be videotaped by the Owner as an aid to ongoing training of Owner's staff.

## **15 CARE, OPERATION AND START-UP**

- .1 Arrange and pay for services of manufacturer's factory service technicians to supervise start-up of installation, check, adjust, balance and calibrate components.
- .2 Provide these services for such periods, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with every aspect of the operation, care and maintenance thereof.
- .3 Arrange and pay for services of applicable manufacturer's factory service engineer or certified independent testing organization to supervise initial start-up of specialized portions of installation and to check, adjust, balance and calibrate components including related wiring and controls. Provide these services for such periods, and for as many visits as may be necessary to put applicable portion of the installation in complete working order. Provide a certificate indicating that the equipment is free and clear of deficiencies.

## **16 TESTING**

- .1 Conduct and pay for the following tests;
  - .1 power distribution system including phasing, voltage, grounding and load balancing,
  - .2 circuits originating from branch distribution panels,
  - .3 lighting and its control,
  - .4 motors, heaters and associated control equipment including sequenced operation of systems where applicable,
  - .5 systems: fire alarm system, communications,
  - .6 additional testing as specified in other Sections.

- .2 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.
- .3 Insulation resistance testing;
  - .1 megger circuits, feeders and equipment up to 350 V with a 500 V instrument,
  - .2 megger 350-600 V circuits, feeders and equipment with a 1000 V instrument,
  - .3 check resistance to ground before energizing.
- .4 Carry out tests in presence of Consultant.
- .5 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .6 Submit test results for Consultant's review. Test electrical equipment to standards and function of specifications, applicable codes and standards in an approved manner. Replace defective equipment and wiring with new material and leave entire system in complete first class operating condition.

## **17 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. Revise circuit labelling as appropriate.
- .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
- .3 Submit, at completion of work, report listing phase and neutral current on panelboards, dry-core transformers and motor control centres, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

## **18 CO-ORDINATION OF PROTECTIVE DEVICES**

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings as per equipment manufacturers' recommendations for each piece of equipment.

## **19 TEMPORARY AND TRIAL USAGE**

### **19.1 General**

- .1 Temporary and trial usage by Owner of any electrical device, machinery, apparatus, equipment or any other work or materials before final completion and written acceptance, is not to be construed as evidence of acceptance by the Consultant.
- .2 Owner to have the privilege of such temporary and trial usage, as soon as the Contractor claims that said work is completed and in accordance with specifications, for such reasonable length of time as is deemed to be sufficient for making a complete and thorough test of same.
- .3 No claims will be considered for damage to or failure of any parts of such work so used which may be discovered during temporary and trial usage, whether caused by weakness or inaccuracy of structural parts or by defective materials or workmanship of any kind whatsoever.

## **20 PRICING OF CHANGE NOTICES**

- .1 The value of a proposed change in the work shall be determined in one or more of the following methods;
  - .1 by time and material,
  - .2 by unit prices set out in the Contract or subsequently agreed upon,
  - .3 by labour and material costs submitted in a detailed quotation.
- .2 In the case of changes in the Work to be paid for under the time and material or the unit price methods, the form of presentation of costs and methods of measurement shall be agreed to by the Consultant and Contractor before proceeding with the change. Keep accurate records, as agreed upon, of quantities or costs and present an account of the cost of the change in the Work, together with vouchers, material receipts and invoices where applicable.
- .3 In the case of changes in the Work to be paid for under the time and material or the labour and material method, the material costs are to be less trade discounts. Provide a 20% discount from list price for items included in the Allpriser catalogue or Electrical Price Guide.
- .4 The detailed quotation referenced under the labour and material method is to include a summary of charges made up of three components: labour charges, material costs and fees.
  - .1 Labour Charges
    - (a) The labour hour estimates are to be based on the current NECA Column 1 manual of labour units.
    - (b) Labour costs are to include burden on wages such as taxes, worker compensation charges, CPP, EI, project insurance, safety meetings, estimating, as-built drawings, supervision, small tools, site facilities, labour warranty and clean up.
    - (c) The all-inclusive hourly labour rate applicable for quotations submitted for changes to the work is 1.34 times the TOTAL PACKAGE RATE of the current Collective Agreement. The hourly labour rate for specialists not governed by union agreements (technicians or engineers) is 1.6 times the TOTAL PACKAGE RATE for electricians, plumbers or pipe fitters.
    - (d) The all-inclusive hourly labour rate indicated above is to include:
      - Collective Agreement relevant to the place of work (vacation pay, RRSP, Health & Welfare, RST of Health & Welfare, Pension, Union admin fund, ECA fund (or others), Secretariat.
      - Legislation as relevant to the place of work (Emp. Health Tax, E.I., CPP, WSIB, taxes)
      - Project insurance, safety meetings, estimating, layouts, site facilities, warranties, storage,
      - clean up, office supervision and miscellaneous charges.
    - (e) Foreman Electrician rates shall be as for the calculated Journeyman rate above plus 10% of the TOTAL PACKAGE RATE. A maximum of 10% of the total calculated journeymen hours on a change may be charged as overhead supervision hours at the Foreman rate.
    - (f) No other overhead supervision hours will be permitted.
  - .2 Material Charges
    - (a) Material costs are to be less trade discounts. Provide a 20% discount for items included in the Allpriser catalogue or Electrical Price Guide.
  - .3 Fees
    - (a) The overhead and profit fee to include for the Contractor's head office and site office expenses, project manager, assistants, site office and storage facilities, utility charges, site security, telephone and facsimile transmission costs, as built, expendable small tools, financing costs, coffee breaks, site facilities, general clean up and disposal, security, storekeeper, and all other non-productive labour.

- (b) Fees for overhead and profit are to be in accordance with the general conditions of the contract

## **21 CONSULTANT REVIEWS**

### **21.1 General**

- .1 Consultant's attendance at site including but not limited to site meetings, demonstrations, site reviews and any resulting reports are for the sole benefit of the Owner and the local authority having jurisdiction.

### **21.2 Site Reviews**

- .1 General reviews and progress reviews do not record deficiencies during the course of the Work until such time as a portion or all of the work is declared complete. In some instances, before the work is completed, deficiencies may be recorded where the item is indicative of issues such as poor workmanship, incorrect materials or installation methods, or may be difficult to correct at a later date. Do not use any such reported items, or lack thereof, as part of the project quality assurance program nor as a change to the scope of work nor as acceptance of the quality of the work.
- .2 Deficiency reviews conducted by the Consultant are performed on a sampling basis, and any deficiency item is to be interpreted as being indicative of similar locations elsewhere in the Work, unless indicated otherwise.

### **21.3 Milestone Reviews**

- .1 Specific milestone reviews may be conducted at key stages by the Consultant, including;
- .1 before the backfilling of buried services,
  - .2 before closing of shafts,
  - .3 before the closing of walls,
  - .4 before closing of ceilings,
  - .5 equipment demonstration,
  - .6 Substantial Performance deficiency review,
  - .7 Total Performance deficiency review.
- .2 Coordinate with the Consultant the type and quantity of milestone reviews required and incorporate these requirements into the construction schedule.
- .3 Prior to Work being concealed, notify the Consultant in writing seven (7) calendar days in advance of the planned concealment to arrange a site review, where required by the Consultant. Correct noted deficiencies before concealing the Work. Failure to provide notification can result in the Work being exposed for review at the Contractor's cost.

### **21.4 Final Review**

- .1 At project completion, submit written request for final review of mechanical and electrical systems.
- .1 Refer to section 26 08 19 Project Close-Out.
- .2 Include with the request a written certification that;
- .1 deficiencies noted during job inspections have been completed,
  - .2 systems have been balanced and tested and are ready for operation,

- .3 completed maintenance and operating data have been submitted and approved,
- .4 tags are in place and equipment identification is completed,
- .5 cleaning is finished in every respect,
- .6 electrical panels, switchboards, cabinets, and equipment surfaces have been touched up with matching paint, or re-finished as required,
- .7 spare parts and replacement parts specified have been provided and receipt acknowledged,
- .8 As-built and Record drawings are completed and approved,
- .9 Owner's operating personnel have been instructed in the operation and maintenance of systems,
- .10 fire alarm verification is 100% completed and the Verification Certificate has been submitted and accepted.

## **22 CORRECTION AFTER COMPLETION**

### **22.1 General**

- .1 At completion, submit a written guarantee, undertaking to remedy defects in work for a period of one year from date of substantial completion. This guarantee is not to supplant other guarantees of longer period called for on certain equipment or materials.
- .2 Guarantee to encompass replacement of defective workmanship, parts, materials or equipment, and to include incidental fluids, gaskets, lubricants, supplies, and labour for removal and reinstallation work.
- .3 Submit similar guarantee for one year from date of acceptance for any part of work accepted by the Owner, before completion of whole work.

**END OF SECTION**

## **ELECTRICAL BASIC MATERIALS AND METHODS**

### **26 05 01**

#### **1 GENERAL**

##### **1.1 Scope**

- .1 Articles that are of a general nature, apply to each Section of Divisions 26, 27 and 28.

##### **1.2 Work Included**

- .1 Work to be done under this section to include furnishing of labour, materials, equipment and services required for installation, testing and putting into proper operation complete electrical systems as shown, as specified, as intended, and as otherwise required. Complete systems to be left ready for continuous and efficient satisfactory operation.

#### **2 ACCESS DOORS**

##### **2.1 Construction:**

- .1 Access doors, unless shown or specified otherwise:
  - .1 constructed from galvanized steel sheet,
  - .2 flush mounted,
  - .3 concealed hinges,
  - .4 180° opening door,
  - .5 round safety corners,
  - .6 anchor straps,
  - .7 plaster lock,
  - .8 screwdriver operated latches,
  - .9 without visible screws,
  - .10 finished prime coat only.
- .2 Door metal thickness as follows:
  - .1 up to and including 400 x400 (16" x 16"): 1.6 mm (16 gauge)
  - .2 height or width larger than 400 (16"): 2 mm (14 gauge)
- .3 Constructed of stainless steel for areas finished with tile or marble surfaces.
- .4 Constructed of stainless steel with neoprene gasketed door where used in damp and high humidity areas.
- .5 Dish type door design to receive a tile insert where acoustic tile is applied to plaster or gypsum board ceilings.
- .6 Fire rated where installed in fire rated walls or ceilings. Fire rating to match the rating of the wall or ceiling.
- .7 With keyed cylinder locks, keyed alike, for areas subject to security risks, EG;
  - .1 public corridors,

- .2 public washrooms,
- .8 Inside clear dimensions:
  - .1 approximately 400 mm x 400 mm (16" x 16") for hand access,
  - .2 at least 600 mm x 600 mm (24" x 24") where personnel are to enter through doors,
  - .3 larger where indicated or required.
- .9 Submit access door shop drawings for approval as soon as possible after award of contract, showing size, type and exact location of access doors.

*Standard of Acceptance*

- Acudor
- Cendrex (up to 400 x 400 only)
- Elmdor (up to 400 x 400 only)
- Mifab (up to 400 x 400 only)
- Nystrom
- Williams Brothers – GP

## **2.2 Installation**

- .1 Provide access doors for locations where equipment requiring access, maintenance or adjustment is "built-in".
- .2 Submit a list of proposed access door locations and obtain approval before commencing installation.
- .3 Access doors to be installed under the Division in whose work they occur. Arrange for and pay cost of access doors and their installation.
- .4 Access doors are not required in removable acoustic panel type ceilings.
- .5 Size and locate access doors in applied tile, or in glazed or unglazed structural tile to suit tile patterns. Refer to Architectural Room Finish Schedule and details on Architectural drawings in this regard.

## **3 SLEEVES AND CURBS**

### **3.1 Materials**

- .1 Sleeves for bus ducts: minimum 3 mm (1/8") galvanized steel.
- .2 Integral flashing clamp on sleeves that pass through floors with a waterproof membrane.
- .3 Removable (non fire rated) sealing material: Duxseal or acceptable alternative.
- .4 Fire rated sealing material: per Article "Fire Stopping".

### **3.2 Installation**

- .1 Provide sleeves for bus ducts, conduits and cable runs passing through;
  - .1 concrete walls, beams, slabs and floors,
  - .2 fire rated walls, partitions and ceilings.
- .2 Place and secure sleeves in concrete form work.



- .3 Supply sleeves to be set in concrete and masonry walls with installation detail drawings.
- .4 Terminate sleeves flush with surfaces of concrete and masonry walls.
- .5 Extend sleeves 100 mm (4") above finished floor.
- .6 Size sleeves to accommodate fire stopping materials where required.
- .7 Make watertight connections between sleeves and waterproof membranes.
- .8 Fill any spaces between sleeves and masonry walls;
  - .1 with non-shrink grout,
  - .2 with a rated fire stopping material for rated walls.
- .9 Seal spare sleeves and the space between sleeves and the through conduits, cables, wireways, bus ducts etc;
  - .1 using removable sealing material,
  - .2 using a rated fire stopping material for floors and rated walls,
  - .3 seal watertight where sleeves penetrate a floor slab.
- .10 Sleeves in existing concrete and masonry walls and floors;
  - .1 cutting and drilling of structural elements, such as floors, slabs, walls, columns, or beams to be carried out in accordance with procedure set out in Article "Cutting and Remedial Work" in Section "Electrical General Requirements",
  - .2 neatly cut or drill holes in existing construction,
  - .3 terminate sleeves flush with surfaces of concrete and masonry walls,
  - .4 extend sleeves 100 mm (4") above finished floor with flange, countersunk, and bolted down flush into floor surface,
  - .5 fill opening between sleeve and wall;
    - (a) with non-shrink grout,
    - (b) with a rated fire stopping material for rated walls.
  - .6 fill opening between sleeve and floor with rated fire stopping material with water barrier,
  - .7 seal as indicated above.
- .11 Provide concrete curbs, minimum 100 mm (4") high above finished floor surrounding sleeves and openings for;
  - .1 conduits,
  - .2 cables,
  - .3 telephone cable risers,
  - .4 bus ducts,
  - .5 wireways,
  - .6 cable trays, and
  - .7 other openings for electrical services through slabs above grade.
- .12 Size concrete curbs for bus ducts to provide sufficient area to adequately carry bus duct support brackets.

- .13 Size openings to accommodate fire stopping materials as required.

## **4 FIRE STOPPING**

### **4.1 General**

- .1 Maintain the integrity of floor and wall fire separations around electrical raceways, cables, bus ducts and boxes passing through rated floors or walls.

### **4.2 Materials**

- .1 Materials to form a ULC or cUL listed firestop system to CAN/ULC-S115 "Standard Method of Fire Tests of Firestop Systems".
- .2 Firestop system rating: minimum 2 hrs., higher where indicated.
- .3 Submit shop drawings consisting of product technical data and ULC or cUL listing.

#### *Standard of Acceptance*

- Hilti Firestop Systems
  - 3M
  - A/D Fire Protection System Inc.
  - Eastern Wire + Conduit
- .4 Other manufacturers having products with explicitly similar characteristics, listings or classifications and approvals are acceptable.

### **4.3 Installation**

- .1 Submit a complete fire stopping and smoke seal schedule to the Consultant for review. Include details, cut sheets, system description and location for each proposed fire stopping and smoke sealing application.
- .2 Install firestopping in accordance with the manufacturer's recommendations and in accordance with the ULC or cUL listing.
- .3 Firestopping to be installed only by personnel trained by the manufacturer on the installation of such systems.
- .4 Firestop system manufacturer's training and inspection services:
  - .1 Provide the services of the firestop system manufacturer to provide training to trades performing the fire stopping. Create and maintain a log of those personnel who obtain training.
  - .2 Provide the services of the firestop system manufacturer to inspect the installation of the firestopping while in progress and a final inspection at completion of work. Provide a manufacturer's inspection report to the Owner and Engineer.
- .5 Seal space between penetrating service and sleeve or opening in fire rated floors and walls with a fire stopping and smoke sealing system.
- .6 At time of application of materials, surfaces to be clean, dry and free from dust, oil, grease, loose or flaking paint, loose concrete or masonry and foreign materials.

- .7 Wiring may penetrate a fire rated assembly provided it is enclosed in non-combustible conduit, and the passage of the conduit in turn is suitably sealed to the assembly with fire stop material.
- .8 Where wiring with a combustible covering and not enclosed in non-combustible conduit penetrates a fire resistance rated assembly, group the wiring into separate fire sealed penetrations to ensure the overall diameter of the combined wire(s) in each penetration does not exceed 25 mm.
- .9 Arrange single conductor metal sheathed cables to individually penetrate the fire rated assembly and be individually fire stopped.
- .10 Where wiring is installed in cable trays and penetrates a fire rated assembly;
  - .1 terminate and independently support the cable tray on each side of the fire rated assembly, and
  - .2 provide sufficient working room to properly install and inspect the fire stopping materials and penetration.
- .11 Smoke seal and fire stop electrical boxes that penetrate a fire rated wall using fire rated putty pads, install putty pads on the outside of boxes.
- .12 Co-ordinate installation of cast-in-place fire stopping devices with the Division responsible for the placement of concrete.

## **5 PENETRATIONS OF BELOW GRADE WALLS AND SLABS ON GRADE**

### **5.1 Materials**

- .1 Expanding cement water stop material.
- .2 Submit manufacturer's literature.

#### *Standard of Acceptance*

- ° WATERSTOP-RX or acceptable equivalent

### **5.2 Installation**

- .1 Fit each cable, conduit and duct passing through floor slab in contact with ground or walls below grade, with a water stop.
- .2 Submit schedule showing location, service.
- .3 Install water stop in accordance with the manufacturer's instructions.
- .4 Encircle each cable, conduit and duct and the perimeter of the wall opening with the water stop material.
- .5 Fill the wall openings around the cables, conduits or ducts with hydraulic cement injected for the full width of the wall.
- .6 Seal the exterior of the wall around the cables, conduits or ducts with a waterproof coating.  
Waterproof coating to be compatible with any existing waterproofing for work in existing building.

## **6 EQUIPMENT SUPPORTS, AND BASES**

### **6.1 Supports for electrical work**

- .1 Equipment supplementary supports to be provided by this Division.

- .2 Concrete housekeeping bases for electrical equipment to be provided by this Division.
- .3 Work to be done by firms specializing in these fields.
- .4 Submit shop drawings for steel and concrete work, prepared by licensed Professional Engineers.

## **6.2 Supplementary supports and support brackets**

- .1 Fabricated from structural grade steel with anchor bolts and fastenings.
- .2 Designed in consultation with building structural consultant to transfer live loads and dead loads to building structural elements.
- .3 Constructed as frames bracketed from walls, and/or supported from building structure above, and/or floor below.

## **6.3 Concrete bases for housekeeping pads**

- .1 Constructed using plywood form work and 20 Mpa (3000 lb) concrete,
- .2 Dowelled to concrete floor slab with steel rods not less than 13 mm (1/2 in) in diameter.
- .3 Finish to make flat, level, smooth, neat surfaces.
- .4 Chamfer corners 25 mm (1 in).
- .5 Dimensions:
  - .1 75 mm (3 in) larger all around than base of apparatus for non-seismic applications,
  - .2 200 mm (8 in) larger all around than base of apparatus for seismically restrained equipment,
  - .3 Height: 100 mm (4 in)

## **6.4 Installation - General**

- .1 Locate supporting steel to permit service or repair, and to allow clear access to junction boxes and equipment.
- .2 Set equipment on supporting frames and brackets and install hangers, anchor bolts, and vibration mountings.
- .3 Install anchor bolts, and vibration mountings between equipment and housekeeping pad.
- .4 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.
- .5 Provide anchorage, dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.
- .6 Make field connections with bolts to CAN/CSA-S16.1, or weld.
- .7 Supply items for casting into concrete or building into masonry to appropriate trades together with setting templates.
- .8 After completion of erection, touch-up field welds, bolts and burnt or scratched surfaces with primer.
- .9 Where gratings or trench covers are cut in field or damaged, touch up with zinc rich paint.

## 7 GENERAL WIRING REQUIREMENTS

### 7.1 Wiring Terminations

- .1 Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.
- .2 Manufacturers' and CSA labels to be visible and legible after equipment is installed.

### 7.2 Location of Outlets

- .1 Locate outlets in accordance with Division 01 - General Requirements.
- .2 Do not install outlets back-to-back in wall.
- .3 Where back boxes on opposite sides of a wall occupy the same stud bay, apply acoustical putty pads to the outside of the boxes.
- .4 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm (10'), and information is given before installation.
- .5 Locate light switches on latch side of doors. Locate disconnect devices in mechanical and elevator machine rooms on latch side of door.

### 7.3 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 For Barrier Free areas verify the mounting heights with the authority having jurisdiction prior to rough-in.
- .4 Install electrical equipment at following heights unless indicated otherwise.

Description	General Area	Barrier Free
Local switches	1200 mm (47")	1050 mm (41")
Wall receptacles: General	300 mm (12")	450 mm (18")
Wall receptacles: above top of counters or counter splash backs	175 mm (7")	175 mm (7")
Wall receptacles shown above top of counters where there is no counter: height above finished floor	1200 mm (47")	1050 mm (41")
Wall receptacles: In Mechanical rooms	1200 mm (47")	1050 mm (41")
Telephone outlets	300 mm (12")	450 mm (18")
Fire alarm pull stations	1050 mm (41")	1050 mm (41")
Fire alarm horns	2100 mm (83")	2100 mm (83")

Description	General Area	Barrier Free
Wall mounted door operator push pads	1000mm (39")	1000mm (39")
Wall or floor mounted, vertical panel type door operator controls	from ≤200mm to ≥900mm (from ≤7.9" to ≥36")	from ≤200mm to ≥900mm (from ≤7.9" to ≥36")
Other controls	1200 mm (47")	1050 mm (41")
Panelboards	As required by code or as indicated	As required by code or as indicated

#### 7.4 Conduit and Cable Installation

- .1 Install embedded conduit prior to pouring of concrete.
- .2 Arrange for holes through exterior walls and roof to be flashed and made weatherproof under Division 7.
- .3 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.
- .4 Supply and deliver inserts to site in ample time to be built into work of other trades. Provide necessary templates and adequate instructions and assistance to locate and install inserts.
- .5 Secure inserts firmly to form work before concrete is poured.
- .6 Provide insert drawings as required.

#### 7.5 Plywood Backboards

- .1 Provide plywood backboards in electrical and telecommunications rooms and closets where indicated or specified for mounting of equipment.
- .2 Plywood to be securely attached to the building structure.
- .3 Plywood to be 19mm, void free, good one side, mounted with good side exposed.
- .4 Plywood to be Class A fire retardant, FSC certified and contain no added urea formaldehyde.

**END OF SECTION**

## **PAINTING FOR ELECTRICAL SERVICES**

### **26 05 02**

## **1 GENERAL**

### **1.1 Scope**

- .1 Provide industrial anti-corrosion coatings for electrical building services and related construction elements including:
  - .1 electrical services and supporting elements as specified under other sections of Divisions 26 to 28,
  - .2 concrete curbs, housekeeping pads, floor trenches and containment floor areas.
- .2 General painting of service room floors and decorative finish painting of building services is provided under Division 09.

### **1.2 Related Sections**

- .1 26 01 01 Electrical General Requirements
- .2 26 05 01 Electrical Basic Materials and Methods

### **1.3 Submittals**

- .1 Submit product data sheets which demonstrate compliance with LEED VOC requirements.

### **1.4 Applicable Codes and Standards**

- .1 Legislation:
  - .1 SOR/2009-264 Canadian Environmental Protection Act, *Volatile Organic Compound (VOC) Concentration Limits for Architectural Coatings Regulations*
- .2 Installation standards and codes:
  - .1 LEED v4 New Construction, credit EQ Cr 4.2
  - .2 SSPC Society for Protective Coatings, Surface Preparation Standards
- .3 Product standards:
  - .1 Green Guard GC-03 Green Seal Environmental Criteria for Anti-Corrosion Paints

## **2 PRODUCTS**

### **2.1 Industrial anti-corrosion coatings – carbon steel materials and structural steel support components**

- .1 Outdoor applications:
  - .1 top coat: industrial urethane alkyd enamel top coat, or single compound 100% acrylic coating,
  - .2 primer coat: as per manufacturers' recommendation for coating of steel piping,
  - .3 colour: Sherwin Williams No SW4027 (Galvano), unless specified elsewhere,
  - .4 VOC limit: 340 g/L of product less water and excluded compounds.

#### *Standard of Acceptance*

- Sherwin Williams – Pro Industrial Urethane Alkyd Enamel
- Sherwin Williams – Pro Industrial Acrylic

- .2 Indoor applications:

- .1 top coat: single compound 100% acrylic coating,
- .2 primer coat: as per manufacturers' recommendation for coating of steel piping,
- .3 colour: Sherwin Williams No SW4027 (Galvano), unless specified elsewhere,
- .4 LEED: certified to Green Guard standard GC-03 for anti-corrosion coatings,
- .5 VOC limit: 250 g/L of product less water, U.S. EPA method 24.

*Standard of Acceptance*

- ° Sherwin Williams – Pro Industrial Acrylic

- .3 Zinc rich primer applications for field painting of carbon steel material, or touch-up of galvanized steel material:

- .1 top coat: as specified for interior or exterior applications,
- .2 primer: single or multi-part zinc rich coating,
- .3 colour: gray-green,
- .4 LEED compliance: certified to Green Guard standard GC-03 for anti-corrosion coatings,
- .5 VOC limit: 250 g/L of product less water, U.S. EPA method 24.

*Standard of Acceptance*

- ° Sherwin Williams – Zinc Clad III HS 100

## **2.2 Industrial coatings – poured concrete**

- .1 For field painting of concrete floor trenches, housekeeping pads, curbs and containment floors in service rooms:
  - .1 resistant to fuel oil, general solvents and water,
  - .2 top coat: water based urethane floor enamel,
  - .3 primer coat: water based epoxy,
  - .4 colour: Sherwin Williams Deck Gray,
  - .5 colour: Sherwin Williams Safety Yellow where shown,
  - .6 VOC limit: 250 g/L of product less water, U.S. EPA method 24.

*Standard of Acceptance*

- ° Sherwin Williams – Armorseal Floor Plex 7100 Primer / Amorseal 1K Topcoat

## **3 EXECUTION**

### **3.1 General**

- .1 Refer to requirements for services to be painted in the relevant sections of Division 26 to 28 and as follows.
- .2 Touch up any damage to factory prime coat resulting from shipping or installation with appropriate primer for indoor/outdoor installation with appropriate top coat, of colour to match existing. Materials to be compatible with the original factory finish.
- .3 Touch up any damage to factory galvanized finish resulting from site welding, shipping or installation with zinc rich primer.



### **3.2 Installation**

#### **.1 Surface preparation**

- .1 Clean surfaces to be painted in accordance with paint manufacturer recommendations and as follows.
- .2 Surfaces to be clean, dry and free from dust, oil, grease, loose or flaking paint and foreign materials at time of application of paint materials.
- .3 For carbon steel materials, remove all loose mill scale, loose rust, loose paint, and other loose detrimental foreign matter by hand chipping, scraping, sanding, and wire brushing in accordance with SSPC-SP2 Hand Tool Cleaning.
- .4 For galvanized steel material, solvent clean to SSPC-SP1 Solvent Cleaning. If galvanized surface is already rusty, remove loose rust and dirt in accordance with SSPC-SP2 and prime the exposed metal the same day as being cleaned.
- .5 For concrete materials, clean surfaces to SSPC-SP13/NACE 13 by mechanical, chemical or thermal methods.
- .6 Tape-off adjacent materials which are not to be painted. Provide drop sheets to protect other surfaces from falling paint or over-spray.

#### **.2 Application - General**

- .1 Apply one coat of primer to metal items, with exception of galvanized or concrete encased items.
- .2 Use primer unadulterated, as prepared by manufacturer.
- .3 Apply top coat in the number of coats recommended by the manufacturer, to obtain 100% coverage to the minimum recommended thickness, free of streaks, drips and sags.
- .4 Do not paint when temperature is lower than 7°C.

#### **.3 Application – Galvanized base metal finish**

- .1 Where material is galvanized, touch up welded sections or other locations where protective galvanized surface has been damaged, with zinc rich primer.
- .2 Apply a top coat to match base material colour.

#### **.4 Application – Concrete trenches, housekeeping pads, curbs and containment floors**

- .1 Apply one coat of primer and two top-coats.
- .2 After paint has dried, seal joints between curbs and containment floors with a silicone based industrial caulking in matching colour.

**END OF SECTION**

## **ELECTRICAL COORDINATION AND INSTALLATION DESIGN SERVICES 26 05 03**

### **1 GENERAL**

#### **1.1 Scope**

- .1 Provide detailed coordination, fabrication, and installation design drawings for the services provided under Division 26. Cooperate with other trades and integrate the coordination drawings into the coordination drawings provided under Division 20.
- .2 Provide the services of an experienced electrical coordination supervisor to manage these contractors' design services. The supervisor is responsible for participating in a multi-trade coordination effort including but not limited to: detailed inspection of existing conditions, layout and finalize routing of services, setting sleeves for structural openings and sequencing of service installation.

#### **1.2 Document Ownership**

- .1 Ownership and copyright of Contractors coordination, fabrication, and installation design drawings remains with the Contractor producing these documents, subject to the requirements of the project agreement. In the absence of any requirements in the project agreement, the Contractor will provide the Owner with a royalty-free, transferrable, and irrevocable license to copy and use the materials for the purpose of operating and maintaining the building and building systems.

#### **1.3 Consultant Drawings**

- .1 Consultant drawings are diagrammatic and illustrate the general location of equipment, and intended routing of bus duct, cable trays, conduit, ductwork, piping, bus duct, etc, and do not show every structural detail. In congested areas drawings at greater scale may be provided to improve interpretation of the Work. Where equipment or systems are shown as "double line", they are done so either to improve understanding of the Work, or simply as a result of the use of a CAD drawing tool, and in either case such drawings are not represented as fabrication or installation drawings.

#### **1.4 Design Commentary**

- .1 The following design commentary is provided to assist the contractor in developing an appreciation for the potential complexities and level of risk which may impact the preparation of a bid price for the Work. This commentary does not limit the scope of work nor does it address all potential risk factors associated with the Work.
  - .1 unknown structural conditions
  - .2 hidden conduit in slabs and walls
  - .3 availability of existing documentation

#### **1.5 Requests for Information**

- .1 Requests for Information (RFI's or similar type of document) concerning coordination are to be submitted with sketch drawings indicating proposed solution for review by the Consultant. RFI's submitted without such proposals will be returned for re-submission.

#### **1.6 Itemized Price**

- .1 Include costs associated with this Section as an Itemized Price in the Bid documents.

## **2 INTERFERENCE CO-ORDINATION DRAWINGS**

### **2.1 General**

- .1 Make good damage to Owner's property or to other trade's work caused by inaccurate layout or careless performance of work of this Division.
- .2 Take information involving accurate measurements from dimensioned Architectural Drawings or at building.
- .3 Install services and equipment which are to be concealed, close to building structure so that furring is kept to minimum dimensions.
- .4 Location of conduit, bus duct, cable trays, raceways and equipment may be altered without extra cost provided instruction is given or approval is obtained, in advance of installation of items involved. Changes will be authorized by site instructions and are to be shown on Record Drawings.
- .5 Location of lighting fixtures, ceiling mounted devices, switches, outlets, and other similar items may be altered without extra cost provided instruction is given prior to roughing in. No claim will be paid for extra labour and materials for relocating items up to 3 m (10 ft) from original location nor will credits be anticipated where relocation up to 3 m (10 ft) reduces material and labour.
- .6 Include incidental material and equipment not specifically shown but which is needed to complete the work as an operating installation.

### **2.2 Interference Coordination Drawings**

- .1 Prepare interference coordination drawings to show location of equipment and relative position of services, and to demonstrate coordination with works of other trades. Drawings shall be prepared by a specialist firm experienced in CAD mechanical and electrical interference drawing production. Interference drawings are to include coordination with all mechanical and electrical services.
- .2 Consult and co-operate with mechanical contractor to identify electrical services which are to be incorporated into the mechanical interference drawings. Contractor shall perform site survey work to document all existing electrical services that are to remain and are to be included in the interference drawings.
- .3 Conduct weekly meetings to discuss and resolve interference issues discovered during interference drawing production.
- .4 Submit drawings to other trades involved in each area and include note in drawing title block as follows;
  - .1 "This drawing was prepared and circulated for review and mark-up to related subcontractors as noted and initialed in the table below. Corrections and concerns identified through this coordination process have been addressed on this drawing. Areas that incorporate significant changes from layouts shown on Contract Drawings have been circled for Consultants' general review."
- .5 Drawing scale to be minimum 1:50 (1/4"=1'-0").
- .6 Produce coordination drawings, preferably in 3D AutoCad MEP or Revit MEP format, and keep a set of drawings on site for Consultant's review.

- .7 Obtain architectural and consultant's drawing files for background information, pending completion and return of any electronic file waiver forms.

### **2.3 Coordination with Other Trades**

- .1 Lay out and coordinate Work to avoid conflict with work under other sections of this Division and other Divisions.
- .2 When equipment provided under other Sections or Divisions connects with material or equipment supplied under this Section, confirm capacity and ratings of equipment being provided.

### **2.4 Interconnecting Control and Power Wiring**

- .1 Provide wiring block diagrams and detailed termination drawings for controls and interlock wiring and connections to equipment and instrumentation, for both Owner's supplied equipment and equipment provided under Divisions 9 to 13. Provide wiring terminal numbers specific for each equipment connection.

### **2.5 Fire Alarm and Building Automation System**

- .1 Provide a wiring coordination interface drawing for termination of fire alarm annunciation circuits to Building Automation System I/O equipment and/or motor starters, adjustable frequency drives, dampers, and motorized fire dampers.
- .2 Drawings to include wiring terminal numbers and description label for FAS annunciation zone.

### **2.6 Owners Equipment and Relocated Equipment**

- .1 The service provisions shown for Owner's supplied equipment and/or relocated equipment is based on the best available information at the time of design. Examine the actual service requirements for this equipment and make adjustments as necessary to connection sizes of service drops to suit. A change (increase or decrease) in one trade size for electrical conductors, conduit and service breakers will be provided at no change to the construction cost.
- .2 Where actual service requirements (except as described above for size) are different between the Consultant's drawings and Owner's equipment requirements, submit proposal for new or deleted services or capacities to the Consultant for review.

## **3 FABRICATION AND INSTALLATION DRAWINGS**

- .1 On an as-needed basis, prepare fabrication, spooling, and/or installation drawings based on the completed interference coordination drawings. CAD drawing system is in accordance with Contractor's company standards.
- .2 Drawing scale: same as the interference coordination drawings or at larger scale as needed.
- .3 Use information from manufacturer's shop drawings for each trade and figured dimensions from latest Architectural and Structural Drawings.
- .4 Layout equipment and services to provide access for repair and maintenance.

**END OF SECTION**

## **EXCAVATION AND BACKFILL**

### **26 05 05**

#### **1 GENERAL**

##### **1.1 General Requirements**

- .1 Coordinate with the site services work to be performed under other Divisions of the Work.
- .2 Drawings are schematic and show the approximate routing of underground conduits, ducts, cables and duct banks.

##### **1.2 References**

- .1 Occupational Health and Safety Act and Regulations for Construction Projects and Industrial Establishments as applicable.

##### **1.3 Work Included**

- .1 Provide labour, materials, and equipment required for installation, testing and putting into proper operation complete systems as shown as specified and as otherwise required.

#### **2 PRODUCTS**

##### **2.1 Aggregates**

- .1 Gradations to be within limits specified when tested to ASTM C136 and ASTM C117. Sieve sizes to CAN/CGSB-8.1.
- .2 Fine aggregates to be one, or blend of the following:
  - .1 Natural sand,
  - .2 Manufactured sand,
  - .3 Screenings produced in crushing of quarried rock, boulders, gravel or slag.
- .3 Coarse aggregates to be one of or blend of the following:
  - .1 Crushed rock,
  - .2 Gravel composed of naturally formed particles of stone.

##### **2.2 Asphalt Material**

- .1 Anionic emulsified asphalt to CAN/CGSB-16.2, grade SS-1.
- .2 Aggregate material of crushed stone or gravel.
- .3 Thoroughly mixed to achieve a uniform coating of asphalt over the aggregate.

##### **2.3 Concrete**

- .1 As specified in Division 3, Cast-in-Place Section.

##### **2.4 Warning Tapes**

- .1 Non-Detectable Warning tape:

- (a) Suitable for direct burial,
  - (b) Polyethylene,
  - (c) 150 mm (6") wide,
  - (d) continuous black lettering on red background, indicating buried electrical services below.
- .2 Detectable warning tape:
- (a) Waterproof and corrosion proof, suitable for direct burial,
  - (b) Detectable from grade using a metal detector,
  - (c) Metallic core encased in polyethylene or polyester
  - (d) continuous black lettering indicating buried electrical services below.

### **3 EXECUTION**

#### **3.1 Preparation Prior to Excavation**

- .1 Carefully review drawings of other trades.
- .2 Examine Architectural Drawings to determine where excavations for this Work interfere with new or existing paved areas, curbs, walks, concrete floors and other finished floors.
- .3 Obtain current "locates reports" for existing buried services from:
  - .1 local government source,
  - .2 service providers as applicable, or
  - .3 a professional locate service.
- .4 Review "locates reports" for any interferences with the Work.
- .5 Carefully check on site, the actual locations of existing services shown on the drawings and report any serious discrepancies.
- .6 Layout the final routing of services.

#### **3.2 Excavation**

- .1 Saw cut pavements, curbs and sidewalks before proceeding with excavation.
- .2 Excavate as required for the Work, both inside and outside the building.
- .3 Remove and dispose of concrete, masonry paving, walks, demolished foundations, rubble, and other obstructions encountered in course of excavation.
- .4 Shore and brace excavations exceeding 1200 mm (48 in) in depth in accordance with applicable Occupational Health and Safety Act and provincial regulations.
- .5 Provide bracing, shoring and underpinning as required to prevent movement or settlement of adjacent structures, earth, services, walks, paving, trees, curbs, adjacent grade.
- .6 Carefully check and avoid disturbing or damaging any existing underground piping, conduit or other services uncovered during execution of the Work.
- .7 Prior to any excavation close to building footings, obtain approval from project structural engineer.

- .8 Do not excavate within the 45 degree splay of bearing from the bottom of any footing without written permission from the project structural engineer.
- .9 Do not disturb soil within branch spread of trees or shrubs that are to remain. Where excavating through roots, excavate by hand and cut roots with sharp axe or saw. Seal cuts with approved tree wound dressing.
- .10 Make good at no cost to the Owner any damage caused by settlement resulting from the excavation.
- .11 Cleanly cut and trim banks of excavations and shore as required to prevent caving in.
- .12 Replace, in an acceptable manner, excavation which has been carried to a depth greater than shown or authorized, with 10 MPa concrete, at no additional expense to Owner, to give a bearing value equal to that provided by undisturbed soil.
- .13 Prepare excavation for underground services so that no portion of any conduit, duct, cable or duct bank bears directly against any rock or other hard surface.
- .14 Form bottoms of trenches so that pipes, conduits, duct banks, etc. are supported on undisturbed soil and will not be subject to undue strain.
- .15 Grade bottoms of excavation for conduits, ducts or duct banks to provide drainage.
- .16 Report to the Consultant any unsuitable sub grade conditions.
- .17 Remove rock encountered by drilling and wedging. Blasting will not be allowed unless approved and authorized in writing.
- .18 Break up rocks and boulders removed from excavations as required to permit handling.

### **3.3 Protection**

- .1 Store excavated materials in acceptable locations and in a manner so as to minimize damage to existing surfaces.
- .2 Cover excavated materials and provide protection to prevent runoff into local drainage facilities.
- .3 Protect from freezing, excavated earth that is to be used for backfilling.
- .4 Grade around excavations to prevent surface water runoff into excavated area.
- .5 Keep excavations dry by bailing, pumping or other acceptable means.
- .6 Cleanly cut and trim banks of excavations and shore as required to prevent caving in.
- .7 Keep sides and bottoms of excavations from freezing and protect as required to prevent damage to the Work or to existing services, by weather or other conditions.

### **3.4 Backfilling**

- .1 Prior to backfilling, remove formwork, shoring etc.
- .2 Do not commence backfilling until approval has been obtained.

- .3 Backfill as required for the Work, both inside and outside the building
- .4 Provide detectable warning (tracer) tape directly above centerline of buried services.
- .5 Provide non-detectable warning (marker) tape midway between buried services and finished grade.
- .6 For trenches exceeding 500 mm (20") in width, provide two non-detectable warning (marker) tapes, one laid 100 mm (4") from each trench edge, midway between buried services and finished grade.
- .7 Backfill excavations, required in close proximity to, or below footing level with 10 MPa concrete up to the top of highest adjacent footing.
- .8 Where solid undisturbed soil is not obtainable at the trench level eg: adjacent to a foundation wall or maintenance hole, provide granular 'A' material from undisturbed soil, compacted in 300mm (12") layers up to bottom of trench.
- .9 Do not use frozen earth for backfilling nor place any backfilling on or against frozen earth.
- .10 Repair, at no cost to the Owner, any of the Work and existing services damaged during backfilling.
- .11 Backfill trenches under building floors, roads and paved areas with sand placed in layers and compacted in an approved manner to achieve 95% modified Proctor compaction. Do not use material from excavation for backfilling.
- .12 For conduits, ducts and cables;
  - .1 provide a base layer of sand at least 100mm (4") deep,
  - .2 tamp sand around and over conduits, ducts and cables, in 150 mm (6") layers to a height of at least 300 mm (12") above top of conduits, ducts and cables.
  - .3 compact each sand layer,
  - .4 fill remainder of trench in 300 mm (12") layers with approved excavated material, free from stone,
  - .5 compact each layer to prevent undue settlement.
- .13 For duct banks at maintenance holes and foundation walls;
  - .1 backfill in 300mm (12") layers with Granular 'A' material to height of at least 300 mm (12") above top of duct banks,
  - .2 compact each layer,
  - .3 fill remainder of space in 300 mm (12") layers with approved excavated material, free from stone,
  - .4 compact each layer to prevent undue settlement.
- .14 Where excavations interfere with new or existing paved areas, curbs, walks, concrete floors and other finished floors, backfill with sand.
- .15 Patch paved areas, walls, walks, lawns and road surfaces, damaged by the Work, in an acceptable manner.



- .16 Make up settlement of backfilling as soon as possible. Fill depressions to restore the correct grade after a period, adequate to reveal settlement, has passed. Make good any subsequent settlement of such fill.
- .17 Pay costs to make good paving, lawns, curbs and any other surfaces damaged by settlement and subsequent restoration.
- .18 Dispose of excess excavated material and leave the site clean.

**END OF SECTION**

## **WIRES & CABLES 0-1000 VOLTS 26 05 19**

### **1 GENERAL**

#### **1.1 Product Data**

- .1 Submit product data in accordance with Section 26 05 01 Electrical General Requirements.

#### **1.2 Conductor sizes**

- .1 Conductor sizes are based on connected equipment having a temperature marking of 75°C or higher. Where equipment does not have a temperature marking or it has a marking lower than 75°C, increase the size of the conductors accordingly, to the satisfaction of the consultant.
- .2 For wires in conduit, conductor sizes are based on not more than 3 current carrying conductors in a conduit. Where more than 3 current carrying conductors are installed in a conduit increase the conductor size accordingly, to the satisfaction of the consultant.
- .3 Do not reduce conductor sizes, conductors may have been oversized due to voltage drop constraints.

### **2 PRODUCTS**

#### **2.1 Building Wires**

- .1 Conductors: copper conductors: size as indicated.
- .2 Minimum wire size: No. 12 AWG.
- .3 Stranded conductors for 10 AWG and larger.
- .4 Insulation:
  - .1 chemically cross-linked thermosetting polyethylene material,
  - .2 RW90 or RWU90 to CSA C22.2 No. 38,
  - .3 1000V and 600V ratings.
- .5 Conductors to be colour coded. Conductors to have colour impregnated into insulation at time of manufacture. Phase conductors No. 8 AWG and larger, with black insulation, may be colour coded with adhesive colour coding tape.

##### *Standard of Acceptance*

- Aetna Insulated Wire
- General Cable
- Nexans Canada Inc.
- Prysmian Cables & Systems Ltd.
- Southwire

#### **2.2 Armoured Cables**

- .1 Type: AC90, 600V 90C to CSA C22.2 No 51, FT4 rated.
- .2 Conductors: copper, minimum size #12 with bare copper #12 bonding wire.

- .3 Insulation: RW90 XLPE.
- .4 Armour: interlocking type fabricated from galvanized steel or aluminum strip.

## 2.3 Instrumentation and Control Cabling

- .1 Control cables to CSA Standard CAN3-C2.1-M86 Control Cables - 600 Volts.
- .2 Control cables as follows:

Conductors	Quantity, arrangement and gauge shown on drawings or specified elsewhere.
Identification	Colour coded or numbered.
Insulation	XLPE
Armour	Steel (No armour required if installed in conduit or approved wireway).
Jacket	FT4 Flame Retardant.

- .3 Shielded cables to provide 100% shield coverage complete with drain wire.
- .4 Multipair twisted shielded cables to have individually shielded pairs, overall shield, drain wires and overall rated jacket.

### *Standard of Acceptance*

- General Cable (Carol)
- Belden
- Nexans Canada Inc.

## 3 EXECUTION

### 3.1 General

- .1 Conductor colour coding to be as follows:
  - Phase A - Red
  - Phase B - Black
  - Phase C - Blue
  - Neutral - White
  - Ground - Green
  - Control - Orange
- .2 Where colour coding tape is utilized, apply at least 50 mm (2") at terminations, junction boxes and pull boxes. Do not paint conductors.
- .3 Use:
  - .1 600 V insulation for 347/600 V and 120/208 V systems.
- .4 Wiring installed underground: RWU90.
- .5 Wiring in channel back of luminaires:

- .1 600 volt type GTF or TEW,
- .2 temperature rating as required by CSA and/or manufacturer requirements.
- .6 Store wire and cable in a clean, dry, well ventilated area.
- .7 Protect white insulated wire from exposure to NOx gas (eg: exhaust from propane fuelled equipment) by wrapping with shrink wrap, by locating away from sources of NOx and by maintaining adequate ventilation to minimize NOx levels.
- .8 Where white insulated wire has discoloured:
  - .1 do not install,
  - .2 dispose of the wire,
  - .3 remove and replace wire that has been installed.
- .9 Neatly train circuit wiring in cabinets, panels, pullboxes and junction boxes and hold with nylon cable ties.
- .10 Splice wires:
  - .1 Up to and including No. 6 AWG: with nylon insulated expandable spring type connectors with moulded thermoplastic body and expandable square edge design spring.
  - .2 Larger than #6 AWG: with compression sleeve connectors and heat shrink insulating sleeves, voltage rating of sleeves equal to or greater than the cable.
  - .3 Aluminum Conductors: with long barrel compression sleeve connectors approved for use with aluminum conductors and heat shrink insulating sleeves, voltage rating of sleeves equal to or greater than the cable.
- .11 Do not splice conductors used in parallel runs.
- .12 Where the Consultant agrees that splicing of conductors in a parallel run is unavoidable, connect the paralleled runs of the feeder together in a junction box at the splice location, using:
  - .1 Copper bus bars of quantity and size to match the circuit,
  - .2 A two hole long barrel compression lug on each cable,
  - .3 Two nuts and bolts on each lug,
  - .4 Two oversized flat washers and a spring lock washer, or two Belleville washers, on each bolt,
  - .5 An oversized CSA Type 1 enclosure to house the above.

### **3.2 Installation of Building Wires**

- .1 Install wiring as follows:
  - .1 In conduit systems in accordance with Section 26 05 33.
  - .2 In wireways and auxiliary gutters in accordance with Section 26 05 37.
- .2 Home runs, of 15 and 20 Ampere circuits to lighting and receptacle panels, which exceed:
  - .1 25 m (75') in length: No. 10 AWG or larger,
  - .2 40 m (120') in length: No. 8 AWG or larger,
  - .3 60 m (180') in length: No. 6 AWG or larger.

- .3 Increase the size of branch circuit conductors and home runs as required so that the total voltage drop, from panelboards to loads, does not exceed 3% under load.
- .4 For branch circuit wiring a common neutral conductor may be used with two or three phase conductors except where indicated otherwise.
- .5 For branch wiring, common neutral conductors may be used in the following applications:
  - .1 lighting circuits, excluding dimming circuits,
  - .2 housekeeping receptacles,
  - .3 specific purpose receptacles for equipment that does not produce harmonic currents, such as resistance heating.
- .6 Where wires are damaged or contaminated during installation, remove and dispose of wires, swab out conduits and pull in new, clean conductors.

### **3.3 Installation of Armoured Cables AC90(BX)**

- .1 May be used for drops to surface and recessed mounted fluorescent luminaires.
- .2 May be used for wiring concealed within walls provided that horizontal runs within the ceiling space do not exceed 3m.
- .3 Terminate cables in accordance with Section 26 27 28 - Wire and Box Connectors - 0 - 1000 V.

### **3.4 Installation of Instrumentation, Communication and Control Cabling**

- .1 Install wiring as follows:
  - .1 In conduit systems in accordance with Section 26 05 33.
  - .2 In wireways and auxiliary gutters in accordance with Section 26 05 37.
  - .3 In open style cable trays in ceiling spaces, using FT6 plenum rated cable assemblies.
  - .4 In open style cable trays in ceiling spaces, using FT4 rated cable where the ceiling space is not used as a return air plenum, as directed by the Consultant.
- .2 Neatly train circuit wiring in cabinets, panels, pullboxes and junction boxes and hold with nylon cable ties.
- .3 Run instrumentation, communication and control cabling point to point and terminate on terminal strips. Do not splice communication or control cabling. Where long runs make a continuous point to point installation impractical, make splices on labelled terminal blocks in an accessible labelled terminal cabinet, installed at 1200 mm (48") above floor, and indicate cabinet location, terminal and wire numbers on the As-built drawings.
- .4 Terminate control cables in equipment with suitable connectors.
- .5 Clearly identify cables at both ends, with permanent PVC wire markers, Weiland type Z or equal, indicating cable number and wire numbers.

**END OF SECTION**

## **GROUNDING AND BONDING SECONDARY**

### **26 05 27**

#### **1 GENERAL**

##### **1.1 General Requirements**

- .1 Conform to Sections of Division 1 as applicable.

##### **1.2 Related Sections**

- .1 26 01 01, Electrical General Requirements.
- .2 26 05 01, Basic Materials and Methods.
- .3 26 05 53, Identification for Electrical Systems.

##### **1.3 Submittals**

- .1 Submit shop drawings and product data in accordance with Section 26 01 01 Electrical General Requirements.
- .2 Submit list of nameplates.

##### **1.4 Applicable Codes and Standards**

- .1 Latest edition of CSA C22.2 No 41 Grounding and Bonding Equipment.

##### **1.5 Work Included**

- .1 Provide labour, materials, and equipment as required for installation, testing and putting into proper operation complete systems as shown, as specified and as otherwise required.

##### **1.6 Operation and Maintenance Data**

- .1 Provide operation and maintenance data for incorporation into manual specified in Section 26 01 01 Electrical General Requirements.

#### **2 PRODUCTS**

##### **2.1 Clamps:**

- .1 conductor to water main clamps suitable for grounding connections,
- .2 type and size as required to make electrically conductive connections to underground water pipe,
- .3 non-corroding copper, bronze and/or stainless steel construction.

##### **2.2 Conductors**

- .1 Buried grounding conductors:
  - .1 bare, stranded, tinned, soft annealed copper,
  - .2 size #4/0 AWG unless indicated otherwise.

.2 Insulated grounding and bonding conductors:

- .1 bare, stranded, soft annealed copper,
- .2 type RW90 green insulation.

### **2.3 Accessories**

.1 Accessories including but not limited to:

- .1 grounding and bonding bushings,
  - .2 protective type clamps,
  - .3 bolted type conductor connectors,
  - .4 bonding jumpers, straps,
  - .5 pressure wire connectors,
- to be of non-corroding copper, bronze and/or stainless steel construction.

### **2.4 Raised Floor Bonding**

- .1 Communication and computer room raised floor ground clamps: Burndy Uniground.

## **3 EXECUTION**

### **3.1 Installation**

- .1 Ground electrical systems in accordance with the Electrical Safety Code and the latest edition of ANSI/IEEE Standard 142.
- .2 Bond electrical equipment in accordance with the Electrical Safety Code and the latest edition of ANSI/IEEE Standard 142.
- .3 Install connectors in accordance with manufacturer's instructions.
- .4 Protect exposed grounding and bonding conductors from mechanical injury.
- .5 Make buried connections, and connections to conductive water main and electrodes, using copper welding by exothermic process.
- .6 Use mechanical connectors for grounding and bonding connections to equipment provided with lugs.
- .7 Soldered joints not permitted.
- .8 Provide a bonding wire for flexible conduit, connected at both ends to bonding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .9 Provide a separate bonding conductor in each conduit:
  - .1 sized as per Table 16A of the ESC,
  - .2 not less than #12 AWG copper,
  - .3 with one bond conductor for every three line conductors.
- .10 Bond building structural steel and metal siding to ground by welding copper to steel.

- .11 Make grounding connections in radial configuration only, with connections terminating at a single grounding point. Avoid loop connections.
- .12 Install grounding conductors outside electrical rooms and electrical closets in PVC conduit and conceal where possible. Where PVC conduit is not permitted use EMT and bond the EMT to the conductor at both ends.

### **3.2 System Grounding**

- .1 Provide system grounding connections to neutral point of secondary systems using not less than #6 copper conductor unless indicated otherwise.
- .2 Install insulated copper grounding conductor for service raceways and service equipment as required by the electric utility company.
- .3 Install grounding conductors in PVC conduit.

### **3.3 Equipment Bonding**

- .1 Install insulated copper bonding connections:
  - .1 sized not less than #12 AWG and not less than indicated in Tables 16A and 16B of the electrical code,
  - .2 to typical equipment including, but not necessarily limited to the following list:
    - (a) service equipment,
    - (b) transformers,
    - (c) panelboards,
    - (d) disconnect switches,
    - (e) junction and outlet boxes,
    - (f) receptacles,
    - (g) luminaires,
    - (h) frames of motors,
    - (i) starters,
    - (j) fire alarm systems,
    - (k) security systems,
    - (l) CCTV systems,
    - (m) audio systems,
    - (n) communications systems,
    - (o) control panels,
    - (p) outdoor lighting,
    - (q) other equipment that is supplied with electrical power.
- .2 Where applicable, run bonding conductors as part of the feeder.
- .3 Where bonding conductors are run separately, install in PVC conduit.

### **3.4 Bonding of Other Items**

- .1 Install insulated copper bonding connections:
  - .1 sized not less than #6 AWG,
  - .2 run in PVC conduit,
  - .3 to typical items including, but not necessarily limited to following list:
    - (a) metallic water piping systems,
    - (b) metallic waste water piping systems,



- (c) metallic gas piping systems,
- (d) metallic vacuum piping systems,
- (e) metallic compressed air piping systems,
- (f) building steel work.

- .2 Review the design and installation of each piping system with the system installer and provide bonding jumpers where necessary to ensure that each piping system is electrically continuous.

### **3.5 Field Quality Control**

- .1 Perform tests in accordance with:
  - .1 Section 26 01 01 - Electrical General Requirements.
  - .2 Section 26 08 05 - System Co-ordination, Verification and Testing.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Consultant and local authority having jurisdiction.
- .3 Perform tests before energizing electrical system.

**END OF SECTION**

## **FASTENINGS AND SUPPORTS**

### **26 05 29**

#### **1 GENERAL**

##### **1.1 Related Work**

- .1 Concrete bases and housekeeping pads for electrical equipment shall be arranged and paid for by Division 26, and installed by trade specialists under respective Carpentry, Concrete, and Painting Divisions.

##### **1.2 Shop Drawings**

- .1 Submit design drawings for custom fabricated trapeze hangers, sealed by a professional engineer licensed in the project location jurisdiction.
  - .1 Shop drawing details:
    - (a) construction detail drawings for each loading condition,
    - (b) span deflection calculations,
    - (c) building attachment load calculations and type.
  - .2 Provide services of engineer who sealed the custom trapeze hanger shop drawings to conduct a general review of the completed installation on site.

#### **2 PRODUCTS**

##### **2.1 Support Channels**

- .1 Hot dipped galvanized steel, U shape, size 41 mm x 41 mm x 2.5 mm (1e" x 1e" x 1/10") thick, surface mounted, suspended or set in poured concrete walls and ceilings.

##### **2.2 Inserts**

- .1 Inserts for conduits and raceway hangers, for single, double and multiple runs shall be galvanized.

###### *Standard of Acceptance*

- Unistrut Canada
- Burndy (Canada) Ltd. - Flexibar
- Pilgrim Technical Products Ltd. - Tufstrut

##### **2.3 Hangers**

- .1 Hangers for electrical conduit shall be hot dipped galvanized after fabrication.

###### *Standard of Acceptance*

- Burndy Canada Ltd.
- Canstrut
- Electrovert Ltd.
- E. Myatt & Co. Ltd
- Steel City Electric Ltd.
- Pilgrim Technical Products Ltd.

##### **2.4 Trapeze hangers**

- .1 Performance:

- .1 Manufactured:
  - (a) to product load listings.
- .2 Custom fabricated:
  - (a) maximum deflection between supports: 1/250 (0.4%) of span
  - (b) minimum factor of safety : 5 times load to ultimate tensile or compressive strength.
- .2 Construction:
  - .1 Carbon steel shapes, to suit load application:
    - (a) hollow steel section,
    - (b) equal leg EI section, or
    - (c) double C channel "strong-back", with welded clips.
  - .2 Hanger rods:
    - (a) as specified above, and
    - (b) minimum two support rods,
    - (c) rods selected for minimum factor of safety of 5 times load to ultimate tensile or compressive strength of rod.
- .3 Finish:
  - .1 hot dipped galvanized finish in mechanical rooms and outdoors.
  - .2 black steel finish in other areas.

*Standard of Acceptance*

- ° Anvil Fig 45, 46, 50

### **3 EXECUTION**

#### **3.1 Installation**

- .1 Supply and deliver inserts to site in ample time to be built into work of other trades. Provide necessary templates and adequate instructions to locate and install inserts.
- .2 Secure equipment to masonry, tile and plaster surfaces with lead anchors.
- .3 Secure equipment to poured concrete with expandable inserts.
- .4 Secure surface mounted equipment with T-bar support hanger fastened to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.

*Standard of Acceptance*

- ° Caddy model No. 512 c/w BHC clip

- .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 (2") and smaller.
  - .2 Two-hole steel straps for conduits and cables larger than 50 mm (2").
  - .3 Beam clamps to secure conduit to exposed steel work.

- .7 Suspended support systems.
  - .1 Support individual cable or conduit runs with 6 mm (¼") dia threaded rods and spring clips.
  - .2 Support 2 or more cables or conduits on channels supported by 6 mm (¼") dia threaded rod hangers where direct fastening to building construction is impractical.
- .8 For surface mounting of two or more conduits use channels.
- .9 Provide galvanized after fabrication 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 [Engineer][Consultant].
- .13 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.
- .14 Supply and erect special structural work required for the installation of electrical equipment. Provide anchor bolts and fastenings unless noted otherwise. Mount equipment required to be suspended above floor level, where details are not shown, on a frame or platform bracketed from the wall or suspended from the ceiling. Carry supports to either the ceiling or the floor, or both as required, at locations where, because wall thickness is inadequate, it is not permitted to use such brackets.
- .15 Electrical panels, switches or other electrical equipment shall be complete with suitable bases or mounting brackets. Install angle or channel iron supports to bear the equipment where it is shown in or on structural tile walls, or walls that are inadequate to bear the equipment.
- .16 Provide channel iron or other metal supports where necessary to adequately support lighting fixtures. Do not use wood. Lighting fixtures shall be supported totally independent of ceiling and supported from structure above.
- .17 Support hangers, in general, from inserts in concrete construction or from building structural steel beams, using beam clamps. Provide additional angle or channel steel members required between beams for supporting conduits.
- .18 Do not use explosive drive pins in any section of work without obtaining prior written approval.
- .19 Provide re-enforced concrete pads under switchboards, generators, and all other floor mounted electrical equipment. Pads are to formed with chamfered edges to prevent chipping. Pads are to be sealed and painted to prevent dust from entering and interfering with electrical equipment.

**END OF SECTION**

## **SPLITTERS, JUNCTION AND PULL BOXES, CABINETS**

### **26 05 32**

#### **1 GENERAL**

##### **1.1 Shop Drawings and Product Data**

- .1 Submit shop drawings and product data for cabinets in accordance with Section 26 05 01 Electrical General Requirements.

##### **1.2 Reference**

- .1 CSA C22.2 No. 40 Junction and Pull Boxes.
- .2 Cabinets to Section 26 27 18 Panel Trim.

#### **2 PRODUCTS**

##### **2.1 Junction and Pull Boxes**

- .1 Welded steel hot dipped galvanized construction with screw-on flat covers for surface mounting.
- .2 Covers with 25 mm (1") minimum extension all around, for flush-mounted pull and junction boxes.

##### **2.2 Cabinets**

- .1 Type E: sheet steel, hinged door and return flange overlapping sides, handle, lock and catch, for surface mounting.
- .2 Type T: sheet steel cabinet, with hinged door, latch, lock, 2 keys, containing sheet steel backboard for surface or flush mounting as indicated.
- .3 Surface mounted cabinets shall be finished in ASA 61 grey.

##### **2.3 Instrumentation and Control Terminal Cabinets**

- .1 Surface mounted, gasketed, drip proof and dust tight, JIC enclosure, CEMA type 12 With hinged door, lock, 2 keys, white raised and removable internal mounting panel, diagram pocket, finished with ASA 61 grey.

###### *Standard of Acceptance*

- ° Hammond

- .2 Panel wiring to be contained in PVC wiring ducts complete with cover strips, minimum 50 mm x 50 mm (2" x 2"). Wireway fill to be limited to 60%. Where there are a large number of door mounted devices, door wiring harnesses shall also be contained in wiring ducts at rear door. All door wiring devices to emanate from the control panel terminal strips. Wiring to panel face mounted devices to be bundled neatly on hinge side of panel, enclosed in flexible spiral wrap, and installed such that wiring will not be damaged when opening and closing door. Ground panel door to panel with a flexible copper bonding strap. Label all wiring with permanent PVC sleeve type markers.
- .3 Phoenix contact terminal blocks with mounting rails, end covers, terminal markers, partition plates and accessories: UK 2.5 termination of wiring 22 to 12 AWG; UK 5 and UK 10 series for current transformers and other leads #10 AWG and #8 AWG; UDK or UK 5 twin for connecting two or more

conductors to one terminal block; DIK 1.5 for three wire sensor device wiring; MTKD for thermocouple leads.

- .4 Provide lamacoid nameplates for all panel mounted control and indicating devices, and all internal components such as terminal strips, control transformers, control devices, relays, etc. as per 26 05 01.

### **3 EXECUTION**

#### **3.1 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 (6'-6") above finished floor.
- .3 Install terminal block as indicated in Type T cabinets
- .4 Only main junction and pull boxes are indicated. Install pull boxes so as not to exceed 30 m of conduit run between pull boxes.

#### **3.2 Identification**

- .1 Provide equipment identification in accordance with Section 26 05 01 - Electrical - General Requirements.
- .2 Install size 2 identification labels indicating system name, voltage, phase and source of power.
- .3 Provide a typed directory in cabinets showing following information: Nature, actual quantities and room number of device or devices connected to each terminal, as well as signal circuit number where applicable.

**END OF SECTION**

## **CONDUITS, FASTENINGS AND FITTINGS**

### **26 05 33**

#### **1 GENERAL**

##### **1.1 General Requirements**

- .1 Conform to Sections of Division 1 as applicable.
- .2 Conform to Section 26 05 01, Electrical General Requirements.

##### **1.2 Shop Drawings and Product Data**

- .1 Submit shop drawings and product data in accordance with Section 26 05 01 Electrical General Requirements.

##### **1.3 Work Included**

- .1 Work to be done under this Section shall include furnishing of labour, materials, and equipment required for installation, testing and putting into proper operation complete systems as shown as specified and as otherwise required.

##### **1.4 Location of Conduit**

- .1 Drawings do not indicate all conduit runs. Those indicated are in diagrammatic form only.

##### **1.5 References**

- .1 CSA C22.2 No. 45 Rigid Metal and Epoxy Coated Conduit
- .2 CSA C22.2 No. 83 Electrical Metallic Tubing
- .3 CSA C22.2 No. 136 Rigid PVC Conduit
- .4 CSA C22.2 No. 56 Flexible Metal and Liquid-Tight Flexible Metal Conduit
- .5 CSA C22.2 No 211.2 Rigid PVC Conduit
- .6 Conduit accessories, conduits and fittings to CSA C22.2 No. 18.

##### **1.6 Wiring Methods**

- .1 Install wiring in surface mounted EMT conduit unless otherwise specified. In finished areas, conceal conduit in walls and ceiling spaces.
- .2 Rigid PVC conduit with ground wire as per Electrical Safety Code Table 16 shall be used throughout below grade areas and may be used in or under slab on grade areas. It shall not be used in above grade slabs.
- .3 PVC coated rigid galvanized steel conduit shall be used in damp locations including but not limited to intake and exhaust shafts and air handling units; for rigid metallic conduit underground or in floor slabs; for wiring outdoors and in unheated buildings; and where noted on Drawings.

- .4 Runs of conduit and cables, where shown, are indicated only by general location and routing. Install conduits and cables so as to provide maximum head room and to interfere as little as possible with free use of spaces through which they pass.
- .5 Use EMT conduit for branch circuit and signal wiring in ceilings, furred spaces, and in hollow walls and partitions.
- .6 Use rigid galvanized steel conduit for wiring where conduits are exposed to possible mechanical damage.
- .7 Use epoxy coated rigid galvanized steel conduit for wiring in poured concrete.
- .8 Flexible conduit and armoured cable will be accepted in parts of existing building, where furred spaces above ceilings are too congested to permit conduit to be installed, but only with Engineer's written permission. Terminate armoured cable, where shown, in accordance with the manufacturer's recommendations.
- .9 Flexible steel conduit with integral insulated green ground wire is permitted for the final connection to luminaires mounted in suspended ceilings from the branch wiring junction box above, with flexible conduit length not to exceed 3 m (10'), and be neatly installed and attached to luminaire support chain
- .10 Flexible armoured conduit (or BX) with an integral insulated green ground wire may be used where concealed in walls for wiring to receptacles, and for the final connection to luminaires.
  - .1 The junction box interfacing the horizontal EMT conduit to the flexible conduit shall be located within 3 m (10') horizontally from the end device in open areas, and in enclosed rooms, located in the same room as the devices being served, in reasonable proximity to the walls, in order to keep the horizontal portion of the run of flexible conduit to less than 3 m (10').
  - .2 The flexible conduit shall be neatly installed parallel or perpendicular to building lines, and independently supported from the slab structure above.]
- .11 Conduit shall be of sufficient size to permit easy removal of conductors at any time. Conduit sizes, where shown, are minimum and shall not be reduced.
- .12 Arrange conduits, installed in suspended ceilings, to provide minimum interference with removal of tiles.
- .13 Where existing locations of flush mounted electrical devices (switches, receptacles, etc.) correspond to new devices shown, the existing downdrop conduit and outlet box may be re-used. Provide new devices, new coverplates, new home-run conduit and complete new wire.
- .14 Vertical raceways to be provided with insulated cable support bushings or other approved method of supporting the weight of the cable, where vertical runs exceed those of Table 21 of the Electrical Code.

## **2 PRODUCTS**

### **2.1 Conduits**

- .1 Rigid hot dipped galvanized steel threaded conduit
- .2 Epoxy coated rigid galvanized steel conduit: with zinc coating and corrosion resistant epoxy finish inside and outside equal to Columbex Green Guard II



- .3 PVC coated hot dipped galvanized rigid steel conduit: with 40 mil PVC exterior coating, 2 mil urethane interior and thread coating equal to Rob Roy Plastibond RedHot
- .4 Electrical metallic tubing (EMT), galvanized: with couplings.
- .5 Rigid PVC conduit.
- .6 Flexible metal conduit and liquid-tight flexible metal conduit.
- .7 Conduit shall be of sufficient size to allow easy removal of conductors at any time. Conduit sizes, where shown, are minimum and shall not be reduced.
  - .1 Minimum permissible conduit size is 19mm (3/4"C), unless noted otherwise.

## **2.2 Conduit Fastenings**

- .1 One hole steel straps to secure surface conduits 50 mm (2") and smaller. Two hole steel straps for conduits larger than 50 mm (2").
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits.
- .4 Six mm dia threaded rods to support suspended channels.

## **2.3 Conduit Fittings**

- .1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.
- .2 Factory "ells" where 90E bends are required for 25 mm (1") and larger conduits
- .3 Insulated throat steel set screw or raintight insulated throat steel compression connectors and couplings for EMT.
- .4 Threaded or compression type raintight/concrete tight insulated throat zinc plated steel connectors and couplings for rigid steel conduit.

## **2.4 Expansion Fittings**

- .1 Electrogalvanized steel with internal grounding for EMT suitable for 100mm linear conduit movement.

### *Standard of Acceptance*

- ° Cooper Crouse Hinds XJG-EMT
- .2 Weatherproof expansion fittings with internal bonding assembly suitable for 00mm (4") linear expansion.
- .3 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm (3/4") deflection in all directions.
- .4 Concrete type, water tight, corrosion resistant for conduit installations embedded in concrete

## **2.5 Fish Cord**

- .1 Polypropylene

### **3 EXECUTION**

#### **3.1 Installation**

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in mechanical and electrical service rooms and in unfinished areas.
- .3 Use electrical metallic tubing (EMT) except: in cast concrete, underground or where installed exposed within 2.0m (6'-6") of floor.
- .4 Use rigid galvanized steel conduit where installed surface mounted within 2.0m (6'-6") of floor.
- .5 Use rigid PVC conduit in slab on grade cast concrete and underground. Do not use PVC conduits in slabs above grade. All conduits shall be surface mounted to minimize risks of future damage when core drilling during future renovations. Where localized congestion or circumstances forces the use of conduits in the floor slabs, they shall be epoxy coated rigid galvanized steel.
- .6 Provide PVC conduit with bonding conductor as per Table 16A of Ontario Electrical Safety Code.
- .7 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment
- .8 Use explosion proof flexible connection for connection to explosion proof motors.
- .9 Install conduit sealing fittings in hazardous areas. Fill with compound.
- .10 Use raintight connectors or hubs for terminating conduits at all surface or floor mounted panelboards, switchboards, and other equipment located in sprinklered areas or where at risk of exposure to dripping liquids.
- .11 Install wiring in conduit unless otherwise specified.
- .12 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .13 Mechanically bend steel conduit over 19mm (3/4") dia.
- .14 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .15 Install fish cord in empty conduits.
- .16 Where conduits become blocked, remove and replace blocked section. Do not use liquids to clean out conduits.
- .17 Dry conduits out before installing wire.
- .18 Conduit manufacturer's touch up enamel shall be used to repair all scratches and gouges on epoxy-coated conduit.
- .19 Install junction boxes or cable anchor boxes wherever necessary for proper pulling or anchoring of cables. Install so as to be accessible after building is completed and set to come within finished lines of building.

- .20 Where EMT or rigid PVC is used, run green insulated bonding conductor in conduit, with minimum one bonding conductor per three ungrounded conductors.
- .21 Provide expansion couplings, with bonding jumper and ground clamps where raceways cross building control joints.
- .22 Where conduits or cables are installed under raised floors and are required to be fastened in place, use two hole inverted "U" straps. No sharp edges or corners will be permitted which may damage PVC jackets or cables.
- .23 Runs of conduit and cables, where shown, are indicated only by general location and routing. Install conduits and cables so as to provide maximum head room and to interfere as little as possible with free use of spaces through which they pass. They shall be installed as close to building structure as possible such that, where concealed, necessary furring can be kept to a minimum. Arrange conduits, installed in suspended ceilings, to provide minimum interference with removal of tiles.

### **3.2 Surface Conduits**

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5m (5') 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 (3") parallel to steam or hot water lines with minimum of 25 mm (1") at crossovers.

### **3.3 Concealed Conduit**

- .1 Do not install horizontal runs in masonry walls.
- .2 Do not install conduits in terrazzo or concrete toppings.

### **3.4 Conduits in Cast-in-place Concrete**

- .1 Locate to suit reinforcing steel. 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 Where conduits pass through waterproof membrane provide oversized sleeve before membrane is installed. Use cold mastic between sleeve and conduit.
- .5 Do not place conduits in slabs in which slab thickness is less than 4 times conduit diameter.
- .6 Encase conduits completely in concrete with minimum 25 mm (1") concrete cover.
- .7 Organize conduits in slab to minimize cross-overs.

**3.5 Conduits in Cast-in-place Slabs on Grade**

- .1 Run conduits 25 mm (1") and larger below slab and encased in 75 mm (3") 75 mm concrete envelope. Provide {50 mm (2")} of sand over concrete envelope below floor slab.

**3.6 Conduits Underground**

- .1 Slope conduits to provide drainage.

**END OF SECTION**

## **OUTLET BOXES, CONDUIT BOXES AND FITTINGS**

### **26 05 35**

#### **1 GENERAL**

##### **1.1 Related Work**

- .1 Box connectors to Section 26 27 28.

##### **1.2 References**

- .1 CSA C22.2 No. 18.
- .2 CSA C22.1 Canadian Electrical Code, Part 1, Ontario Hydro Electrical Safety Code.

#### **2 PRODUCTS**

##### **2.1 Outlet and Conduit Boxes - General**

- .1 Size boxes in accordance with CSA C22.1
- .2 102 mm (4") square or larger outlet boxes as required for special devices
- .3 Gang boxes where wiring devices are grouped.
- .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 Sheet Steel Outlet Boxes**

- .1 Hot dipped galvanized steel single and multi gang flush device boxes for flush installation, minimum size 76 mm x 50 mm x 38 mm (3" x 2" x 1½") or as indicated. 102 mm (4") square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .2 102 mm (4") square or octagonal outlet boxes for lighting fixture outlets.
- .3 102 mm (4") square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster or tile walls.

##### **2.3 Masonry Boxes**

- .1 Hot dipped galvanized steel masonry single and multi gang boxes for devices flush mounted in exposed block walls.

##### **2.4 Concrete Boxes**

- .1 Hot dipped galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

##### **2.5 Floor Boxes**

- .1 Concrete tight hot dipped galvanized sheet steel floor boxes with adjustable finishing rings to suit floor finish with brass or brushed aluminum faceplate. Device mounting plate to accommodate short or

long ear duplex single or receptacles. Minimum depth: 28 mm (1¼") for receptacles; 73 mm (3") for communication equipment.

- .2 Adjustable, watertight, concrete tight, cast floor boxes with openings drilled and tapped for 12 mm (½") and 19 mm (¾") conduit. Minimum size: 73 mm (3") deep.

## **2.6 Conduit Boxes**

- .1 Cast FS boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle, outside building and where weatherproof boxes are required.

## **2.7 Fittings - General**

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 32 mm (1½") and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

# **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 (¼") of opening.
- .4 Provide a suitable outlet box for each light, switch, receptacle or other outlet, approved for the particular area in which it is to be installed.
- .5 Locate outlet boxes, mounted in hung ceiling space, so they do not obstruct or interfere with the removal of lay-in ceiling tiles.
- .6 Offset outlet boxes, shown back to back in partitions, horizontally to minimize noise transmission between adjacent rooms.
- .7 Use gang boxes at locations where more than one device is to be mounted. Use combination boxes with suitable barriers where outlets for more than one system are shown.
- .8 Where 100 mm (4") square boxes are installed in exposed concrete or cinder block in finished areas, blocks will be cut under masonry division as instructed under this section. Openings shall be cut to provide a close fit to boxes and covers so that edges of openings are not visible after installation of plates. Mortar shall not be used to patch up openings that are cut too large or to patch ragged edges.

**END OF SECTION**

## **INSTALLATION OF CABLES IN TRENCHES AND DUCTS**

### **26 05 38**

## **1 GENERAL**

### **1.1 General Requirements**

- .1 Conform to Sections of Division 1 as applicable.
- .2 Conform to Section 26 05 01, Electrical General Requirements.

### **1.2 Related Work**

- .1 Excavation and backfilling: Section 26 05 05 - Excavating, Trenching and Backfilling.

### **1.3 Work Included**

- .1 Provide labour, materials, and equipment required for installation, testing and putting into proper operation complete systems as shown as specified and as otherwise required.

## **2 PRODUCTS**

### **2.1 Cable Protection**

- .1 Cable protection to match existing installation, or be one of the following options:
  - .1 38mm x 140mm (1" x 5½") planks, pressure treated with water repellant preservative.
  - .2 50mm (2") thick poured concrete.
  - .3 50mm (2") thick concrete slabs.

## **3 EXECUTION**

### **3.1 Direct Burial of Cables**

- .1 After sand bed is in place, lay cables into trench, do not pull cables into trench.
- .2 Maintain separation between cables as shown and as required to achieve required ampacity.
- .3 Maintain at least 75mm (3") clearance from each side of trench to nearest cable.
- .4 Maintain separation between cables of not less than:
  - .1 75mm (3") between cables of different circuits,
  - .2 300mm (12") horizontal separation between low and high voltage cables,
  - .3 300mm (12") vertical separation where low voltage cables cross high voltage cables, with low voltage cables in upper position,
  - .4 75mm (3") vertical separation between low voltage cables at crossover,
  - .5 150 mm (6") vertical separation between high voltage cables at crossover,
  - .6 300 mm (12") horizontal and vertical separation for fire alarm and control cables when crossing other cables, with fire alarm and control cables in upper position.
- .5 At crossovers, install treated planks or concrete slabs over lower cables and extend 0.6 m (2') in each direction.

- .6 Provide offsets for thermal action and minor earth movements. Offset cables 150mm (6") for each 60m (200') run. Maintain cable separation and bending radius thru offsets.
- .7 Maintain radius of cable bends as per the manufacturer's instructions but not less than:
  - .1 8 times diameter of cable for:
    - (a) rubber jacketed cables,
    - (b) plastic jacketed cables,
  - .2 12 times diameter of cables for:
    - (a) armoured cables,
    - (b) lead covered cables,
    - (c) tape shielded cables,
    - (d) aluminum sheathed cables (corrugated).
- .8 Make terminations and splices as indicated, leaving 0.6 m (2') of surplus cable in each direction.
- .9 Make splices and terminations in accordance with manufacturer's instructions using approved splicing and termination kits.
- .10 Underground cable splices not acceptable.
- .11 After sand protective cover is in place, install continuous row of overlapping treated planks, poured concrete, or concrete slabs to cover length of run. Match existing installation.

### **3.2 Cable Installation in Ducts**

- .1 Install cables in accordance with the manufacturer's instructions.
- .2 Examine duct routing and ensure that duct size, radius of bends and maintenance hole sizing is compatible with cable manufacturer's recommendations.
- .3 Calculate pulling tensions and sidewall pressures and confirm that they do not exceed the manufacturer's recommendations.
- .4 Install cables as indicated in ducts.
- .5 Use CSA approved lubricants of type compatible with cable jacket to minimize pulling tension.
- .6 Monitor cable pulling tension and stop the pull if the tension exceeds the allowable limit.
- .7 Do not pull spliced cables inside ducts.
- .8 Install multiple cables in duct simultaneously.
- .9 To facilitate matching of colour coded multiconductor control cables, reel off in same direction during installation.
- .10 After installation of cables, seal duct ends with duct sealing compound.

### **3.3 Field Quality Control**

- .1 Perform tests in accordance with Section 26 05 01 - Electrical General Requirements.
- .2 Perform tests using qualified personnel.



- .3 Provide instruments and equipment as required to conduct testing.
- .4 Check phase rotation and identify each phase conductor of each feeder.
- .5 Check each feeder for continuity, short circuits and grounds. Ensure resistance to ground of circuits is not less than 50 megohms.
- .6 Pre-acceptance tests.
  - .1 After installing cable but before splicing and terminating, perform insulation resistance test with 1000 V megger on each phase conductor.
  - .2 Check insulation resistance after each splice or termination to ensure that cable system is ready for acceptance testing.
- .7 Acceptance Tests
  - .1 Disconnect terminations and accessory equipment.
  - .2 Ground shields, ground wires, metallic armour and conductors not under test.
  - .3 Leakage Current Testing;
    - (a) Raise voltage in steps from zero to maximum values as specified by ICEA for type of cable being tested,
    - (b) Hold maximum voltage for time period as specified by ICEA,
    - (c) Record leakage current at each step.
- .8 Provide Consultant with list of test results showing location at which each test was made, circuit tested and results of each test.
- .9 Remove and replace entire length of cable if cable fails to meet any of the test criteria.

**END OF SECTION**

## **IDENTIFICATION FOR ELECTRICAL SYSTEMS**

### **26 05 53**

#### **1 GENERAL REQUIREMENTS**

##### **1.1 Scope**

- .1 Provide identification and warning signs for complete electrical systems as shown, as specified, as intended, and as otherwise required.

##### **1.2 Shop Drawings**

- .1 Submit list of nameplates with proposed wording, prior to engraving.
- .2 Submit list of labels with proposed wording, prior to printing.
- .3 Submit representative samples of nameplates, labels and warning signs.

#### **2 PRODUCTS**

##### **2.1 Warning Signs**

- .1 As required to meet requirements of Electrical Safety Authority.
- .2 Outdoor signs:
  - .1 fibreglass,
  - .2 minimum size 250 mm x 360 mm (10" x 14").
- .3 Indoor signs;
  - .1 aluminum,
  - .2 baked enamel finish,
  - .3 minimum size 180 mm x 250 mm (7" x 10").

##### *Standard of Acceptance*

- Brady
- Seton

##### **2.2 Equipment Identification**

- .1 Nameplates for panels and equipment:
  - .1 3 mm ( $\frac{1}{8}$ ") thick laminated plastic plates,
  - .2 engraved lettering,
    - (a) first line: 11 mm (7/16") high lettering,
    - (b) second line: 7mm (1/4") high lettering,
    - (c) third line: 5mm (3/16") high lettering,
  - .3 black lettering on white background,
  - .4 with bevelled edges,
  - .5 mechanically attached with self-tapping stainless steel screws.
- .2 Labels for warnings, instructions etc on panels and equipment:

- .1 printed on white polyester background,
- .2 7 mm (¼") high letters unless specified otherwise,
- .3 UV resistant inks,
- .4 clear polyester over lamination,
- .5 pressure sensitive adhesive.

*Standard of Acceptance*

- Brady
- Ideal Industries
- Safety Sign

- .3 Do not commence manufacture of nameplates and labels until wording has been reviewed by the Consultant.

## **2.3 Wiring Identification**

- .1 Colour coded phasing tapes:
  - .1 7 mil poly vinyl chloride,
  - .2 pressure sensitive adhesive,
  - .3 compatible with wire insulation,
  - .4 permanent colour,
  - .5 electrically insulating,
  - .6 UV and moisture resistant,
  - .7 to CSA C22.2 No. 197

*Standard of Acceptance*

- 3M Scotch 35
- Electro Tape Specialties 103/103C Series

- .2 Wire markers:
  - .1 heat shrink,
  - .2 military grade polyolefin sleeves,
  - .3 permanent printed wire identification.

*Standard of Acceptance*

- Brady
- Panduit

## **3 EXECUTION**

### **3.1 Equipment Identification**

- .1 Identify electrical equipment with nameplates, directories and labels.
- .2 Nameplates:
  - .1 secure to top exterior of equipment except where indicated otherwise,
  - .2 switchboards: indicate name, voltage and ampacity,
  - .3 rear of switchboard cubicles or cells: indicate name of cell or cubicle,

- .4 panelboards: indicate name, voltage and source of power,
- .5 terminal cabinets: indicate name, system and voltage,
- .6 disconnects, starters and contactors: indicate equipment being controlled and voltage,
- .7 transformers: indicate name, capacity, primary and secondary voltages,
- .8 pull boxes and junction boxes: indicate system, circuit numbers and voltage,
- .9 cabinets for low voltage systems, such as signals and communications: indicate name and system,
- .10 equipment not listed above, such as, instruments, fire alarm, clock and program equipment and control panels: identify in a similar manner showing name and number of the equipment, voltage and load information.
- .11 typical identification standards:
  - (a) Lighting, Receptacle and Power Panels: each identified with an engraved lamicoid nameplate secured to top interior trim as follows:

LP-4NW-1EA	11 mm (7/16") high lettering
120/208 volts	7 mm (1/4") high lettering
Fed from PP-SBSW-EAA	5 mm (3/16") high lettering

.3 Directories:

- .1 Supply each panelboard with a directory card holder welded to inside of door, complete with a neatly typewritten list showing information as follows:

Panelboard Name	LP-4NW-1EA
Panel Voltage	120/208 Volts
Circuit Number	Description
1	Lighting Room #34
2	Receptacles Room #34
3	Ice Machine Room #17

- .2 Cabinets for low voltage systems, such as signals and communications: as for panelboards with a directory showing circuit numbers and room locations plus a blank column for "Remarks".
- .3 Cover directory list with a 0.8mm (1/32") minimum thick clear plastic sheet to protect it.
- .4 Pull Boxes and Junction Boxes
  - .1 Identify feeder pull boxes and junction boxes:
    - (a) lettering stamped on brass or aluminum tags,
    - (b) showing the name of the feeder or system,
    - (c) voltage involved,
    - (d) data for both termination points whether equipment or panel,
    - (e) secure tag under box lid screws using steel wire.

### 3.2 Service Rough-in Identification

- .1 Apply a small dab of paint to inside of each outlet box, pull box and panel as it is installed, using colour code as follows:

Red	Fire Alarm System and Emergency Voice Communication System
Dark Blue	Intercom and Public Address
Dark Green	Telephone and Data Systems
Black	Annunciator and Buzzer System
Grey	Clock System
White	Central Dictation
Orange	Nurse Call
Yellow	Alarm Systems
Pink	Computer Systems
Light Green	TV Systems

- .2 Junction boxes in furred ceilings to have colour identification on both inside and outside.  
.3 As an alternative to applying paint dabs, prepainted conduit/EMT may be used where applicable.  
.4 Colour coding is not required for lighting and power circuits.

### 3.3 Wiring Identification

- .1 Identify feeders and branch circuit wiring with wire markers;
- .1 at each end of run,  
.2 in each junction box,  
.3 wherever they are introduced into ducts or equipment.
- .2 Identify incoming utility service lines by Red - Phase "A", Black - Phase "B", Blue - Phase "C", with colour coded phasing tape.
- .3 Band buswork in each;
- .1 switchboard,  
.2 unit substation cubicle,  
.3 power panel,  
.4 lighting and receptacle panel,  
with colour coded phasing tape as follows:

Red	Phase A
Black	Phase B

Blue	Phase C
White	Neutral
Green	Ground

- .4 Band feeder and sub-feeder bus and conductors as above.
- .5 Maintain phase sequence and colour coding throughout.
- .6 Connections in equipment to be Phase A, B, C from left to right when viewing from front or accessible direction.
- .7 For control conductors for motors and equipment, schedule and chart marker numbers with corresponding machine numbers and locations and include with Record Drawings and Operation and Maintenance Data.
- .8 Use colour coded wires in communication cables, matched throughout system. Schedule and chart, marker numbers and wire colours with corresponding equipment and include with Record Drawings and Operation and Maintenance Data.

### **3.4 Conduit and Cable Identification**

- .1 Label;
  - .1 incoming service cables,
  - .2 bus ducts,
  - .3 feeder conduits/EMT,
  - .4 feeder cables,
  - .5 communications cables.
- .2 Locate labels as follows;
  - .1 at every end of every conduit, duct or cable run, adjacent to item of equipment serviced,
  - .2 on each exposed conduit, duct or cable passing through a wall, partition or floor (one on each side of such wall, partition or floor),
  - .3 at intervals of not more than 15 m (50') along every exposed conduit, EMT, duct or cable run exceeding 23 m (75') in length,
  - .4 at every access point on concealed conduit, EMT, duct or cable runs,
  - .5 visible from 1.5 m (5') above adjacent floor or platform.

### **3.1 Fire Stopping Identification**

- .1 Provide a warning card adjacent to each opening exceeding 25mm (1") in diameter, indicating the following;
  - .1 a warning that the opening is protected by a fire stopping material,
  - .2 the fire stop system used, ULC or cUL,
  - .3 F rating or FT rating,
  - .4 specific fire stop product(s) used,
  - .5 name and telephone number of the contact person should any changes to the fire stopping be required.
- .2 Provide warning labels for each fire stopped penetration as follows;
  - .1 permanently attached to walls, floors, underside of slabs, adjacent to the penetration,

- .2 on each side of the penetration,
- .3 vinyl panel, white and red background with black lettering,
- .4 self adhesive with permanent pressure sensitive adhesive,
- .5 stating:

<b>WARNING</b>
THROUGH PENETRATION FIRESTOP SYSTEM - DO NOT DISTURB
NOTIFY BUILDING MANAGEMENT OF ANY DAMAGE

### 3.2 Single Line Electrical Diagrams

- .1 Provide a single line schematic diagram in each Electrical room to illustrate every component including;
  - .1 main service,
  - .2 transformers,
  - .3 grounding,
  - .4 circuit breakers,
  - .5 disconnect switches,
  - .6 panelboards,
  - .7 major items of equipment such as roof top units,
  - .8 feeders,
  - .9 metering,
  - .10 transformer winding arrangements,
  - .11 voltage levels, including number of phases and wires,
  - .12 equipment ratings such as: Amperes, kW, kVA, kVAR.
- .2 Diagram:
  - .1 print of an AutoCAD drawing using the latest version of AutoCAD,
  - .2 not less than 600 mm x 600 mm (2' x 2'),
  - .3 in a wood frame,
  - .4 plexiglass covered.
- .3 Submit diagram to Electrical Inspection Authority and incorporate all requirements indicated in their comments.
- .4 Submit diagram as shop drawing for review.
- .5 Provide an electronic version of the drawing file to the Owner for the Owner's future use.

### 3.3 Fire Alarm Diagrams

- .1 Provide at the fire alarm control panel and annunciator;
  - .1 a fire alarm riser diagram,
  - .2 plan diagrams showing fire alarm zoning.
- .2 Diagrams:

- .1 print of an AutoCAD drawing using the latest version of AutoCAD,
- .2 not less than 600 mm x 600 mm (2' x 2'),
- .3 in a wood frame,
- .4 plexiglass covered.

**END OF SECTION**



## **ELECTRICAL POWER SYSTEM STUDIES**

### **26 08 03**

## **1 GENERAL**

### **1.1 Summary**

- .1 Scope: Provide labor, engineering, supervision and related services, required for execution of short-circuit, protective device coordination and arc flash hazard analysis studies as required for the complete performance of the work, as shown on the Drawings, as specified herein.
- .2 Power system studies shall be provided by a qualified Power System Study Supplier (also identified as PSSS). The Contractor shall ultimately be responsible for providing the Power System Study and shall supplement the supplier's Work as necessary to provide a complete and accurate study along with associated work in applying the study's results. The Contractor shall coordinate the equipment and systems provided by others that are part of the scope of the study to ensure necessary data and work are provided for the required functionality of the electrical power distribution system.
- .3 The scope of the power system studies shall include modeling of the entire electrical system.
- .4 In order to ensure the requirement for independence, the ITO must be retained directly by the Division 26 contractor. The ITO must not be retained by an equipment manufacturer or their distributor as part of an equipment package.
- .5 Related Sections: Related sections include, but shall not be limited to, the following:
  - .1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
  - .2 Applicable general requirements for electrical Work specified within Division 26 Specification Sections apply to this Section.

### **1.2 References**

- .1 General, Publications: The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the latest date as of the date of the Contract Documents, unless otherwise specified.
  - .1 American National Standards Institute (ANSI):
    - (a) ANSI C37.13, "Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures"
  - .2 Canadian Standards Association (CSA):
    - (a) Z462, Workplace Electrical Safety
  - .3 Institute of Electrical and Electronics Engineers, Inc. (IEEE):
    - (a) IEEE 141, "Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems"
    - (b) IEEE 241, "Recommended Practice for Electric Power Systems in Commercial Buildings"
    - (c) IEEE 242, "Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems"
    - (d) IEEE 399, "Recommended Practice for Industrial and Commercial Power System Analysis"
    - (e) IEEE 1015, "Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems."
    - (f) IEEE 1584, "Guide for Performing Arc-Flash Hazard Calculations"
  - .4 International Organization for Standardization (ISO)

- (a) ISO 9001, "Quality Management Systems - Requirements"
- .5 The National Fire Protection Association (NFPA)
  - (a) NFPA 70, "National Electrical Code, latest edition"
  - (b) NFPA 70E, "Standard for Electrical Safety in the Workplace"

### **1.3 Definitions**

- .1 Unless specifically defined within the Contract Documents, the words or acronyms contained within this specification shall be as defined within, or by the references listed within this specification, the Contract Documents, or, if not listed by either, by common industry practice.
  - .1 PSSS: Power System Studies Supplier
  - .2 TCC: Time-Current Curves
  - .3 DER: Distributed Energy Resources (e.g. engine generators, energy storage, solar, turbines, etc.)

### **1.4 Submittals**

- .1 General: Submittals shall be in accordance with the requirements of Division 01 and Section 26 01 01 Electrical General Requirements, in addition to those specified herein.
  - .1 Submit sufficient information to determine compliance with the Contract Documents. Identify submittal data with the specific equipment tags and/or service descriptions to which they pertain. Submittal data shall be clearly marked to identify the specific model numbers, options, and features of equipment and work proposed.
  - .2 Deviations from the Contract Documents shall be indicated within the submittal. Each deviation shall reference the corresponding drawing or specification number, show the Contract Document requirement text and/or illustration, and shall be accompanied by a detailed written justification for the deviation.
  - .3 Submit product data on the application software, including any modules or software plug-ins used to perform the studies.
  - .4 Submit the name and qualifications of the Power System Studies Supplier and registered engineer(s) in charge of the studies for this Project.
  - .5 Initial studies shall be submitted to the Engineer prior to receiving release to furnish the electrical distribution equipment. After sufficient data is available to ensure proper selection of devices proceed with completion of the power system studies and submit. If completion of the studies may cause delays in equipment shipments, request an exception from the Engineer for a preliminary submittal of data to ensure that the selection of device ratings and characteristics shall be satisfactory to properly select the distribution equipment.
- .2 Operation & Maintenance (O&M) manuals shall be provided in accordance with the minimum requirements specified in Section 01 78 23 Operation and Maintenance Data, Section 26 01 01 Electrical General Requirements and additional requirements specified herein.
  - .1 The results of the short-circuit, protective device coordination and arc flash hazard analysis studies shall be summarized in a final report. In addition to the hardcopies required by the Contract Documents provide electronic PDF files of the report on digital media acceptable to the Owner. The report shall include the following:
    - (a) Executive Summary including Introduction, Scope of Work and Results/Recommendations.
    - (b) Short-Circuit Methodology, Analysis, Results and Recommendations
    - (c) Short-Circuit Device Evaluation Table
    - (d) Protective Device Coordination Methodology, Analysis, Results and Recommendations
    - (e) Protective Device Settings Table
    - (f) Time-Current Coordination Graphs and Recommendations

- (g) Power system one-line diagram shall be computer generated and clearly identify individual equipment buses, bus numbers used in the short-circuit analysis, cable and bus connections between the equipment, calculated maximum short-circuit current at each bus location, device numbers used in the time-current coordination analysis and other information pertinent to the computer analysis.

## **1.5 Quality Assurance**

- .1 Electrical power system software used for the studies shall be developed under an established quality assurance program and comply with ISO 9000 with accredited certification agency such as UL.
- .2 Power System Study Supplier Qualifications:
  - .1 The PSSS shall have 10 years of experience in performing power system studies.
  - .2 The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the responsible charge and approval of a registered professional engineer skilled in performing and interpreting the electrical power system studies.
  - .3 The approved power system study supplier shall demonstrate experience with Arc Flash Hazard Analysis by submitting names of at least ten actual arc flash hazard analyses it has performed in the past year.
  - .4 The registered professional engineer shall have a minimum of five (5) years of experience in performing power system studies. The registered professional engineer shall sign and affix their seal to the completed power system study in accordance with state laws.

## **1.6 Warranty**

- .1 General: Refer to Section 01 77 00 - Closeout Procedures and 26 08 19 – Project Close-Out Electrical.
- .2 Additional Owner Rights: The warranty shall not deprive the Owner of other rights the Owner 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.

## **1.7 Approved Testing Organizations**

### *Standard of Acceptance*

- Haronitis & Associates Limited
- Brosz and Associates
- Eastenghouse
- G.T. Wood
- Qualus (Enkompass)

## **2 PRODUCTS**

### **2.1 Power System Studies**

- .1 Power system studies specified herein shall be provided by a single Power System Study Supplier and shall not be the same supplier as that of the equipment being provided. Provide the specified studies and related work without exception, unless allowed as a substitute per the general provisions of the Contract.
- .2 All power system studies shall use a robust electrical power system design and analysis software package which complies with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.

- .3 The Power System Study Supplier shall furnish an arc flash hazard analysis study per CSA Z462 in conjunction with the short-circuit and protective device coordination studies furnished.

## **2.2 Data**

- .1 Contractor shall coordinate with Owner and Supply Authority and gather all input data required for the power system studies. The power system study supplier performing the short-circuit, protective device coordination and arc flash hazard analysis studies shall furnish the Contractor with a list of required data immediately after award of the contract. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.
- .2 Source combination shall include current and any identified future motors.
- .3 Load data utilized shall include proposed loads obtained from Contract Documents.
- .4 If applicable, fault contribution of existing motors shall be included in the study. The Contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

## **2.3 Short Circuit Analysis**

- .1 Transformer design impedances shall be used when test impedances are not available.
- .2 Short Circuit Analysis shall include the following:
  - .1 Calculation methods and assumptions.
  - .2 Selected base per unit quantities.
  - .3 One-line diagram of the system being evaluated that clearly identifies individual equipment buses, bus numbers used in the short-circuit analysis, cable and bus connections between the equipment, and other information pertinent to the computer analysis.
  - .4 The study shall include input circuit data including electric utility system characteristics, source impedance data, conductor lengths, number of conductors per phase, conductor impedance values, insulation types, transformer impedances and X/R ratios, motor contributions, and other circuit information as related to the short-circuit calculations.
  - .5 Tabulations of calculated quantities including short-circuit currents, X/R ratios, equipment short-circuit interrupting or withstand current ratings and notes regarding adequacy or inadequacy of the equipment rating.
  - .6 Results, conclusions, and recommendations. A comprehensive discussion section evaluating the adequacy or inadequacy of the equipment shall be provided and include recommendations as appropriate for improvements to the system.
- .3 For solidly-grounded systems, provide a bolted line-to-ground fault current study for applicable buses as determined by the engineer performing the study.
- .4 Protective Device Evaluation shall include:
  - .1 Evaluation of equipment and protective devices and comparison to short circuit ratings
  - .2 Evaluation of adequacy of switchgear, motor control centers, and panelboard bus bars to withstand short-circuit stresses
  - .3 PSSS shall notify Engineer in writing, of any circuit protective devices improperly rated for the calculated available fault current.

## **2.4 Protective Device Time Current Coordination Analysis**

- .1 Protective device coordination time-current curves (TCC) shall be displayed on log-log scale graphs.
- .2 Protective device time current coordination analysis shall include on each TCC graph, a complete title with descriptive device names.
- .3 Protective device time current coordination analysis shall include device termination characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
- .4 Protective device time current coordination analysis shall identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
- .5 Protective device time current coordination analysis shall plot the following characteristics on the TCC graphs, where applicable:
  - .1 Electric utility's overcurrent protective device.
  - .2 Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands.
  - .3 Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
  - .4 Ground fault protective devices, as applicable.
  - .5 Pertinent motor starting characteristics and motor damage points, where applicable.
  - .6 The largest feeder circuit breaker in each motor control center and applicable panelboard.
- .6 Protective device time current coordination analysis shall provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.
- .7 Protective device time current coordination analysis shall provide the following:
  - .1 A One-line diagram shall be provided which clearly identifies individual equipment buses, bus numbers, device identification numbers and the maximum available short-circuit current at each bus when known.
  - .2 Enough log-log plots shall be provided to indicate the degree of system protection and coordination by displaying the time-current characteristics of series connected overcurrent devices and other pertinent system parameters.
  - .3 Computer printouts shall accompany the log-log plots and will contain descriptions for each of the devices shown, settings of the adjustable devices, and device identification numbers to aid in locating the devices on the log-log plots and the system one-line diagram.
  - .4 The study shall include a separate, tabular printout containing the recommended settings of all adjustable overcurrent protective devices, the equipment designation where the device is located, and the device number corresponding to the device on the system one-line diagram
  - .5 A discussion section which evaluates the degree of system protection and service continuity with overcurrent devices, along with recommendations as required for addressing system protection or device coordination deficiencies.
  - .6 PSSS shall notify Engineer in writing of any significant deficiencies in protection and/or coordination and shall provide recommendations for improvements.

### **3 EXECUTION**

#### **3.1 General**

- .1 In addition to the requirements specified herein, execution shall be in accordance with the requirements of specifications Section 26 01 01, Section 26 08 05 and Drawings.

**END OF SECTION**

## **VERIFICATION AND TESTING**

### **26 08 05**

#### **1 GENERAL**

##### **1.1 Related Specification Sections**

- .1 26 05 73 Electrical Power System Studies
- .2 26 05 27 Grounding and Bonding Secondary

##### **1.2 Work Included**

- .1 The Division 26 contractor shall retain and pay for the services of an Independent Testing Organization (ITO) to provide In-plant Inspection, Verification and On-Site Commissioning Service in accordance with the details specified herein. ITO shall be the same organization hired to perform electrical power system studies performed as part of Section 26 05 73.
- .2 In order to ensure the requirement for independence, the ITO must be retained directly by the Division 26 contractor. The ITO must not be retained by an equipment manufacturer or their distributor as part of an equipment package.
- .3 The Division 26 Contractor shall include in the Bid Amount the cost for the services of tradesmen to handle equipment, make temporary connections, operate equipment and make repairs and adjustments and assist the testing organization's on-site specialists during the on-site pre-service inspection, testing, calibration, on-site witness testing and supplementary Commissioning phase of the work and as required by the [Engineer][Consultant] until the equipment and systems are accepted by the Owner.
- .4 The Bidders for Division 26 work shall advise all equipment suppliers bidding for the equipment supply for this project prior to Tender close of the requirement for comprehensive factory and on-site testing and commissioning and the requirement for on-site services of technical representatives during the testing and extensive commissioning phase and ensure the services and associated costs are included in the suppliers' quotations for the equipment for the project and in the Bidder's Tender Price.

##### **1.3 Approved Testing Organizations**

*Standard of Acceptance*

- Qualus (Enkompass)
- Haronitis & Associates Limited
- Brosz and Associates
- Eastenghouse
- G.T. Wood

#### **2 PRODUCTS**

##### **2.1 Co-ordination Study**

- .1 Refer to Section 26 05 73, Electrical Power System Studies.

## **2.2 Pre-service On-site Inspection, Testing of Equipment and Devices**

- .1 Upon Completion of the installation and prior to energization of components and systems, perform a complete inspection and testing to verify phase and polarity match of feeders with equipment and the tightness of power wiring terminations.
- .2 In addition, perform the following tests and functions:
  - .1 Power Feeders
    - (a) Thorough physical inspection
    - (b) Insulation resistance of all feeders
    - (c) Polarity and rotation tests of power terminations
  - .2 Metering and Instruments throughout all components and systems
    - (a) Verify correctness of wiring and operation
    - (b) Provide a third-party calibration of all metering in coordination with metering supplier.

## **3 EXECUTION**

### **3.1 Testing, Adjusting and Verification**

- .1 Provide necessary test equipment, material, labour and miscellaneous services during the testing, adjusting, verification and commissioning procedure.
- .2 Work normal to the electrical trade such as providing temporary feeders, jumpers and connections, and handling equipment shall be done by the contractor under Division 26.
- .3 Work and technical supervision by manufacturers' technical representatives in the verification, testing and commissioning phase shall be provided and all costs for tradesmen and representatives shall be included in the tender price.
- .4 Verify that all protective device schemes function properly. Conduct circuit breaker trip tests. Apply correct voltage and current to protective devices.
- .5 Verify the performance of the ground fault alarm and protection systems
- .6 Provide cross wattmeter readings or equivalent or any differential and/or directional relay schemes. Verify metering schemes.
- .7 During the testing and verification procedure, conduct supplementary spot checks on selected protective devices in company with representative of the Owner and/or Engineer to adjust and re-test protective devices so that final settings will result in performance in accordance with approved issue of respective co-ordination curve.

### **3.2 Performance Verification of the Entire System**

- .1 After the energization of the electrical systems have been satisfactorily completed and all testing and calibration work have been done and all reports submitted as shop drawings to the Engineer and all deficiencies noted to-dated have been corrected, the systems shall be subjected to supplementary dynamic simulation and verification of their operating performance characteristics in accordance with the Engineer's Test Plans and in the presence of the Engineer and Owner's representative.
- .2 The Contractor's forces and manufacturer's technicians shall also be present to start, stop and operate equipment and make adjustments as directed by the Engineer.



- .3 Upon completion of the Commissioning phase, prepare a comprehensive report summarizing the findings.

### **3.3 Reports**

- .1 Prepare and submit the following reports. Simultaneously submit one copy directly to the Engineer and a further copy to the Contractor to be processed as a shop drawing:
  - .1 Site Testing Report for each item of equipment within 5 working days of completion of site test.
  - .2 Site Performance verification report(s) to reflect each significant phase of system completion.
  - .3 Upon completion of the Commissioning phase, prepare a comprehensive report summarizing the findings.
- .2 Completed studies and reports shall be submitted simultaneously to the Engineer as well as part of the requirements of the Maintenance Manuals. Provide 5 copies of final reports and co-ordination study.

**END OF SECTION**

## **COMMISSIONING OF LIFE SAFETY AND FIRE PROTECTION SYSTEMS - ELECTRICAL 26 08 11**

### **1 GENERAL**

#### **1.1 Scope**

- .1 Provide coordinated commissioning of life safety system provided under Division 26 with those provided under Division 20 and in accordance with Section 01 91 11.
- .2 Coordinate and jointly prepare with the Division 20 contractor to conduct complete and thorough testing and documentation of the systems interface and integration between various LSFP systems provided under Division 26 and those provided under Division 20.
- .3 Include all labour and material as required to participate in the life safety and fire protection commissioning process, as outlined in this section, for equipment and systems provided under Division 26.

#### **1.2 References**

- .1 CAN/ULC-S1001 "Requirements for Integrated System Testing", Current Edition

#### **1.3 Definitions**

- .1 Refer to Section 01 91 11.

#### **1.4 Related Sections**

- .1 In addition to the requirements of this section, coordinate and implement the commissioning of life safety and fire protection systems in conjunction with:
  - .1 Section 01 91 15 General Commissioning Requirements
  - .2 Section 26 08 15 Electrical Commissioning
- .2 The commissioning requirements described in the LSFPCx program are the minimum required. Commissioning procedures under Section 26 08 15 may have greater requirements, and the greater requirements of the two govern.

### **2 PRODUCTS**

#### **2.1 Not Applicable**

### **3 EXECUTION**

#### **3.1 Commissioning requirements**

- .1 Participate in the development and implementation of the coordinated commissioning program for life safety and fire protection systems in compliance with Section 01 91 11 and CAN/ULC-S1001 standard.

**END OF SECTION**

## **PROJECT CLOSE-OUT ELECTRICAL**

### **26 08 19**

#### **1 GENERAL**

##### **1.1 Scope**

- .1 Provide documentation deliverables at completion of the Work.
- .2 Submit all supporting close-out documents by email to [ca.toronto@loringengineers.com](mailto:ca.toronto@loringengineers.com) for review by Consultant.

##### **1.2 Occupancy Permit**

- .1 Submit the reviewed final Life Safety and Fire Protection Commissioning report two weeks prior to application for occupancy permit.

##### **1.3 Substantial Performance**

- .1 Complete the Substantial Performance Checklist and submit with required documentation when applying for Substantial Performance of the Work.
- .2 Where the work is sub-divided into separate scopes of Work, each requiring a separate Substantial Performance application, provide a separate checklist for each application.
- .3 Prepare and submit to the Consultant a comprehensive deficiency list of items to be completed or corrected, as part of the application for a review by the Consultant to establish Substantial Performance of the Work, or for each designated portion of the Work in the case of phased Substantial Performance.
  - .1 Failure to include an item on the list does not alter the Contractor's responsibility to complete the Work.
- .4 Within five working days of the Consultant's review report which indicates that Substantial Performance of the Work has been achieved, provide a detailed schedule for completion and/or correction of the Work of all items described in the Contractors' and the Consultants' deficiency list.

##### **1.4 Total Performance**

- .1 Submit the following documentation with the application for Total Performance. Application for Total Performance cannot be submitted any earlier than the date of Alternate Season testing.
  - .1 Where documentation has already been submitted to the Owner, provide a copy of the transmittal.

SUBSTANTIAL PERFORMANCE APPLICATION CHECKLIST	
Project Name:	
Contract:	
Contract Scope:	
Application Date:	
Signed:	

*The following requirements are completed and included in this application. Where documentation has been issued directly to the Owner, a copy of the transmittal is enclosed.*

- ☐ Contractor has compiled and submitted a detailed deficiency list, identifying work still to be completed, incomplete, or requires correction.  
Equipment start-up reports (Interim).
- ☐ Building department inspection reports.
- ☐ ESA field inspection reports.
- ☐ Fire alarm verification certificate.
- ☐ Independent testing company, coordination study and testing reports submitted.
- ☐ Equipment and wiring identification completed
- ☐ Clean-up completed.
- ☐ Spare parts and replacement parts turned over to Owner; transmittal attached.
- ☐ Warranty certificates
- ☐ Operating and Maintenance Manuals, draft, submitted.
- ☐ As-built drawings submitted
- ☐ Training completed and attendance logs submitted.
- ☐ Commissioning reports submitted and reviewed by Consultant

Consultant Review	
Status:	<input type="checkbox"/> Reviewed <input type="checkbox"/> Incomplete or deficient - resubmit
Signed:	
Date:	

TOTAL PERFORMANCE APPLICATION CHECKLIST	
Project Name:	
Contract:	
Contract Scope:	
Application Date:	
Signed:	

*The following requirements are completed and included in this application. Where documentation has been issued directly to the Owner, a copy of the transmittal is enclosed.*

- ☐ All known deficiencies have been corrected, including latent deficiencies reported by the Owner.
- ☐ Final commissioning reports submitted and accepted by Owner.
- ☐ Operating and Maintenance manuals - finalized and submitted (if final version was issued at time of Substantial Performance indicated here: ☐.
- ☐ As-built drawings final version submitted (if final version was issued at time of Substantial Performance indicate here: ☐ Date of delivery: \_\_\_\_\_)

Consultant Review	
Status:	<input type="checkbox"/> Reviewed <input type="checkbox"/> Incomplete or deficient - resubmit
Signed:	
Date:	

**END OF SECTION**

## **DRY TYPE TRANSFORMERS UP TO 600 V PRIMARY**

### **26 22 13**

#### **1 GENERAL**

##### **1.1 General Requirements**

- .1 General Conditions as applicable.
- .2 Section 26 01 01, Electrical General Requirements.
- .3 Section 26 05 01, Electrical Basic Materials and Methods
- .4 Section 26 05 48, Vibration Isolation and Seismic Restraints.

##### **1.2 Applicable Codes and Standards**

- .1 Latest edition of:
  - .1 CSA C22.2 No. 47 Air-Cooled Transformers (dry type),
  - .2 CSA C9 Dry-Type Transformers,
  - .3 CAN/CSA C802.2 Minimum Efficiency Values for Dry-Type Transformers.

##### **1.3 Scope**

- .1 Provide labour, materials, and equipment for the installation, testing and putting into proper operation complete systems as shown as specified and as otherwise required.

##### **1.4 Submittals**

- .1 Submit shop drawings and product data for each type and rating of transformer.
- .2 Provide operation and maintenance data for incorporation into the Operating and Maintenance Manual.

##### **1.5 Operating and Maintenance Instructions**

- .1 Provide operating and maintenance instructions.

##### **1.6 Quality Control**

- .1 Type tests:
  - .1 to have been conducted in accordance with CSA C9 for the following:
    - (a) temperature rise,
    - (b) sound level.
- .2 Production tests:
  - .1 conduct in accordance with CSA C9 for the following:
    - (a) Voltage ratio, including all taps,
    - (b) polarity or angular displacement,
    - (c) dielectric, applied potential and induced potential,
    - (d) partial discharge (cast-coil transformers only).

.3 Energy efficiency:

- .1 Submit the energy efficiency reports to show compliance with the specified efficiency values.

## **2 PRODUCTS**

### **2.1 General**

- .1 Constructed in accordance with the referenced standards except where indicated otherwise.
- .2 Self-contained, free standing units suitable for floor mounting.
- .3 Up to and including 75 kVA to also be suitable for wall mounting.
- .4 Supply wall mounting brackets for transformers shown to be wall mounted.
- .5 Vacuum impregnated epoxy or polyester resin construction.
- .6 Type ANN.
- .7 Efficiency to meet or exceed CSA C802.2.
- .8 Windings: copper or aluminum.
- .9 Buswork and all current carrying parts, other than the windings: copper.
- .10 Primary and secondary voltages and kVA ratings as indicated.
- .11 Delta connected primary and 120/208 volt Wye connected secondary.
- .12 Secondary neutral terminals, suitable for the connection of:
  - .1 the neutral conductor,
  - .2 #6 AWG copper grounding conductor and
  - .3 bonding conductor.
- .13 Primary-to-secondary phase shift of -30 degrees, except where indicated otherwise.
- .14 Taps: four (4) @ 2.5% full capacity primary taps, two above and two below nominal voltage.
- .15 Provisions for incoming and outgoing conductor entry of sizes shown.
- .16 Front accessible primary and secondary conductor entry and connections, unless indicated otherwise.
- .17 System bonding lugs, connected to the enclosure for:
  - .1 primary feeder bonding conductor,
  - .2 secondary feeder bonding conductor and
  - .3 bonding conductor to the secondary neutral terminal.
- .18 System bonding lugs sized to accommodate cables sizes in accordance with Table 16 of the Electrical Code.

- .19 Core bonded to the enclosure, either inherently by design or by a bonding strap.
- .20 Labelled to warn of an arc flash potential in accordance with the Electrical Code.

*Standard of Acceptance*

- Atlas Transformer Inc.
- Bemag
- Delta Transformers Inc.
- Hammond Manufacturing Co. Ltd.
- STI

## **2.2 Ratings**

- .1 KVA capacity based on Class 220 degree C insulation, with 150 degree C rise.
- .2 Impedance:
  - .1 not less than 3% up to and including 75kVA,
  - .2 not to exceed 6%.
- .3 Full load voltage regulation at 80% power factor:
  - .1  $\leq 300$  kVA:  $\leq 3\%$ ,
- .4 Noise levels:
  - .1 Per Table 8 of CSA C9 for ratings  $\leq 300$  kVA, unless noted otherwise.

## **2.3 Support and Isolation**

- .1 Support core and coil assemblies on in-shear vibration isolation mounting pads. Pads to:
  - .1 provide a uniform deflection under weight and weight distribution of supported equipment,
  - .2 consist of 2 layers of 9mm (3/8") ribbed or waffle pattern neoprene pads of not more than 50 durometer,
  - .3 include a galvanized steel plate separating and bonded to the layers of elastomer,
  - .4 equal to Kinetics Noise Control Model "NGS", with a static deflection  $\geq 3.5$ mm,
  - .5 include a thru bolt with extra thick extra large washers, tightened for shipping purposes.

## **2.4 Enclosure and Finish**

- .1 Enclosure: Type 1, except where indicated otherwise.
- .2 Finish:
  - .1 rust-inhibiting metal treatment process,
  - .2 powder coat finish to UL50 3R,
  - .3 colour: ANSI #49 or ANSI #61 grey.
- .3 Provide a quart of matching paint to touch-up small areas marred during installation.

## **2.5 Equipment Identification**

- .1 Provide equipment identification in accordance with Section 26 05 53 Identification for Electrical Systems.



- .2 Submit nameplate wording.

### **3 EXECUTION**

#### **3.1 Installation**

- .1 Mount transformers:
  - .1 ≤ 75 kVA suspended, on wall brackets or on floor as indicated,
- .2 Provide, under this division, a 100mm (4") reinforced concrete pad with beveled edges for each floor mounted transformer. Seal with paint or concrete sealer to prevent concrete dust from entering equipment.
- .3 Anchor the concrete pad to the building structure in accordance with Section 26 05 48, Vibration Isolation and Seismic Restraints.
- .4 Install transformers in level upright position.
- .5 Provide suitable mounting hardware.
- .6 Where specified, install the external vibration isolation mounts for both floor mounted (between enclosure and pad) and bracket (wall) mounted transformers (between enclosure and brackets)
- .7 Where specified, install the external spring isolation hangers in the support rods of suspended transformers.
- .8 Install seismically rated vibration isolation mountings in accordance with Section 26 05 48, Vibration Isolation and Seismic Restraints.
- .9 Position transformers to provide:
  - .1 adequate clearance for ventilation,
  - .2 adequate access to connections,
  - .3 adequate access to taps.
- .10 Remove shipping supports only after transformer is installed and just before putting into service.
- .11 Loosen isolation pad bolts until no compression is visible.
- .12 Make final primary and secondary connections using flexible steel conduits.
- .13 Make primary and secondary connections in accordance with wiring diagram.
- .14 Provide a #6 AWG green insulated copper ground conductor in rigid PVC conduit from transformer secondary neutral to the building grounding system.
- .15 Connect the bonding conductors from the primary and secondary feeders to the transformer bonding lugs.
- .16 Provide a bonding conductor, sized not less than the secondary feeder bonding conductor, from the transformer bonding lugs to the transformer secondary neutral terminal.
- .17 Program the temperature monitoring devices for correct operation.

- .18 Provide nameplates in accordance with Article "Equipment Identification".
- .19 Energize transformers after installation is complete.
- .20 Adjust transformer taps as required to achieve suitable secondary voltage at loads, with the transformer operating under its typical load.
- .21 Touch up small areas marred in transit or during installation with touch up paint.
- .22 Repaint entire enclosure using electrostatic process where significant damage to factory finish has occurred.

**END OF SECTION**

## **LIGHTING & RECEPTACLE PANELS**

### **26 27 16**

#### **1 GENERAL**

##### **1.1 References**

- .1 CSA C22.2 No. 29-M1989.

##### **1.2 General Requirements**

- .1 Conform to Sections of Division 1 as applicable.
- .2 Conform to Section 26 01 01, Electrical General Requirements.
- .3 Conform to Section 26 05 01, Electrical Basic Materials and Methods.

##### **1.3 Shop Drawings**

- .1 Submit shop drawings in accordance with Section 26 01 01 Electrical General Requirements.
- .2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.
- .3 Provide equipment identification in accordance with Section 26 05 53 Identification for Electrical Systems.

##### **1.4 Work Included**

- .1 Work to be done under this Section shall include furnishing of labour, materials, and equipment required for installation, testing and putting into proper operation complete systems as shown as specified and as otherwise required.

##### **1.5 Operation and Maintenance Data**

- .1 Provide operation and maintenance data for incorporation into manual specified in Section 26 01 01 Electrical General Requirements.

##### **1.6 Maintenance Materials**

- .1 Provide maintenance materials as required and as specified in Section 26 01 01 Electrical General Requirements.

##### **1.7 Operating and Maintenance Instructions**

- .1 Provide operating and maintenance instructions as specified in Section 26 01 01 Electrical General Requirements.

##### **1.8 Plant Assembly**

- .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.

## **1.9 Identification**

- .1 Provide equipment identification in accordance with Section 26 05 53 Identification for Electrical Systems.
- .2 Submit nameplate wording.

## **2 PRODUCTS**

### **2.1 Panelboards**

- .1 Product of one manufacturer.
- .2 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. When numbering breakers, number from top to bottom and from left to right.
- .3 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
- .4 Two keys for each panelboard and key panelboards alike.
- .5 Copper bus with neutral of same ampere rating as mains.
- .6 Panels shall be constructed and finished in accordance with details specified in Section 26 27 18 "Panel Trim".
- .7 Panels shall be surface or flush mounted type, as shown.
- .8 Panels shall be dead front type in code gauge steel enclosure.
- .9 Each panel shall be complete with a typewritten directory which shall be mounted inside door with clear plastic cover.
- .10 Panels shall have mains of voltage and capacity, and main and branch breakers and contactors, as shown on the "Lighting and Receptacle Panel Schedule". Spaces shall include the necessary bus work such that Owners, at a later date, need buy only the breakers.
- .11 Main breaker shall be mounted separately from the branch breaker connections. Location of the main breaker (top or bottom) is to be coordinated by the Contractor prior to procurement.
- .12 Where panels exceed 42 circuits, use multi-section panel with main cross-over solid bus bars. Main bus capacity of each section shall be full size to match cross-over bus. Cross-over bus shall be concealed by panel trim. Separate covers are not acceptable.
- .13 Breakers shall have bolted type connections.
- .14 Panels for 120/208 volts, three phase, four wire systems shall be complete with full size breakers, having a symmetrical interrupting rating as indicated in fault current calculations.
- .15 Where indicated, breakers shall have a ground fault interrupter.
- .16 Panels for 600 volt, 3 phase, 3 wire or 4 wire systems shall be complete with breakers having a symmetrical interrupting rating as indicated in fault current calculations.

*Standard of Acceptance*

- Eaton Cutler Hammer
- Siemens
- Schneider Square D

## **2.2 Breakers General**

- .1 Bolt-on moulded case circuit breaker: quick-make, quick-break type, for manual and automatic operation.
- .2 Common-trip breakers: with single handle for multi-pole applications.
- .3 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting. Trip settings on breakers with adjustable trips to range from 5 - 10 times current rating.
- .4 Circuit breakers with interchangeable trips over 150 A.
- .5 Lock-on devices for clock outlet, fire alarm, security systems, battery chargers, door supervisory, intercom, stairway, exit and night light circuits.
- .6 Tandem breakers are not permitted.

## **2.3 Thermal Magnetic Breakers**

- .1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

## **2.4 Trim**

- .1 Front panel trim shall be overall hinged type, door within door construction. Trim assembly shall provide hinged access to the internal tub and wiring channels for access to wiring and breaker terminals without removal of the trim assembly. With overall trim assembly closed and secured, a second integral hinged door forming part of the trim assembly shall provide access to the circuit breakers only for opening and closing purposes
- .2 Panels shall be given a rust-resistant treatment to both tub and trim. Locks shall be chrome plated.
- .3 Flush panels shall have concealed hinges and flush type combination lock latch. Doors shall open minimum 135 degrees. Trims shall have fasteners concealed and shall be prime coated to receive room finish paint.
- .4 Surface mounted panels shall be constructed in accordance with CSA Type 2 enclosures with overall door assembly protecting all circuit breakers. Door(s) shall be gasketed, with overhanging drip shield, with T-handle 2 point locking system complete with lock and latch.
- .5 Panels shall be finished with two coats of paint in accordance with the following Sherwin Williams colour code:
  - .1 Normal Power: ASA # 61, Grey
- .6 Panel locks shall be common to one key throughout project.

## **2.5 Equipment Identification**

- .1 Provide equipment identification in accordance with Section 26 05 53 Identification for Electrical Systems.
- .2 Complete circuit directory with typewritten legend showing location and load of each circuit. Cover directory with a 0.8 mm (1/32") thick clear plastic sheet.

## **3 EXECUTION**

### **3.1 Installation**

- .1 Locate panel boards 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 01 - Electrical General Requirements, or with top of trim at uniform height of 2000 mm (6' -6") or to match door heads or to suit tile layout, or as indicated.
- .4 Deliver ten (10) duplicate keys for panel locks to Owner.
- .5 Connect loads to circuits.
- .6 Connect neutral conductors to common neutral bus with respective neutral identified.

**END OF SECTION**

## **WIRING DEVICES**

### **26 27 26**

## **1 GENERAL**

### **1.1 Related Sections**

- .1 Section 26 05 01 - Electrical Basic Materials & Methods.
- .2 Section 26 05 53 - Identification for Electrical Systems.
- .3 Section 26 28 19 - Ground Fault Circuit Interrupters.

### **1.2 Submittals**

- .1 Submit shop drawings for each type and size of device.

### **1.3 Applicable Codes and Standards**

- .1 Latest version of CSA C22.2 No. 111-18 Switches.
- .2 Latest version of CSA C22.2 No. 42:10 (R2020) Receptacles.

### **1.4 Scope**

- .1 Provide labour, materials, and equipment required for installation, testing and putting into proper operation complete systems as shown as specified and as otherwise required.

## **2 PRODUCTS**

### **2.1 Nameplates**

- .1 Wall mounted:
  - .1 engraved laminated plastic to Section 26 05 53 Identification for Electrical Systems,
  - .2 7 mm ( $\frac{1}{4}$ ") high letters unless indicated otherwise.
- .2 Receptacle mounted:
  - .1 permanently printed on white polyester background,
  - .2 7 mm ( $\frac{1}{4}$ ") high letters unless indicated otherwise,
  - .3 UV resistant inks,
  - .4 clear polyester over lamination,
  - .5 pressure sensitive adhesive.
- .3 Colours:
  - .1 normal power: black lettering on white background,

### **2.2 Switches**

- .1 Features:
  - .1 20 A, 120 V, general purpose AC type,

- .2 higher ratings where indicated,
- .3 CSA listed,
- .4 HP rated where used in motor circuits, with rating not less than the motor HP,
- .5 industrial/specification grade for toggle switches, commercial grade for Decora style switches,
- .6 Decora style in finished areas, toggle handle type in unfinished areas,
- .7 silent operation,
- .8 terminals rated for No. 10 AWG wire,
- .9 suitable for back and side wiring,
- .10 silver alloy contacts,
- .11 single pole, double pole, three-way, four-way switches as indicated.

.2 Toggle colours:

.1 Normal power:

- (a) white in finished areas,
- (b) brown in unfinished areas.

.3 Decora rocker colour: white

*Standard of Acceptance*

- Pass & Seymour (Legrand)
- Hubbell
- Bryant Electric
- Cooper-Eaton Wiring Devices (Arrow Hart)
- Leviton

.4 Catalogue numbers listed below have been used for convenience only to indicate quality standards:

	Approved Catalogue Numbers
	Hubbell(120 Volt) (Toggle) / (Decora)
Single Pole	1221 / DS120
Double Pole	1222 / DS220
Three-Way	1223 / DS320
Four-Way	1224 / DS420

.5 Weatherproof switches:

- .1 equal to those above,
- .2 complete with weatherproof box,
- .3 with 'While-In-Use' weather protective cover.

*Standard of Acceptance*

- Pass & Seymour No. WIUC10



## 2.3 Receptacles

- .1 Decora style in finished areas, standard style in unfinished areas.
- .2 Heavy duty industrial/specification grade.
- .3 With the following features:

- .1 eight back wired entrances, four side wiring screws,
- .2 suitable for no. 10 AWG for back and side wiring,
- .3 break-off links for use as split receptacles,
- .4 triple wipe contacts,
- .5 riveted or integral ground contacts.

- .4 Colour coded as follows:

- .1 Normal power: white

- .5 One manufacturer throughout the project.

### *Standard of Acceptance*

- Pass & Seymour (Legrand)
- Hubbell
- Bryant Electric
- Cooper-Eaton Wiring Devices (Arrow Hart)
- Leviton

- .6 The receptacles listed below represent the most common configurations and are not necessarily used on this project. Refer to drawings for types used.

- .1 Duplex receptacle: 15 ampere, 120 volt, grounded CSA Configuration 5-15R:

### *Standard of Acceptance*

Type	Approved Catalogue Numbers				
	P & S	Hubbell	Bryant	Leviton	Cooper
Non-decora	5262	5262	5262	5262	5262
Decora	26252	2152	9252	5280	6262

- .2 Weatherproof:

- (a) 15 ampere, 120 volt as above,
- (b) complete with weatherproof box,
- (c) with 'While-In-Use' weather protective cover.

### *Standard of Acceptance*

- Pass & Seymour No. WIUC10D

- .3 Duplex receptacle: 15 / 20 ampere, 120 volt, grounded CSA Configuration 5-20R:

### *Standard of Acceptance*

Type	Approved Catalogue Numbers				
	P & S	Hubbell	Bryant	Leviton	Cooper
Non-decora	5362	5362	5352	5362	5362
Decora	26352	2162	9352	-	6362

## 2.4 Floor Outlets

- .1 Flush mounted duplex floor receptacles, 15 ampere, 120 volts CSA configuration 5-15R with adjustable, watertight floor boxes.

### *Standard of Acceptance*

- Hubbell B2431 single gang box (brass)
- Hubbell B2432 double gang box (brass)
- Hubbell B2433 three gang box (brass)

- .2 Service fitting for floor receptacle to be complete with receptacle specified above, unless noted otherwise.

### *Standard of Acceptance*

- Hubbell S3625, duplex screw cover (brass)
- Hubbell S3825, duplex flap (brass)

## 2.5 Cover Plates

- .1 Compatible with wiring device.
- .2 Service rooms: Stainless steel 18-8 chrome metal alloy, Type 302, vertically brushed, 1 mm (1/32") thick cover plates for wiring devices in flush-mounted outlet boxes.
- .3 Cast cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
- .4 Engraving, where indicated:
  - .1 6 mm (1/4") high letters filled with red paint,
  - .2 parallel to finished floor level.
- .5 One manufacturer throughout the project.

### *Standard of Acceptance*

- Pass & Seymour #93000 Series
- Harvey Hubbell of Canada Ltd. #93000 Series
- Bryant Electric #S600 Series
- Leviton #84000 Series
- Cooper #93000 Series

## 2.6 Ground Fault Circuit Interrupters (GFCI's)

- .1 CSA approved Type A.
- .2 Complete with suitable outlet box.

- .3 15A grounded duplex Decora receptacle type 5-15R.
- .4 15A/20A grounded duplex Decora receptacle type 5-20R where indicated.
- .5 Auto-monitoring (self-test), manual test feature and reset switch.
- .6 Units to include current transformer and sensing mechanism.
- .7 Unless noted otherwise, unit to trip at 6 mA.
- .8 No power at device face if reversed wired.
- .9 Complete with USB-C connections, where noted.
- .10 Colour coded as follows:
  - .1 Normal power: white
- .11 Where shown in outdoor locations, units to be enclosed in "While-In-Use" weatherproof surface-mounted enclosures. In other locations units to be furnished with stainless steel cover plate.

*Standard of Acceptance*

Type	Approved Catalogue Numbers				
	P & S	Hubbell	Bryant	Leviton	Cooper
15A: Decora	1597	GFST15	GFRST15	7599	SGF15
15/20A: Decora	2097	GFST20	GFRST2	7899	SGF20

### 3 EXECUTION

#### 3.1 Identification

- .1 Label receptacles with circuit identification using a lamacoid label with label attached to the receptacle.

#### 3.2 Installation

- .1 Switches
  - .1 Mount switches vertically so that the switch contacts are closed when the toggle is up or, in the case of Decora switches, when the top part of the rocker is depressed.
  - .2 Install switches in gang type outlet box when more than one switch is required in one location.
  - .3 Provide separate boxes where switches are supplied from different power systems (normal and emergency).
  - .4 Mount switches at heights specified in Section 26 05 01 - Electrical Basic Materials & Methods unless indicated otherwise.
  - .5 Verify the door swing and ensure easy access before installing switches.

- .6 Switches installed adjacent to dimmers: provide switches that match appearance of dimmers.

.2 Dimmers

- .1 Where more than one dimmer is shown in the same location, mount dimmers in individual backboxes.
- .2 Where remote dimmers are utilized, install associated components in accordance with the manufacturer's recommendations.

.3 Receptacles

- .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
- .2 Provide separate boxes where receptacles are supplied from different power systems (normal and emergency).
- .3 Mount receptacles at heights specified in Section 26 05 01 - Electrical Basic Materials & Methods unless indicated otherwise.
- .4 For each type of receptacle 20 ampere or larger, supply and hand to Owner two heavy duty caps.
- .5 Connect receptacle grounding terminal to the outlet box with an insulated green bonding conductor.
- .6 Verify exact position of service fittings to suit furniture layout.
- .7 Do not mount receptacles directly on a column, unless column has been appropriately furred, to avoid breaking fire barrier.
- .8 Mental health areas: install using tamper proof screws.
- .9 Where equipment is located on a rooftop provide receptacle(s) for maintenance purposes:
  - (a) 15/20A weather resistant GFCI receptacle, type 5-20R,
  - (b) weatherproof housing,
  - (c) located within 7.5 m of the equipment,
  - (d) mounted at least 750mm above the finished roof,
  - (e) supplied from a dedicated circuit,
  - (f) provide additional receptacles as required so that a receptacle is located within 7.5 m of each item of equipment.

.4 Cover Plates

- .1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
- .2 Install suitable common cover plates where wiring devices are grouped.
- .3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

.5 Install explosion proof wiring and devices in hazardous locations of Class, Division and Group as indicated on Drawings.

.6 Ground fault circuit interrupters:

- .1 Mount receptacles at height indicated in Section 26 05 01 - Electrical Basic Materials & Methods unless indicated otherwise.
- .2 Do not connect GFCI receptacles to provide protection to downstream receptacles, unless indicated otherwise.

.7 Outlets in Movable Partitions

- .1 Co-ordinate installation of outlet boxes and conduits with the particular trade involved.

### **3.3 Testing**

- .1 Verify the operation of illuminated handles in switches.
- .2 Verify the operation of lights on pilot light switches.
- .3 Test each receptacle for correct polarity and ground continuity.
- .4 Test the manual trip and reset functions of each GFCI.

**END OF SECTION**

## **WIRE AND BOX CONNECTORS 0-1000 V 26 27 28**

### **1 GENERAL**

#### **1.1 Applicable Codes and Standards**

- .1 Latest version of CSA C22.2 No.65 Wire Connectors.
- .2 Latest version of CSA C22.2 No.188 Splicing Wire Connectors.

### **2 PRODUCTS**

#### **2.1 Materials**

- .1 Mechanical pressure type wire connectors:
  - .1 for copper conductors: current carrying parts of copper or tin plated aluminum,
  - .2 for aluminum conductors: current carrying parts of aluminum.

*Standard of Acceptance*

- Burndy
- IlSCO
- Thomas & Betts

- .2 Compression type pressure wire connectors:
  - .1 long barrel
  - .2 tin plated copper for copper conductors
  - .3 aluminum for aluminum conductors

*Standard of Acceptance*

- Burndy
- IlSCO
- Thomas & Betts

- .3 Twist on wire connectors:
  - .1 for copper wire up to and including #6 AWG,
  - .2 "live" spring construction,
  - .3 corrosion resistant spring,
  - .4 square wire spring construction,
  - .5 polypropylene cap rated for 105°C

*Standard of Acceptance*

- T&B Marett
- Ideal
- 3M

- .6 For damp, wet, outdoor and submersible locations: filled with silicone gel.
- .4 Fixture type splicing connectors:
  - .1 current carrying parts of copper,

- .2 sized to fit copper conductors 10 AWG or less,
- .3 temperature rating of not less than 105°C

*Standard of Acceptance*

- Burndy
- Hubbell
- Thomas & Betts

### **3 EXECUTION**

#### **3.1 Installation**

- .1 Provide connectors in accordance with the manufacturer's recommendation for the size, quantity and type of wires.
- .2 Install connectors in accordance with the manufacturer's recommendations.
- .3 Remove insulation carefully from ends of conductors:
  - .1 where the conductor is damaged, remove the damaged portion and strip the insulation back further as necessary,
  - .2 where the conductor is too short, replace the conductor.
- .4 For aluminum conductors, clean the conductors and immediately coat with electrical joint compound.
- .5 Tighten screws of mechanical pressure type connectors in accordance with the manufacturer's recommendations. Installation to meet secureness tests in accordance with CSA C22.2 No.65.
- .6 Install compression type connectors using the appropriate compression tool and die as recommended by the manufacturer. Make two crimps on each wire. Installation to meet secureness tests in accordance with CSA C22.2 No.65.
- .7 Connectors shall be torqued to recommended values as per Appendix D in the Electrical Safety Code, or to the manufacturer's recommendation.
- .8 Once torqued, all bolts and connectors are to be marked across nut and set screw or bolt in permanent fashion to indicate torquing is complete for future maintenance.
- .9 Remove all traces of electrical joint compound after each connection has been made.
- .10 Install fixture type connectors and tighten. Replace insulating cap.

**END OF SECTION**

## **DISCONNECT SWITCHES UP TO 1000 VOLTS 26 27 33**

### **1 GENERAL**

#### **1.1 General Requirements**

- .1 Conform to Sections of Division 1 as applicable.
- .2 Conform to Section 26 01 01, Electrical General Requirements.

#### **1.2 Scope**

- .1 Provide labour, materials, and equipment required for installation, testing and putting into proper operation complete systems as shown as specified and as otherwise required.

#### **1.3 Related Sections**

- .1 Section 26 28 13 Fuses - Low Voltage.

#### **1.4 Submittals**

- .1 Submit shop drawings for each type and size of switch.

#### **1.5 Applicable Codes and Standards**

- .1 Latest version of CSA C22.2 No. 4:16 (R2020) Enclosed and Dead Front Switches.
- .2 Latest version of CSA C22.2 No. 39:13 (R2022) Fuseholder Assemblies.

### **2 PRODUCTS**

#### **2.1 Disconnect Switches**

- .1 Fusible and non-fusible disconnect switch in CSA Type 1 (indoor) or CSA Type 3R (outdoor) enclosure, sizes as indicated.
- .2 2 pole or 3 pole as required for single phase or three phase circuits.
- .3 2 pole with solid neutral for three wire circuits with neutral.
- .4 3 pole with solid neutral for four wire circuits with neutral.
- .5 HP rated where used in motor circuits, with rating not less than the largest motor in the circuit.
- .6 Provision for padlocking switch in OFF position.
- .7 Mechanically interlocked door to prevent opening when handle in ON position.
- .8 Fuses: size as indicated, to Section 26 28 13 - Fuses - Low Voltage.
- .9 Fuseholders: suitable without adaptors, for type and size of fuse indicated.
- .10 Heavy Duty, quick-make, quick-break action, rated for load breaking operation.



- .11 ON-OFF switch position indication on switch enclosure cover.
- .12 Rust inhibiting process to enclosures prior to finishing.
- .13 Finish enclosures using manufacturer's standard process, colour to be grey ASA No.49 or 61.

### **3 EXECUTION**

#### **3.1 Installation**

- .1 For CSA Type 3R enclosures use watertight connectors complete with O rings for conduit connections.
- .2 Provide fuses in disconnect switches, sizes as shown.

**END OF SECTION**

## **LIGHTING**

### **26 51 13**

#### **1 GENERAL**

##### **1.1 General Requirements**

- .1 Conform with the requirements of Section 26 01 01 Electrical General Requirements.
- .2 Conform with the requirements of Section 26 05 01 Electrical Basic Materials and Methods.

##### **1.2 Work Included**

- .1 Work to be done under this Section shall include furnishing of labour, materials, and equipment required for installation, testing and putting into proper operation complete Electrical systems as shown, as specified and as otherwise required. Complete systems shall be left ready for continuous and efficient satisfactory operation.

##### **1.3 Shop Drawings and Product Data**

- .1 Submit shop drawings in accordance with Section 26 01 01 Electrical General Requirements - Shop Drawings and Product Data.
- .2 Submit complete photometric data prepared by independent testing laboratory for luminaires where specified, for review by Engineer.
- .3 Photometric data to include:
  - .1 Total input watts, candlepower summary, candela distribution zonal lumen summary, luminaire efficiency, CIE type, coefficient of utilization, lamp type and lumen rating in accordance with IESNA testing procedures.

##### **1.4 Requirements**

- .1 Luminaires shall not be delivered to building or stored therein until dry and protected space is available for proper storage of luminaires.
- .2 Submit samples of luminaires which are not catalogue items for approval. Additional luminaires shall not be manufactured until sample has been approved. Each approved sample shall be retained on job site until final completion of project. Luminaires which do not match quality and workmanship of standard sample will be rejected.
- .3 Finishes of luminaires, as specified in the "Luminaire List" must be maintained. Where the description of the luminaire directs a "colour/ finish to suit Architect" it is to be understood that during construction the final colour/finish will be selected. The Architect must be permitted to make their choice from a standard colour/finish range but the selected colour will apply to all of the particular type of luminaire unless otherwise specified.
- .4 "Allowances" when shown, are in Canadian dollars and cover the cost of the lighting luminaires and lamps. Allowances do not include applicable taxes, delivery to the site, handling, installation, overhead or profit.

##### **1.5 Substitutions**

- .1 Substitutions will not be permitted unless approved in writing by Consultant and/or Owner.

## **2 PRODUCTS**

### **2.1 General**

- .1 Luminaires shall be suitable for individual or continuous mounting.
- .2 Supply recessed luminaires, where installed in plaster or in acoustic ceilings, complete with plaster trim frame or ring and mounting brackets.
- .3 LED troffers in ceiling shall be equipped with adjustable mounting brackets.
- .4 Luminaires shall be completely assembled in factory and shall be delivered to building in cartons or in palletized form, as directed.

### **2.2 Exit Signs**

- .1 Exit signs to CSA 22.2 No. 141 Emergency Lighting Equipment.
- .2 Internally illuminated by white L.E.D. sources, edge lit style.
- .3 Single or double face as shown.
- .4 Each face to show a green "running man" pictogram.
- .5 With directional arrows as shown.
- .6 Where directional arrows are shown in two directions, provide two exit signs mounted side by side.
- .7 Directional arrows to be white.
- .8 Visibility of signs to ISO 3864-1 Graphical Symbols – Safety Colours and Safety Signs – Part 1: Design Principles for Safety Signs in Workplaces and Public Areas.
- .9 Dimensions of signs, pictograms and symbols to ISO 7010 Graphical Symbols – Safety Colours and Safety Signs – Safety Signs Used in Workplaces and Public Areas.
- .10 With 24 Volt two wire DC emergency power input.

## **3 EXECUTION**

### **3.1 Installation**

- .1 Locate and install luminaires as indicated.
- .2 Locate hangers on tile centres or intersections. Mount recessed down lights, troffers and surface mounted luminaires in or on full tiles.
- .3 Verify quantity of luminaires before placing orders.
- .4 Verify ceiling types with the latest revised Architectural Drawings and order luminaires to suit the correct ceiling.
- .5 Check lighting luminaires and mountings for their electrical and physical characteristics in relation to conditions due to building construction and mechanical equipment. Make necessary adjustments to

- luminaires or hanging arrangement without expense to Owners. Give notification at time of shop drawings and before construction if decision on necessary changes is required.
- .6 Cooperate with other trades to ensure proper installation of lighting luminaires.
  - .7 Carefully align luminaires, shown in continuous lines or rows, so that rows appear as straight lines.
  - .8 Mount luminaires perfectly level or plumb. Luminaires shall fit tightly to ceiling without showing a space or light leak between frame and ceiling.
  - .9 Take down any improperly installed luminaires and re-install without expense to Owner.
  - .10 Standard octagonal boxes may be supplied where conduits feeding luminaires in finished areas are exposed on ceiling if hanger canopies entirely cover outlet boxes and are neatly notched for conduit. Otherwise, provide cast conduit outlet boxes with a diameter larger than canopies.
  - .11 Attach boxes or hickies directly to poured concrete with 6mm (1/4") minimum diameter bolts and lead expansion anchors where luminaires are suspended directly from concrete slabs. Use 8mm (5/16") minimum bolts through precast slabs, welded to 100mm x 100mm (4" x 4") minimum, 3.5mm (10 gauge) plate above slabs.
  - .12 Do not mount luminaires above pipes, ducts or equipment. In event of unavoidably tight locations, provide hangers to clear obstructions. Check layouts of other trades on job and plan co-operatively. Luminaires in any room shall hang at one height. Obtain approval before any changes are made to layouts shown
  - .13 All luminaires mounted in or on ceilings shall be supported independently of ceiling by means of chains.
  - .14 Provide continuous 12mm x 38mm (1/2" x 1 1/2") channel above the ceiling, where luminaires are suspended or mounted on furred ceilings. Fasten luminaires to channel with two 6mm (1/4") minimum diameter studs with minimum 1220mm (4'- 0") on centre.
  - .15 Luminaires installed in or on "T" bar ceilings shall be equipped with safety chains anchored in an approved manner to the floor slab or roof structure above. 2x2 and 2x4 luminaires shall have two chains, each supporting two corners of the luminaire. Chain shall be #10 Tensile jack chain, installed as noted below.
  - .16 Chain shall be No. 10 Tensile jack chain, bright zinc coated, with a strength of 180 kg (400 lbs.) where luminaires are indicated to be chain hung. Attachments shall be made using a No. 10 "S" hook. Caddy fasteners may be used where applicable. "S" hooks must be closed after installation.
  - .17 Industrial luminaires where suspended shall be 12mm (1/2") conduit hangers and ARB ball aligners. Length and location shall clear equipment, ducts and pipes. Metal strut (Flexibar or equal) may be used for mounting of luminaires in mechanical areas and electrical rooms.

### **3.2 Lighting Luminaires**

- .1 Provide lighting luminaires exactly as shown and as specified in the following schedule. Luminaires shall be complete with necessary accessories and lamps at time of acceptance.
- .2 All luminaires shall be ULC or CSA certified.

### **3.3 Exit Signs**

- .1 Connect 24 Volt DC circuit to the emergency power input.
- .2 In addition to the Exit signs shown, provide a quantity of four (4) exit signs including circuit breakers, lock on devices, junction boxes and DC wiring from the remote battery source. Signs to be installed as required by the local building authority. Turn over any signs, not required to be installed, to the Owner as spares.

**END OF SECTION**

## **UNIT EQUIPMENT FOR EMERGENCY LIGHTING**

### **26 52 00**

#### **1 GENERAL**

##### **1.1 References**

- .1 CSA C22.2 No. 18.
- .2 CSA C22.1 Canadian Electrical Code, Part 1, Ontario Electrical Safety Code.

##### **1.2 General Requirements**

- .1 Conform to Sections of Division 1 as applicable.
- .2 Conform to Section 26 01 01, Electrical General Requirements.

##### **1.3 Shop Drawings and Product Data**

- .1 Submit shop drawings and product data in accordance with Section 26 01 01 Electrical General Requirements.
- .2 Nameplates shall be in accordance with Section 26 05 53 Identification for Electrical Systems.

##### **1.4 Work Included**

- .1 Work to be done under this Section shall include furnishing of labour, materials, and equipment required for installation, testing and putting into proper operation complete systems as shown as specified and as otherwise required.

##### **1.5 Operation and Maintenance Data**

- .1 Provide operation and maintenance data for incorporation into manual specified in Section 26 01 01 Electrical General Requirements.

##### **1.6 Maintenance Materials**

- .1 Provide maintenance materials as required and as specified in Section 26 01 01 Electrical General Requirements.

##### **1.7 Operating and Maintenance Instructions**

- .1 Provide operating and maintenance instructions as specified in Section 26 01 01 Electrical General Requirements.

##### **1.8 Warranty**

- .1 For batteries, the 12 months warranty period is extended to 120 months, with a no-charge replacement during the first 60 months and a pro-rate charge on the second 60 months.

## **2 PRODUCTS**

### **2.1 Equipment**

- .1 Supply voltage: 120 V, AC.
- .2 Output voltage: 24 V DC for indoor units.
- .3 Operating time:
  - .1 24 volt units: 180 watts for 30 minutes.
- .4 Battery: sealed, maintenance free, lead acid or lead calcium.
- .5 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected. Unit shall have externally accessible means for testing of unit and shall have two lamps indicating A.C. on, and high charge. Unit shall include a low voltage cut-off protection circuit and self-diagnostic auto test.
- .6 Solid state transfer.
- .7 Low voltage disconnect: solid state, modular, operates at 80% battery output voltage.
- .8 Signal lights: solid state, life expectancy 100,000 h minimum, for 'AC Power ON' and 'High Charge'.
- .9 Lamp heads: integral on unit and remote, 360° horizontal and 180° vertical adjustment.
- .10 Lamp type (integral and remote):
  - .1 adjustable type LED: 4 W, 24 VDC to suite battery, glare free mounted in a Lexan cube approximately 113 mm square
- .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 Cabinet finish: Painted steel Type 1 enclosure
- .13 Auxiliary equipment for central battery units:
  - .1 Ammeter.
  - .2 Voltmeter.
  - .3 Lamp disconnect switch.
  - .4 Test switch.
  - .5 Time delay relay.
  - .6 Battery disconnect device.
  - .7 AC input and DC output terminal blocks inside cabinet.
  - .8 Shelf.
  - .9 RFI suppressors.
  - .10 Voltage sensing relay.

## **2.2 Wiring of Remote Heads**

- .1 Conduit: type EMT, to Section 26 05 33 - Conduits Fastenings and Fittings.
- .2 RFI suppressors.
- .3 Conductors: RW90 type to Section 26 05 19 - Wires & Cables 0-1000 Volts, sized in accordance with manufacturer's recommendations.

### *Standard of Acceptance*

- Emergi-Lite
- Lumacell Inc
- Beghelli
- Approved equivalent

## **3 EXECUTION**

### **3.1 Installation**

- .1 Provide complete emergency battery lighting system as shown and specified.
- .2 For all unit equipment located in tenant or occupied office ("front-of-house") area, unit is to be located above accessible ceiling and equipped with remote heads. Provide discreet label on ceiling tile or stringer to indicate location of unit equipment above for access and maintenance.
- .3 Unless otherwise noted, mount units on the wall 2440 mm above floor. Unit shall be hardwired to source. Provide lock-on devices on breakers.
- .4 Connect exit lights to unit equipment where indicated.
- .5 Where heads are shown remote from unit, provide suitable outlet box at 2440 mm and install head. Connect with conduit to battery and charger unit. Wire size to suit manufacturer's recommendations, but not less than #10 gauge, and for a maximum of 3% voltage drop at remote heads. Ensure remote head wiring lengths are reviewed with manufacturer prior to installation. Voltage drops will be tested by Building Inspector. Replace and upsize any wiring not passing the 3% voltage drop test with new size and retest.
- .6 Direct heads as indicated.
- .7 For areas supported by unit equipment, Contractor shall wire the voltage sensing relay to the applicable lighting circuits to sense undervoltage and activate lighting when partial or complete area lighting circuit undervoltage is detected.

**END OF SECTION**



## **COMMUNICATION SERVICES**

### **27 05 13**

#### **1 GENERAL**

##### **1.1 Work Included**

- .1 Comply with the General requirements and documents referred to within.
- .2 To be read in conjunction with associated electrical and communication specification sections.

##### **1.2 Quality Assurance**

- .1 The Contractor shall be certified, along with all technicians who should be properly trained by the manufacturer of a proposed cabling solution, with proof of certification readily available upon request.
- .2 Only new products listed in this document may be used unless otherwise submitted for approval.

##### **1.3 Scope**

- .1 The Contractor shall be responsible for the complete supply and installation of the following where required:
- .2 Horizontal Cabling: Follow Cat 6 standards, including faceplates, Keystone jacks, patch cords, patch panels, etc.
- .3 Installation of cabinets and data racks supplied by Owner along with associated hardware.
- .4 Grounding of data racks/cabinets.
- .5 Testing of all horizontal voice, data, and backbone fibre cabling.
- .6 Contractor to make all necessary preparations, allowances and precautions to comply with the labour requirements for the job site to ensure that there will not be any disruption of work arising from the successful bidders work or workers.

##### **1.4 General Stipulations**

- .1 The Contractor shall furnish all labour, materials, tools and other equipment necessary to provide a complete horizontal and backbone (copper and fibre) cabling system.
- .2 The Contractor shall be responsible for the completion of all work included in the contract and shall employ certified, skilled technicians as necessary to satisfy all work and trades.
- .3 The Contractor shall carefully review all drawings (architectural, mechanical, electrical and communications) associated with the project and carry out the work so as not to delay or interfere with other trades.
- .4 The Contractor must comply with all requirements of the Occupational Health & Safety Act.
- .5 The Contractor shall provide all necessary permits to carry out their work.
- .6 Local codes shall take precedence over the drawings and specifications, except where the contract documents are more stringent, then the contract documents shall apply.

- .7 When the installation of the cabling system is completed and ready for acceptance the Owner shall be present for testing of the complete system.
- .8 All testing and retesting shall be done at the Contractor's expense.
- .9 Contractor to provide cable test results 10 (ten) business days prior to the cutover to the Owner for review.
- .10 A DRAFT network drawing, detailing physical port locations, quantities and identifications must be provided ahead of time for I&ITS Network Engineering to configure network equipment. This length of time is variable and is represented as a function of the number of data drops. Each drop requires approximately 7 minutes of configuration time, hence a network map for a building with 500 data drops must be provided at least 8 business days prior to commissioning network equipment:  $500 \text{ drops} \times 7 \text{ minutes per drop} = 3,500 \text{ minutes} = 58.33 \text{ hours}$ ;  $58.33 / 7.25 \text{ working hours per day} \approx 8.04 \text{ days}$ .
- .11 Contractor to provide a finalized network drawing reflecting the cable tray routing and all data drop labels. A network drawing is similar to, but less complex than, an as-built drawing. Its sole purpose is to depict the physical locations of each network wall jack and its associated label on a floor plan.
- .12 All network drawings and printing of drawings for the Owner shall be done at the Contractor's expense.
- .13 The Project Manager and lead technician that start the project must remain on the project until its completion.

## **1.5 Schedule Of Work**

- .1 The Contractor shall submit a schedule of work to be approved by the Owner. The schedule shall clearly indicate the proposed order in which the various activities will be undertaken and the estimated time required for the completion of the various activities.
- .2 The schedule of work may be revised periodically during the course of the project and must be approved by the Owner.

## **1.6 Clean-Up**

- .1 The working space, telecommunications rooms and office spaces must be swept and free of unused cables, cable clippings, cardboard boxes or any other debris produced by the Contractor, on a daily basis, by the end of each day, or as needed during the course of the day. The Contractor is responsible for removing all trash to outside garbage containers at least once a day. The Contractor shall provide a complete clean-up of the rooms at the end of the project or MAC work activity.
- .2 Workstation outlet location areas shall be cleaned on an on-going basis each time the Contractor completes any MAC work activity in the area.
- .3 Costs associated for keeping the areas clean are the responsibility of the Contractor.
- .4 Cleanliness of the site to be governed by the General Contractor/Construction Manager who may, after proper notice, back charge the Contractor for site clean-up.

## **1.7 Delivery and Storage**

- .1 Delivery and receipt of project materials shall be the sole responsibility of the Contractor to receive, move, secure and store all equipment and material. All delivery costs are to be included in the Contractor's proposal.
- .2 All cable to be used in the project shall be stored according to manufacturer's recommendations. In addition, all cable must be stored in a protected area. If cable is stored outside, it must be covered with opaque plastic or canvas for protection from the elements, with adequate ventilation to prevent condensation. If air temperature at the cable storage location will be below 4.4 °C (40 °F), the cable shall be moved to a heated location, minimum 10 °C (50 °F). If necessary, cable shall be stored off-site at the Contractor's expense.
- .3 The Contractor is allowed one (1) standard size job box on the site during construction. All tools, material and the job box are the sole responsibility of the Contractor. The Contractor is responsible for the complete storage, handling, moving, delivery and installation of all materials used in the performance of the work.

## **1.8 Project / Site Condition**

- .1 All bidders to arrange to obtain all necessary or referenced drawings and documents.
- .2 The Contractor is responsible for seeking clarification with the Consultant on how to address site and technical issues that may arise due to unforeseen difficulties. The Contractor is not to operate under assumptions and make design changes without prior approval of the Owner. Whenever necessary, clarification must be sought every time unpredictable difficulties arise, from start to completion of a project.
- .3 No claim for additional payment to be made for extra material or work made necessary by circumstances encountered due to conditions which were made visible upon, or reasonably inferable from thorough examination and review of all associated project documents, drawings and systems, prior to the submission of the response.
- .4 No claim for additional payment to be made for extra material or work made necessary by circumstances encountered due to conditions which were made visible upon visit to premises. The Contractor must be abundantly experienced to infer material and workmanship required to carry out work performed both within visible and obstructed, hidden and underground locations. Such assessment is to be performed prior to the submission of the response
- .5 During the implementation phase of a project, the Contractor is not to deviate, willingly or due to misunderstanding of documentation, from the specifications, diagrams and project documents provided by the Owner. Doing so will require immediate corrective action by the Contractor and additional costs incurred in order to match the implementation with the design and specifications of the project will be done without hesitation at the Contractor's expenses.
- .6 The cable routing diagrams only depict the cable routing and cable connectivity requirements. They are not installation drawings. Make all necessary allowances in the bid price to achieve the intent of the drawings.

## **1.9 Cutting and Patching**

- .1 Complete all cutting and patching required for the installation of the infrastructure.
- .2 In existing work and work already finished, cutting, patching and painting will be required by the Contractor.

- .3 Be aware of fire rated partitions and return all services to the condition encountered before start of the work.

#### **1.10 Site Responsibilities**

- .1 All pull strings present at the beginning of the installation must be returned or replaced to the initial state at the end of the communications cabling installation.
- .2 Do all cutting and patching required for the installation of the infrastructure.
- .3 The Owner is not responsible or liable for any missing material and/or tools belonging to the Contractor.
- .4 The Contractor is responsible for the removal and re-installation of all ceiling/floor tiles in the areas affected by its work. This is to be completed on a daily basis for the areas affected.
- .5 Any damage to ceiling tiles during the completion of any work outlined in this document is the responsibility of the Contractor. Damage includes breaking, chipping or smudging. The decision with respect to any damage will be made by the General Contractor, Project Manager and the Owner.
- .6 The Contractor is responsible for the storage and protection of the floor/ceiling tiles that are removed for cable installation.
- .7 Cabling that is not terminated on both ends, must not, under any circumstances, be abandoned in place. At the completion of work, the Contractor is responsible for end-to-end removal of dead and unterminated cables from existing conduits, raceways, fittings, cable trays, wiring troughs and any other apparatus used to protect and route cables, i.e. from 8P8C receptacles (a.k.a. RJ45 jacks) to the cable's termination point (usually a patch panel or network switch). Great care should be taken during the removal process so as to protect the existing live cables from damage.

#### **1.11 Terms and Conditions**

- .1 All terms and conditions of the specifications, bid documents and accompanying drawings to be strictly adhered to by the Contractor, unless otherwise noted.
- .2 Any inability to comply with these requirements must be stated in writing, in detail with the response submission. Otherwise, it will be understood that the Contractor is bound to the compliance with the stated terms and conditions.
- .3 Contractor to comply with the G.C. construction and installation schedule.
- .4 Do not assign or sub-contract any work without prior written consent from the IT department and or communication consultant.
- .5 Perform the complete installation in accordance with the latest editions of the Ontario and National Building Codes along with any other governing authorities of competent jurisdiction.

#### **1.12 Coordination**

- .1 Coordinate telecommunications work with that of the other trades.
- .2 Contractor to review any interference between general construction, telecommunications, architectural, mechanical, electrical, structural, and other specialty trades involved and bring it to the attention of the G.C.

### **1.13 Equipment and Identification**

- .1 All telecommunication equipment such as cabinets, racks and similar items shall be identified with labels which, ideally, should not exceed 8cm in length and 4cm in height.
- .2 Coordinate telecommunications work with that of the other trades.

### **1.14 Warranty**

- .1 Contractor shall warrant the materials and workmanship used in the installation of this project. Components must be covered by a manufacturer's warranty against defects in material and workmanship for a period of at least 25 years from the date test results are submitted to the manufacturer.
- .2 All cabling system will meet or exceed the UTP channel transmission requirements specified by ANSI/TIA 568-D.
- .3 Contractor shall provide all material and labour to make any deficiencies due to faulty materials or workmanship which become apparent within a one-year period.
- .4 All terminated horizontal cabling runs shall be 100% tested for defects in installation. Cabling system performance under installed conditions should comply to the requirements found in the TIA/EIA-568-C series of standards. All pairs in each installed cable shall be verified prior to system acceptance. Any defect in the cabling system installation, including (but not limited to) cables, connectors, and cordage shall be repaired or replaced in order to ensure 100% usability of all installed cable runs.
- .5 The communications Contractor shall submit the test results for the project to the Owner 10 (ten) business days prior to the cutover, as indicated in 1.5.9.
- .6 Upon completion of the testing by the Contractor for any MAC work, the Contractor shall submit to the Owner the network drawing, including cable ID numbers related to the cabling completed for the project, 10 (ten) business days prior to the cutover, as indicated in 1.5.10.
- .7 Failure to provide test results upon request will require the Contractor to retest all horizontal and or backbone cabling related to the project and any MAC work with no cost to the Owner.

### **1.15 Submissions**

- .1 The Contractor shall provide product data and shop drawings for all materials proposed for installation under this contract. The product data and shop drawings shall be submitted to the Owner for approval before such equipment is purchased and or delivered to the site.
- .2 Review all aspects of the specifications and drawings and identify any and all issues for inclusion in the contract documents examination report.
- .3 This section contains the definitions, acronyms and abbreviations that have special technical meaning or are unique to the technical content of this document

### **1.16 Standards**

- .1 The design considerations, and installation guidelines provided in this document are in part derived from recommendations found in recognized telecommunications industry standards. The following are used as guidelines.
  - .1 Spaces and Pathways  
TIA-569-B– Commercial Building Standard for Telecommunications Pathways and Spaces.

- .2 Grounding  
ANSI-J-STD-607-B – Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
- .3 Cabling Systems  
ANSI/TIA 568-C.0 Generic Telecommunications Cabling for Customer Premises.  
ANSI/TIA 568-C.1 Commercial Building Telecommunications Cabling Standard.  
ANSI/TIA 568-C.2 Balanced Twisted-Pair Telecommunications Cabling and Components Standards.  
ANSI/TIA 568-C.3 Optical Fibre Cabling Components Standard.
- .4 Cabling Administration  
TIA/EIA-606-B – Administration Standard for Commercial Telecommunications Infrastructure
- .5 Networking  
IEEE Standard 802.3an (2006) – 10GBASE-T
- .6 Design  
BICSI Telecommunications Distribution Methods Manual (TDMM) – 13th edition.
- .7 Installation  
BICSI Information Transport Systems Installation Manual (ITSIMM) – 6th edition.

#### **1.17 Definitions**

- .1 This section contains the definitions, acronyms and abbreviations that have special technical meaning or are unique to the technical content of this document.
- .2 Above Finished Floor (AFF) - Standard mounting height (e.g. 12-inch AFF) for a device using the centre line of the device as the measuring point.
- .3 Backbone - A facility (e.g. pathway, cable or conductors) between the telecommunications room and the main telephone room.
- .4 Bonding - The permanent joining of metallic parts to form an electrically conductive patch that will assure electrical continuity and the capacity to conduct safely any current likely to be imposed on it.
- .5 Cable - An assembly of one or more conductors or optical fibres within a sheath, constructed so as to permit use of conductors singly or in groups.
- .6 Entrance Room - A space in which the joining of inter or intra-building telecommunications backbone facilities takes place. An entrance room may also serve as the equipment room
- .7 Horizontal Cabling - Portion of the cabling system that extends from the work area outlet, through the cabling in the wall/ceiling/floor and then to the patch panel in the telecommunications room. The system also includes the patch cords at the work area outlet, and patch cords in the telecommunications room.
- .8 Intra-building Backbone - A backbone network providing communications within the building.
- .9 Inter-building Backbone - A backbone network providing communications for more than one building.
- .10 Patch Panel - A cross connect system of connectors that can be mated together to facilitates administration of a cabling system.

- .11 Pathway - A facility for the placement of telecommunication cabling.
- .12 Patch Cord - A length of copper or fibre cable with connectors on each end to be used to join telecommunications circuits/links at the cross-connects. Copper cables will usually, but not always, be of Cat 6 grade.
- .13 Telecommunications Room (TR) - An ample space in which the end of horizontal cabling is terminated in data racks. It connects to another TR or to the MTR for intrabuilding data and voice communication. The facility must be clean, dust-free and include proper air handling to regulate temperature and moisture in order to prevent the lifespan reduction of the equipment.
- .14 Main Telecommunications Room (MTR) - An ample space in which the end of horizontal and backbone cabling is terminated in data racks. It is also a TR and is usually the node assigned for inter-building data and voice communication. The facility must be clean, dust-free and include proper air handling to regulate temperature and moisture in order to prevent the lifespan reduction of the equipment.
- .15 Telecommunications Grounding Busbar (TGB) - A common point of connection for the telecommunications system and bonding to ground. It is located in the telecommunications room.
- .16 Telecommunications Main Grounding Busbar (TMGB) - A common point of connection for the telecommunications system and bonding to ground. It is located in the main telecommunications room.
- .17 Wireless Access Point (WAP) - The central or control point in a wireless cell that acts as a link for data traffic to and from the wireless devices in the cell.

#### **1.18 Acronyms and Abbreviations**

ACR	Attenuation-to Crosstalk Ratio
ANSI	American National Standards Institute
AWG	American Wire Gauge
BC	Building Conductor
BICSI	Building Industry Consulting Service International
BTU	British Thermal Unit
CATV	Community Antenna Television (cable television)
CCTV	Closed Circuit Television
CSA	Canadian Standards Association
CT	Cable Tray
dB	Decibel
DSL	Digital Subscriber Line
DSU	Digital Service Unit

EMT	Electrical Metallic Tubing
EP	Entrance Point
FOTP	Fibre Optic Test Procedure
Ga	Gauge
Gb	Gigabit
HC	Horizontal Cross-connect
HVAC	Heating, ventilating and air conditioning
Hz	Hertz
IC	Intermediate cross-connect
LAN	Local Area Network
MTR	Main Telecommunications Room
NIC	Network Interface Card
OSP	Outside Plant
OTDR	Optical Time Domain Reflectometer
PB	Pull Box
PE	Polyethylene RF Radio Frequency
RFI	Radio Frequency Interference
RMC	Rigid Metal Conduit
SM	Single-mode
TBB	Telecommunications Bonding Backbone
TBBIBC	Telecommunications Bonding Backbone Interconnecting Bonding Connector
UPS	Uninterruptible Power Supply
WAP	Wireless Access Point



**2 PRODUCTS**

**2.1 Not Used**

**3 EXECUTION**

**3.1 Not Used**

**END OF SECTION**

## **HANGERS AND SUPPORTS FOR COMMUNICATION SYSTEMS**

### **27 05 29**

## **1 GENERAL**

### **1.1 Work Included**

- .1 Comply with the general requirements and documents referred to within.
- .2 Provide labour, materials, products, equipment and services to complete the hangers and supports for communications systems work specified within.
- .3 To be read in conjunction with associated electrical and communication specification sections.

### **1.2 Quality Assurance**

- .1 Only new products and applications listed in this section may be used unless otherwise submitted for approval.

### **1.3 System Description**

- .1 Hangers and supports are to be supplied and installed as per this document and drawings to support the various cabling from the workstation to the overhead cable tray or to the MTR and/or TR locations.
- .2 For cabling run above suspended ceiling, adjustable cable supports specified in this Section are permitted.
- .3 Where cabling is run at high level in an open ceiling or is visible from the finished floor, adjustable cable supports are not permitted; cable shall be installed within conduit to the nearest suspended ceiling location.

### **1.4 Submittals**

- .1 Shop drawings for each type of product indicated in the following document, including construction details, material descriptions, dimensions of individual components and profiles and finishes for the products listed. Include rated capacities, operating characteristics along with furnished specialties and accessories.

## **2 PRODUCTS**

### **2.1 Adjustable Cable Supports (Cable Slings)**

- .1 nVent Caddy 425, or approved equivalent.
- .2 Suitable for use in air handling spaces.
- .3 Allow for attachment to ceilings, beams, walls, threaded rods and underfloor supports.
- .4 Support a minimum cable capacity of 210 Cat 6A.
- .5 Support a minimum static load of 46kg (100lbs).

### 3 EXECUTION

#### 3.1 Installation

- .1 The horizontal cabling pathway shall be a self-supporting system.
- .2 Cable supports shall not be attached to ceiling grid support rods, conduits, water pipes HVAC ducts or lighting fixture wires.
- .3 The cable supports shall be installed no more that 1.2 meters (48") apart.
- .4 All cable supports shall be rated for a minimum of Cat 6 for the structured cabling infrastructure.
- .5 In a ceiling distribution design, the cable supports shall be installed at a minimum of 36" clearance between the ceiling tile and the structured cabling pathway.
- .6 All hangers, rods and supports must be suspended from or attached to the structural steel, concrete slab and or walls with proper hardware designed to support their load bearing rating.
- .7 Only touch-fasteners (a.k.a. velcro fasteners) shall be used where required. Under no circumstances plastic zip ties and similar products shall be utilized.
- .8 Where support for horizontal cable is required, the contractor shall install appropriate sized cable supports to support the horizontal cabling listed in this document.
- .9 To minimize any possibility of disruption, maintain the following minimum clearances from electrical and heat sources when installing cable supports for the horizontal cabling pathway:

<b>CLEARANCES TABLE</b>	
Item	Minimum Clearance
Motor	1.2 m (4'-0")
Transformers	1.2 m (4'-0")
Conduit and cables used for electrical distribution less than 1kV	0.3 m (1'-0")
Conduit and cables used for electrical distribution greater than 1kV	1.0 m (3'-0")
Fluorescent Luminaires	12 cm (5")
Pipes (gas, oil, water, ETC.)	0.3 m (1'-0")
HVAC (equipment, ducts, etc.)	15 cm (6")

**END OF SECTION**

## **CONDUITS AND BACK BOXES FOR COMMUNICATION SYSTEMS**

### **27 05 33**

## **1 GENERAL**

### **1.1 Work Included**

- .1 Comply with the General requirements and documents referred to within.
- .2 Provide labour, materials, products, equipment and services to complete the conduits and back boxes for communications systems work specified within.
- .3 To be read in conjunction with associated electrical and communication specification sections.

### **1.2 Quality Assurance**

- .1 Only new products and applications listed in this section may be used unless otherwise submitted for approval.

### **1.3 System Description**

- .1 The conduits and telecommunication boxes are to be supplied and installed as per this document and drawings to support the various cabling from the workstation to the IT rack locations.

### **1.4 Submittals**

- .1 Shop drawings for each type of product indicated in the following document, including construction details, material descriptions, dimensions of individual components and profiles and finishes for the products listed. Include rated capacities, operating characteristics along with furnished specialties and accessories.

## **2 PRODUCTS**

### **2.1 Conduit**

- .1 All indoor conduits shall be thin wall EMT reamed and bushed at both ends provided by Division 26.
- .2 The external surface of all visible indoor conduits shall be painted as to match colours already existing on the surrounding structure so as not to create an unpleasant view.
- .3 Conduits exposed to the weather, in wet locations, subject to mechanical injury, or in any hazardous locations or where required by code, shall be rigid threaded, galvanized steel conduit.
- .4 Joints in conduits installed underground, in concrete slab on grade or in a concrete duct bank shall be made completely watertight.

### **2.2 In-Slab Floor Boxes**

- .1 All in slab floor boxes shall be constructed of galvanized steel and includes a lid assembly.
- .2 Box equipped with conduit knockouts at each end and on each side for conduit feeds for data cabling and power.
- .3 The lid to be available either recessed for carpet or tile or a flat flush lid.

- .4 The lid shall have an open for the easy access for data patch cords and power cords.
- .5 The floor box shall be a minimum of 12" x 12" x 5" deep.
- .6 Joints in conduits installed underground, in concrete slab on grade or in a concrete duct bank shall be made completely watertight.
- .7 Minimum concrete thickness over or around a conduit in a concrete slab shall be 75mm (3").

### **3 EXECUTION**

#### **3.1 Installation**

- .1 The inside radius of a bend in a conduit shall be at least 10 times the internal diameter of the conduit.
- .2 All zone conduits shall be identified and labelled at both ends. Tags shall identify the start and finish of conduit runs. Pull boxes shall be labelled on the exposed exterior.
- .3 All conduits dedicated for the communication structured cabling system shall not be shared with other services.
- .4 The telecommunication system shall be labelled green from end to end on conduits and at pull boxes.
- .5 All conduits shall originate and be physically connected to the IT rack, backboards, and pull boxes.
- .6 All fittings, connectors and couplings are to be steel.
- .7 All conduits entering or exiting through the ceilings or walls of the IT room shall be installed to 150mm above the communication rack.
- .8 All conduit runs shall follow the building grid lines and shall be concealed where possible.
- .9 Unless otherwise specified, all conduit runs shall be a maximum of 30 meters (100 feet) in length with a maximum of two ninety-degree bends between pull boxes.
- .10 A pull box shall be placed in conduit runs where the sum of the bends exceeds 180 degrees, where the overall length of the conduit run is more than 30m, or if there is a reverse bend in the run.
- .11 In all instances pull boxes shall be placed in straight sections of a conduit run and shall not be used in lieu of a bend. Corresponding ends of the conduit are to be aligned with each other.
- .12 Conduit fittings or pull elbows fittings shall not be used in place of pull boxes or bends.
- .13 Pull boxes shall be installed at a reasonable height, in an exposed location and such that access for the installation of cables is not prohibited.
- .14 Pull boxes shall not be placed in a fixed false ceiling space, unless immediately above a suitably marked and hinged access panel.
- .15 Provide and install 25mm (1") diameter green dot decals on the ceiling T-bar rail showing location of pull box.
- .16 Pull boxes shall be constructed and sized in accordance with the Ontario Electrical Code and ANSI/TIA standards of gauge steel and shall have a rust resistant finish.

- .17 Place pull boxes in readily accessible locations only.
- .18 Locations and sizes of all pull boxes shall be indicated on the design submission.
- .19 Pull boxes shall be placed in straight sections of a conduit run and shall not be used in lieu of a bend. Corresponding ends of the conduit are to be aligned with each other. Conduit fittings or pull elbow fittings shall not be used in place of pull boxes or bends.
- .20 All conduits shall be installed in accordance with the Canadian Electrical Code, Part 1 Section 12, applicable building codes and in accordance with TIA/EIA 569-B.
- .21 The use of C, LB, LL, LR and T type fittings or elbows fittings is not permitted.
- .22 The minimum size (inside diameter) for EMT conduit running between the IT room and the telecommunications outlet location is twenty-five millimeters (25mm) (1").
- .23 Cable fill of conduit, cable tray and raceways shall not be greater than 40% capacity.
- .24 A pull cord or fish tape shall be installed in all conduits.
- .25 Conduit must enter the outlet boxes from the top or bottom.
- .26 The contractor is responsible for cleaning all conduits prior to pulling any cable.
- .27 The outlet boxes shall be installed in the locations identified on the drawing. The outlet box shall be installed at 300mm (12") AFF or at the same height and within 300mm (12") of the adjacent electrical duplex receptacles, unless otherwise noted on the drawings. Wherever possible, the face of the plastic ring should be installed flush with the finished wall.
- .28 Back to back outlet boxes shall not be used.
- .29 Outlet boxes must be equipped with a plaster ring to accommodate the installation of the multimedia faceplate.
- .30 Plaster rings will be specified as a single or double gang to accommodate cabling requirements.
- .31 Plaster rings or raised adapter plates shall not reduce the size of the outlet such that two additional outlets could not be added in the future.
- .32 In slab floor boxes are to be sized to reflect the total quantity of data cabling along with power requirements.
- .33 See conduit fill chart in item 3.1.24 related to the size of conduits that are required for the number of data drops for floor boxes.
- .34 Quality and workmanship shall be at the highest of professional tradesman levels to be accepted for completion.
- .35 To minimize any possibility of disruption, maintain the following minimum clearances from electrical and heat sources when installing the horizontal conduits for the horizontal cabling pathway:

<b><i>CLEARANCE TABLE</i></b>	
<b>Item</b>	<b>Minimum Clearance</b>
Motor	1.2m (4'-0")
Transformers	1.2m (4'-0")
Conduit and cables used for electrical distribution less than 1kV	0.3 m (1'-0")
Conduit and cables used for electrical distribution greater than 1kV	1.0 m (3'-0")
Fluorescent Luminaires	12 cm (5")
Pipes (gas, oil, water, etc.)	0.3 m (1'-0")
HVAC (equipment, ducts, etc.)	15 cm (6")

- .36 For concrete wall locations the single channel shall be used and properly secured to the block wall.
- .37 If more than two data cables are to be installed at a single location the metal raceway is to be sized to accommodate the total number of data cables using the 40% fill ratio.
- .38 At the faceplate location a surface wiremold box is to be connected using proper mounting hardware to install voice and data cabling in a communication faceplate

**END OF SECTION**

## **DATA COMMUNICATIONS HORIZONTAL CABLING**

### **27 15 01 19**

#### **1 GENERAL**

##### **1.1 Work Included**

- .1 Comply with the General requirements and documents referred to within.
- .2 Provide labour, materials, products, equipment and services to complete the horizontal data cabling for communications systems work specified within.
- .3 To be read in conjunction with associated electrical and communication specification sections.

##### **1.2 Quality Assurance**

- .1 All materials, equipment and parts comprising the unit's specified within this document shall be new and unused and of a current manufacture.
- .2 Only new products and applications listed in this section may be used unless otherwise submitted for approval.
- .3 All horizontal data cabling must be certified to manufacturer's warranty of at least 25 years

##### **1.3 System Description**

- .1 The horizontal data cabling and its connecting hardware provides the means of transporting signals between the telecommunication outlet/connector and the horizontal cross connect location in the IT rack location. This cabling and its connecting hardware are called the "Permanent Link" a term that is used in testing protocols.
- .2 The horizontal data cabling shall not contain any transition points or consolidation points between the horizontal cross-connect and the telecommunications outlet/connector. If a transition point or consolidation point is necessary for the functionality of the horizontal data cabling, a request shall be submitted to the Consultant for approval.
- .3 Bridge taps and splices shall not be installed in the data horizontal cabling.
- .4 The maximum distance for horizontal data cabling is 90m.

##### **1.4 Performance Requirements**

- .1 The complete end-to-end horizontal cabling system shall meet or exceed the requirements for Category 6 cabling as specified by the TIA/EIA-568-C.2 Telecommunication Cabling Standard.

##### **1.5 Submittals**

- .1 Shop drawings shall be submitted for each type of product indicated or equivalent in the following document.



## **2 PRODUCTS**

### **2.1 Balanced Twisted-Pair Cables**

- .1 Data cabling shall be 4-pair balanced twisted pair Cat 6 UTP, plenum rated (CMP) cables for all cabling projects
- .2 The horizontal Cat 6 data cable jackets shall be blue in colour.
- .3 The cable conductors shall be #22 AWG solid copper.
- .4 The outside diameter (OD) shall be no greater than 6.73mm (0.265").
- .5 The minimum bend radius shall be no greater than four times the OD of the cable.

## **3 EXECUTION**

### **3.1 Data Cable Installation**

- .1 No data cable shall exceed 90 meters.
- .2 Pair untwist at the termination point shall not exceed 13mm (0.5").
- .3 Bend radius of the cable along its pathway and at the termination areas shall not be less than four times the OD of the cable.
- .4 The pulling tension on any 4-pair balanced UTP cable shall not exceed 110N (25lbf).
- .5 All cable ties shall be black, touch-fasteners (a.k.a. velcro fasteners) style.
- .6 No plastic cable ties are allowed. If found on site during any phase of the project the plastic cable ties will be removed by the contractor at the contractor's expense.
- .7 All exposed cables in IT racks are to be placed in a neat and professional manner and routed in accordance with the specifications and drawings provided.
- .8 If installing horizontal data cabling outlets/connectors through floors/walls and into furniture access locations, all exposed cabling at the workstation between the wall/floor and the furniture access locations is to be wrapped with black split loom tubing, size and length as required to suit.
- .9 Cable raceways shall not be filled greater than the TIA/EIA-569-B recommended maximum fill for the particular raceway type, or 40% whichever is less.
- .10 Cable support systems shall be provided and installed by contractor everywhere along the cable pathway and shall adhere to the following:
  - .1 All cable support systems shall be self-supporting.
  - .2 At no point shall cable(s) rest on acoustic ceiling grids, water pipes, metal conduits, ceiling panels or any other structure not defined as a cable support.
- .11 Horizontal data cables shall be bundled in groups of no more than 16 cables.

- .12 The horizontal data cable shall not be attached to above-ceiling services or any associated ancillary equipment or hardware. The cabling system and its associated pathways shall be installed so that they do not obscure any valves, fire alarm conduit(s), boxes, or other control devices.
- .13 Any data cable damaged or exceeding recommended installation parameters during installation shall be replaced by the contractor prior to final acceptance at no cost to the owner of the cabling system.
- .14 All data cables shall be identified by a self-adhesive label in accordance with the Identification for Comm. System section of this specification, Section 27 05 53.
- .15 All data cables must be terminated on the same floor as the workstation location.
- .16 Coloured jacks will be used to differentiate cable types. The colour scheme for 8P8C modular connector jacks (a.k.a. RJ45) is the following. Coordinate with Owner during shop drawing process prior to procurement.

\Description	Cable Type
Keystone Style T568A/B, Blue	Workstation Data Cabling
Keystone Style T568A/B, Yellow	Security Cabling
Keystone Style T568A/B, Orange	Wireless Access Point Data Cabling

- .17 Minimize any possibility of disruption, maintain the following minimum clearances from electrical and heat sources when routing cables:

<b>CLEARANCE TABLE</b>	
Item	Minimum Clearance
Motor	1.2 m (4'-0")
Transformers	1.2 m (4'-0")
Conduit and cables used for electrical distribution less than 1kV	0.3 m (1'-0")
Conduit and cables used for electrical distribution greater than 1kV	1.0 m (3'-0")
Fluorescent Luminaires	12 cm (5")
Pipes (gas, oil, water, etc.)	0.3 m (1'-0")
HVAC (equipment, ducts, etc.)	15 cm (6")

**END OF SECTION**

## **COMMUNICATION FACEPLATES AND CONNECTORS**

### **27 15 43**

#### **1 GENERAL**

##### **1.1 Work Included**

- .1 Comply with the General requirements and documents referred to within.
- .2 Provide labour, materials, products, equipment and services to complete the faceplates and connectors for the communications systems work specified within.
- .3 To be read in conjunction with associated electrical and communication specification sections.

##### **1.2 Quality Assurance**

- .1 All materials, equipment and parts comprising the unit's specified within this document shall be new and unused and of a current manufacture.
- .2 Only new products and applications listed in this section may be used unless otherwise submitted for approval.

##### **1.3 System Description**

- .1 The horizontal voice and data connectors provide the means of transporting signals between the telecommunication outlet/connector and the horizontal cross connect location in the IT rack locations.

##### **1.4 Performance Requirements**

- .1 The voice and data connecting hardware shall match the horizontal voice and data cabling specifications for performance

##### **1.5 Submittals**

- .1 Shop drawings shall be submitted for each type of product indicated or equivalent in the following document

#### **2 PRODUCTS**

##### **2.1 UTP Connectors**

- .1 Minimum rates for the 8P8C modular connector jacks (a.k.a. RJ45) are as follows: insertion loss 0.10dB @ 100MHz, return loss 27dB @ 100MHz.
- .2 The PSANEXT isolation between modules must be greater than 70dB @ 100 MHz when connectors are mounted side by side, top to bottom in a 48 ports 1U configuration.
- .3 Colour details for 8P8C modular connector jacks are found in section 27 15 01 19.

##### **2.2 Faceplates**

- .1 Available in 2, 4 and 6 port configurations for greater workstation outer density.
- .2 Faceplates shall be available in multiple colours to match any suit décor.

- .3 Faceplates are compatible for Cat 6 8P8C modular connector (Keystone).
- .4 Space to facilitate outlet labelling identification and ease of network management.
- .5 Blanks supplied to fill all unused ports.
- .6 Faceplates to fit over standard NEMA type outlet boxes or wall mounting bracket for flush mounting installations
- .7 Faceplates shall be able to fit over an interface adaptor boxes for surface mount installations.

### 3 EXECUTION

#### 3.1 Data Connector Termination

- .1 At the workstation faceplate terminate each data cable on a blue 8P8C modular connector Keystone jack wired TIA/EIA-568A ISDN standard.
- .2 The data 8P8C modular connector jack will be blue in colour and shall occupy the top left position of the 4-port faceplate (top to bottom).
- .3 Pinning of connectors shall be coordinated with Owner's Representative prior to termination.
- .4 Use blanks for all unused ports. Blanks to match faceplate colour.
- .5 Where communications are ganged with electrical decora type inserts are to be used and the colour is to match electrical.
- .6 Where the data cabling is terminated at a furniture workstation the 4-port faceplate shall be installed in an interface surface adaptor box and secured to the furniture base using short self-tapping screws. **(Do not install the self-adhesive product that is with the interface surface adapter box).**
- .7 Include all necessary furniture adaptors/spacers/surface boxes/Keystone type jacks and any other hardware required to ensure the faceplate can be properly installed/secured to the furniture while maintaining a proper bend radius.
- .8 Include all necessary adaptors/spacers/surface boxes/Keystone type jacks and any other hardware required to ensure the faceplate can be properly installed in the floor box while maintaining a proper bend radius.
- .9 Any data cable damaged or exceeding recommended installation parameters during termination shall be replaced by the contractor prior to final acceptance at no cost to the owner of the cabling system.
- .10 All data cables shall be identified by a self-adhesive label.
- .11 Each data cable shall be clearly labeled on the cable jacket within 4 inches of the termination behind the connector at the faceplate. Labels are to be a self-laminating wrap around style. Labels obscured from view will not be accepted and will be replaced by the contractor at no cost to the client.
- .12 The data cabling will be terminated on either existing patch panels or on new 48-port patch panels.
- .13 If existing patch panels are full, the contractor is to install new, black 48-port patch panels (match existing) that is to be properly secured to the existing 19" data rack.

- .14 If a new patch panel is installed below an existing full panel, a 2RU horizontal cable manager will be installed above the new panel to preserve the interlacing of patch panels and horizontal cable manger as per section 27 11 23.
- .15 Pair untwist at the termination point shall not exceed 13mm (0.5in).
- .16 All cable ties shall be black, touch-fasteners (a.k.a. velcro fasteners) style

**END OF SECTION**

## **ADDRESSABLE FIRE ALARM SYSTEM**

### **28 31 18**

## **1 GENERAL**

### **1.1 Summary**

- .1 Section includes:
  - .1 Materials and installation for fire alarm systems.
  - .2 Control panel to carry out fire alarm and protection functions including receiving alarm signals, initiating single-stage alarm, supervising system continuously, and initiating trouble signals.
  - .3 Trouble signal devices.
  - .4 Power supply facilities.
  - .5 Manual alarm stations.
  - .6 Automatic alarm initiating devices.
  - .7 Audible signal devices.
  - .8 Visual alarm signal devices.
  - .9 End-of-line devices.
  - .10 Ancillary devices.
  - .11 Sustainable requirements for construction and verification.

### **1.2 Related Sections**

- .1 Section 01 91 11 – Commissioning of Life Safety and Fire Protection Systems
- .2 Section 26 01 01 – Electrical General Requirements
- .3 Section 26 05 01 – Electrical Basic Materials and Methods
- .4 Section 26 05 02 – Paint for Electrical Services
- .5 Section 26 05 32 – Splitters, Junction and Pull Boxes, Cabinets
- .6 Section 26 05 33 – Conduits, Fastenings and Fittings
- .7 Section 26 05 35 – Outlet Boxes, Conduit Boxes and Fittings
- .8 Section 26 08 11 – Commissioning of Life Safety and Fire Protection Systems
- .9 Section 26 08 19 – Project Close-Out Electrical
- .10 Section 26 27 28 – Wire and Box Connectors 0-1000 V

### **1.3 References**

- .1 Government of Canada
  - .1 TB OSH Chapter 3-03, Treasury Board of Canada, Occupational Safety and Health, Chapter 3-03, Standard for Fire protection Electronic Data Processing Equipment.

- .2 TB OSH Chapter 3-04, Treasury Board of Canada, Occupational Safety and Health, Chapter 3-04, Standard for Fire Alarm Systems.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .3 Government of the Province of Ontario
  - .1 Ontario Building Code (O.Reg. 332/12, latest edition, including all amendments and references)
  - .2 Ontario Electrical Safety Code (CSA C22.1-18, latest edition, including all bulletins and references)
  - .3 Ontario Fire Code (O.Reg. 213/07, latest edition, including all amendments and references)
- .4 Underwriter's Laboratories of Canada (ULC)
  - .1 CAN/ULC-S524-14-AMD1, Standard for the Installation of Fire Alarm Systems.
  - .2 CAN/ULC-S525-16, Audible Signal Device for Fire Alarm Systems.
  - .3 CAN/ULC-S526-16, Visual Signal Devices for Fire Alarm Systems.
  - .4 CAN/ULC-S527-11-AMD1, Control Units.
  - .5 CAN/ULC-S528-14, Manual Pull Stations for Fire Alarm Systems.
  - .6 CAN/ULC-S529-16, Smoke Detectors for Fire Alarm Systems.
  - .7 CAN/ULC-S530-M91-R2018, Heat Actuated Fire Detectors for Fire Alarm Systems.
  - .8 CAN/ULC-S536-13, Standard for Inspection and Testing of Fire Alarm Systems
  - .9 CAN/ULC-S537-13, Standard for Verification of Fire Alarm Systems
- .5 National Fire Protection Agency
  - .1 NFPA-70-2020, National Electrical Code
  - .2 NFPA 72-2019, National Fire Alarm Code.
  - .3 NFPA 90A-2018, Installation of Air Conditioning and Ventilating Systems.

#### **1.4 Action and Informational Submittals**

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 26 01 01.
  - .2 Submit electronic copy of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS).
- .2 Shop Drawings:
  - .1 Submit shop drawings in accordance with Section 26 01 01.
    - (a) Shop drawings: stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
- .3 Include:
  - .1 Layout of equipment.
- .4 Zoning.

- .1 Complete wiring diagram, including schematics of modules.
- .5 Quality assurance submittals: submit following in accordance with Section 26 01 01.
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2 Instructions: submit manufacturer's installation instructions.
  - .3 Manufacturer's Field Reports: manufacturer's field reports specified.
- .6 Closeout Submittals:
  - .1 Submit maintenance and engineering data for incorporation into manual specified in Section 01 78 05 – Project Close-out in accordance with ANSI/NFPA 20.
    - (a) Engineer will delegate authority for review and approval of submittals required by this Section.
  - .2 Submit to Engineer electronic set of approved submittals and drawings immediately after approval but no later than 15 working days to prior to final inspection.
- .7 Include:
  - .1 Instructions for complete fire alarm system to permit effective operation and maintenance.
  - .2 Technical data - illustrated parts lists with parts catalogue numbers.
  - .3 Copy of approved shop drawings with corrections completed and marks removed except review stamps.
  - .4 List of recommended spare parts for system.
  - .5 Detailed maintenance instructions for control equipment and each device type, maintenance schedule in accordance with CAN/ULC-S536. Trouble shooting guide for control panels and devices.
  - .6 Copy of verification certificate, verification report and warranty certificates such as for fire alarm system, batteries, ancillary devices, and other similar items, including battery suppliers date coding for batteries.
  - .7 Name, address, and telephone number of service representative of manufacturer to be contacted during warranty period.
- .8 Submit the following for review by the Consultant:
  - .1 Manufacturer's data for:
    - (a) Control panel and modules.
    - (b) Storage batteries.
    - (c) Battery charger.
    - (d) Manual pull stations.
    - (e) Heat detectors.
    - (f) Open-area smoke detectors.
    - (g) Alarm speakers.
    - (h) Visible appliances / strobes.
    - (i) Main annunciator.
    - (j) Graphic annunciator panel.
    - (k) Control modules
    - (l) Monitor modules
    - (m) Isolation modules
    - (n) End-of-line devices
    - (o) Surge suppression devices.
  - .2 Mark data which describe more than one type of item to indicate which type will be provided.



- .3 Submit electronic original for each item and clear, legible, first-generation photocopies for remainder of specified copies for O&M manual.
- .4 System wiring diagrams:
  - (a) Complete wiring diagrams of system showing points of connection and terminals used for electrical connections in the system.
  - (b) Complete wiring diagrams of signalling circuits, including separate speaker and strobe circuits
- .5 Show modules, relays, switches, and lamps in control panel.
- .6 Design data: Power Calculations:
  - (a) Submit design calculations new work specified to substantiate that battery capacity exceeds supervisory and alarm power requirements.
  - (b) Show comparison of detector power requirements per zone versus control panel smoke detector power output per zone in both standby and alarm modes.
  - (c) Show comparison of notification appliance circuit alarm power requirements with rated circuit power output.
- .7 Schedules:
  - (a) Conductor wire marker schedule.
- .8 Test Reports:
  - (a) Open-area 2-wire smoke detectors.
  - (b) Preliminary testing:
- .9 Final acceptance testing.
  - (a) Submit for inspections and tests specified under Field Quality Control.

## **1.5 Quality Assurance**

- .1 Qualifications:
  - .1 Installer: company or person specializing in fire alarm system installations approved and/or certified by manufacturer.
  - .2 Provide services of representative or technician from manufacturer of system, experienced in installation and operation of type of system being provided, to supervise installation, adjustment, preliminary testing, and final testing of system and to provide instruction to project personnel.
- .2 System:
  - .1 To TB OSH Chapter 3-04.
  - .2 Subject to Fire Commissioner of Canada (FC) approval.
  - .3 Subject to FC inspection for final acceptance.
  - .4 To Ontario Fire Marshal approval.
- .3 Extra Materials:
  - .1 Provide maintenance materials in accordance with Section 01 78 05 – Project Close-out.
  - .2 Include:
    - (a) spare glass rods for manual pull box stations if applicable.
- .4 Maintenance Service:
  - .1 Provide one year's free maintenance with two inspections by manufacturer during warranty period. Inspection tests to conform to CAN/ULC-S536. Submit inspection report to Engineer.

## **1.6 Delivery, Storage, and Handling**

- .1 Packing, shipping, handling, and unloading:
  - .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

## **1.7 Maintenance**

- .1 Provide one (1) year free maintenance with two inspections by manufacturer during first year of operation. Inspection tests to conform to ULC-S536. Submit inspection report to Engineer.

## **1.8 Work Included**

- .1 Work to be done under this Section shall include furnishing of labour, materials, and equipment required for installation, testing and putting into proper operation complete fire alarm systems as shown, as specified and as otherwise required. Complete systems shall be left ready for continuous and efficient satisfactory operation.
- .2 Supply and install a complete and operating single-stage, zoned, addressable fully supervised microprocessor-based fire detection/alarm system as shown, as specified and as otherwise required. Complete systems shall be left ready for continuous and efficient satisfactory operation.

## **1.9 Scope of Work**

- .1 Provide a new fire alarm detection system with a fire alarm control panel to cover all areas of the project as indicated on the drawings.
- .2 Provide LCD displays at each annunciator location. The LCD annunciator shall be able to report all of the fire alarm system zones.
- .3 Establish detection loops for the project and as indicated on drawings and schedules.
- .4 The fire alarm system capacity shall account for the installation of all devices plus 25% spare capacity within each detection loop and address allocations in each of the control panels, distributed gathering panels, and annunciators so that the Owner only needs to install the devices in the future and field program the control panels to account for future devices.
- .5 At the completion of the Contract, the complex shall be left with a complete fire alarm and voice communication system accepted by the Local Authorities and meeting all applicable codes.

## **1.10 System Operation**

- .1 Provide complete, electrically supervised, code 3 temporal common coded, manual and automatic, zoned, annunciated, fire alarm system.
- .2 Single stage operation: operation to actuation following:
  - .1 Manual station.
  - .2 Heat detector.
  - .3 Smoke detector.
- .3 Actuation of single stage operation device to initiate following:
  - .1 Audible signal devices throughout building to sound continuously.
  - .2 Zone of alarm to be indicated on control panel and remote annunciator.

- .3 Transmit signal to fire department via monitoring station.
- .4 Operations to remain in alarm mode (except alarm notification appliances if manually silenced) until system is manually restored to normal.
- .4 Capability to program smoke detector status change confirmation on any or zones in accordance with CAN/ULC-S527, Appendix C.

#### **1.11 System Reset**

- .1 It shall not be possible to completely reset the fire alarm system until all alarm zones have been properly reset or cleared. The zone that is intentionally bypassed shall show as a trouble signal until the fault has been cleared.
- .2 When the system is reset to normal, a signal to the Building Automation System shall be provided to allow a staggering of the start-up of air handling systems at one minute intervals to insure that no more than 25% are started at the same time. Coordinate this programming and testing with the Building Operators.

## **2 PRODUCTS**

### **2.1 Materials**

- .1 Equipment and devices: ULC listed and labelled and supplied by single manufacturer.
- .2 Power supply: to CAN/ULC-S524.
- .3 Audible signal devices: to CAN/ULC-S525.
- .4 Visual signal devices: to CAN/ULC-S526.
- .5 Control unit: to CAN/ULC-S527.
- .6 Manual pull stations: to CAN/ULC-S528.
- .7 Thermal detectors: to CAN/ULC-S530.
- .8 Smoke detectors: to CAN/ULC-S529.

### **2.2 Control Panel**

- .1 Class A.
- .2 Single stage operation.
- .3 Zoned.
- .4 Non-coded.
- .5 Enclosure:
  - .1 CSA Enclosure 1, c/w lockable concealed hinged door, full viewing window, flush lock and 2 keys.
  - .2 Provide modular type panel installed in surface mounted steel cabinet with hinged door and cylinder lock.

- .3 Mount with panel centerline 1.5 m above finished floor elevation.
- .4 Switches and other controls: not accessible without use of key.
- .5 Design of control panel: neat, compact assembly containing parts and equipment required to provide specified operating and supervisory functions of system.
- .6 Control panel components: CSA approved and approved by control panel manufacturer for use in control panel.
- .7 Panel cabinet: finished on inside and outside with factory-applied enamel finish.
- .8 Provide main annunciator located on exterior of cabinet door or visible through cabinet door.
- .9 Provide audible trouble signal.
- .10 Provide permanent engraved metal identification plates (lamacoids), silk-screened labels attached to rear face of panel viewing window, for lamps and switches.
- .11 Provide one (1) set of Form C dry alarm contacts per zone, common system Form C dry alarm contact, and common system Form C dry trouble contact. Indicate set/unset condition of auxiliary transmitter by control panel.
- .12 Permanently label switches.
- .13 Provide panel with following switches:
  - (a) Trouble silencing switch which silences audible trouble signals including remote trouble devices without extinguishing trouble indicating lamp(s).
    - For non-self-resetting type switch: Upon correction of trouble condition, audible signals will again sound until switch is returned to its normal position.
    - For silencing switch of momentary action self-resetting type: trouble signal circuit automatically restored to normal upon correction of trouble condition.
  - (b) Evacuation alarm silencing switch which when activated will silence alarm notification appliances without resetting panel, and cause operation of system trouble signals. Subsequent alarm(s) from additional zone(s) not originally in alarm to cause activation of notification appliances even with alarm silencing switch in "silenced" position.
  - (c) Individual zone disconnect switches which when operated will disable only their respective initiating circuit and cause operation of system and zone trouble signals.
  - (d) Reset switch which when activated will restore the system to normal standby status after cause of alarm has been corrected, and activated initiating devices reset.
    - Operation of reset switch to restore activated smoke detectors to normal standby status.
  - (e) Lamp test switch.
  - (f) Drill switch which will enable test of notification appliances and restoration to normal without tripping master box.
- .6 Supervised, modular design with plug-in modules:
  - .1 Alarm receiver with trouble and alarm indications and provision for remote supervised annunciation, for class A initiating circuit.
  - .2 Spare zones: compatible with smoke detectors and open circuit devices.
  - .3 Space for future modules.
  - .4 Latching type supervisory receiver circuits. Discrete indication for both off-normal and trouble.
- .7 Components:
  - .1 Alarm continuous pulse rate panel for single stroke output to signal control panel.
  - .2 Audible signal control panel with control circuits (quantity as per Drawings) complete with terminals for wiring and plug-in modules for dc signals up to 2.0 A load with trouble indication with class A connections.

- .3 Common control and power units:
  - (a) Control panel containing following indications and controls:
    - "Power on" LED (green) to monitor primary source of power to system.
    - "Power trouble" indication.
    - "Ground trouble" indication.
    - "Remote annunciator trouble" indication.
    - "System trouble" indication.
    - "System trouble" buzzer and silence switch c/w trouble resound feature.
    - System reset switch.
    - "LED test" switch if applicable.
    - "Alarm silence" switch to silence signals manually. If new alarm occurs after signals have been silenced, signals to resound.
    - "Signals silenced" indication.
  - (b) Master power supply panel to provide 24 V dc to system from 120 V ac, 60 Hz input.
  - (c) Fire department connections:
    - Plug-in module for municipal box.
    - Fire department bypass switch c/w indicator for trouble at panel.
- .4 Auxiliary relays: plug-in type, dust cover, supervised against unauthorized removal by common trouble circuit and c/w individual bypass switch.
  - (a) Contacts: 2.0 A, 120 V ac, for functions such as release of door holders or initiation of fan shut down.
  - (b) Contact terminal size: capable of accepting 22-12 AWG wire.

## **2.3 Power Supply**

- .1 120 V, ac, 60 Hz input, 24 V dc output from rectifier to operate alarm and signal circuits, with standby power of VRLA batteries with a minimum expected life of 4 years, sized in accordance with OBC.

## **2.4 Manual Alarm Stations**

- .1 Provide non-coded double action type with mechanical reset features.
  - .1 Non-coded single pole normally open contact for single stage.
- .2 Stations: surface or semi-flush mounted and interior or weatherproof type as indicated, and as to match legacy installation.
  - .1 For surface mounting provide station manufacturer's approved back box.
  - .2 Back box finish to match station finish.
  - .3 Equip each station with terminal strip with contacts of proper number and type to perform functions required.
  - .4 Auxiliary contacts.
  - .5 Stations: type not subject to operation by jarring or vibration.
    - (a) Break-glass-front stations are not permitted.
  - .6 Station colour: red.
  - .7 Provide station with visible indication of operation.
  - .8 Restoration to require use of key.
    - (a) Keys: identical throughout system for stations and control panel(s).

- .9 Mount stations with operating lever not more than 1.2 m above finished floor, as per CAN/ULC-S524.
- .10 Where weatherproof stations are required, provide stations with cast metal, weatherproof housings with hinged access doors.
  - (a) Finish housings with red enamel paint and provide engraved metal bilingual signage indicating "FIRE ALARM" with white letters of 19 mm high.
  - (b) Include STI Stopper II for protection of weather-proof stations

## **2.5 Automatic Alarm Initiating Devices**

- .1 Heat detectors: provide heat detectors designed for detection of fire by combination fixed temperature rate-of-rise, or rate compensating as indicated on Contract Drawings:
  - .1 135 ° F, fixed temperature and 15 ° F per minute, rate of rise
  - .2 200 ° F, fixed temperature only
  - .3 as indicated on Drawings
- .2 Combination Fixed Temperature Rate-Of-Rise Detectors (Spot Type): designed for semi-flush outlet box mounting and supported independently of conduit, tubing or wiring connections.
  - .1 Contacts: self-resetting after response to rate-of-rise actuation
  - .2 Operation under fixed temperature actuation to result in external indication.
  - .3 Detector units located in boiler rooms, showers, or other areas subject to abnormal temperature changes to operate on fixed temperature principle only.
- .3 Rate Compensating Detector (Spot Type): designed for flush outlet box mounting and supported independently of conduit, tubing or wiring connections.
  - .1 Detectors: hermetically sealed and automatically resetting type which will operate when ambient air temperature reaches detector setting regardless of rate of temperature rise.
  - .2 Detector operation: not be subject to thermal time lag.
- .4 Open-Area Smoke Detectors: provide detectors designed for detection of abnormal smoke densities by photoelectric principle.
  - .1 Detectors: 4-wire type.
  - .2 Provide necessary control and power modules required for operation integral with control panel.
  - .3 Detectors and associated modules: compatible with control panel and suitable for use in supervised circuit.
  - .4 Malfunction of electrical circuits to detector or its control or power units to result in operation of system trouble signals.
  - .5 Equip each detector with visible indicator lamp that will flash when detector is in normal standby mode and glow continuously when detector is activated.
  - .6 Provide remote indicator lamps for each detector that is located above suspended ceilings or concealed from view.
  - .7 Each detector: plug-in type with tab-lock or twist-lock, quick disconnect head and separate base in which detector base contains screw terminals for making wiring connections.
  - .8 Detector head: removable from its base without disconnecting wires. Removal of detector head from its base to cause activation of system trouble signals.
  - .9 Screen each detector to prevent entrance of insects into detection chamber(s).

- .5 Photoelectric Detectors: operate on light scattering principle using LED light source.
  - .1 Detector: respond to both flaming and smoldering fires.
- .6 Locate detectors in accordance with their listing by ULC and the requirements of NFPA 72, except provide at least 2 detectors in rooms of 54 square meters or larger in area.
- .7 Mount detectors at underside of ceiling or deck above unless otherwise indicated, at highest point in the space, as per CAN/ULC-S524.
  - .1 For mounting heights of heat detectors greater than 3 m above floor level, reduce actual detector linear spacing from listed spacing as required by CAN/ULC-S524 (Figure 20).
  - .2 For heights greater than 9 m space detectors no farther apart than 34% of their listed spacing.
- .8 Temperature rating of detectors: in accordance with NFPA 72.
- .9 Locate detectors minimum 300 mm to lighting fixtures and not closer than 600 mm to air supply or return diffuser.
  - .1 Where the light fixtures project more than 100 mm from the surface of the ceiling, additional detectors are to be provided in accordance an uneven ceiling surface with CAN/ULC-S524. Confirm all applicable locations with Engineer prior to adjusting locations and quantities of detectors.
- .10 Ensure detectors, located in areas subject to moisture or exterior atmospheric conditions or hazardous locations as defined by OESC, are approved for such locations.
- .11 Provide detectors with terminal screw type connections.
- .12 Removal of detector head from its base to cause activation of system trouble.

## **2.6 Alarm Initiating Device Spacing and Location**

- .1 Detector spacing and location: in accordance with manufacturer's recommendations and requirements of NFPA 72.
- .2 Provide at least 2 detectors in rooms of 54 square meters or larger.
- .3 Spacing: not to exceed 9 m by 9 m per detector, and 9 linear m per detector along corridors.
- .4 Locate detectors minimum 600 mm from air discharge or return grille, and not closer than 300 mm to lighting fixtures.
- .5 In areas without finished ceilings, mount detectors at underside of deck above unless otherwise indicated.

## **2.7 Audible Signal Devices**

- .1 Provide remote system trouble buzzer arranged to operate in conjunction with panel's integral trouble signal.
- .2 Locate remote trouble buzzer.
  - .1 Provide external trouble buzzer at control panel arranged to operate in conjunction with panel's integral trouble signal.

- .2 Provide trouble buzzer with white on red engraved identification sign which reads "FIRE ALARM SYSTEM TROUBLE".
- .3 Lettering on identification sign: minimum 25 mm high.
- .3 Audible device(s):
  - .1 Wall-mounted / recessed horn shall be:
    - (a) at locations shown, and to meet audibility requirements of Ontario Building Code
    - (b) Compatible with 70 V amplifier system
    - (c) Rated to EIA Std RS-426A, and shall have a coil impedance of 8 Ohm, power rating of 20 Watt
    - (d) Line matching transformer shall be complete with ¼ Watt, ½ Watt, 1 Watt, and 2 Watt taps.
    - (e) Wide-dispersion bandwidth type, in a hemispherical pattern in both horizontal and vertical planes
    - (f) Permanently and completely sealed
    - (g) At the 1 Watt tap, speaker should achieve a minimum of 88 dBA sound pressure level at a distance of 3 metres from the speaker over a frequency range of 400 to 4000 Hz.
  - .4 Do not exceed 80 percent of listed rating in amperes of notification appliance circuit. Provide additional circuits above those shown if required to meet this requirement.
  - .5 Provide appliances specifically listed for outdoor use in locations exposed to weather.
  - .6 Finish appliances in red or white enamel. Red appliances are for all service areas; white appliances are for all public and finished spaces.
  - .7 For surface mounting provide appliance manufacturer's approved back box. Back box finish to match appliance finish.

## **2.8 Visual Alarm Signal Devices**

- .1 Surface or flush-mounted assembly of stroboscopic type suitable for use in electrically supervised circuit and powered from notification appliance circuits, as indicated on Contract Drawings.
- .2 Appliances: minimum of 15 candela measured as approved by ULC, but not less than effective intensity required by Ontario Building Code for appliance spacing and location.
- .3 Protect lamps with thermoplastic lens and labelled "FIRE" in letters at least 12 mm high.
- .4 Provide visible appliances integral to audible appliances in all locations where permissible by field conditions (i.e. conduit capacity, backbox dimensions, etc).
  - .1 Where not feasible to install single visible/audible device, provide visible appliances within 300 mm of each audible appliance, as shown on Drawings.

## **2.9 End-Of-Line Devices**

- .1 End-of-line devices to control supervisory current in signalling circuits, sized to ensure correct supervisory current for each circuit. Open, short or ground fault in any circuit will alter supervisory current in that circuit, producing audible and visible alarm at main control panel and remotely as indicated.



## **2.10 Central Processing Unit (CPU)**

- .1 Provide a functional microcomputer to serve as an interface and a controller for the input/output functions of the system. The CPU shall be suitably programmed to provide automatic operation of the life safety systems in response to an alarm condition.
- .2 The Fire Alarm/Detection and Voice Communication system software programming, operating system and data tables shall be permanently stored on non-volatile semiconductor memory chips. The CPU shall contain circuitry to continually monitor all microprocessor functions, communications and data processing hardware and shall initiate an audible and visual alarm to advise attending personnel of a failure.
- .3 It shall be possible to individually disable and enable any input, output, auxiliary circuit or entire DGP from the CPU or other DGP to facilitate maintenance and/or testing of a circuit or DGP on a standalone basis without initiating an alarm on the CPU as permitted by the applicable codes.
- .4 When a zone or DGP has been disabled, a trouble condition shall be initiated by the CPU and annunciated on the CACF and other control panels from which the system may be reset.
- .5 The CPU shall be incorporated in the CACF.

## **2.11 Common Control Panel**

- .1 The Common Control Panel shall have the following operator system indicators and controls:
  - .1 power on LED (green) to monitor primary source of power (L1) to system.
  - .2 ground fault LED (amber)
  - .3 system trouble LED (amber)
  - .4 system trouble silence switch. The system shall provide a subsequent alarm feature to re-sound the trouble signal, if required.
  - .5 fire department/common contact disconnected LED (amber) and disconnect switch and alert/activated LED (red).
  - .6 system reset switch.
  - .7 fan bypass switches.
  - .8 pressurization fan bypass switches.
  - .9 door holder and locking bypass switches.
  - .10 elevator bypass switches.
  - .11 vent bypass switches.

## **2.12 Power Supply**

- .1 Provide in each DGP an internal integrated power conditioner which includes surge suppression and circuitry for the elimination of voltage transients which may damage system components.
- .2 DC power supply for the fire alarm system shall be provided from a completely automatic battery charger and batteries forming part of the control panel.
- .3 An automatic charger with necessary equipment shall keep battery charged without requiring manual adjustment. The charger shall be supplied with a circuit which cycles the batteries to achieve full capacity charge. Arrange on outside of the panels: ammeter to indicate charging rate, voltmeter, AC power "ON" LED, AC "TROUBLE" LED and power failure signal and silencing switch.

- .4 The batteries shall be sufficiently sized to operate the system under supervisory load conditions without recharging for not less than 24 consecutive hours with sufficient power remaining to operate signals for at least 2 hours.
- .5 Battery charging circuits shall be sufficiently sized to charge fully depleted batteries to 70% of their maximum capacity within 12 hours.
- .6 Connect each control panel, DGP, RAU etc. to the existing emergency power circuit on the respective floor. Power wiring from the emergency panel to each fire alarm DGP and RAU shall be MICC, two hour rated cable or be installed in a two-hour rated enclosure such as in the concrete floor slab.

### **2.13 Off-Premises Fire Alarm**

- .1 Provide auxiliary connection to base fire alarm system in accordance with NFPA 72, except as specified.

### **2.14 Peripheral Alarm Initiating Devices**

- .1 Local control panels interfaced with other existing equipment such as pre-action systems or other control panels, shall be a single zone capable of operating on 120 VAC, 60 Hz and shall be complete with two isolated Form 'C' contacts and capability to initiate a fire alarm signal.

### **2.15 Grounding**

- .1 Ground each panel by connection from grounding terminal connection of box to existing grounding system connection.

### **2.16 Wiring**

- .1 Wire for 120 V circuits: No. 12 AWG minimum solid copper conductor.
- .2 Wire for low voltage DC circuits: No. 14 AWG minimum solid copper conductor
- .3 Wire to remote annunciators: No. 18 AWG minimum solid copper conductor.
- .4 Wire for connection to base telegraphic alarm loop: No. 10 AWG minimum solid copper conductor.
- .5 Insulation 90 degrees C minimum with nylon jacket.
- .6 For underground or wet allocations cable from control panel to auxiliary transmitter and to telegraphic loop: type UF.
- .7 Colour code wiring.

### **2.17 Surge Suppression**

- .1 Provide line voltage surge suppression devices to suppress voltage transients which might damage control panel components.
- .2 Mount suppressors in separate enclosure(s) adjacent to control panel unless suppressors are specifically UL approved for mounting inside control panel provided and approved for such use by control panel manufacturers.

## **2.18 Line Voltage Surge Suppressor**

- .1 Suppressor: ULC approved with maximum 330 volt clamping level and maximum response time of 5 nanoseconds.
- .2 Suppressor: multi-stage construction which includes inductors and silicon avalanche zener diodes.
- .3 Equip suppressor with LED which extinguishes upon failure of protection components.
- .4 Fuses: externally accessible.
- .5 Wire in series with incoming power source to protected equipment using screw terminations

## **2.19 As-built Riser Diagram**

- .1 Fire alarm system riser diagram: in glazed frame, minimum size 600 x 600 mm.

## **2.20 Ancillary Devices**

- .1 Remote relay unit to initiate fan shutdown.

## **2.21 Materials**

- .1 Fire alarm systems and components shall be:

### *Standard of Acceptance*

- Notifier
- Mircom
- Chubb Edwards
- Simplex

- .2 No alternate vendors will be considered without written approval from Owner and Consultant.

## **3 EXECUTION**

### **3.1 Manufacturer's Instructions**

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

### **3.2 Installation**

- .1 Installation of the Fire Alarm system components shall be in accordance with latest edition and all amendments of CAN/ULC-S524 Standard for the Installation of Fire Alarm Systems.
- .2 Install main control panel and connect to ac power supply, dc standby power.
- .3 Locate and install manual alarm stations and connect to alarm circuit wiring.
- .4 Locate and install detectors and connect to alarm circuit wiring.
- .5 Connect alarm circuits to main control panel.
- .6 Locate and install audible and visual signal devices and connect to signaling circuits.

- .7 Connect signaling circuits to main control panel.
- .8 Install end-of-line devices at end of Class B signaling circuits.
- .9 Locate and install door releasing devices.
- .10 Wire alarm initiating, alarm output, auxiliary output and signal devices to local DGP's as indicated in the schedules, or as required to meet Ontario Building Code.
- .11 Wire alarm initiating circuits. Connect detectors and manual stations. Properly arrange and connect circuit wiring to their respective circuits as shown on the drawings.
- .12 Provide a separate class A addressable Loop for each zone as indicated on the drawings.
- .13 Provide line isolators in all locations where required by CAN/ULC-S524 and Ontario Building Code.
- .14 Connect the addressable pull stations, intelligent smoke detectors, flow switches, valves, zone alarm modules etc. to the addressable loops.
- .15 Install wiring for the alarm signal, alarm initiating and speaker circuits in separate raceways.
- .16 Wire signal circuits alternatively such that no two adjacent signal devices are on the same circuit.
- .17 Synchronize the flashing of any visual signaling devices (e.g. strobes) where multiple devices are visible from a single location.
- .18 Synchronize the tones from any audible signaling device where multiple devices are audible from a single location.
- .19 Equip all raceways with a separate ground conductor and connect to ground bus in the Central Alarm Control Facility or local Satellite Control Panel.
- .20 Test each automatic detector to ensure correct wiring and zoning by setting off its rate of rise component and sounding the signals or by ringing it out. Test each smoke detector, annunciator, sprinkler system and standpipe system valves to ensure correct wiring.

### **3.3 Wiring**

- .1 Install wiring in conduit using wire size and type in accordance with manufacturer's recommendations, but in no cases smaller than specified herein.
- .2 Connect automatic detectors, smoke detectors and manual stations between red and black conductors at each outlet. Cut red and black conductors at each outlet and connect to terminal screws provided, red to red and black to black.

### **3.4 Manual Pull Station Mounting Height**

- .1 All manual pull stations are to be installed between 1050 mm and 1150 mm AFF, measured from the centre of the manual station, as per CAN/ULC-S524 and the current OBC amendments.
- .2 Where the existing infrastructure does not accommodate this mounting height, Contractor is to adjust the height in the field to meet this requirement.
  - .1 Masonry boxes: provide surface raceway to lower the mounting height of the pull station.
  - .2 Drywall boxes: remove existing box and replace with new at correct mounting height.

.3 Refer to Contract Drawings.

### **3.5 Field Quality Control**

#### **.1 Site Tests:**

- .1 Perform tests in accordance with Section 26 08 11 – Commissioning of Life Safety and Fire Protection Systems.
- .2 Fire alarm system:
  - (a) Test each device and alarm circuit to ensure manual stations, thermal and smoke detectors, sprinkler system, pre-action system monitoring, transmit alarm to control panel and actuate general alarm.
  - (b) Check annunciator panels to ensure zones are shown correctly.
  - (c) Simulate grounds and breaks on alarm and signalling circuits to ensure proper operation of system.
  - (d) Class A circuits.
    - Test each conductor on circuits for capability of providing alarm signal on each side of single open-circuit fault condition imposed near midmost point of circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.
    - Test each conductor on circuits for capability of providing alarm signal during ground-fault condition imposed near midmost point of circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.
  - (e) Class B circuits.
    - Test each conductor on circuits for capability of providing alarm signal on one side of single open-circuit fault condition imposed at electrically most remote device on circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.
    - Test each conductor on circuits for capability of providing alarm signal during ground-fault condition imposed at electrically most remote device on circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.
  - (f) Verify audibility of fire alarm system in all occupied areas to ensure compliance with Ontario Building Code.
    - Measure ambient noise sound pressure level in A-weighted decibels (dBA).
    - Measure sound pressure level during alarm in dBA.
    - Confirm alarm SPL is a minimum of 10 dBA higher than ambient noise, and no higher than 100 dBA in any location.

#### **.2 Manufacturer's Field Services:**

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

### **3.6 System Verification**

- .1 The fire alarm system shall be verified in accordance to CAN/ULC-S537 Standard for the Verification of Fire Alarm Systems.

- .2 The manufacturer of the fire alarm and voice communication system shall make a complete inspection of all components installed for system, such as manual stations, speakers, strobes, smoke detectors, annunciators, and voice communications to ensure the following:
  - .1 That the system is complete in accordance with Contract Drawings and Specifications.
  - .2 That the system is connected in accordance with Manufacturer's recommendations and requirements.
  - .3 That the regulations concerning the supervision of components have been adhered to (e.g. stations, detectors, supervised valves) and are properly wired and supervised.
  - .4 That all equipment as part of the system is inspected for visible damage or tampering which might interfere with its intended operation.
  - .5 That any subsequent changes necessary to conform to the above will be carried out with technical advice supplied by the Manufacturer.
  - .6 That all thermal detectors, smoke detectors and manual pull stations have been operated and are in good working order.
  - .7 That all annunciators correctly pinpoint the origin of any fire alarm.
  - .8 That actual smoke concentrations of sufficient density, have been applied to each new smoke detector to cause the detector to be set off and that the sensitivity of each smoke detector has been set. On completion of test, a letter shall be forwarded stating that tests have been completed and that system is operating correctly.
  - .9 All tests required by Local Authorities have been carried out and all zones have been verified.
- .3 Verification records shall be maintained with the following minimum requirements:
  - .1 verification records shall list each device and show the date on which each device was verified and the initials of the person who verified it.
  - .2 verification records shall show the date on which all devices were verified.
  - .3 verification records shall show the date of all deficiencies encountered in the control equipment, wiring and field devices.
  - .4 verification records shall show the date when deficiencies were corrected and re-verified
- .4 Provide any necessary equipment, test apparatus, ladders and scaffolding as required.
- .5 Adjust system and components as required to ensure complete system operation.
- .6 Only after the testing and verification task is completed, and all deficiencies rectified, notify the Engineers and representatives of the Fire Department and demonstrate the proper functioning of the system.
- .7 The system shall be capable of being reprogrammed when all the devices are finally installed.
- .8 Where partial occupancies occur, the fire alarm system for the area to be occupied (including control units, annunciators, etc) shall be tested and meet the requirements noted above. Upon system completion, those parts of the fire alarm system tested to this specification shall be retested in accordance with the requirements of CAN/ULC-S536, Standard for the Inspection and Testing of Fire Alarm Systems and as required by Local Authorities.
- .9 Fire Alarm system supplier shall provide assistance and support in achieving S1001 certification, in coordination with General and Electrical Contractors.

### **3.7 Training**

- .1 Provide five (5) days of on-site lectures and demonstrations by fire alarm equipment manufacturer to train operational personnel in use and maintenance of fire alarm system, including operation of the VDT.

### **3.8 Cleaning**

- .1 Proceed in accordance with Section 26 01 01 – Electrical General Requirements.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

### **3.9 Spare Materials**

- .1 Provide for the following devices, including a minimum of 25' of conduit, wiring, testing, verification and field coordination as spares in addition to the device quantities shown on the Contract Drawings:
  - .1 Two (2) manual pull stations c/w auxiliary contacts.
  - .2 Four (4) horns
  - .3 Three (3) visual strobes (assume max 30 candela).
  - .4 Two (2) control relay modules.
  - .5 Two (2) monitor modules.
  - .6 Four (4) smoke or heat spot detectors.
- .2 Any spare materials not used as part of this project are to be handed over to the Owner during project close-out.

### **3.10 Warranty for Equipment and Installation**

- .1 Provide a two (2) year full warranty for service and installation of the system for a period of two years beginning upon acceptance of the completed project.
- .2 Include a complete test and inspection at the end of the two years in accordance with the requirements of CAN/ULC-S536 "Standard for the inspection and testing of fire alarm systems."
- .3 Replace any defective components as the result of the test inspection.

### **3.11 Maintenance and Service Contract**

- .1 Provide a separate price for a service and maintenance program for a further three years from the end of the two-year warranty period.
- .2 The maintenance program shall include all testing as required by CAN/ULC-S536 and the replacement of any defective components at any time during the three-year maintenance period.
- .3 At the end of the three-year period a test inspection shall be conducted in accordance with CAN/ULC-536. Any defective components as well as all batteries shall be replaced.
- .4 Provide the Owner with complete inspection reports each time that an inspection is conducted.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Division 03 Cast-in-Place Concrete.
- .2 Landscape Drawings.

**1.2 REFERENCES**

- .1 ASTM International (ASTM)
  - .1 ASTM C33/C33M-24, Standard Specification for Concrete Aggregates.
  - .2 ASTM C140/C140M-24, Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
  - .3 ASTM C144-18, Standard Specification for Aggregate for Masonry Mortar.
  - .4 ASTM C936/C936M-24, Standard Specification for Solid Concrete Interlocking Paving Units.
  - .5 ASTM C1645-22a, Standard Test Method for Freeze-thaw and De-icing Salt Durability of Solid Concrete Interlocking Paving Units.
  - .6 ASTM D448-12 (2022), Standard Classification for Sizes of Aggregate for Road and Bridge Construction.
- .2 CSA Group (CSA)
  - .1 CSA A231.1:19/A231.2:19, Precast concrete paving slabs/Precast concrete pavers.
- .3 Interlocking Concrete Pavement Institute (ICPI) Guidelines.
- .4 National Concrete Masonry Association (NCMA) Guidelines.

**1.3 ADMINISTRATIVE REQUIREMENTS**

- .1 Pre-Installation Meeting: Convene pre-installation meeting one week prior to beginning work of this Section with Contractor and installer to:
  - .1 Verify project requirements.
  - .2 Review installation and substrate conditions.
  - .3 Coordination with other trades.

**1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data: Submit product data sheets, standard details and manufacturer's installation instructions.
- .3 Submit samples:
  - .1 Submit colour samples of pavers, polymeric sand, and joint fillers for initial selection by Consultant.
  - .2 Final colour and finish selections to be approved by Consultant from samples, prior to ordering materials for delivery.
- .4 Submit shop drawings:
  - .1 Indicate layout, pattern, and relationship of paving joints to fixtures and project formed details, and methods and details of edge restraint.



## **1.5 QUALITY ASSURANCE**

- .1 Qualifications:
  - .1 Installer: company or person specializing in precast concrete paver installations with 5 years documented experience and approved by manufacturer.
- .2 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
- .3 Mock-Ups:
  - .1 Provide mock-ups in accordance with Section 01 45 00 – Quality Control.
  - .2 Construct unit paver mock-up, 20 m<sup>2</sup> in area.
  - .3 Show construction and patterns including edge finishing.
  - .4 Construct mock -ups in locations as designated by Consultant.
  - .5 Consultant will evaluate mock-ups and may request changes or variation to materials.
  - .6 Accepted mock-ups will form standard for remaining unit paving work.

## **1.6 EXTRA MATERIALS**

- .1 Provide 30 extra paver units to Owner for maintenance purposes.

## **1.7 WARRANTY**

- .1 Submit manufacturer's limited lifetime product warranty.
- .2 Provide certificate warranting installation of concrete unit paving specified in this Section against movement of more than (1/4") 6 mm in any direction including heaving, sinkage or widening of joints, for 2-years from the Date of Substantial Completion.

## **Part 2 Products**

### **2.1 CONCRETE PAVERS**

- .1 Pre-cast pavers: to ASTM C936/C936M, permeable, slip-resistant texture.
  - .1 Compressive strength (ASTM C140): 8,000 psi.
  - .2 Water absorption (ASTM C140): Average 5%, but no greater than 7%.
  - .3 Freeze-thaw durability (ASTM C1645): pass.
  - .4 Size: 120 x 240 x 80 mm.
  - .5 Acceptable product: ECO PRIORA by Unilock,
    - .1 Colours and finish: As selected by Consultant from manufacturer's full range.

### **2.2 BEDDING AND JOINT MATERIAL**

- .1 Bedding material, As shown in Landscape Drawings.
- .2 Joint material: Permeable Joint Opening Aggregate materials conforming to ASTM C33 and gradation requirements of ASTM D448 No. 8.
- .3 Where pavers do not abut walls or concrete curbs, supply edge restraints as recommended by paver manufacturer, suitable to pavers being installed and site conditions, and as approved by Consultant.

## **2.3 ACCESSORIES**

- .1 Provide accessories recommended by paver manufacturer as required for complete installation.

## **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, as recommended by manufacturer for removal of contamination encountered on pavers.

## **Part 3 Execution**

### **3.1 COMPLIANCE**

- .1 Compliance: comply with manufacturer's published installation instructions, specifications, technical datasheets, and standard details.
- .2 Product installation shall be consistent with Interlocking Concrete Pavement Institute (ICPI) or National Concrete Masonry Association (NCMA) Guidelines.

### **3.2 STRUCTURAL SURFACE**

- .1 Verify that structural surfaces conform to levels and compaction required for installation of unit pavers. If discrepancies occur, Consultant and do not commence work until instructed Consultant.
- .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 Consultant and do not commence work until instructed by Consultant.

### **3.4 INSTALLATION OF EDGE RESTRAINTS**

- .1 Install restraints true to grade, in accordance with manufacturer's recommendations.

### **3.5 SUBBASE AND BEDDING PLACEMENT**

- .1 Bedding Course: coarse sand in accordance with ASTM D2940, compacted to 98% Standard Proctor Density and screeded over subbase.
  - .1 Ensure bedding material at all times is not saturated or frozen until installation is complete.
  - .2 Spread and screed material on subbase to achieve minimum 25 mm compacted thickness after vibrating pavers in place. Do not use joint sand for bedding sand.
  - .3 Do not disturb screeded material. Do not use bedding material to fill depressions in structural surface.

### **3.6 INSTALLATION OF CONCRETE PAVERS**

- .1 Lay pavers to pattern(s) indicated. Joints between pavers: 4 mm wide, or as recommended by manufacturer.

- .2 Use appropriate end, edge and corner stones. Saw cut pavers to fit around obstructions and at abutting structures.
- .3 Installation by mechanical equipment:
- .4 Prepare installation sequence and obtain approval of sequence by Consultant.
- .5 Place paver pallets and other materials without exceeding load bearing capacity, or otherwise detrimentally affecting installations.
- .6 Run equipment approved for installation only on paving surfaces vibrated in place.
- .7 Complete installation after placing each 100 square metres or after placing each 5 m width of installation.
- .8 Inspect pavers and remove chipped, broken or otherwise damaged pavers as directed by Consultant, or if structural performance or aesthetics is adversely compromised.
- .9 Replace pavers removed without altering layout and structural quality.
- .10 Use a low amplitude, high frequency plate compactor capable of at least 22 kN centrifugal compaction force to vibrate pavers into bedding sand.
- .11 Inspect, remove, and replace chipped, broken and damaged pavers.
- .12 Sweep dry joint aggregate material into joints.
- .13 Settle sand by vibrating pavers with plate compactor.
- .14 Continue application of joint material and vibrating of pavers until joints are full. Do not vibrate within 1 m of unrestrained edges of pavers.
- .15 Complete installation to within 1 m of laying face, with sand-filled joints, at completion of each workday, or before any work-stoppage greater than 1 hour.
- .16 Sweep off excess joint material when installation is complete.
- .17 Final surface elevations not to exceed plus or minus 10 mm under 3 m long straightedge.
- .18 Surface elevation of pavers: 3 to 4 mm above adjacent drainage inlets, concrete collars or channels.
- .19 Ensure conformance of final elevations.

### **3.7 CLEANING**

- .1 Carry out cleaning at times and conditions recommended by manufacturer of cleaning compound, immediately prior to sealing and as directed by Consultant.
- .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 FINAL CLEANING AND WASTE DISPOSAL**

- .1 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .2 Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.

### **3.9 PROTECTION**

- .1 Protect installed products and components from damage during construction.

- .2 Repair damage to adjacent materials caused by Work of this Section.

**3.10 SCHEDULE**

- .1 Refer to Landscape Drawings; coordinate with related Drawings and requirements.

**END OF SECTION**

**Part 1 General**

**1.1 SUMMARY**

- .1 This section includes requirements for supply and installation of perimeter foundation drainage system.

**1.2 RELATED REQUIREMENTS**

- .1 Division 31 Excavating, Trenching and Backfilling.
- .2 Mechanical: connections to sump pits and storm water management system.

**1.3 REFERENCES**

- .1 American Association of State and Highway Transportation Officials (AASHTO)
  - .1 AASHTO M 288-17, Standard Specification for Geotextile Specification for Highway Applications.
- .2 ASTM International (ASTM)
  - .1 ASTM C4-04(2023), Standard Specification for Clay Drain Tile and Perforated Clay Drain Tile.
  - .2 ASTM C136/C136M-19, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
  - .3 ASTM C444/C444M-21, Standard Specification for Perforated Concrete Pipe.
  - .4 ASTM C654-19, Standard Specification for Porous Concrete Pipe.
  - .5 ASTM D698-12 (2021), Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)).
  - .6 ASTM D4355/D4355M-21, Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc-Type Apparatus.
  - .7 ASTM D4491/D4491M-22, Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
  - .8 ASTM D4751-21a, Standard Test Methods for Determining Apparent Opening Size of a Geotextile.
  - .9 ASTM F449-20, Standard Practice for Subsurface Installation of Corrugated Polyethylene Pipe for Agricultural Drainage or Water Table Control.
  - .10 ASTM F1732-24, Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer and Drain Pipe Containing Recycled PVC Material.
  - .11 ASTM F1866-23, Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Schedule 40 Drainage and DWV Fabricated Fittings.
- .3 CSA Group (CSA)
  - .1 CSA B1800-18, Thermoplastic Nonpressure Piping Compendium, Includes Update No. 1 (2019).
  - .2 CSA G401-14(R2019), Corrugated Steel Pipe Products.
- .4 Ontario Provincial Standard Specification (OPSS)
  - .1 OPSS 1010, Material Specification for Aggregates – Base, Subbase, Select Subgrade, and Backfill Material, April 2013.

**1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:

- .1 Submit manufacturer's product literature for each product listed including manufacturer's recommended installation procedures and any modifications required to suit installation conditions.
- .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 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.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Corrugated PVC Drainage Pipe: corrugated polyvinylchloride perforated DWV pipe, to CSA B1800 (CSA B181.2) with tapered ends, 100 mm diameter.
  - .1 Provide all pipe fittings, and accessories such as factory-assembled expansion joints, closet flanges, backwater valves, and fire-stop fittings as required for a complete installation, to CSA B1800 (CSA B181.2).
- .2 Other pipe as indicated on the drawings or as directed by the Consultant, to CSA B1800.
- .3 Granular A and Granular B: to OPSS 1010.
- .4 Filter 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 Fabric: Woven geotextile fabric, manufactured for separation applications, manufactured from polyolefin or polyester and having elongation less than 50% in accordance with AASHTO M288 and as follows:
  - .1 Survivability: Class 2.
  - .2 Apparent Opening Size: 0.250 mm sieve, maximum in accordance with ASTM D4751.
  - .3 Permittivity: 0.02 per second, minimum in accordance with ASTM D4491.
  - .4 UV Stability: 50% after 500 hours' exposure in accordance with ASTM D4355.

## **Part 3 Execution**

### **3.1 TRENCHING AND BACKFILLING**

- .1 Perform excavating, trenching, and backfilling as indicated, and in accordance with the requirements of Section 31 23 33.01 – Excavating, Trenching and Backfilling.
- .2 Trim and compact base and subbase to provide firm uniform support throughout length of pipe.
- .3 Compact subbase to 100% SPD, to ASTM D698.

- .4 Compact base to 98% SPD, to ASTM D698.
- .5 Allow 200 mm clearance on both sides of pipe for specified granular materials.

### **3.2 GRANULAR FILL**

- .1 Place 200 mm layer of Granular A over 200 mm layer of Granular B and compact each layer in 100 mm lifts compacted to minimum 98% of maximum proctor density to ASTM D698.

### **3.3 INSTALLATION OF PIPE SUB-DRAINS**

- .1 Comply with ASTM F449 guidelines and requirements.
- .2 Lay pipe drains on prepared bed, true to line and grade with inverts smooth and free of sags or high points.
- .3 Place at trench bottom geotextile fabric of sufficient width to completely wrap around filter aggregate and pipe with minimum 300 mm overlap.
- .4 Provide pre-manufactured filter sock slipped over the perforated pipe.
- .5 Ensure barrel of each pipe is in contact with bed throughout full length.
- .6 Begin laying at outlet and proceed in upstream direction.
- .7 Lay perforated pipes on fabric with perforations 2/3 down.
- .8 Lay bell and spigot pipe with bell ends facing upstream.
  - .1 Do not mortar joints.
- .9 Make joints tight in accordance with manufacturer's instructions.
- .10 Make watertight connections to existing drains, new or existing manholes and catch basins where indicated or as directed by Consultant. Seal joints with approved sealant.
- .11 Plug open upstream ends of pipes with watertight concrete bulkheads.
- .12 Surround and cover drain with filter material in uniform 100 mm layers to an elevation of at least 200 mm above top of drain and compact to at least 98% SPD, to ASTM D698. Level aggregate surface and overlap geotextile fabric.
- .13 Backfill remainder of trench to Section 31 23 33.01 – Excavating, Trenching and Backfilling, and as directed by Consultant.
- .14 Do not place bedding surround and backfill materials in frozen condition.
- .15 Protect sub-drains against flotation during installation.
- .16 Install "Y" connections to surface as indicated for flushing.

### **3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning. Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3 Manage and dispose of demolition and construction waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.

**3.5 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

**3.6 SCHEDULE**

- .1 Install at perimeter of building slab-on-ground.

**END OF SECTION**