

**PART 1: GENERAL**

**1.1 GENERAL REQUIREMENTS**

- .1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

**1.2 RELATED WORK UNDER OTHER SECTIONS**

- .1 Contractor shall be responsible for coordinating this section with all related sections.

**1.3 REFERENCE STANDARDS**

- .1 All Codes, Standard Specifications and By-Laws referred to in this Specification shall be current editions including all latest revisions and addenda.
- .2 Conform with the Building Code from the province of construction.
- .3 Concrete Formwork is to conform with CSA Standard CAN3-A23.1.
- .4 Falsework, where required, is to conform with CSA Standard S269.
- .5 Assume full responsibility for the design and for the adequacy and for the safety of all formwork and falsework.
- .6 Conform with all applicable standards listed in National Building Code of Canada Table 1.3.1.2.

**1.4 SHOP DRAWINGS**

- .1 Formwork and supporting falsework shall be designed by a qualified professional Engineer registered in the province of construction and familiar with the methods and procedures to be employed, who shall be hired by the contractor.
- .2 Prepare drawings showing complete details of materials, design, fabrication and erection of formwork and falsework for the framed slabs. Formwork shall be constructed maintained and removed in conformity to these drawings, which must be stamped signed and dated by the professional engineer responsible for the formwork design. The contractor's engineer shall:
  - A) Design the formwork.
  - B) Produce formwork drawings.
  - C) Work out the procedures and timing for the removal of the forms.

- D) Set the procedure for controlling the strength of concrete in the structure for the purpose of form and re-shore removal.
  - E) Carry out field supervision of construction, maintenance, and removal of forms shores and re-shores, including the procedures for controlling the strength of concrete. An adequate number of inspections shall be performed by the contractor's engineer to enable him to certify that all requirements set in his drawings and instructions have been followed by the construction crew.
  - F) Issue construction reports to the Architect twice monthly.
  - G) Form removal and re-shoring shall not commence until in place strength of concrete is at least 75% of its specified 28 day strength or otherwise specified by the consulting engineer in writing.
- .3 Show on the drawings:
- .1 All materials, sizes, lengths and connection details.
  - .2 Field adjustment provisions.
  - .3 Anchors, shores and braces including spacing of diagonal bracing.
  - .4 Camber or adjustment elevations to compensate for settlement or deflection of forms, as well as any camber specified or noted on the drawings.
  - .5 Details on shoring, re-shoring or leaving original shores in place as forms are stripped.
  - .6 Locations and details of construction joints. Construction joints not shown on drawings shall be subject to structural consultant's approval.
- .4 Submit for review copies of drawings as directed by the Architect. Drawings to bear the stamp of the registered professional engineer responsible for the design.
- .5 Be responsible for the structural design of formwork, its construction, maintenance, and removal, including shoring and bracing, to ensure its stability and to support safely and resist loads imposed by weight of forms and wet concrete, wind, fluid pressure of concrete, equipment and workers.
- .6 Conform with the requirements of Regulatory Agencies including submission of required shop drawings. Proceed with construction of formwork only with the approval of the jurisdictional authorities.

## **1.5 CRANES OR OTHER CONSTRUCTION EQUIPMENT**

- .1 Submit for review as directed by the Architect, details of any crane or the construction equipment which is to be used to erect formwork and place concrete, which will affect the structure as shown on the structural drawings. Include details for dismantling and removal of crane upon Completion of Work.

## **PART 2 : PRODUCTS**

### **2.1 MATERIALS**

- .1 Formwork Lumber:  
  
Plywood and wood formwork materials are to conform with CSA Standard CAN3-A23M.
- .2 Plywood:  
  
Form plywood shall be exterior grade. Plywood shall be resin coated on side (in contact with concrete). Use sound undamaged plywood with clean true edges. Make-up or patching strips between panels shall be kept to a minimum.
- .3 Steel:  
  
Minimum 16-gauge sheet, well matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
- .4 Exposed Surfaces:  
  
Form materials for concrete surfaces which will be exposed to view, or which required smooth and uniform surfaces for applied finishes or other purposes, shall consist of square edged smooth panels of plywood, metal or plastic. The panels shall be square and made in a true plane, clean, free of holes, surface markings and defects.
- .5 Falsework Materials:  
  
To conform with CSA Standard S269. Materials shall bear grade marks or be accompanied with certificates, test reports or other proof of conformity.
- .6 Formwork Release Agent:  
  
Shall be a proprietary material which will not stain the concrete or impair the natural bonding or colour characteristics of coating intended for use on the concrete.
- .7 Chamfers wood, 45 degree cut from 1" x 1" or plastic type.

## **PART 3: EXECUTION**

**3.1 EARTH FORMS**

- .1 Obtain Engineer's approval for use of earth forms.
- .2 Hand trim sides and bottoms and remove loose earth from excavations before placing concrete.
- .3 Footings and caps to have plywood side forms unless otherwise approved by the Engineer.

**3.2 SURFACE CONDITIONS**

- .1 Examine the excavation and foundations for adequate working room and support for the Work of this Section. Report discrepancies which affect the Work in the Section.

**3.3 PREPARATION**

- .1 Coat the inside surface of forms with a form release agent, used in strict accordance with the manufacturer's instructions. Apply the agent prior to placing reinforcing steel, anchoring devices and embedded parts.
- .2 Do not apply form release agent where concrete surface will receive special finishes and applied coverings which would be affected by the agent. Soak the inside surface of untreated forms, subject to shrinkage or absorption of water, with clean water and keep surface wet prior to placing concrete.

**3.4 ASSEMBLY AND ERECTION**

- .1 Construct the formwork and shoring and bracing to meet the design requirements, accurately, so that the resultant finished concrete shall conform to the shapes, lines and dimensions of the members shown on the drawings (within the tolerances stipulated below).
- .2 Formwork shall be so arranged and assembled as to permit easy dismantling and stripping so that concrete will not be damaged during its removal.

**3.5 CAMBER**

- .1 Camber forms for slabs and beams  $\frac{1}{4}$ " per 10' – 0" of span, unless otherwise shown.
- .2 Uplift ends of forms for cantilever beams or slabs  $\frac{1}{4}$ " per 6' – 0" of cantilever length.
- .3 Maintain beam and slab thickness from cambered surface.

**3.6 TOLERANCES**



- .1 Variations from plumb: In 10' – 0" ...  $\frac{1}{4}$ ".
- .2 In any storey of 20' – 0", maximum ...  $\frac{3}{8}$ ".
- .3 Variation from level in tops of floor slabs: In 10' – 0" ...  $\frac{1}{4}$ ".
- .4 For exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines: In any bay ...  $\frac{1}{4}$ ".
- .5 Variation of the linear building lines from established position in plan and related position of columns, wall and partitions: In any bay of 20' – 0", maximum ...  $\frac{1}{4}$ ".  
In greater than 40' – 0" ...  $\frac{1}{2}$ ".
- .6 Variation in size of walls and floor openings: ... +  $\frac{1}{2}$ ".
- .7 Variation in cross-sectional dimensions:
  - .1 Variation in plan dimensions: -  $\frac{1}{4}$ " +  $\frac{1}{2}$ ".
  - .2 Slabs and walls: -  $\frac{1}{8}$ " +  $\frac{1}{4}$ ".
- .8 Footings and Caps:
  - .1 Variation in plan dimensions: -  $\frac{1}{2}$ " + 2".
  - .2 Variation in thickness: - 0".
- .9 Variation in steps: Rise  $\pm \frac{1}{8}$ ". Tread  $\pm \frac{1}{4}$ ".

### 3.7 JOINTS IN FORMS

- .1 Make form joints tight in order to prevent leakage of mortar. Keep form joints to a minimum.
- .2 Form chases, slots, openings, drips, recesses, expansion joints and control joints as detailed.

### 3.8 SHORING AND BRACING

- .1 Provide bracing to ensure the stability of the formwork as a whole. Prop or strengthen all previously constructed parts liable to be overstressed by construction loads.
- .2 Provide a positive means for adjustment of shores and struts and to take up settlement of formwork during placing of concrete.

### 3.9 TEMPORARY PORTS AND OPENINGS

- .1 Provide temporary ports or openings where required to facilitate cleaning and inspection. Such openings are to be closed with tight fitting panels so that joints will not be apparent in exposed concrete surfaces.

### **3.10 FORMWORK SCHEDULE**

- .1 Concrete Finish C-1:
  - .1 Plywood panel forms for surfaces not exposed to view.
- .2 Concrete Finish C-2:
  - .1 Plywood panel forms, snap form ties, with tie holes patched immediately after forms are stripped, for surfaces exposed to view and surfaces to receive waterproofing and sandblasted finish.

### **3.11 FIELD QUALITY CONTROL**

- .1 Inspect and check the complete formwork, shoring and bracing to ensure that the work is in accordance with the formwork design. The engineer responsible for the design of the formwork shall assist in this inspection.
- .2 Obtain the approvals of the engineer responsible for the design of the formwork and the general approval of the engineer before placing concrete.
- .3 If requested, submit test data on patented and proprietary devices and assemblies that are proposed for use on the Work.

### **3.12 CLEANING**

- .1 Clean the forms as erection proceeds to remove foreign matter. Remove cuttings, shavings and debris from within the forms.

### **3.13 REMOVAL OF FORMWORK**

- .1 Do not remove forms, shores and bracing until the concrete has gained sufficient strength to carry its own weight and construction and design loads which are liable to be imposed on it. The strength of concrete shall be verified by compressive test results to the approval of the Engineer.
- .2 Where early stripping of forms is contemplated, comply with Section 03 30 00 Cast-In-Place Concrete.
- .3 Remove falsework progressively so that no shock loads or unbalanced loads are imposed on the structure. In general, and unless otherwise approved by the Engineer, load supporting forms may be removed when the concrete has attained 75% of the required design 28 day compressive strength, provided the construction is re-shored.

- .4 Forms not directly supporting the weight of concrete may be removed as soon as stripping operation will not damage concrete.
- .5 The following is a table of minimum time that forms should remain in place under ordinary conditions, unless otherwise specified, but compliance with these requirements shall not relieve the Contractor of his obligation to delay the removal of forms if the concrete has not set sufficiently so as not to cause any damage whatsoever..

.1 Beam Soffits	28 days or 7 days if re-shored, and 75% of specified 28 day strength is achieved in the concrete elements.
.2 Columns	24 hours.
.3 Walls	24 hours.
.4 Sides of Beams & Slabs	24 hours.
.5 Soffits of Slabs	28 days or 7 days if re-shored and 75% of the specified 28 days strength of the concrete has been achieved.
.6 Removal of Re-shores	28 days, if no formwork is erected or to be erected above same.

.6 Minimum Curing Period Prior to Form Removal:

- |                                   |        |
|-----------------------------------|--------|
| .1 Air Temperature: Above 15C:    | 3 days |
| .2 Air Temperature: 10C to 15C:   | 5 days |
| .3 Air Temperature: 5C to 10C:    | 7 days |
| .4 Air Temperature: Less than 5C: |        |
- When temperature below 5C prevails, leave forms until concrete reaches 75% of 28 – day design strength.

- .7 Observance of minimum curing periods listed above does not relieve Contractor of responsibility for safety of structure during construction.
- .8 Any stripping sequence at an accelerated rate than that given above, requires approval of the Engineer. Approval and instruction to be in writing and at no cost to the Owner.

### 3.14 RE-SHORING

- .1 Re-shore in two directions so that no large areas of new construction are permitted to support their own weight. Install re-shores at mid-span of members and in no case at more than 10' – 0" on centre. Tighten re-shores to carry the weight of new

- construction and any loads imposed thereon. Do not over-stress new construction by over-tightening.
- .2 Leave re-shores in place beneath framed slabs which support the weight of newly placed concrete above. Locate such shoring so that it is concentric with shoring above and leave in position until the newly placed concrete reaches at least 75% of its specified 28-day compressive strength.
- .3 The Contractor shall be responsible for the design, installation and maintenance of the re-shoring system.

**END OF SECTION**

**PART 1:     GENERAL**

**1.1           GENERAL REQUIREMENTS**

- .1       General Conditions, Supplementary Conditions and Division 01 apply to this section.

**1.2           RELATED WORK UNDER OTHER SECTION**

- .1       Contractor shall be responsible for coordinating this section with all related sections.

**1.3           REFERENCE STANDARDS**

- .1       All Codes and Standards referred to in this Specification shall be current editions including all latest revisions and addenda.
- .2       Conform with CSA-A23.1, .2, and .3.
- .3       Conform with the Building Code from the province of construction.
- .4       Conform with ACI Standard 315 and the RSIO Manual of Standard Practice.
- .5       Conform with CSA Standard G30.12.
- .6       Conform with CSA Standard G30.5.
- .7       Conform with ASTM A775.

**1.4           SOURCE QUALITY CONTROL**

- .1       Provide certified copies of mill test reports of steel supplied, with each major shipment to the site.
- .2       If requested by Engineer, submit test data from an approved testing company that each size and grade of reinforcing steel meets the Specification requirements. Pay for cost of such testing.
- .3       Any reinforcing which fails to conform with the Specification requirements shall be removed from the site and replaced at no additional expense to the contract.
- .4       Comply with Section 03 30 00 Cast-In-Place Concrete.

**1.5           SHOP DRAWINGS**

- .1       Provide shop drawings (placing drawings and bar bending schedules) showing dimensions and information necessary for fabrication and placing the reinforcing steel, without recourse to the structural drawings.
- .2       Submit copies in accordance with Section 01 30 00 Administrative Requirements.

- .3 Generally, placing diagrams shall be in accordance with the Manual of Standard Practice for Detailing Reinforced Concrete Structures ACI-315 and the RSIO.
- .4 Structural drawings take precedence over placement drawings and bar schedules unless otherwise instructed, in writing, by the Engineer.
- .5 Conform with the typical details shown on the structural drawings.

**1.6 SUBSTITUTIONS**

- .1 Substitution of different size bars permitted only with written approval of the Engineer.

**PART 2: PRODUCTS**

**2.1 MATERIALS**

- .1 Reinforcing Bars:  
  
Shall be new deformed "hi-Bond" bars of Canadian manufacture conforming with CSA Standard G30.18 with a minimum yield stress of 400 MPa. All bars shall have typical identification patterns of Canadian producers and standard identification requirements as shown in the RSIO Manual of Standard Practice.
- .2 Welded Wire Mesh:  
  
Shall conform with CSA Standard G30.5. Shall be supplied and stored in flat sheets.
- .3 Epoxy Reinforcing Bars:  
  
To meet specified requirements of ASTM Specification A775.
- .4 Provide chairs, bolsters, bar supports, side wall spacers and spacers adequate for strength and support of reinforcing to satisfy the construction conditions. Chairing of slab steel shall be in accordance with the Standard Practice - Bar Supports Section of the Reinforcing Steel Manual of Standard Practice produced by The Reinforcing Steel Institute of Canada. Reinforcing steel shall be tied and supported such that it cannot be displaced by normal or expected construction activity. Any and all reinforcement not adequately secured in place shall be rectified prior to concreting. Always provide support bars below the lowest layer of top steel. Main reinforcement, hung from the support bars, will be rejected.
- .5 For exposed architectural concrete surfaces, use solid plastic chairs and/or side wall spacers, etc.
- .6 Tie wires shall be annealed wire No. 16 (U.S. Standard Gauge), or heavier or an approved proprietary system, conforming with CSA G30.3. Provide epoxy or plastic-coated wires to tie epoxy coated reinforcing steel.

- .7 Wire mesh laps shall be minimum 150 mm.

## **2.2 FABRICATION**

- .1 Fabricate and place all reinforcement in conformity to current manual of standard practice for detailing reinforced concrete structures A.C.I. 315, CSA-A23.1, CSA-A23.3, and reinforcing steel manual of Standard practice by RSIO.
- .2 Where tension laps are specified, lap reinforcing steel in accordance with the requirements of CSA-A23.3. All other laps and embedment of dowels shall be 24 bar diameters, but not less than 450 mm if not specified otherwise.
- .3 Location of splices not shown on the drawings shall be approved by the Engineer and shall, for beams and slabs, be away from points of maximum stress.
- .4 Ship bundles of bar reinforcement, clearly identified in accordance with the bar lists.

## **PART 3: EXECUTION**

### **3.1 EXAMINATION**

- .1 Examine Work upon which this Section depends and report any discrepancies to the Architect and Engineer, before proceeding with the Work.

### **3.2 PLACING OF REINFORCEMENT**

- .1 Conform with CSA-A23.1.
- .2 Place reinforcing within the following tolerances:
  - .1 For clear protection of reinforcement  $\pm 6\text{mm}$ .
  - .2 Lateral spacing of bars shall be within  $\pm 25\text{mm}$  of the specified spacing.
  - .3 For longitudinal location of bends and ends of bars  $\pm 50\text{mm}$  except discontinuous ends  $\pm 20\text{mm}$ .
- .3 Side form spacers shall be used for all column, beam and wall construction to secure reinforcement against displacement and maintain required cover distance between the reinforcement and the vertical formwork.
- .4 Spacing of bars shall be approximately uniform within the corresponding strips of two-way slabs. Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain approval of all modifications from the structural engineer before placing concrete..

- .5 All materials shall be clean and free of all deleterious material. All deleterious material shall be removed in a manner acceptable to the Engineer.
- .6 Provide dowels from all footings into reinforced concrete walls, piers and columns. Column dowels shall be secured in position before concrete is placed.
- .7 Where new concrete abuts existing concrete; dowels shall be drilled in and epoxy grouted to existing concrete. Size, and number of dowels to match reinforcement in new concrete which runs perpendicular to the face of the existing concrete. If not specified on drawings, assume min. 200mm embedment into existing concrete. Lap length as per above specification. (This does not apply at expansion joints).
- .8 Reinforcement around openings to be provided in accordance with typical details unless if not specified elsewhere on drawings.

### **3.3 EPOXY COATED REINFORCING STEEL**

- .1 All reinforcing steel used in cast-in-place concrete work which is within 60mm of concrete surfaces which are exposed to weather (including slab soffits), in contact with earth (unless scheduled to receive a waterproof membrane), or where so indicated on the drawings shall be fusion bonded epoxy coated (F.B.E.C.). Such coating shall conform to ASTM Specification A775.
- .2 All handling and hoisting of F.B.E.C. reinforcing steel shall be performed using methods and equipment designed to minimize damage to the epoxy coating. Use nylon or padded lifting slings at multiple pick-up points to keep curvature of bundles of bars to a minimum. Bundled bars shall not be dropped or dragged.
- .3 Bars bundled for shipping shall have padded ties. Bundles shall be stored on padded or wooden cribbing. Foot traffic on coated bars shall be discouraged at all stages of the construction process.
- .4 Inspect reinforcing steel for coating damage after unloading and during and after the placing operation.
- .5 Repair all areas of damage where the total damaged area does not exceed two percent of the total bar surface. Where damage exceeds two percent of the total bar surface, the bar shall be replaced.
- .6 Where rusted areas or areas of cracking and debonding occur, the bar shall be cleaned using power tools and the coating repaired or the bar replaced according to the previously described "two percent" criteria.
- .7 Repair all damage using patching material conforming to ASTM Specification A775-86 applied as recommended by the manufacturer. Temperature and moisture conditions shall be suitable during repairs.
- .8 All F.B.E.C. reinforcing steel shall be set in position on the forms using plastic low and



high chairs and shall be tied firmly in place using plastic- or plastic-coated tie wire to avoid damage to the epoxy coating.

- .9 During concrete placing operations, suitable care shall be employed in the use of equipment and tools to avoid damage to the coating of the bars.
- .10 All supplementary chair, spreader or separator bars used to support F.B.E.C. reinforcing steel in position shall be epoxy coated, or solid plastic. In no case shall epoxy coated steel reinforcement be in contact with black steel. Epoxy coated steel installed against black steel will be removed and replaced at the contractor's expense.
- .11 All F.B.E.C. reinforcing steel shall be bent cold. All field-cut ends of F.B.E.C. reinforcing steel shall be coated with approved patching material.

### **3.4 FIELD REVIEW**

- .1 Refer to Section 03 30 00 Cast-In-Place Concrete.

**END OF SECTION**

**PART 1: GENERAL**

**1.1 GENERAL REQUIREMENTS**

- .1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

**1.2 RELATED WORK UNDER OTHER SECTIONS**

- .1 Contractor shall be responsible for coordinating this section with all related sections.

**1.3 REFERENCE STANDARDS**

- .1 All Codes, Standard Specifications and By-Laws referred to in this Specification shall be current editions including all revisions and addenda.
- .2 Conform with the Building Code from the province of construction.
- .3 Conform with CSA Standards CAN3-A23.1, .2, and .3. (References made to CAN/CSA A23M shall mean whichever Part .1, .2 or .3 that is relevant to the topic.)
- .4 Conform with all applicable standards listed in National Building Code of Canada Table 1.3.1.2.

**PART 2: PRODUCTS**

**2.1 GENERAL**

- .1 Provide new materials equal in all respects to those specified.
- .2 No substitutions will be allowed unless the following arrangements are made:
- A) Written permission is obtained from the architect/engineer
  - B) The contractor ensures that substitutions can be both physically and dimensionally incorporated in the work with no loss of intention, function or construction time and at no additional cost to the owners.

The contractor shall reimburse all consultants for additional expenses due to these substitutions.

**2.2 MATERIALS**

**.1 Cement:**

Provide Portland Cement of Canadian Manufacture conforming with CSA Standard CAN/CSA-A5. **Type GU**, unless noted otherwise on plans, (from the same source for entire project for concrete exposed to view.)

**.2 Aggregates:**

- .1 Provide clean, uncoated sand and coarse aggregates from approved sources which conform with CSA Standard CAN3-A23.1. Nominal size of coarse aggregate shall be 20mm unless otherwise stated on the structural drawings or specification.
- .2 Coarse aggregate for concrete in 300mm to 375mm thick columns shall be of calcareous nature and shall contain a combined total of not more than 10% of quartz, chert and flint.
- .3 **Water:**  
  
To CSA-A23.1. Verify that no salts are present which will cause efflorescence.
- .4 **Ready Mix Concrete:**  
  
Shall be quality controlled concrete conforming with CSA-A23.1.
- .1 Unless noted on drawings, the following concrete mixes and 28-day compressive strengths for concrete shall be used:  
  

Interior Foundations.....	25 MPa	Class N
Exterior Foundations.....	25 MPa	Class F2
Basement walls.....	25 MPa	Class F2
Foundation walls.....	25 MPa	Class F2
Grade beams.....	25 MPa	Class F2
Interior slab-on-grade.....	25 MPa	Minimum cement content 280kg/m <sup>3</sup> Maximum water/cement ratio 0.55
Interior piers, walls, columns and all other interior concrete.....	25 MPa	Minimum cement content 280kg/m <sup>3</sup> Maximum water/cement ratio 0.55
Retaining walls.....	35 MPa	Class C1
Parking structure slabs, walls and columns.....	35 MPa	Class C1
All exterior reinforced concrete.....	35 MPa	Class C1
All exterior unreinforced concrete.....	32 MPa	Class C2
- .2 Concrete shall also conform to the following:
  - a) Conform with the requirements of CSA-A23.1.

- b) The coefficient of variation of 28-day compressive test results shall be in the "Good or Better" range (15% variation is acceptable) as laid down in ACI 214.
- c) Chlorides of any kind shall not be used.
- d) Limit water / cement ratio of mixes to no more than the requirements of CSA-A23.1 or as specified on the structural drawings/specifications, whichever is less.

**.5 Slumps:**

In accordance with CSA-A23.1 unless otherwise noted on structural drawings.

**.6 Admixtures:**

Where permitted, shall conform with CSA -A266M.

- .1 Water Reducing Admixtures: CSA-A266.2 and A266.4.
- .2 Air Entrainment: CSA-A266.1.
- .3 Chemical Admixtures: CAN3-A266.2 and A266.4, Type A – water reducing.
  - a) Admixtures containing thiocyanates, calcium chloride or more than 0.1% chloride ions are not permitted. Corrosive content: no more than present in municipal drinking water.
  - b) Maximum water-soluble chloride ion content in hardened concrete at 28 days: Not to exceed 0.15% by weight of cement.

**.7 Fly-Ash and Slag:**

Do not incorporate Fly-Ash or Slag into concrete mix designs without prior approval in writing.

Fly-Ash will not be accepted in any concrete which is exposed to view.

Obtain consultant's written approval prior to the use of any other admixtures.

**.8 Grout:**

- .1 **Dry pack grout:** Use a mix consisting of one (1) part Portland Cement and 1-1/2 parts sand and 2 parts of 8mm pea gravel with only sufficient water to dampen the mixture, and to attain a compressive strength of 50 MPa @ 28 days.
- .2 **Non-Shrink Grout:** Pre-mixed, non-shrinking, high strength grout, COE CRD-621; compressive strength of 50 MPa in 28 days.

1. Masterflow 713 by Master Builders Co.
2. Euco-N-S Grout by Euclid Chemical Company.
3. SonogROUT by Sonneborn Building Products.
4. M-BED standard by Stern Construction Products.

**.3 Epoxy Bonding Agent: ASTM C881**

1. Concretive 1001 LPL by M.B.T. Co.
2. Similar product by other manufacturers; submit name, compressive strength and tensile strength for acceptance.
3. Sikadur 32 by Sika Canada Inc.

**.9 Concrete Curing Materials**

- .1 Chemical Cure for Slabs:** Kure-N-Seal by Sonneborn Building Products, or Flortec 22 by Sika Canada Inc.; acrylic formula designed and certified to compatible with resilient flooring adhesives.

- .1 Substitutions:** None accepted.

**Chemical curing shall not be used for parking deck slabs.**

**.2 Moisture Cure:**

1. Water: Potable
2. Moisture-retaining Coverings: burlap, cotton mats, or other moisture-retaining fabrics; AASHTO M182, ASTM C171 or AASHTO M73. Provide burlap free of seizing; rinse thoroughly in caustic soda to remove soluble substances and make burlap more absorbent.

**.10 Concrete Mix**

- .1** Mix and deliver concrete in accordance with CSA-A23.1 and ASTM C94.

**PART 3: EXECUTION**

**3.1 APPROVALS**

- .1** Submit for review proposed concrete mix designs for each class and strength of concrete to be utilized in the project, including pump mix designs as intended to be provided by the supplier.
- .2** Submit copies of mix designs to the Architect, the Engineer and the appointed inspection and testing company.
- .3** Submit for approval brand name, etc. of admixtures to be incorporated in mix designs.

- .4 Submit for approval brand name of proposed curing compound to be used.
- .5 Submit for the Architect's review, drawings (scale 1:48 or 1:50) showing type, extent and location of items to be cast in, and openings to be formed in concrete work. Concrete must not be placed until Architect has reviewed these drawings. Particular emphasis is to be placed on accurately locating all openings in walls.
- .6 Use concrete pumps to place concrete only with approval of methods, equipment and mix design.
- .7 Submit drawings or marked-up prints showing proposed locations of construction and control joints in all slabs for review by the Engineer.

### **3.2 EXAMINATION**

- .1 Ensure that no water is present. No flooding water is permitted on foundation beds. Provide skim coats where footings and other concrete work are to be placed on soils which do not provide an acceptable working surface. Place concrete only on frost-free ground. Remove previously frozen bearing surfaces.
- .2 Ensure that all spread foundations bear on undisturbed soil or approved engineered fill. If bearing surfaces are disapproved because conditions do not meet those anticipated during design, make adjustments only as directed. No extra payment will be made for adjustments made necessary because of damage to bearing surfaces caused by weather, traffic, or removal of frozen material, or by presence of adjacent construction or services incorporated in the Work.
- .3 Ensure that compacted fill has been placed to meet specified requirements and that under-slab services have been installed, inspected, tested and approved.
- .4 Keep excavations dry while placing concrete. Pump as required.
- .5 Verify anchors, seats, plates reinforcement and other items to be cast into concrete are accurately placed, held securely and will not cause hardship in placing concrete.

### **3.3 PREPARATION**

- .1 Reinforcement shall be stored in such a manner that it is off the ground and kept free of mud and foreign matter.
- .2 Before concrete is placed, all reinforcing steel, accessories and hangers, inserts, conduits, sleeves, outlets, etc., must be securely tied in place and reviewed.
- .3 Before casting concrete, obtain engineer's approval of reinforcement in place. Leave open one side of forms for the following structural elements until all reinforcement is secured in place and reviewed and accepted by the consultant's representatives:

A) All columns;

B) walls or deep beams containing heavy or complicated reinforcement.

- .4 At least 75% of all reinforcing steel in any structural concrete member must be properly secured in position before the reviewing inspector can accept the steel for casting concrete.
- .5 All dirt, clips, sawdust, water, snow, ice and other foreign matter must be removed from forms and reinforcing steel.
- .6 All forms, surfaces, reinforcing steel and ground with which the concrete is, or is calculated to come in contact with, shall be heated to a temperature of not less than 5° C.
- .7 The bottom of excavations for footings and foundations must be undisturbed soil or approved engineered fill, clean, free from loose material, organic material, water and frost, properly leveled and approved by the soils consultant prior to the placing of concrete.
- .8 All sides of footings shall be formed unless hand excavated on stiff cohesive soil.
- .9 Prepare previously placed concrete by cleaning with steel brush and applying bonding agent. Apply bonding agent in accordance with manufacturer's instructions. Do not apply bonding agent at slab-on-grade construction joints.

### **3.4 WORKMANSHIP**

- .1 Conform with the requirements of CSA Standard CAN/CSA-A23M. Maintain a copy of the Standard on the site throughout the construction period.
- 2. Provide a competent and experienced supervisor or foreman who shall be present on the site continuously throughout each working day.

### **3.5 PLACING CONCRETE**

- .1 Place concrete in accordance with CAN/CSA-A23-1; including hot and cold weather placement procedures.
- .2 Notify the rebar inspection company at least 24 hours before any concreting operation is to proceed, for a review of the preparations. The planned casting must be made continuously without stopping.
- .3 Maximum time between adding mix water and complete discharge of concrete into forms shall be ninety (90) minutes.
- .4 Conveying and placing equipment shall be such that once concreting has started, the depositing of concrete shall be at such a rate and of such sequence that the concrete is at all times sufficiently plastic to ensure proper bonding of successive layers or panels.

- .5 Conveying and placing equipment shall be kept free from hardened concrete and foreign material and shall be cleaned at frequent intervals.
- .6 Contact local meteorological office at least 24 hours before start of concrete casting. Re-schedule casting if adverse weather conditions are imminent (rain, snow, etc.). Do not place concrete when it is raining or likely to rain.
- .7 Notify testing laboratory minimum 24 hours prior to commencement of concreting operations.
- .8 Inspect reinforcement, insets and embedded parts before beginning concrete placement to ensure accurate size and location.
- .9 Ensure reinforcement, insets, embedded parts and formed joints are not disturbed during concrete placement.
- .10 Do not deposit concrete which has partially set or hardened. Do not deposit initial lubricating mortar when pumping concrete. Remove hardened or partially hardened concrete which has accumulated on forms or reinforcement. Do not place concrete on previously deposited concrete which has hardened sufficiently to cause formation of seams or planes of weakness within respective members or sections, except as specified.
- .11 Do not deposit concrete into excavation where water is standing. If place of deposit cannot be successfully pumped dry, place through tremie with outlet end near bottom of place of deposit.
- .12 Consolidate and screed concrete slabs-on-grade by use of vibratory screed of size to allow construction joint pattern as indicated on Structural drawings and specified.
- .13 Excessive honeycomb or embedded debris in concrete is not acceptable. Notify Structural Engineer upon discovery.
- .14 Trench Drain: Form trench drain, providing minimum 3mm slope to drain as indicated. Provide solid bearing surface for continuous grating, Section 05500. Interior surfaces of trench: trowel smooth.

### **3.6 JOINTS**

- .1 Construction Joints:

In general, incorporate both horizontal and vertical construction joints in accordance with CSA Standard CAN/CSA-A23-M and typical details shown on the drawings.
- .2 Refer also to in slabs-on-grade specifications in this section.
- .3 Refer to Submittals in this section



- .4 ACI recommends that reinforced concrete slabs shall be cast in sections not exceeding 560 square metres in area. Contractor shall take necessary measures to prevent excessive cracking if pour size is increased and shall be responsible for repairing cracked concrete resulting from exceeding recommended maximum pour size. Each pour shall be bounded by a vertical bulkhead or abutting construction. Provide additional reinforcement as per typical details.
- .5 Maximum spacing between vertical construction joints in walls shall be 9000mm. Engineer's approval shall be obtained for location and details of construction joints if required otherwise by site conditions.
- .6 Provide 40mm deep x 90mm wide continuous key in all footings under reinforced concrete walls and wall joints below grade.

### **3.7 COLD WEATHER PROTECTION REQUIREMENTS**

- .1 Conform with the requirements of CSA Standard CAN/CSA-A23M, and as hereinafter specified.
- .2 Protection Against Early Frost Damage:

Effective means shall be provided for maintaining the temperature of the concrete in place above the minimum limits shown in Table 14 in CAN/CSA-A23.1-M for a minimum period of 3 days or until sufficient hydration has occurred to protect the concrete from frost damage.
- .3 Protection for Structural Safety:

If, subsequent to the above period of protection, the ambient conditions are not likely to be favourable for continuous strength development, the protection period shall be extended until the concrete has achieved sufficient strength for structural safety.
- .4 Protection for Strength and Durability:

When subsequent ambient conditions are not conducive to continued curing and strength development, the protection period shall be extended until a total period of seven (7) days at temperatures above 10° C has been attained.
- .5 The Architect may instruct that additional protection and/or heating facilities be provided, if in his opinion, that which has already been provided is inadequate, at no extra cost to the contract.
- .6 Equipment and materials capable of maintaining adequate temperature, humidity and protection shall be available on site and be ready for operation when any concrete is placed.

### **3.8 HOT WEATHER PROTECTION REQUIREMENTS**

- .1 Conform with the requirements of CSA Standard CAN/CSA-A23M, the

recommendations of ACI Standard 305 and as hereinafter specified.

.2 Job Preparation:

Facilities shall be provided for protection of the concrete in place from the effects of hot and/or drying weather conditions. In extremely hot weather, the formwork, reinforcement and concreting equipment shall be protected from the direct rays of the sun, or cooled by fogging and evaporation.

.3 Concrete Temperature:

When the air temperature is at or above 25° C or when there is a probability of it rising to this during the placing (as forecast by the local official meteorological office) special effort shall be made to maintain the temperature of the concrete as low as practicable and in no case more than that stipulated in Table 14 in CAN/CSA-A23.1-M.

**3.9 FINISHING OF CONCRETE**

.1 Exposed Surfaces:

Cut off projecting fins, cut out and fill all honeycombed areas and fill all holes left by form separators using a 1:2 cement-sand mix and a bonding agent. Rough, unsightly or other imperfect areas shall be rubbed flush with the general surface by use of a carborundum brick and water, unless otherwise specified.

.2 Non-Exposed Surfaces:

Honeycombing shall be cut out and filled and any fins which interfere with strapping, etc., shall be cut back. Holes left by form separators shall be filled. (See also Defective Concrete.)

.3 Concrete to be Waterproofed:

Where membrane waterproofing is required, treat as exposed finish in accordance with CSA Standard CAN/CSA-A23M, to obtain a surface which will ensure a good waterproofing job. Obtain the approval of the finished surfaces by the waterproofing sub-contractor.

.4 Exposed concrete shall be "Architectural Quality" and shall have removable cone-ties to Architect's approval. Finish is to be consistent and be approved by the Architect.

.5 Where shown on architectural drawings and/or specifications, floor slabs to be "sealed". Use approved sealing compound in strict accordance with manufacturer's recommendations.

**3.10 CONCRETE BASES AND CURBS FOR EQUIPMENT**

.1 Whether indicated on drawings or not, form curbs around duct shafts, electrical shafts, pipe shafts and other floor openings for mechanical and electrical services except

where protected by masonry walls. Make curbs 100 mm high, 100 mm wide. Cove base and chamfer corners. Anchor to slab with minimum 10M@300mm steel dowels cast into slab, unless otherwise specified on drawings.

- .2 Use 25 MPa concrete unless indicated otherwise.

### 3.11 TROWELLING AND SCREEDING

- .1 Conform with the requirements of CSA Standard CAN/CSA-A23M and as modified hereinafter.
- .2 Bring tops of floors to even level or sloping surfaces as shown on the drawings.
- .3 Machine trowel all floor slabs, except as required by the Drawings and/or Specifications. (Class A Finish.) For Class "F-1 & C-1" exposure, limit power float to a single pass.
- .4 Surfaces of exterior exposed steps and platforms shall be finished, with a wood float and given a "fine broom" finish to the Architect's satisfaction. (Class A Finish.)
- .5 Floors to receive separate finishes shall be screeded to proper elevation and wood float finished. (Class B Finish.)
- .6 Finished levels shall be determined by a 3000mm straight edge placed anywhere on the slab in any direction.
- .7 Tolerances as follows: (Refer to CAN/CSA-A23.1-M).
- .8 Cement finishing of floors shall be by a contractor thoroughly experienced in this type of work. The floor finishes shall be guaranteed for a period of two (2) years against dusting, disintegration or any other defect coming within the control of the finishes.

### 3.12 CURING

- .1 Conform with the requirements of CSA Standard CAN/CSA-A23M.
- .2 Refer also to COLD WEATHER PROTECTION REQUIREMENTS and HOT WEATHER PROTECTION REQUIREMENTS.
- .3 All equipment needed for curing and protection of the concrete shall be on hand and ready for use before actual placing is started.
- .4 All exposed non-formed surfaces shall be kept wet cured for a period of at least 7 consecutive days after casting. The water for curing shall be clean and free from any materials that will stain or discolour the concrete. A liquid, membrane forming, curing compound may be used under circumstances where application of such compounds will not jeopardize the appearance of the concrete nor the bonding of floor finishes.

- .5 Wheeling, handling, piling or storing of any material over or on slabs is prohibited during the first seven (7) days after placing concrete, except  
  
such handling or wheeling on planked runways as may be approved by the Engineer.
- .6 Protect all freshly placed concrete from extreme heat, running water and mechanical shock for the duration of the curing period.

### **3.13 DEFECTIVE CONCRETE**

- .1 Concrete not meeting the requirements of the specifications and drawings shall be considered defective concrete.
- .2 Concrete not conforming to lines, details, quality and grade specified or as shown on the drawings shall be modified or replaced at no increase to the contract price, and to the satisfaction of the Architect and Engineer.
- .3 Finished lines, dimensions and surfaces shall be correct and true within tolerances specified.
- .4 Cores drilled and tested from areas in question, as directed by the Engineer and in accordance with CSA Standard CAN/CSA-A23M and/or load testing of the structural elements in accordance with the requirements of the Engineer shall be done at no increase to the contract price.
- .5 Defective concrete shall be repaired or replaced to the Architect's and Engineer's satisfaction at no increase to the contract price.

### **3.14 CONDUITS, PIPES, OPENINGS AND INSERTS**

- .1 Comply with Clause Submittals in this section.
- .2 No sleeves, ducts, pipes or other openings shall pass through joists, beams or columns, except where expressly detailed or approved by the structural engineer in writing.
- .3 Electrical conduit and other pipe embedded in the concrete shall not be of aluminum or any other material harmful to the concrete and shall:
  - .1 Not pass through or be embedded in a column.
  - .2 Not be a larger outside diameter than one-third the thickness of the slab, wall or beam in which they are embedded.
  - .3 Not be spaced closer than 3 diameters on centre unless otherwise shown on the structural drawings.

- .4 Have a concrete covering of not less than 25mm or one third the thickness of the slab, whichever is greater.
- .5 Be so installed that it will not require cutting, bending or displacement of the reinforcement or impair the structural strength of the system.
- .4 Provide and cast-in all sleeves, frameouts, inserts and fastening devices shown on the drawings except as otherwise specified.
- .5 Provide sleeves in slabs or walls for mechanical piping and avoid openings where possible. Engineer's approval must be obtained for any concentration of sleeves in column band and around columns. Conform to typical details. Sleeving drawings must be submitted for approval minimum two weeks prior to pouring of concrete.
- .6 Provide openings in slabs or walls as shown on structural drawings or otherwise required by various trades. Engineer's approval must be obtained for locations and sizes of openings not shown on structural drawings. All openings must be formed before the slab or wall is poured. See typical details. Do not cut any openings, after concrete has been poured, unless specifically authorized by the engineer.
- .7 Openings and driven fasteners required in the concrete work after the concrete is placed shall be approved by the Engineer prior to installation.
- .8 Install where required in the concrete frame, all brackets and inserts etc., as required by the window and/or curtain wall supplier for the support of the windows, and/or curtain walls.
- .9 Check the drawings and specifications for the requirements of other trades as they may affect the placing of concrete and make provisions for holes through structural members and be responsible for all inserts, sleeves, conduits, etc., as set by all trades.
- .10 Give instruction and information in writing or by schedules to all trades, of the requirements necessary for services, materials or inserts prepared and/or supplied by other trades which will affect the work of this section.
- .11 Assist and coordinate with all trades in the preparation of drawings showing the type, extent and location of items to be cast in and openings to be formed in Concrete Work. These drawings must be submitted to the Engineer and reviewed prior to placing of concrete. (Refer to Clause 3.1.5).

### **3.15 GROUT**

- .1 Provide and place dry pack concrete grout or non-shrink grout as required and cooperate with other trades in the placing thereof.

### **3.16 REINFORCED MASONRY LINTELS**

- .1 Where required or where covered by the requirements of the General Notes and

Typical Details, provide reinforcing and place concrete for reinforced masonry block lintel beams. Reinforcing and concrete is to be in accordance with the requirement of the Drawings and General Notes.

### **3.17 SLABS-ON-GRADE**

- .1 Provide screeds set to an engineer's level for leveling the surface of floor slabs-on-grade.
- .2 Provide keys or dowels at construction joints as detailed on the drawings.
- .3 Provide separate concrete pour around columns. Unless otherwise shown, leave out diamond shaped, or circular shaped areas around columns equal to the dimension of the cap below or 300mm larger than the column. Concrete shall be placed in these areas not less than fourteen (14) days after the adjoining floor slabs have been placed. See typical details on structural drawings.
- .4 ACI recommends that slab-on-grade shall not be cast in sections exceeding 950 square metres. Contractor shall take necessary measures to prevent excessive cracking if pour size is increased and shall be responsible for repairing cracked concrete resulting from exceeding recommended maximum pour size. Each pour shall be bounded by a vertical bulkhead or abutting construction joint.
- .5 Provide 3mm wide x 25mm deep saw cuts as soon as possible after slab is poured at maximum 36 times the slab thickness each way. Also provide saw cuts in slab along column lines each way, and at building expansion joints.
- .6 Where panels abut construction joints, construction joints shall be considered to act as saw cuts, and additional saw cutting is not required.
- .7 Slab-on-grade panels are to be approximately square with the longer side of the panel not greater than 1.5 times the shorter side.
- .8 Caulk at saw cut lines with approved flexible caulking material.
- .9 Provide a drawing, or marked-up print, for review by the Architect, for proposed joint locations in the slab-on-grade. Also, co-ordinate saw cuts with architectural floor pattern.
- .10 Provide double stripping in terrazzo and/or line tile joints over saw cuts.
- .11 Where floor depressions occur, maintain the slab thickness specified on the foundation plans. Refer to architectural drawings for depression locations, depths, etc.
- .12 For granular material under slab-on-grade, see soil report and foundation plan. Recommendations in soil report shall govern when specifications differ.
- .13 Permission to pour concrete slab-on-grade shall be granted subject to the following conditions:

- A) That the grade is compacted to min. 97% modified Proctor maximum dry density or as recommended by the soil engineer.
  - B) That any trenches, holes, etc., which are dug after the compaction as stated in A) above, are finished, and filled with new granular 'B' material and compacted to a minimum of compaction mentioned above.
  - C) That a properly spaced system of saw cuts is used to take care of shrinkage of the slab-on-grade.
  - D) That the operations mentioned under items A to C inclusive are carried out under approved supervision.
- .14 Obtain all requirements, and provide for mechanical bases, pits, sumps and trenches not shown on the structural drawings.
- .15 Do not use frozen material containing ice or snow. Do not place concrete on frozen sub-grade or on sub-grade containing frozen material. Ascertain that forms, reinforcing steel and adjacent concrete surfaces are entirely free of frost, snow and ice, and that the temperature of these materials are above 5 degrees Celsius before placing concrete.

#### **PART 4: QUALITY CONTROL**

##### **4.1 GENERAL**

- .1 Refer also to Section 03 20 00 Concrete Reinforcing.
- .2 Refer also to Clauses 3.1.
- .3 Refer also to Clauses 3.16.1.
- .4 Routine testing of materials and of proposed mix designs shall be carried out by an independent inspection and testing company, appointed by the Owner, and will be paid for by the Owner.
- .5 Any testing required by the Contractor to vary mix design, grade of steel, or to prove strength of concrete in place, or load testing where specified design strengths are not attained, or where errors have been made in construction, shall be done at the Contractor's expense.

##### **4.2 ROUTINE INSPECTION AND TESTING**

- .1 Inspect the ready-mix plant and truck mixers and ascertain that good quality control practices are followed in accordance with CSA Standard CAN/CSA-A23M and ASTM C-94.
- .2 Review proposed concrete mix design and check-test if considered necessary.
- .3 Concrete Strength Tests:

- .1 Obtain representative samples of fresh concrete from each 130 cubic yards or fraction thereof and of each mix design of concrete placed in any one day.
- .2 Perform a standard slump test to conform with CSA Standard CAN/CSA-A23M for each set of specimens.
- .3 Perform standard air entrainment test for concrete so specified to conform with CSA Standard CAN/CSA-A23M for each set of specimens.
- .4 Three specimens moulded in 150mm diameter cylindrical steel moulds, stored, and laboratory cured to conform with CSA Standard CAN/ CSA-A23M, shall comprise a strength test. One specimen shall be compression tested at seven (7) days and the remaining two at twenty-eight (28) days after sampling.
- .5 During the placing of concrete under the conditions of "Cold Weather Concreting", one additional specimen shall be made and shall be stored on the job site under conditions similar to the concrete it represents. This specimen is intended as a field control test and shall be field cured to conform with CSA Standard CAN/CSA-A23M. This specimen shall be compression tested at seven (7) days after sampling.
- .6 Early Stripping of Forms:

Any stripping sequence at an accelerated rate to that specified, requires approval in writing by the Architect. "Pull-Out" moulds cast with the casting may be required. The use of "Pull-Out" moulds shall be at the discretion of the Engineer. (Refer also to Clause 4.5).

- .4 Identify and correlate reinforcing steel from Canadian Mills with mill test reports for compliance with the requirements of CSA Standard G30.12-M1977.

Specimens of unidentified reinforcing steel or reinforcing steel from non-Canadian mills shall be tested for each ten (10) tonnes of steel. The cost of this inspection and testing shall be paid for by the Contractor.

- .5 Reports:

- .1 Inspection company reports of test of materials and compression tests of concrete control cylinders shall be distributed as directed by the Architect.
- .2 Concrete cylinder test reports shall contain the following information: whether specimens are laboratory or field cured, date cast, date received in lab, date tested, unit weight of concrete, specified twenty-eight (28) day strength, correlate the exact location of each casting with the test cylinders in question, concrete supplier, person who cast the cylinder, time mixer charged, time cylinder cast, measured slump, temperature of concrete and air, whether or not water was added at the job and by what authority, nominal aggregate size, type of admixture, air-entrainment agent, project identification and with sequential numerical identification.



- .3 Should a crushed cylinder show a test result below that which is anticipated, the inspection company shall immediately advise the Architect and Engineer by telephone of such occurrence in order to expedite curing or remedial measures which may be required.
- .4 In the event that test cylinders indicate a strength of concrete below that which is specified, the test report shall state the reason for the lack of strength, i.e. poor quality concrete in place, cylinders improperly taken, stored, capped, frozen, improperly handled or faulty testing procedure. A correct analysis of the cause of poor tests will save unnecessary inconvenience when the report is submitted to all parties involved.
- .5 The inspection company shall supply written reports of tests of materials and reinforcing steel, giving all pertinent information required by the above-mentioned Specifications and Standards.

#### **4.3 RESPONSIBILITY OF THE INSPECTION COMPANY**

- .1 The representative of the inspection company shall not be required to supervise the Work or to instruct the Contractor. The inspector's function shall be that of sampling and testing materials, observing procedures and reporting of same to the Engineer. If any material is at variance with the Specification the inspector shall immediately advise the superintendent and then inform the Engineer by telephone.
- .2 The inspection company will advise and cooperate with the Contractor regarding adequate protection of cylinders. The inspection company will supply the Contractor, with a copy to the Engineer, with a drawing and specification for an insulated storage box for cold weather curing of cylinders.

#### **4.4 RESPONSIBILITY OF THIS SECTION**

- .1 Cooperate with the representatives of the inspection company.
- .2 Advise the inspection company and the Engineer at least twenty-four (24) hours in advance of the placing of concrete.
- .3 Provide an insulated storage box according to the specification and drawing supplied by the inspection company.
- .4 Protect test cylinders.
- .5 Keep a record set of drawings upon which shall be marked by the Contractor's Superintendent, the time and date of casting of each section of concrete, the date of removal of forms and a daily record of the temperature.

#### **4.5 RETESTING**

- .1 Payment for re-testing and re-inspection of Work replacing that found defective

following initial inspection made under Contract Work, or as otherwise made evident, is the responsibility of the Contractor and will not be considered as additional Work to this Section..

**PART 5: CLEAN-UP (GENERAL)**

- .1 Upon satisfactory Completion of the Work, clear away from the building and site, excess or waste materials and debris and leave the premises in a condition acceptable to the Architect within the contract time.
- .2 Do not unload excess concrete from concrete trucks during clean-up operations and do not deposit in undesignated or unauthorized locations within the Scope of Work boundaries whether concealed or not.

**END OF SECTION**

## General

### SECTION INCLUDES

Architectural precast concrete elements

Supports, anchors and attachments

### RELATED SECTIONS

Section 03 30 00 - Cast-in-Place Concrete: Building structural frame.

Section 03 38 00 - Post Tensioned Concrete: Building structural frame

Section 03 41 00 - Structural Precast Concrete: Building structural frame.

Section 03 47 13 - Site Cast Tilt-up Concrete: Building structural frame.

Section 05 12 00 - Structural Steel: Building structural frame.

Section 03 41 13 – Precast Concrete Hollow Core Planks: Building structural floor system.

### REFERENCES

ASTM International (ASTM):

*ASTM A1035/A1035M-23- Standard Specification for Deformed and Plain, Low-Carbon, Chromium, Steel Bars for Concrete Reinforcement*

*ASTM A123/A123M-17 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.*

*ASTM A307-21 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength.*

*ASTM A416/A416M-18 – Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete.*

*ASTM A555/A555M-22 – Standard Specification for General Requirements for Stainless Steel and Wire Rods.*

*ASTM A666-23 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.*

*ASTM A1064/A1064M-22 - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.*

*ASTM C260/C260M-10a (2016) - Standard Specification for Air-Entraining Admixtures for Concrete*

*ASTM C494/C494M-19E1 - Standard Specification for Chemical Admixtures for Concrete.*

*ASTM C881/C881M-20a - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.*

*ASTM D2240-15(2021) – Standard Test Method for Rubber Property - Durometer Hardness.*

*ASTM D2240-15(2021) – Standard Test Method for Rubber Property - Durometer Hardness.*

*ASTM D7957/D7957M-22 - Standard Specification for Solid Round Glass Fiber Reinforced Polymer Bars for Concrete Reinforcement*

*ASTM F3125/F3125M-22 - 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.*

CSA Group (CSA):

*CSA A23.1-19/A23.2-19 - Concrete Materials and Methods of Concrete Construction / Methods of Test for Concrete.*

*CSA A23.3-19 - Design of Concrete Structures.*

*CSA A23.4-16 (R2021) - Precast Concrete - Materials and Construction.*

*CSA A3000-18 - Cementitious Materials Compendium.*

*CSA G30.18-21 - Carbon steel bars for concrete reinforcement*

*CSA G40.20-13/G40.21-13 (R2018) - General Requirements for Rolled or Welded Structural Quality Steel /Structural Quality Steel.*

*CSA W47.1-19 - Certification of Companies for Fusion Welding of Steel.*

*CSA W59-18 - Welded Steel Construction (Metal Arc Welding).*

*CSA W186:21 - Welding of Reinforcing Bars in Reinforced Concrete Construction.*

CISC/CPMA Standard 2-75 - Quick-drying Primer for Use on Structural Steel

Canadian Precast/Prestressed Concrete Institute (CPCI):

*CPCI Design Manual – 5th Edition. CPCI Design Manual*

*CPCI – Architectural Precast Concrete Walls: Best Practice Guide. Architectural Precast Concrete Walls: Best Practice Guide*

*CPCI - Architectural Precast Concrete Colour and Texture - Selection Guide. Colour and Texture Selection Guide*

*CPCI (Canadian Precast/Prestressed Concrete Institute) – Precast Concrete Insulated Wall Technical Guide. Insulated Wall Panel Technical Guide*

*Engineer of Record & Engineering Roles & Responsibilities for Precast Concrete Design. Engineer of Record (EOR) Roles and Responsibilities (2023)*

*RDH Building Science - Maintenance and Inspection Manual for Precast Concrete Building Enclosures. CPCI Maintenance and Inspection Manual for Precast Concrete Building Enclosures*

*RDH Building Science – High Performing Precast Concrete Building Enclosures – Rain Control.*

*High Performing Precast Concrete Building Enclosures - Rain Control*

*RDH Building Science – Meeting and Exceeding Building Code Thermal Performance Requirements. Meeting and Exceeding Building Code Thermal Performance Requirements*

National Building Code of Canada (NBC), current edition

## ADMINISTRATIVE REQUIREMENTS

Refer to Section 01 31 00: Project management and coordination procedures.

The roles and responsibilities of the Engineer of Record and the Precast engineer should be set according to the CPCl publication: Engineer of Record & Engineering Roles & Responsibilities for Precast Concrete Design.

## SUBMITTALS FOR REVIEW

Refer to Section 01 33 00: Submission procedures.

Shop Drawings and Samples:

*Prepare and submit Shop Drawings in accordance with the General Conditions of the contract, CSA A23.3 and CSA A23.4, and as specified below.*

*Submit fully detailed and dimensioned drawings showing a method of fastening [and sealing]. Indicate the type of finish and other pertinent information on Shop Drawings.*

*Show locations of inserts and anchors for interface elements.*

*Show the system of identifying precast concrete components for erection purposes on Shop Drawings and apply similar marks on components at the time of manufacture.*

*Each drawing submitted shall bear the stamp and signature of a qualified professional engineer registered in the Province of Work.*

*Pre-production Samples: Provide samples with dimensions of 300 mm x 300 mm to illustrate surface finish, colour and texture. Make samples sets until final approval is obtained.*

*Installation Data: Precast Concrete Manufacturer's special installation requirements, indicating special procedures, crane and truck access locations, perimeter conditions requiring special attention.*

## SUBMITTALS FOR INFORMATION

Refer to Section 01 33 00: Submission procedures.

Sustainable Design: This section is not applicable.

*Refer to Section 01 35 18: LEED documentation procedures (N/A)*

*Provide required LEED documentation for precast concrete components (N/A)*

## CLOSEOUT SUBMITTALS

Refer to Section 01 78 10: Submission procedures.

Maintenance Data: Indicate surface cleaning & joint sealant repair instructions.

Sustainable Design Closeout Documentation: not applicable.

## QUALITY ASSURANCE

Perform work in accordance with the latest CSA A23.1/A23.2, CSA A23.3, CSA A23.4, PCI MNL-135, and CPCI Architectural Precast Concrete Walls: Best Practice Guide

Welding: Perform work to CSA W59 and CSA W186.

Welders: Certified to CSA W47.1. Certificates for welders doing the work shall be provided upon request.

### **Fabricator:**

“Standard of Acceptance” for Precast panels as manufactured by tkl Group. tkl Group is a Canadian Owned & Operated Company.  
Contact: Marc Bombini 416-746-2479 x 231

*Precast Concrete Manufacturers to be certified to Canadian Precast Concrete Quality Assurance (CPCQA) Certification Program in the appropriate Architectural Category prior to the time of bid [Category A1, AT, CA1, CA2, CA3, CA4, BA1, BA2, BA3, or BA4].*

*Precast fabrication to meet the requirements of CSA A23.4, [PCI MNL-116, PCI MNL-117] and CPCQA certification requirements.*

*Only precast elements fabricated under the CPCQA plant certification program are acceptable, and plant certification shall be maintained for the duration of fabrication, [erection,] and until the warranty expires.*

Erector: A company specializing in performing the work should have documented experience in erecting architectural precast concrete structures

Design precast concrete members under the direct supervision of a Professional Structural Engineer experienced in the design of this Work and licensed to practice engineering in the [province/state] where the Project is located.

## MOCK-UP

Fabricate and erect in plant, one (1) full size panel, with typical window, fully glazed, insulated panel and sealants. The mock-up panel shall illustrate the shape, lifting devices, attachment points, and finish in accordance with the approved sample. Material and labour for windows, doors, flashing shall be provided by others. Reviewed and accepted mock-up panels shall remain as part of the Work.

## DELIVERY, STORAGE, AND PROTECTION

Deliver, handle and store precast concrete components in a method approved by the Precast Concrete Manufacturer. Components shall not come into contact with earth or staining influences. Do not rest a component on its corners.

Blocking and Lateral Support during Transport and Storage: Clean, non-staining spacers that do not cause harm to exposed surfaces shall be placed between each unit. Temporary lateral supports should be provided to prevent bowing and warping.

Protect precast concrete components to prevent staining, chipping, or spalling of concrete. Protect holes and reglets from water and ice during freezing weather.

Mark precast concrete components with a date of production in a location not visible to view when in the final position in the structure

## Products

### DESIGN AND PERFORMANCE REQUIREMENTS

Design precast concrete components to withstand specified loads, including superimposed dead loads, live loads, wind, and thermal loads.

Seismic Loads: Design and size precast concrete components and connections to withstand specified seismic loads and sway displacements.

Design precast concrete components to accommodate code allowable construction tolerances, specified deflections of building structural members, and clearances of intended openings.

Insulated precast concrete components to achieve building energy performance as required by Contract Documents.

Design non-insulating precast concrete panels with pressure equalized joints and cavity compartmentalization in accordance with established design principles for rain screen and pressure equalization of wall systems.

Design insulated precast concrete panels with internal weep and drainage system, providing continuous insulation and sealed joints between panels.

Design concrete reinforcement and steel connections required by the Contract Documents to withstand design loadings indicated and in accordance with requirements of the Building Code as follows:

*Design and fabricate panels, brackets and anchorage devices to tolerances as specified in CSA A23.4 and PCI MNL-135.*

*Design panels to resist handling, transportation, and erection stresses. Compensate for structural deflection of span/360 due to live load and distortion of the structure, under design criteria conditions, without imposing a load on panel assembly.*

*Sustain precast panel loads, superimposed wind, snow and rain loads, and seismic loads, without exceeding deflection of 1/360.*

*Permit no water infiltration into the building under design loads.*

*Wind Loads: 0.50 kPa 1/50 year occurrence in accordance with the Building Code and commentary I of the structural commentaries of the NBC.*

Engage a Precast Concrete Manufacturer who utilizes a registered professional engineer to prepare calculations, shop drawings, and other structural data for architectural precast concrete panels that comply with the requirements of this Section.

Retain a delegated design professional engineer registered in the Province of Work to ascertain and report that fabrication and erection of work meets the specific design criteria for materials

## **MATERIALS**

Portland cement, Portland limestone cement, supplementary cementitious materials, aggregates, water and admixture: CSA-A3000, Concrete Materials: in accordance with CSA A23.4 and CSA A23.1/A23.2

Reinforcing Steel Bars: CSA G30.18, deformed steel, unfinished, grade 400W strength and size commensurate with precast unit design.

Welded Steel Wire Fabric: ASTM A1064/A1064M, welded steel wire fabric, in unfinished.

Tensioning Steel Strands: ASTM A416/A416M, ASTM A421/A421M, Grade 270 ksi

Concrete admixtures in accordance with CSA A23.1/23.2

Surface Finish Aggregates as noted on Architectural drawings: Aggregates shall be procured from a single source conforming to the approved sample.

## **SUPPORT DEVICES**

Connecting and Supporting Devices: conforming to ASTM A123/A123M hot dip galvanized plates, angles, items cast into concrete, items connected to steel framing members, and inserts; fasteners to ASTM F3125/F3125M.

Miscellaneous Plates, Angles, Inserts: CSA A23.1/A23.2.

Protective Finish: Hot-dip galvanized to ASTM A123/A123M.

Bolts, Nuts, and Washers: ASTM A307

Prime Paint: CISC/CPMA Standard 2-75 - Quick-drying Primer for Use on Structural Steel

## **ACCESSORIES**

Integral Insulation: polyisocyanurate Insulation type and thickness shall meet the code and contract requirements or approved by consultants to meet building energy requirements

Bearing Pads: High-density plastic. Bearing pad type and thickness shall be specified by the Precast Engineer.

Shims: Plastic.

Recessed Reglets: Plastic, shaped and flanged to remain in place once cast, [foam plastic filled] [taped closed] to eliminate wet concrete intrusion.

Sealant: Sealant shall be specified by the Precast Concrete Manufacturer.

Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place according to PCI MNL 117; use plastic materials only.

Grout Materials shall be specified by the Precast Concrete Manufacturer.



## CONCRETE MIXES

Use white or grey cement in the facing matrix, as required to achieve an aesthetic appearance.

Design mixes may be prepared by a qualified independent testing agency or by qualified precast plant personnel at the Precast Concrete Manufacturer.

Limit water-soluble chloride ions to the maximum percentage by weight of cement permitted by CSA standard.

Normal Weight Concrete Face and Backup Mixes: Proportion mixes by either laboratory trial batch or site test data methods with materials to be used on Project to provide normal-weight concrete with the following properties:

*Compressive Strength (28 Days): [34.5] MPa.*

*Maximum Water-Cementitious Materials Ratio: [0.45].*

## FABRICATION

Fabricate architectural precast concrete components to CSA A23.4 and as follows:

*Identify pickup points of precast architectural concrete units and orientation in structure with permanent markings, complying with markings indicated on shop drawings.*

*Mark each precast unit to correspond to the identification mark on shop drawings for location.*

*Mark each precast unit with the date cast.*

*Verify that surfaces to receive sealant are smooth and free of laitance to provide a suitable base for adhesion.*

*Verify that release agents do not deleteriously affect the sealing of the joints.*

*Precast concrete components shall be cured in accordance with CSA A23.4 [cl. 23.2].*

*Cast panels face down in accurate rigid moulds designed to withstand high-frequency vibration.*

*Vibrate concrete if required to reach proper consolidation.*

*Provide necessary holes and sinkages for flashings, anchors, cramps, and similar insert items.*

*Lift points shall be sealed according to design requirements. The Precast Concrete Manufacturer shall take into consideration lifting hardware location in externally visible architectural elements. Visible lift points shall be patched to closely match the panel finish.*

Maintain plant records and quality control program during the production of precast concrete components in accordance with CPCQA requirements

Use rigid moulds constructed to maintain precast concrete components uniformly in shape, size, and finish.

Utilize form liners in accordance with the form liner manufacturer's written instructions.

Maintain consistent quality during manufacture.

*Mix the concrete according to the fabricators' mix design requirements in this section. After concrete batching, no additional water may be added.*

*Place face mix to a minimum thickness after consolidation of the greater of 25 mm or 1.5 times the maximum aggregate size, but not less than the minimum reinforcing cover.*

*Place concrete in a manner to prevent seams or planes of weakness from forming in precast concrete components, and in accordance with PCI MNL 117 for measuring, mixing, transporting, and placing concrete.*

*Thoroughly consolidate placed concrete by internal and/or external vibration without dislocating or damaging reinforcement and built-in items. Equipment and procedures complying with PCI MNL 117.*

*Precast units with defects shall be examined by the precast engineer to determine appropriate repair methods.*

Defects that are cosmetic (non-structural) shall be repaired in a manner so the appearance of the precast concrete component is not impaired.

Defects of structural nature should be assessed by both the Engineer of Record and the Precast Engineer. A repair procedure shall be established and carried out. The completed repair work must be approved by both the Engineer of Record and the Precast Engineer. If repair is not feasible or unsuccessful, then the defective precast concrete component shall be replaced.

Any repair work of precast concrete components after the installation and acceptance of erected structure is the responsibility of the general contractor.

Non-conforming precast concrete components should be removed from site by the responsible party

Note: it is recommended to establish and approve repair procedures before production begins.

Fabricate connecting devices, plates, angles, [items fit to steel framing members,] inserts, bolts, and accessories. Fabricate to permit initial placement and final attachment.

Embed reinforcing steel, anchors, inserts plates, angles, and other cast-in items.

Install window units in place (to be determined at the time of construction) while fabricating precast concrete components. Protect assembly from damage.

Cast rigid insulation into precast concrete components as required.

Design and locate hoisting devices so that they can be concealed when the structure is in service. These devices shall be treated so they will not corrode in service.

Cure precast concrete components to develop strength and to minimize appearance blemishes such as non-uniformity, staining, or surface cracking. Cure in accordance with CSA A23.4.

## **FINISHES**

Precast Concrete Surface Finish: as noted on architectural drawings. Conform to approved range samples.

Non-visible Surface Finish: Element surfaces that are not intended to be visible shall use a float finish

Connecting Supporting Steel Devices: Hot dip galvanized.

## **FABRICATION TOLERANCES**

Conform to CSA A23.4

## **SOURCE QUALITY CONTROL AND TESTS**

Provide concrete test reports and mill certificates as required by Contract Documents

Provide mill certificates for stressing strands.

## **Execution**

### **EXAMINATION**

Refer to Section 01 70 00: Verification of existing conditions prior to beginning work.

Erect precast work in accordance with CSA A23.4.

General Contractor to verify site conditions and supporting materials are ready to receive work and field measurements are as indicated on approved Shop Drawings.

Supply anchors required for installation of the precast concrete components to the general contractor. Provide such items in ample time to meet the construction program. Supply layout drawings locating all cast-in items to be installed by other Sections.

[Engineer of Record] [General Contractor] to sign off on building stability prior to precast erection.

### **PREPARATION**

Provide and install sufficient temporary bracing to brace precast concrete components adequately at all stages of construction so that precast components will safely withstand loads to which they may be subjected. This temporary bracing shall remain in position until the required connections have been completed.

### **ERECTION**

Erect precast concrete components without damage to shape or finish.

Erect precast concrete components level, square and plumb within allowable tolerances.

Align and maintain uniform horizontal and vertical joints as erection progresses.

When precast concrete components require adjustment beyond design or tolerance criteria, discontinue affected work; advise [Engineer on Record] [and General Contractor]

[Fasten] [and] [Weld] component securely in place. [Perform welding in accordance with CSA W59 for welding to steel structures and CSA-W186, for welding of reinforcement. Welds shall be performed by a certified CWB welder]. Where bolts are used for installation, tighten with equal torque. Secure bolts with lock washers, jam nuts, or tack-weld nut to bolt, or crimp threads of the bolt after the nut is installed.

Touch up [field welds and] scratched or damaged [primed painted] [galvanized] surfaces.

Set vertical precast concrete components dry, without grout, attaining joint dimension with spacers. [Grout to the base of the unit if required.]

Apply sealant and joint backing in accordance with per details on the Contract documents. All exterior joints are to be vented.

## **ERECTION TOLERANCES**

Erect precast concrete components level, square and plumb, within allowable tolerances as per CSA A23.4.

General building tolerances and interface to other scopes as per, Tolerances and the National Building Code of Canada (NBC).

## **CLEANING**

Section 01 74 00: Cleaning installed work.

Precast concrete components to be erected in clean condition. Any cleaning of the precast after the installation and acceptance of work is the responsibility of the general contractor.

Clean weld marks, dirt, or blemishes from surface of exposed precast concrete components, caused by erection work

Clean field welds with wire brush and touch up with [primer] [galvanized] paint.

Upon completion of the work in this Section, all surplus materials and debris shall be removed from this site.

## **PROTECTION OF FINISHED WORK**

Protect all installed work.

Protect precast concrete components from damage caused by field welding or erection operations performed by work of this trade. Protection of work after the precast erection is completed is to be the responsibility of the General Contractor.

Provide non-combustible shields during welding operations, as required.

**END OF SECTION**

1 General

1.1 **SECTION INCLUDES**

- .1 Labour, Products, equipment and services necessary for masonry Work in accordance with the Contract Documents.

1.2 **REFERENCES**

- .1 ASTM A1064/A1064-M, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
- .2 ASTM C207, Specification for Hydrated Lime for Masonry Purposes.
- .3 CAN/CSA A23.1/A23.2, Concrete Materials and Methods of Concrete Construction, Methods of Test and Standard Practices for Concrete.
- .4 CSA A165 Series, CSA Standards on Concrete Masonry Units.
- .5 CSA A179, Mortar and Grout for Unit Masonry.
- .6 CSA A370, Connectors for Masonry.
- .7 CSA A371, Masonry Construction for Buildings.
- .8 CAN/CSA A3000, Cementitious Materials Compendium.
- .9 CSA G30.18, Carbon Steel Bars for Concrete Reinforcement.
- .10 CSA S304.1, Design of Masonry Structures.

1.3 **DESIGN REQUIREMENTS**

- .1 Design unit masonry in accordance with following Climatic Design Data for the Municipality contained in the Ontario Building Code:
  - .1 Design temperature: January 1%, July 2 1/2%.
  - .2 Hourly wind pressures: 1 in 50 year occurrence.

1.4 **SUBMITTALS**

- .1 Shop drawings:
  - .1 Submit shop drawings in accordance with Section 01 33 00 indicating.
  - .2 Wall sections and details, reinforcing and anchors, special detailing, patterning and locations of control joints.
  - .3 Seismic anchors, supports and accessories for complete installation.
- .2 Samples:
  - .1 Submit samples in accordance with Section 01 33 00:

- .2 Submit samples of each type and colour of masonry unit used prior to placing order.
  - .3 Submit samples of coloured mortar to match masonry samples.
  - .4 Submit samples of masonry anchors, and ties.
  - .5 Submit 250 x 200 mm samples of dampproof course and flashing.
- .3 Quality control submittals: Submit manufacturer's certificates stating that materials supplied are in accordance with this Specification.

## 1.5 QUALITY ASSURANCE

- .1 Provide plain and reinforced masonry in accordance with CSA A370, CSA A371, CSA S304.1, and as indicated.
- .2 Retain a licensed Professional Engineer, registered in Province of Ontario, to perform following services for unit masonry Work:
- .1 Design of unit masonry Work.
  - .2 Design of brick ties and anchors, including requirements necessary to meet seismic requirements.
  - .3 Review, stamp and sign shop drawings.
  - .4 Conduct shop and field inspections and prepare and submit inspection reports.
- .3 Cold Weather Protection:
- .1 To CAN/CSA-A371 and as follows:
    - .1 Maintain temperature of mortar between 5°C and 50°C until batch is used or becomes stable.
    - .2 Maintain ambient temperature of masonry work and its constituent materials between 5°C and 50°C and protect site from windchill.
    - .3 Maintain temperature of masonry above 0°C for minimum of 3 days, after mortar is installed.
    - .4 Preheat unheated wall sections in enclosure for minimum 72 hours above 10°C, before applying mortar.
    - .5 Do not use scorched aggregate. Do not use salts or anti-freezes. Only use approved smokeless heaters.
- .4 Hot Weather Requirements:
- .1 To CAN/CSA-A371 and as follows:
    - .1 Plan in advance for hot weather construction. Protect freshly laid masonry from drying too rapidly, by means of waterproof, non-staining coverings.
    - .2 Avoid using dry masonry in hot weather conditions. Use predampened masonry unit nominally saturated, but surface dry at time of laying. Do not dip masonry unit in bucket of water.
    - .3 Spread only enough mortar to permit soft setting of masonry units; do not over mix mortar materials; do not retemper mortar after 2 hours of use; do not retemper pigment coloured mortar; do not spread more than 900 mm of mortar for placement of masonry unit.

- .5 Mock-up:
  - .1 Construct one mock-up panel of unit masonry construction, 1200 mm wide x 1200 mm high in a location accepted by Consultant.
  - .2 Demonstrate use of reinforcement, ties, through-wall flashing, weep holes, jointing, coursing, coping and sills, mortar, bonding, control joints, and workmanship.
  - .3 Mock-up may form part of Work if accepted by Consultant. Mock-ups which do not form part of Work are to be removed from Site during final cleanup, or when directed by Consultant.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle Products in accordance with the Conditions of the Contract and as specified herein.
- .2 Remove unacceptable materials from Site and replace to acceptance of Consultant. Store materials off ground protected from wetting by rain, snow or ground water, or inter-mixture with earth or other materials. Store metal ties and reinforcement to prevent corrosion.
- .3 Do not concentrate storage of materials on any part of structure beyond design load, take particular care not to overload unsupported portions of structure which may have not attained their full design strength.
- .4 Comply with CSA A371. Do not use salt or calcium-chloride to remove ice from masonry surfaces.
- .5 Deliver mortar materials in original unbroken and undamaged packages with the maker's name and brand distinctly marked thereon. Prevent damage to units.
- .6 Keep masonry materials free from ice and frost. Keep units protected from concrete, mortar and other materials which could cause staining.

## 2 Products

### 2.1 MASONRY UNITS

- .1 **Architectural Block:** normalweight units, 90 mm thick unless otherwise indicated, sizes as indicated, CSA A165 Series; H/15/A/M; S/15/A/M; Sc/15/A/M; as shown on Materials Legend. Profiled concrete block to have profile on face and on exposed ends where special shapes are required. Provide the following block types:
  - .1 Type 1: Ground face block as manufactured by Richvale York Block Inc.
  - .2 Type 2: Polished ground face block as manufactured by Day & Campbell.
- .2 **Insulated concrete block:** normalweight concrete block, metric modular size complete with expanded polystyrene as manufactured by Omni Block or approved alternative.

- .3 **Concrete block units:** Normalweight units, CSA A165 Series, as indicated on Contract Drawing, classifications as follows:
  - .1 H/15/A/M.
  - .2 S/15/A/M.
  - .3 Sc/15/A/M.
- .4 **Special shapes:** Unless indicated otherwise, supply and install corner returns, bull-nosed or double bull-nosed units for exposed and external corners, bond beams, sash blocks for control joints, solid block where noted, concrete block lintels over openings in concrete block walls and any additional special shapes as indicated.
- .5 Obtain each masonry unit type from same manufacturer. Supply and install units of uniform texture and colour for each kind required.
- .6 Supply masonry units with exposed surfaces free of cracks, chips, blemishes, and broken corners.
- .7 **Glazed Concrete Block:** 10" (240mm) unless otherwise indicated, as shown on architectural drawings. Profiled concrete block to have profile on face and on exposed ends where special shapes are required. Provide the following block types:
  - .1 Spectra Glaze 10" Concrete Block by Brampton Brick, Colour: Champagne Beige (D-204).

## 2.2 ACCESSORIES

- .1 **Reinforcement:** CSA A370, CSA A371, and ASTM A1064/A1064-M, all components to be hot dip galvanized unless otherwise specified:
  - .1 This specification is based on products manufactured by Blok-Lok Limited. Products by Dur-O-Wal Ltd. and Fero Corporation are approved alternatives.
  - .2 Type 1 (single wythe): Truss type; >Blok-Trus BL30'.
  - .3 Type 2 (cavity wall block back-up): Adjustable truss type, fabricated from minimum 4.76 mm wire, complete with adjustable box anchor and insulation fasteners; >Adjustable Econo-Cavity Blok-Trus II BL37 System 2000' with 'wedge-Lok Insulation Retainers'. Insulation retainer to straddle wire bridging the cavity.
  - .4 Provide Fero brick ties where indicated as shown on Structural drawings.
  - .5 Connectors: CSA A370 and CSA S304.1.
  - .6 Reinforcing steel: CSA G30.18, Grade 400, refer to Contract Drawings for number, size, and location.
- .2 **Cavity wall insulation:** In accordance with Section 07 21 00.
- .3 **Loose steel lintels and lateral support angles:** Supplied as part of Work of Section 05 50 00 and as indicated.
- .4 **Through wall flashings:** Prefinished metal flashings in accordance with Section 07 62 00, continuous strips with a 19 mm folded drip edge.



- .5 Dampproof course and flashing: Reinforced SBS rubberized asphalt compound laminated to cross-laminated polyethylene film, 40 mils thick; 'Airshield Thru Wall Flashing' by W.R. Meadows or approved alternative, complete with primer and adhesive recommended by flashing manufacturer.
- .6 Compressible filler: 75 x 6 mm thick preformed, polyurethane foam; 25V by Emseal Joint Systems Ltd.
- .7 Control joint filler: Prefabricated extruded rubber joint to suit wall thickness; RS Series Rubber Control Joint by Blok-Lok or approved alternative.
- .8 Mortar net: 250 mm high x thickness to suit cavity; Mortar Net by Mortar Net USA Ltd.
- .9 Weep hole vents:
  - .1 Flexible ultra-violet resistant polypropylene-copolymer plastic, 'Cell-Vent' by Blok-Lok, 'Mortar Maze Cell Vents' by Advanced Building Products Inc. or approved alternative.
  - .2 Provide manufacturer recommended clear silicone adhesive for suspended applications.
  - .3 Colour: To be selected by the Consultant.

## **2.3 MORTAR MATERIALS**

- .1 Loadbearing masonry: CSA A179, Type S, proportion method.
- .2 Interior non-loadbearing masonry: CSA A179, Type N, proportion method.
- .3 Exterior non-loadbearing masonry: CSA A179, Premixed 1-1-6 Type N, portland cement/lime, proportion method.
- .4 Cement: CAN/CSA A3000, normal Portland, Type GU. Provide white cement where required for white or light coloured mortars.
- .5 Masonry aggregate: CSA A179. Provide white aggregate where required for white or light coloured mortars.
- .6 Hydrated lime: ASTM C207, Type S.
- .7 Water: Clean potable, free from deleterious elements and free from salts that can cause efflorescence.
- .8 Mortar pigment: 'Bay Ferrox' by Bayer Inc. or approved alternative by Elementis Pigments. Colour to later selection by Consultant.
- .9 Concrete fill and grout: 20 Mpa concrete in accordance with CAN/CSA A23.1/A23.2.

3 Execution

3.1 **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.

3.2 **PROTECTION**

- .1 Supply and install temporary waterproof, non-staining coverings, secured against displacement, to extend over walls and down sides to protect masonry Work from snow and wind driven rain, and from drying too quickly, until masonry Work is completed and protected by flashings or other permanent construction.
- .2 Supply and install non-staining, protective coverings on horizontal and vertical surfaces to protect Work of this Section from damage, staining, marking, and mortar droppings.

3.3 **WORKMANSHIP**

- .1 Perform masonry Work in accordance with CSA A371 and as indicated.
- .2 Supply and install masonry Work plumb, level and true to line, with vertical joints in alignment and horizontal courses level, uniform, and straight.
- .3 Install masonry Work to a plane flatness and exposed end tolerance of 3 mm in 2400 mm.
- .4 Variation in Alignment from Unit to Adjacent Unit: 1.5 mm maximum.
- .5 Variation of Mortar Joint Thickness: 3 mm every metre.

3.4 **MASONRY - GENERAL INSTALLATION**

- .1 Construct masonry work as required by jurisdictional authorities.
- .2 Before commencing masonry work, verify required limitations for wall heights, wall thicknesses, openings, bond, anchorage, lateral support, and compressive strengths of masonry units and mortars.
- .3 Construct masonry fire protection and fire separations of the thickness indicated on Drawings for the fire resistant ratings as noted on Drawings, and conforming to the Fire-Performance Ratings, Appendix 'D' to the National Building Code of Canada.
- .4 Fire Separations and Fire Separations with Fire Resistance Ratings: Construct walls tightly to construction above and at perimeter, and without openings or voids. Do not reduce the thickness of walls to less than the thickness indicated on the Drawings or for the required fire resistance rating where required.

- .5 Do not butter corner units, throw mortar droppings into joints, or excessively furrow bed joints. Do not shift or tap units after mortar has taken initial set. If adjustment is necessary after mortar has started to set, remove and replace with fresh mortar.
- .6 Do not use admixtures without Consultant's written acceptance.
- .7 Tool mortar joints slightly concave with non-staining tools unless indicated otherwise. Strike joints flush in non-exposed areas or where shown on Contract Drawings. Use sufficient force to press mortar tight against masonry units on both sides of joints. Remove excess, remaining mortar material and burrs.
- .8 Install masonry walls 25 mm clear of underside of steel building frames, roof or floor deck. Install masonry with a 19 mm space beneath shelf angles and install compressible filler.
- .9 Cut masonry units with a wet saw to obtain straight, clean, even, unchipped edges. Cut units as required to fit adjoining work neatly or for flush mounted electrical outlets, grilles, pipes, conduit, leaving 3 mm maximum clearance. Use full-size units without cutting wherever possible.
- .10 Reinforce veneer walls with adjustable wall reinforcing at maximum 400 mm o.c. vertically and 600 mm o.c. horizontally. Install reinforcing in accordance with manufacturer's instructions. In veneer walls extend reinforcement from support wall, spanning cavity into exterior wythe. Place at maximum 75 mm o.c. each way around perimeter of openings, within 300 mm of openings.
- .11 Reinforce block walls with continuous wire reinforcement in every second block course and as indicated. Supply and install prefabricated L and T sections. Cut, bend and lap reinforcing units as per manufacturer's printed directions for continuity at returns, offsets, pipe enclosures, and other special conditions. Bending of masonry reinforcement is not permitted.
- .12 Reinforce masonry walls with reinforcing steel as indicated. Vertical reinforcing shall be fully grouted in masonry cores with grout.
- .13 At openings in block walls install extra reinforcement, so that first and second courses above and below openings are reinforced. Extend extra reinforcement 600 mm beyond opening in each direction.
- .14 Reinforce joint corners and intersections with strap anchors 400 mm o.c.
- .15 Do not place reinforcement across masonry wythes at control joints.
- .16 Install masonry with 10 mm thick joints unless indicated otherwise. Make vertical and horizontal joints equal and of uniform thickness.

- .17 Build control joints in masonry walls at intervals and in locations shown. Form joints for block walls using sash block units in accordance with details shown. Form joints for veneer walls by leaving head joints between stacked units void of mortar. Fill chase and joint with joint filler full height of control joints. Leave a depth of 13 mm for sealing unless otherwise shown.
- .18 Install control joints in masonry walls where indicated on drawings and at projections and changes in direction. Where control joints have not been indicated provide joints at 6100 mm o.c. for exterior walls and 9150 mm o.c. for interior walls.
- .19 If required, provide movement joints, similar to building control joints, installed between areas with different support conditions.
- .20 Supply and install solid block or metal lath under block, and fill block cells solid for lintel bearing and as required to secure built-in anchor bolts and/or anchors shown.
- .21 Do not tooth intersections of walls except as otherwise indicated.
- .22 Install weep hole vents in accordance with manufacturer's directions, in exterior wythe of masonry above dampproof courses and flashings and at tops of walls using adhesive. Space weep hole vents maximum 600 mm o.c. horizontally. Prevent weep hole vents from becoming plugged with mortar or debris.
- .23 Coordinate installation of masonry with installation of air barrier and vapour retarder to ensure continuity of these systems.

### 3.5 **DAMPPROOF COURSES AND FLASHING**

- .1 Install dampproof courses beneath first masonry bearing course on slabs-on-grade. Trim dampproofing to conceal it.
- .2 Install flashings in masonry in accordance with CSA A371.
- .3 Install flashings under exterior masonry bearing on foundation walls, slabs, shelf angles, and steel angles over openings and elsewhere as indicated. Where flashings occur over openings in walls extend them past openings a minimum of 200 mm and turn up minimum 150 mm at each end to create a waterproof dam to prevent water draining into cavity.
- .4 In veneer walls install flashings continuously from front edge of masonry, under outer wythe, turn up backing minimum 200 mm and provide watertight seal against support wall.
- .5 Lap dampproofing and flashing 150 mm and seal in accordance with manufacturer's instructions.
- .6 At bottom of cavity install mortar net to manufacturer's instructions. Apply additional mortar net layer as required to fill cavity thickness. Place net in continuous layer.

- .7 Before masonry work begins, place specified dampproofing under first course of masonry. Install continuous dampproofing with ends lapped and cut flush with exterior face of wall. Place similar dampproofing over top course.

### 3.6 MORTAR MIXING

- .1 Thoroughly mix mortar ingredients in proper quantities needed for immediate use to requirements of CSA A179.
- .2 Measure and batch mortar materials either by volume or weight, to accurately control and maintain proportions. Do not measure materials by shovel.
- .3 Mix mortar with maximum amount of water consistent with workability for maximum tensile bond strength within capacity of mortar.
- .4 Do not use mortar which has begun to set. Use mortar within 2 hours after initial mixing. Re-temper mortar during 2 hour period only as required to restore workability.
- .5 Add mortar colour and admixtures to requirements of manufacturer's instructions.
- .6 Provide uniformity of mix and colouration.

### 3.7 BLOCK

- .1 Lay blocks in running bond except as indicated otherwise. Align block webs vertically and install thicker ends of face shells up.
- .2 Install a full bed of mortar for first courses of masonry, for masonry units 100 mm thick and less, and between solid units. For remaining courses bed face shells, including vertical end joints, fully in mortar.
- .3 Install special shaped and sized concrete block units as indicated and as required for a complete and coordinated assembly and to minimize cut units.
- .4 Supply and install two courses of solid block beneath lintel bearing.
- .5 Stagger end joints in every course. Align joints plumb over each other in every other course.
- .6 Bond intersecting block walls in alternate courses. Where block work abuts concrete, anchor each block course to concrete.

### 3.8 MASONRY VENEER

- .1 Prior to installation of masonry veneer, coordinate installation of air and vapour retarder with Section 07 26 00.

- .2 Prior to installation of cavity insulation, examine air and vapour retarder and make good damage. Install cavity wall insulation in accordance with Section 07 21 00.
- .3 Lay masonry veneer in running bond, unless indicated otherwise, and in a full bed of mortar.
- .4 Form angle corners with special shaped units; cutting of units is not permitted.
- .5 Erect exterior cavity wall construction as shown on Contract Drawings.
- .6 Install masonry veneer to prevent mortar droppings and protrusions from impeding drainage and pressure equalization of rainscreen cavities and drained walls.
- .7 Apply sufficient mortar on end of stretchers to ensure end joints are compressed full when masonry unit is pressed into place.

### 3.9 **LINTELS**

- .1 Install concrete block lintels over openings in masonry except where steel lintels are indicated.
- .2 Set lintels with minimum of 200 mm uniformly distributed bearing at each end and as indicated. Provide bond breaker under bearing ends.
- .3 Install reinforcing steel and concrete fill in block lintels as indicated.
- .4 Install loose steel lintels, as indicated. Centre over opening width..

### 3.10 **LATERAL SUPPORT ANGLES**

- .1 Where non-load bearing unit masonry partitions meet structural elements at top of partitions, provide lateral supports as required by the Ontario Building Code and in accordance with Structural details. In areas where ceilings are scheduled, use 150 mm lengths of steel angle located each side of partition at 1200 mm and staggered.

### 3.11 **BUILT-IN ITEMS**

- .1 Coordinate and locate build-in items required to be built into masonry or supplied under Work of other Sections including hollow metal doors, windows, lintels, sleeves, inserts, etc. Build-in items to present a neat, rigid, true and plumb installation.
- .2 Build wall openings, slots, and recesses required for ducts, grilles, pipes and other items.
- .3 Coordinate installation of conduit, outlet boxes and other mechanical and electrical built-ins with Work of Divisions 21, 22, 23 and 26.
- .4 Prevent displacement of built-in items during construction. Check plumb, location and alignment frequently, as Work progresses.

- .5 Brace door jambs to maintain plumbness. Set anchors between metal frames and masonry and fill voids between hollow metal frames and masonry walls with mortar.

### 3.12 **INSTALLATION TOLERANCES**

- .1 Planes true to within 3 mm under 3 m straightedge.
- .2 Plumb within 6 mm in 3 m, or in 6 mm in 6 m at external corners, expansion joints, or other conspicuous lines.
- .3 Level within 6 mm in any bay or 6 m maximum distance, and 12 mm in 12 m or more.
- .4 Located from position shown, and from related position of columns, walls, and partitions within 12 mm in any bay or 6 m maximum distance, and 19 mm in 12 m or more.
- .5 Opening sizes within 6 mm of designated dimension.
- .6 Column and wall cross-section dimensions within minus 6 mm and plus 12 mm.
- .7 With joints to dimensions indicated, but in no case greater than 12 mm.

### 3.13 **REPAIR AND POINTING**

- .1 Remove and replace masonry units which are loose, chipped, broken, cracked, marked, stained, discoloured, or otherwise damaged. Supply and install new units to match adjoining units and install in fresh mortar, and point to eliminate evidence of replacement.
- .2 During tooling of joints, enlarge any cracks, holes, or other defects, point and completely fill with mortar.
- .3 Point-up joints including corners, openings, and adjacent Work for a neat, uniform appearance, properly prepared for application of sealant compounds.

### 3.14 **CLEANING**

- .1 Obtain and follow unit masonry manufacturer's written instructions for cleaning of masonry.
- .2 Clean exposed, masonry surfaces, removing excess mortar as work progresses. Allow mortar droppings to partially dry then dry brush with a stiff fibre brush.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

- .1 Design, labour, Products, equipment and services necessary for the structural steel Work in accordance with the Contract Documents.

1.2 **REFERENCES**

- .1 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- .2 ASTM A325M, Standard Specification for Structural Bolts, Steel, Heat Treated 830 Mpa Minimum Tensile Strength (Metric).
- .3 ASTM A563M, Standard Specification for Carbon and Alloy Steel Nuts [Metric].
- .4 ASTM C1107/C1107M, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-Shrinkable).
- .5 ASTM F436M, Standard Specification for Hardened Steel Washers [Metric].
- .6 CAN/CSA-G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steels.
- .7 CAN/CSA G164-M, Hot Dip Galvanizing of Irregularly Shaped Articles.
- .8 CAN/CSA S16, Limit States Design of Steel Structures.
- .9 CAN/CSA S136, North American Specification for the Design of Cold Formed Steel Structural Members.
- .10 CSA W47.1, Certification of Companies for Fusion Welding of Steel Structures.
- .11 CSA W55.3, Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings.
- .12 CSA W59, Welded Steel Construction (Metal Arc Welding) (Metric Version).
- .13 CAN/CGSB 1.181, Ready Mixed Organic Zinc-Rich Coating.
- .14 CISC Handbook of Steel Construction.
- .15 SSPC Steel Structures Painting Council.



### 1.3 DESIGN REQUIREMENTS

- .1 Design details and connections in accordance with requirements of CAN/CSA S16 and CSA S136 to resist forces, moments, shears indicated or implied and handling, transportation, erection loads and as indicated on the Contract Drawings.
  - .1 Include in design for connections between columns, beams, girders, trusses and braces, and between such members as spandrel angles and beams, hangers, stiffeners and their supporting members.
  - .2 Standard connections such as connections for shear only:
    - .1 Select shear connections from the CISC Handbook of Steel Construction.
    - .2 If forces are not indicated, select or design connections to support reaction from maximum uniformly distributed load that can be safely supported by beam in bending, if no point loads act on beam, assuming fully supported compression flange.
  - .3 All connections: Designed and stamped by a Professional Engineer licensed in the Province of Ontario.
- .2 Structural design to accommodate active loads including live, dead, lateral, wind, seismic, handling, transportation, and erection loads.
- .3 Design connections:
  - .1 To safely withstand the combined effects of shear, moment, and torque at applicable design stresses.
  - .2 Not to interfere with architectural clearance lines or finishes.
  - .3 Of base plate and cap plate bearing on column-to-column section by welding or grinding column to bear.
  - .4 Taking into account any eccentricity.
  - .5 With direct fastening to flanges of spandrel beams to restrain twisting.
  - .6 Single angle and fish-plate type connections are not permitted, except for secondary, lightly loaded elements.
  - .7 Make single angle connections of wrapped type.

### 1.4 SUBMITTALS

- .1 Shop drawings:
  - .1 Submit shop drawings in accordance with Section 01 33 00.
  - .2 Include shop and field splices, cuts, copes, camber, connection details, holes, reinforcements, bearing plates, welds, anchors, identification marks, surface preparation and finishes.
  - .3 Indicate welds in accordance with CSA W59 welding symbols standard.
  - .4 Submit sketches and design calculations for structural members and connections with the corresponding shop drawings.
- .2 Erection drawings:
  - .1 Submit erection drawings in accordance with Section 01 33 00.
  - .2 Indicate details and information necessary for assembly and erection purposes such as description of methods, member identification, sequence of erection, type of equipment used in erection, and temporary bracings.

- .3      Reproduction of the Contract Drawings for use as erection drawings is not permitted without the approval of the Consultant.
- .3      Test reports: 4 weeks minimum, prior to structural steel fabrication, submit 2 copies of mill test reports by steel manufacturer indicating chemical and physical properties of steel to be used in the Work and confirming that tests completed conformed to the requirements of CAN/CSA-G40.20/G40.21.
- .4      Certifications:
  - .1      Submit certifications for welding companies under division 1 or 2.1 of CSA W47.1 for fusion welding of steel structures and CSA W55.3 for resistance welding of structural components.
  - .2      Submit confirmation by the design Consultant that fabrication and erection complies with the Contract Documents..
- .5      Inspection reports: Submit field reports of shop and field inspections.

## 1.5      **QUALITY ASSURANCE**

- .1      Retain a Professional Engineer, licensed in the Province of Ontario, with experience in design, fabrication, and erection of structural steel Work of comparable complexity and scope, to perform following services as part of Work of this Section:
  - .1      Design of structural members and connections.
  - .2      Stamp, and sign shop and erection drawings, design calculations, and amendments.
  - .3      Conduct fabrication and erection inspections and prepare and submit written inspection reports verifying that the Work is in accordance with the Contract Documents and reviewed shop and erection drawings.

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

- .1      Exercise care in handling galvanize finished materials. Use nylon slings for handling and a combination of wood or polystyrene blocking between units, in stockpile and in transit. Schedule and sequence the Work so a minimum of handling occurs prior to erection.

## 2      **Products**

### 2.1      **MATERIALS**

- .1      Rolled structural steel shapes, and flat hot-rolled steel Products: CAN/CSA G40.20/G40.21, Grade: 350W.
- .2      Hollow structural sections: CAN/CSA G40.20/G40.21, Grade 350W, Class H.
- .3      Beam connections, columns, base plates, beams, purlins, and girts: CAN/CSA G40.20/G40.21.

- .4 Surface preparation: Remove moisture, oil, grease, dirt, excessive rust, loose mill scale, and clean to SSPC SP6 - Commercial aggregate blast.
- .5 Grating: In accordance with Section 05 50 00.
- .6 Hot dip galvanizing: CSA G164-M; minimum zinc coating of 600 g/m<sup>2</sup>.
- .7 Touch-up primer (galvanized steel): CAN/CGSB-1.181.
- .8 Welding materials: CSA W59 and certified by the Canadian Welding Bureau.
- .9 Anchor bolts and rods: ASTM A307, Grade C, with hexagon heads and nuts, lengths shown with a minimum of 13 mm projecting beyond the nut. Nuts: ASTM A563M.
- .10 High strength bolts: ASTM A325M, Type 1, heavy hexagon high strength bolts, of standard size, of lengths required for thickness of members joined and for type of connection.
  - .1 Lock washers, lock nuts, burr thread to prevent bolts from working loose.
  - .2 ASTM A563; Hexagon semi-finished nuts.
  - .3 ASTM F436M; Flat, smooth hardened washers, quenched and tempered.

## **2.2 FABRICATION**

- .1 Fabricate structural steel in accordance with CAN/CSA S16 and CISC Handbook of Steel Construction fabrication tolerances except as indicated otherwise.
- .2 Splicing of members is not permitted except as shown on the Contract Drawings or as accepted by the Consultant.
- .3 Clean, prepare surfaces and galvanize structural steel in accordance with CAN/CSA S16.
- .4 Continuously weld structural steel members where indicated. Galvanize vent / weep holes for structural steel members.
- .5 Grind shop fabrication welds smooth.
- .6 Fabricate structural steel members true and without twists or open joints.
- .7 Weld in accordance with CSA W59.
- .8 Fabricate properly sized holes to accommodate other parts of the Work including holes required for attachment; locate holes to prevent appreciable reduction of structural member strength. Reinforce openings as necessary to maintain strength of structural members.
- .9 Fabricate HSS members with sufficient holes to prevent the accumulation of water.

3 Execution

3.1 **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.
- .2 Obtain the Consultant's written approval prior to field cutting or altering of structural members.

3.2 **MARKING**

- .1 Mark materials in accordance with CAN/CSA G40.20/G40.21; do not use die stamping.
- .2 Match marking: Mark bearing assemblies and splices in shop for fit and match.

3.3 **STRUCTURAL STEEL ERECTION**

- .1 Supply and coordinate the location and placement of anchor bolts, and base plates.
- .2 Erect structural steel in accordance with accepted shop and erection drawings and tolerances of CAN/CSA S16 and CISC Handbook of Steel Construction tolerances except restrict the maximum variation in elevation to 6 mm.
- .3 Splicing of members is not permitted except as shown on the Contract Drawings or as accepted by the Consultant.
- .4 Set steel accurately to lines and elevations indicated. Set column bases and shim to proper elevations. Install structural grouting in accordance with details and the manufacturer's recommendations.
- .5 Assemble structural steel members true, plumb, and level, free of twist and open joints.
- .6 Make high strength bolted connections in accordance with CSA S16.
- .7 Weld in accordance with CSA W59.

3.4 **FIELD TOUCH-UP**

- .1 Upon completion of erection, mechanically brush clean bolts, rivets, welds, and burned or scratched surfaces.

- .2 Touch up damaged surfaces with galvanized touch-up primer in accordance with manufacturer's written instructions.

END OF SECTION

**PART 1: GENERAL**

**1.1 GENERAL REQUIREMENTS**

- .1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.
- .2 Conform to the National Building Code of Canada, the Construction Safety Act, CSA Standard S16-01 and applicable Provincial Building Code. All codes and standards shall be current editions with all revisions to date.
- .3 Co-operate with other trades for satisfactory completion of the Work.
- .4 Where structural steel members specified on the drawings are not available to the contractor, the structural steel contractor shall provide members having all section properties equal to or better than the specified members at no additional cost. Contact engineer for acceptance of any and all substitutions.

**1.2 RELATED WORK SPECIFIED ELSEWHERE**

- .1 Contractor shall be responsible for coordinating this section with all related sections.

**1.3 QUALITY ASSURANCE**

- .1 Any organization undertaking to weld under this contract shall be fully approved by the Canadian Welding Bureau under the requirements of CSA W47.1-03, W55.3- (latest edition) and CSA W59- (latest edition).

**1.4 SUBMITTALS**

- .1 Shop Drawings:
  - .1 Prepare and submit shop and erection drawings which conform to the requirement of the General Conditions and Section 01 33 00, CSA S16-01, and as specified herein.
  - .2 Show the size, spacing and location of structural steel connections, attachments, reinforcing and anchorage. Include necessary plans, elevations and details. Indicate size and type of fastening. For welded connections, use welding symbols in compliance with AWS and indicate clearly net weld lengths.
  - .3 Submit typical details of connections and any special connections for review by the Consultant before preparation of shop drawings.
  - .4 Review of shop drawings by the Architect and Engineer will not absolve the Contractor from his responsibility of providing materials and equipment to complete and finish his work in accordance with the contract documents. Departures or differences from the referenced drawings shall be approved, in writing, by the Architect/ Consultant.

- .5 The Subcontractor shall include in his delivery schedule a minimum of two (2) weeks for consultant review of shop drawings.
- .6 All connections to be designed by a qualified engineer registered to practice in the province of construction.
- .7 All shop drawings are to be signed and sealed by a qualified engineer registered to practice in the province of construction, who shall take responsibility for the design of all connections.
- .8 Do not use contract documents as shop drawings or erection drawings. Contract documents used for this purpose will not be reviewed. Delays resulting from this procedure will be the responsibility of the contractor.

## **1.5 INSPECTION AND TESTING**

- .1 Qualified inspectors will be employed by the Owner for this Work. Inspection organization undertaking to inspect welding shall be qualified in accordance with the requirements of CSA W178.1- (latest edition) "Qualification Code for Welding Inspection Organizations" and approved by the Canadian Welding Bureau.
- .2 Provide free access for inspectors to all places where Work is being done.
- .3 Inspectors are to ensure that materials conform with the requirements of this Specification.
- .4 Mill test reports, properly correlated to the materials, will be accepted in lieu of physical tests.
- .5 Inspection shall include:
  - .1 Shop inspection of fabrication in the plant.
  - .2 Identification of material grades.
  - .3 Check of overall dimensions.
  - .4 Check of cambers.
  - .5 Check of workmanship regarding layout, punching and reaming of holes.
  - .6 Shop and field inspection of bolted connections.
  - .7 Shop and field inspection of welded joints.
  - .8 General inspection of field cutting and alternations.

- .9 General inspection of shop priming and field touch-up.
- .6 The installation and testing of bolts shall conform to the requirements CSA S16-01. Inspector shall check one representative connection in ten by torque testing every bolt and shall check each bolt in every connection with a tap of a hammer for soundness. Inspectors shall enforce the requirements of the connection type.
- .7 Inspector shall examine visually all welded joints for inclusions, porosity, lack of fusion, penetration, contour, under-cuts and cracks. Root passes shall be checked for penetration and cracks from the back of the joint. When directed by the Consultant, have one representative weld in ten and every weld in direct tension tested ultrasonically.
- .8 Inspector shall make a full prompt written report to the Architect of all inspections and tests. Circulate reports to the Architect (2 copies), Engineers (1 copy), General Contractor (2 copies), Owner (1 copy) and Authorities having jurisdiction.
- .9 Steel materials and workmanship not conforming to this Specification will be rejected. Remove and replace defective materials without unnecessary delay and without extra cost.

## 1.6 DESIGN

- .1 Design connections in accordance with the Handbook of Steel Construction by the Canadian Institute of Steel Construction for loads shown or required.
- .2 Conform to the National Building Code of Canada (latest edition) and applicable Provincial Building Codes and subsequent updates, CSA S16-01, local by-laws and regulations.
- .3 Top of beam elevations given in relation to the underside of steel deck levels shall be:
  - A) Beams support joists..... underside of joist shoe.
  - B) Beams not supporting joists..... 0.
  - C) Other..... as noted on plans/sections.

## 1.7 DELIVERY, STORAGE AND HANDLING

- .1 Coordinate deliveries to comply with Construction Progress Schedule and arrange ahead for off-the-ground storage location. Do not load any area beyond the design limits.
- .2 Adequately protect steel against rust and damage during manufacturing, delivery and storage.
- .3 Store material on planks on a dry area and protect from damage. Make good



immediately any damage done, clean scratches and the like, touch-up with specified primer.

**PART 2: PRODUCTS**

**2.1 MATERIALS**

- .1 Structural Steel: New stock (not weathered or rusted); to conform to CAN/CSA-G40.20/G40.21- (latest edition), Grade 350W.
- .2 Hollow Structural Sections: (HSS); New stock; to conform to CAN/CSA-G40.20/G40.21- (latest edition), Grade 350W, Class H, stress relieved.
- .3 Provide high-strength bolts in compliance with ASTM Standard A325 (latest edition) – High Strength Bolts for Structural Steel Joints, including suitable nuts and plain hardened washers.
- .4 Provide welding electrodes in compliance with CSA W48-Series – Mild Steel Covered Arc Welding Electrodes. Welding materials shall conform to CSA W59- (latest edition).
- .5 Structural Steel Primer: CAN/CGSB-1.40-M (latest edition), Structural Steel, Oil Alkyd Type or CAN/CGSB-140-M (latest edition): Red Lead, Iron Oxide, Oil Alkyd type and zinc rich paint to approved manufacturer's specifications containing 85% zinc in dry film for exterior exposed members. Shop coat and on-site touch-up shall be no less than 0.5 mils thickness.
- .6 Touch-up Primer: CAN/CGSB-1.181- (latest edition), zinc rich organic primer, "Gild Zinc 100" by ICI Paints Canada Inc., or other approved manufacturer.
- .7 Commercial galvanizing to conform to CSA Standard G164-M (latest edition).
- .8 Welded studs shall be by an approved manufacturer such as TRW Nelson and shall conform to CSA Standard W59- (latest edition).

**PART 3: EXECUTION**

**3.1 PREPARATION RELATED TO OTHER TRADES**

- .1 As the work of other trades progresses, supply anchor bolts, adjustable lintel inserts, bearing plates, lintels and other members required to be built-in with the work of other trades.
- .2 Give necessary instructions to other trades for setting bearing plates, anchor bolts and other members to be built-in with the work of other trades.
- .3 Verify the locations and elevations of concrete foundations and anchor bolts for column

bases before standing columns, or commencement of erection will be deemed to represent acceptance of the previous work and conditions.

### 3.2 FABRICATION

- .1 Fabrication of structural members shall comply with CSA S16-01 and as specified below.
- .2 Use only clean and straight material. If straightening or flattening is necessary, do it only by a process and in a manner that will not injure the material. Material having kinks or bends not called for on the drawings will be rejected.
- .3 Shop or field connections shall be bolted with high strength bolts or welded. Connections shall be made with due regard for Architectural Drawings and appearance. **Do Not** interfere with clearance lines or architectural finishes.
- .4 Minimum size of welds to be 5mm.
- .5 Beam connections shall be adequate to resist the reactions produced by the framing or load conditions.
- .6 Provide double angle header connections where practical. Otherwise use seat connections with top clip angles for lateral support.
- .7 Header connections shall be used at all expansion joints for structural steel.
- .8 Minimum length of double angle header connections shall not be less than half of the depth of the beams.
- .9 Do not use one-sided or fish plate type connections.
- .10 Provide top and bottom flange angle clips for all spandrel beams.
- .11 Provide punched holes 11mm to 27mm in diameter for convenience of other trades in attaching wood or other materials to steel work, when so directed by the Architect. Holes shall be so placed as not to cause any appreciable reduction in the strength of the member.
- .12 Provide holes for pipes and ducts and the reinforcing for same as indicated on drawings. Cutting of holes in steel beams in the field will not be permitted, without the written approval of the Consultant.
- .13 Provide separators at approximately 1200mm o.c. for double beams and channels as follows:
  - .1 Beams and channels 200mm or less in depth – one or two rows of pipe separators.

- .2 Beams and channels over 200mm in depth – channel separators unless otherwise detailed on the drawings.
- .14 Mill column bearing plates under column bearing..
- .15 Structural steel members shall not be spliced unless approved by the structural engineer in writing.
- .16 Provide 50mm clear space between structural steel at expansion joints.
- .17 Provide adjustable galvanized steel anchors 40mm x 6mm on columns that abut masonry for anchoring every 400mm in height.
- .18 Provide adjustable galvanized steel anchors 40mm x 6mm on beams that abut masonry at 400mm on centre vertically and 2000mm on centre horizontally.
- .19 Welding shall comply with CSA W59- (latest edition).
- .20 Fabricator shall be approved by the Canadian Welding Bureau under the requirements of CSA W47.1-03.

### **3.3 SHOP PAINTING AND PROTECTION**

- .1 Clean steel by shot-blasting or power wire brushing to remove rust, mill scale, oil, dirt, and other foreign matter before commencing shop painting. The quality of cleanliness shall be of standard stated in SSPC-SP6 Commercial Blast Cleaning, or SSPC-SP3 Power Tool Cleaning, as may be required to satisfy final paint finish requirements.
- .2 Clean welds by wire brushing and wash down with clean water, to remove the chemical residues left by the electrodes, prior to painting.
- .3 All steel work shall receive one shop coat of exterior grade primer.
- .4 Steel work shall be painted and shall remain under cover until the paint protection has dried.
- .5 Give the parts which are inaccessible after assembly two coats of primer coat paint, of different colours, when members are noted to be painted.
- .6 Provide sandblasting before finish painting for steel members at edge of openings as shown on drawings.
- .7 Steel work shall be left installed in a clean state ready to receive applicable finishes.
- .8 Where steel is to be covered with sprayed fireproofing, ensure that paint primer used is compatible with sprayed fireproofing.
- .9 The following surfaces shall not be painted:

1. Surfaces and edges to be field welded, except joist surfaces to receive steel decking. If painted, remove paint for field welding for a distance of at least 50mm on all sides of the joint.
  2. The contact surfaces of friction-type connections assembled by high strength bolts.
  3. Portions of steel members which are to be encased in, or in contact with, concrete slabs cast-in-place.
- .10 All exterior exposed structural steel shall be galvanized or painted with approved rust inhibitive paint.

### **3.4 ERECTION**

- .1 Make adequate provision for horizontal and vertical erection loads and for sufficient temporary bracing to keep structural steel plumb and in true alignment until the completion of erection and installation of concrete work and roof decks which provide the necessary permanent bracing. Any failure to make proper and adequate provisions for erection stresses shall be entirely at the risk and responsibility of the Contractor.
- .2 When temporary steel members are required for erection purposes, such members shall be provided and removed when no longer required.
- .3 Handle and store structural steel on the job site in such a manner that no damage shall be caused to the material, or the structure.
- .4 Erect individual members of the structural steel to the following tolerances:
  - .1 Exterior columns, spandrel beams and angles, 1 to 1000.
  - .2 All other pieces 1 to 500.
  - .3 Adjustable Shelf Angles attached to steel frame 3mm plus or minus, with abutting ends of members at the same level. These elements shall be welded in place after final adjustment and galvanizing shall be touched-up with zinc rich paint.
  - .4 A variation of 1.5mm is permissible in the overall length of members with both ends milled. Members without milled ends which are to be framed to other steel parts of the structure may have a variation from the detail length not greater than 2.5mm for members 9000mm or less in length; and not greater than 3mm for members over 9000mm in length.
  - .5 Execute all field assembly and welding in accordance with the requirements for shop fabrication excepting such as manifestly apply to shop conditions only.

- .6 Provide bearing plates and standard government wall anchors for beams bearing on masonry or concrete.
- .7 Provide 150mm bearing for angle lintels and bolt or weld together upstanding legs. Maximum spacing of bolts or welds shall be 600mm.
- .8 Paint field bolts, field welds and any abrasions or damage to the shop coat or primer, after erection.
- .9 Provide C100 x 8 structural members for framing at perimeter of holes through metal decking where openings between 450mm and 1200mm in roof deck and between 300mm and 1200mm in floor deck measured across the flutes. Connect to main framing members.

### **3.5 ARCHITECTURALLY EXPOSED STEEL**

- .1 Where finished surfaces of steel are to be left exposed to view, fabricate as specified in AISC Specification for Architecturally Exposed Steel, including specified straightness.
- .2 Continuously weld connection joints where exposed to view and grind them smooth and flush with adjacent surfaces.
- .3 Remove mill marks, identification and surface imperfections by grinding smooth and flush with adjacent surfaces.
- .4 Clean, prime and protect all steel as specified in this Section. Apply one coat of primer compatible with finish.

**END OF SECTION**

**PART 1: GENERAL**

**1.1 GENERAL REQUIREMENTS**

- .1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.
- .2 Unless otherwise specified, conform to CSA Standard S16-01, Steel Structures for Building – Limit States Design and CSA S136-01, Cold Formed Steel Structural Members including all supplements as of the date of tender.

**1.2 RELATED WORK SPECIFIED ELSEWHERE**

- .1 Contractor shall be responsible for coordinating this section with all related sections.

**1.3 QUALITY ASSURANCE**

- .1 Execute the work of this Section only by personnel who have adequate plant, equipment and skill and are known to have been responsible for satisfactory work similar to that specified during a period of at least five years.
- .2 Any organization undertaking to weld under this Contract shall be fully approved by the Canadian Welding Bureau under the requirements of CSA W47.1-03, W55.3 and W59, (latest editions).

**1.4 SUBMITTALS**

- .1 Submit in accordance with the General Conditions and Section 01 33 00.
- .2 Shop Drawings:
  - .1 Submit structural design calculations and supporting engineering information concerning joists. Each design data document shall bear the seal of the design engineer responsible for its preparation.
  - .2 Prepare erection and detail drawings for open web steel joists for review by the Architect and Consultant.
  - .3 Show pertinent details including capacity, types, and sizes of joists, details of bridging and anchoring, chord extensions, and reinforcing where required.
  - .4 Do not use contract drawings as shop drawings or erection drawings. Contract drawings used for this purpose will not be reviewed. Delays resulting from this procedure will be the responsibility of the contractor.

**1.5 INSPECTION AND TESTING**

- .1 Make copies of mill test reports (properly correlated to the materials) available to the Consultant upon request. Mill test reports will be accepted in lieu of mill inspection.

## 1.6 DELIVERY, STORAGE AND HANDLING

- .1 Coordinate deliveries to comply with Construction Progress Schedule and arrange ahead for off-the-ground storage location. Do not load any area beyond the design limits.
- .2 Adequately protect steel against rust and damage during manufacturing, delivery and storage.
- .3 Store material on planks in a dry area and protect from damage. Make good immediately any damage done, clean scratches and the like, touch-up with specified primer.

## 1.7 DESIGN

- .1 Design joists by a qualified Engineer registered to practice in the province of construction to safely support the uniformly distributed loading shown, all concentrated loads carried by the joists, and in addition, snow accumulation loads as shown.
- .2 Design joists for conditions such as non-uniform load, fixed or cantilevered ends or absence of adequate lateral support by the decking.
- .3 Design joists for all loading conditions specified in the National Building Code and local building codes, in addition to the snow loads specified on plans.
- .4 Specified loads are shown on plans.
- .5 Areas shaded on the roof plan indicate extent of additional snow piling with peak specified loads noted. Roof joists shall be designed, manufactured and erected to support basic specified loads as well as additional snow loading.
- .6 For water filled pipe sizes and locations, refer to mechanical drawings and sprinkler drawings. In the absence of detailed information, the weights of water filled pipes shall be assumed as follows:

100mm diameter pipes and smaller	w = 0.10 kN/m
125mm diameter pipes	w = 0.35 kN/m
150mm diameter pipes	w = 0.47 kN/m
200mm diameter pipes	w = 0.75 kN/m

Add 0.45 kN point loading at the hanging points

Design joists for additional point loads P in kN due to pipe hangers as follows:

$$P = wL + 0.45 \text{ kN}$$

Where L is the hanger spacing in meters and w is the weight of the filled pipe in kN/m.

- .7 All mechanical pipes 50mm in diameter and larger shall be hung from top chord of joists at panel points only.
- .8 Design joists for net uplift due to wind using gross uplift in accordance with N.B.C. Supplement (latest edition).
- .9 All joists are to be cambered for full dead load deflection.
- .10 Live load deflection of roof joists when subjected to full total load shall not exceed 1/240 of the span for roof members, except where such members support a plaster ceiling or similar finish like drywall, the deflection due to live load shall not exceed 1/360 of the span. Live load deflection for floor joists shall be as specified on the structural drawings.
- .11 T.J. denotes tie joists. Full size of bottom chords shall be framed into columns or beams. Top and bottom chords shall be designed and connected for horizontal loads resulting from a live load moment of negative 14 kN.m specified, or 10% of the specified dead + live vertical end reactions of the joists, (whichever is greater), in addition to the gravity and wind uplift loads specified.
- .12 Minimum size of bottom chords for tie joists to be 2L 45x45x5
- .13 In order to facilitate the passage of mechanical ducts and pipes through joists, the joist supplier shall locate the diagonals so that they line up from joist to joist..
- .14 Steel joist supplier shall design, supply and erect joist bridging of sufficient size and spacing in accordance with the CSA S16-01, and if the assembly is to be fire rated, provide bridging as required by the applicable fire rated design.
- .15 Ensure that all bridging is located so that it clears all equipment to be installed between the joists, such as lighting, ductwork, piping etc.
- .16 All pipes must be hung from top chord of joists. If a load, (approved by the structural Consultant), is hung from a joist at a location other than the panel point, then a web diagonal shall be welded from the hanger location to the nearest panel point on the opposite chord.

## **PART 2: PRODUCTS**

### **2.1 MATERIALS**

- .1 Steel for open web steel joists shall be of quality suitable for the applicable welding processes and shall conform to CSA Standard G40.20/G40.21 (latest edition), General Requirements for Rolled or Welded Structural Quality Steel, and Structural Quality Steels, except that steel used in cold roll-formed components shall conform to the requirements for such steel as prescribed by CSA Standard S136-01, Cold Formed Steel Structural Members.
- .2 Welding Electrodes: Conforms to CSA W48.1-M (latest edition) Mild Steel Covered



Arc-Welding Electrodes.

- .3 Primer: Refer to Structural Steel, Section 05 10 00.
- .4 Commercial galvanizing – CSA Standard G164-M (latest edition).

### **PART 3: EXECUTION**

#### **3.1 WORKMANSHIP**

- .1 Conform to CSA Standard W55.3-(latest edition), Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings.
- .2 Conform to CSA Standard W59-(latest edition), Welded Steel Construction (Metal-Arch Welding).
- .3 Connect component members of joists by arc or resistance welding, bolting or other methods approved by the Consultant.
- .4 Provide bearings at ends of joists proportioned so that the allowable bearing pressure on the supporting material is not exceeded. On masonry or concrete, extend the end of the bearing a minimum of 100mm beyond the face of the support. On steel, extend the end of the bearing a minimum of 65mm beyond the face of the support.

#### **3.2 PRIME COAT PAINTING AND GALVANIZING**

- .1 Clean joists by wire brushing or other effective means to remove loose mill scale, rust, oil, dirt and other foreign matter.
- .2 Apply one coat of paint in the shop by dipping or spraying.
- .3 Touch-up field welds and abrasions in the field.
- .4 Where steel joists are covered with sprayed fireproofing, ensure that paint primer used is compatible with sprayed fireproofing.

#### **3.3 ERECTION**

- .1 Erect, set accurately and in correct alignment, all joists level and true, and so secure them as to remain in place during the installation of the deck.
- .2 Anchor joists supporting up to 9 square meters of area to steel supports at each end bearing by a minimum of two 5mm fillet welds, each 25 long, or other comparable means approved by the Consultant.
- .3 Anchor joists supporting more than 9 square meters of area to steel supports of each end bearing by not less than two 5mm fillet welds, each 50 long, or other comparable mechanical means approved by the Consultant.

- .4 Supply steel packing to elevate joists to the required bearing level or provide a special shoe at the joists.
- .5 After erection is complete, remove accumulations of soil or other foreign matter, leaving the surfaces of joists suitable for receiving field painting.
- .6 Erect joists in accordance with design.

### **3.4 INSTALLATION OF BRIDGING**

- .1 Before the application of any construction load, install bridging in accordance with Section 16.7 of CSA S16-01, and as required by ULC test design where applicable. Anchor each line of bridging to walls and other supporting structural members.
- .2 Provide 1 row of horizontal bridging at the first bottom chord panel point at each end of all joists.
- .3 Provide additional cross bridging as indicated on plans.
- .4 Provide additional X-bridging between the outside perimeter beams/joists and the first row of joists, in all areas where perimeter members run parallel with the joists.
- .5 Additional X-bridging is shown thus = = = = on plans.
- .6 Minimum size of X-bridging to be L35x35x3 spaced at maximum 6'-8" on centre, unless noted otherwise on plan.
- .7 Adjust bridging locations to allow for mechanical / electrical /architectural equipment to be installed between the joists. Contact engineer for advice before relocating bridging shown on contract documents and shop drawings.

### **3.5 FURRING EXTENSION RODS**

- .1 Provide furring extension rods for bottom chords of joists where required, suitable to support the weight of ceiling construction.

### **3.6 SPACING OF JOISTS**

- .1 All joists are to be equally spaced between tie joists unless specifically dimensioned on the structural drawings.
- .2 Where tie joists do not exist, all joists are to be equally spaced in the area in which they are shown, unless specifically dimensioned on the structural drawings.

**END OF SECTION**

1 General

1.1 **SECTION INCLUDES**

- .1 Design, labour, Products, equipment and services necessary for the steel joists Work in accordance with the Contract Documents.

1.2 **REFERENCES**

- .1 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
- .2 ASTM A325M, Standard Specification for Structural Bolts, Steel, Heat Treated 830 Mpa Minimum Tensile Strength (Metric).
- .3 ASTM A563M, Standard Specification for Carbon and Alloy Steel Nuts [Metric].
- .4 ASTM F436M, Standard Specification for Hardened Steel Washers [Metric].
- .5 CAN/CSA-G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steels.
- .6 CAN/CSA S16, Limit States Design of Steel Structures.
- .7 CAN/CSA S136, North American Specification for the Design of Cold Formed Steel Structural Members.
- .8 CSA W47.1, Certification of Companies for Fusion Welding of Steel Structures.
- .9 CSA W55.3, Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings.
- .10 CSA W59, Welded Steel Construction (Metal Arc Welding).
- .11 CAN/CGSB 85.10, Protective Coatings for Metals.
- .12 CISC Handbook of Steel Construction.
- .13 CISC/CPMA 1.73a Quick Drying Primer.
- .14 SSPC Steel Structures Painting Council.

1.3 **DESIGN REQUIREMENTS**

- .1 Design steel joists and bridging to carry loads shown on Contract Drawings in accordance with CAN/CSA-S16 and for a minimum load. Design bearing plates where the support is masonry or concrete.
- .2 Line up web members to allow unobstructed passage of mechanical services.

- .3 Centre bearing of joists except where shown otherwise:
  - .1 25 mm past web of supporting steel beam where joists are framing in from one side only.
  - .2 25 mm maximum short of web of supporting steel where joists are framing in from two sides.
  - .3 Over centre line of supporting masonry, 100 mm maximum from inside face of masonry wall or concrete.
- .4 Limit roof joist deflection due to specified live load to 300 of span and deflection due to specified total load to 240 of span.

#### 1.4 SUBMITTALS

- .1 Shop drawings:
  - .1 Submit shop drawings in accordance with Section 01 33 00.
  - .2 Include load design criteria, joist geometry, centre line of bearing, member size, properties, framed openings, splicing details, camber, bearing plates, anchorage, identification marks, orientation and finishes.
  - .3 Indicate welds in accordance with CSA W59 welding symbols standard.
- .2 Erection drawings:
  - .1 Submit erection drawings in accordance with Section 01 33 00.
  - .2 Indicate details and information necessary for assembly and erection purposes such as description of methods, sequence of erection, type of equipment used in erection, joist marks, tie joints, depths, spacing, bridging lines, bearing and anchorage details, and temporary bracings.
  - .3 Reproduction of the Contract Drawings for use as erection drawings is not permitted. Do not use Contract CADD files.
- .3 Test reports: 4 weeks minimum, prior to structural steel fabrication, submit 2 copies of mill test reports by a qualified metallurgist indicating chemical and physical properties of steel to be used in the Work and confirming that tests completed are in accordance with the requirements of CAN/CSA G40.20-04/G40.21.
- .4 Certifications: Submit certifications for welding companies under division 1 or 2.1 of CSA W47.1 for fusion welding of steel structures and CSA W55.3 for resistance welding of structural components.

#### 1.5 QUALITY ASSURANCE

- .1 Retain a Professional Engineer, licensed in the Province of Ontario, with experience in steel joist Work of comparable complexity and scope, to perform the following services as part of the Work of this Section:
  - .1 Design structural members and connections.
  - .2 Review, stamp, and sign fabrication and erection shop drawings, design calculations, and amendments thereto.

- .3 Conduct shop and on-site inspections, and prepare and submit written inspection reports verifying this part of the Work is in accordance with the Contract Documents and reviewed shop drawings.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Exercise care in handling primer finished materials. Do not handle steel until primer paint has cured sufficiently to handle without damage to same. Use nylon slings for handling and a combination of wood or polystyrene blocking between units, in stockpile and in transit. Schedule and sequence the Work so a minimum of handling occurs prior to erection.

## 2 Products

### 2.1 MATERIALS

- .1 Structural steel for OWSJ: CAN/CSA G40.20-04/G40.21, Grade 300W.
- .2 Surface preparation: Remove moisture, oil, grease, dirt, excessive rust, loose mill scale, and clean to SSPC SP6 - Commercial aggregate blast
- .3 Shop paint primer and touch-up: CISC/CPMA 1.73a.
- .4 Welding materials: CSA W59 and certified by the Canadian Welding Bureau.
- .5 Anchor bolts: CAN/CSA G40.20-04/G40.21-M, Grade 300W.
- .6 Bolts, nuts and washers: ASTM A325M and ASTM A307.
  - .1 Lock washers, lock nuts, burr thread to prevent bolts from working loose.
  - .2 ASTM A563M; Hexagon high strength bolts and semi-finished nuts.
  - .3 ASTM F436M; Flat, smooth hardened washers, quenched and tempered.

### 2.2 FABRICATION

- .1 Fabricate steel joists and accessories, as indicated and in accordance with CAN/CSA S16 and within the CISC Code of Standard Practice Handbook fabrication tolerances except as indicated otherwise.
- .2 Clean, prepare surfaces and shop prime steel joists and accessories in accordance with CAN/CSA S16.
- .3 Apply primer and finish compatible with arc welding where joints are supporting steel deck and where shear studs are welded to top chord.
- .4 Fabricate steel joists and accessories true and without twists or open joints. Grind shop fabrication welds smooth.

- .5 Splicing of members is not permitted except as shown on the Contract Drawings or as accepted by the Consultant.
- .6 Weld in accordance with CSA W59.
- .7 Supply and install chord extensions where indicated. Supply and install diagonal, horizontal and anchorage bridging as indicated.

### 3 Execution

#### 3.1 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.
- .2 Obtain the Consultant's written approval prior to field cutting or altering of structural members.

#### 3.2 JOIST ERECTION

- .1 Supply and install base plates where required.
- .2 Erect steel joists and bridging as indicated in accordance with CAN/CSA-S16 and in accordance with the CISC Code of Standard Practice Handbook tolerances.
- .3 Splicing of members is not permitted except as shown on the Contract Drawings or as accepted by the Consultant.
- .4 Assemble joists true, plumb, and free of twist. Install diagonal, horizontal and anchorage bridging as indicated.
- .5 Obtain written approval from consultant prior to field cutting or altering joists or bridging that are not shown on shop drawings.
- .6 Clean and touch up shop primer to bolts, welds, burned or scratched surfaces at completion of erection.
- .7 Weld in accordance with CSA W59.

#### 3.3 FIELD TOUCH-UP PAINTING

- .1 Upon completion of erection, mechanically brush clean bolts, welds, and burned or scratched surfaces. Touch up damaged surfaces and surfaces in accordance with CGSB 85-GP-14M.

END OF SECTION

**PART 1: GENERAL**

**1.1 GENERAL REQUIREMENTS**

- .1 General Conditions, Supplementary Conditions and Division 01 apply to this Section.

**1.2 RELATED WORK UNDER OTHER SECTIONS**

- .1 Contractor shall be responsible for coordinating this section with all related sections.

**1.3 QUALITY ASSURANCE**

- .1 Execute the work of this Section only by personnel who have adequate plant, equipment and skill and are known to have been responsible for satisfactory work similar to that specified during a period of at least five (5) years.
- .2 Welding shall meet specified requirements of CSA Standard W59- (latest edition) and shall be performed only by a fabricator fully certified to the conditions of CSA Standard W55.3- (latest edition), and W47.1-03.

**1.4 SHOP DRAWINGS**

- .1 Submit in accordance with the General Conditions and Section 01 33 00.
- .2 Submit in accordance with the General Conditions.
- .3 Shop Drawings:
  - .1 Prepare erection and detail drawings for review by the Architect and Consultant.
  - .2 Indicate the types of deck, their locations, design load, location of openings and their reinforcement, gauge of steel, surface protective coating, flashing and closure plates, locations of welds, anchorage plates and the like. Provide sufficient detail and sections indicating the deck's orientation to support members.
  - .3 Do not use contract drawings as shop drawings or erection drawings. Contract drawings used for this purpose will not be reviewed. Delays resulting from this procedure will be the responsibility of the contractor.

**1.5 INSPECTION AND TESTING**

- .1 Make copies of mill test reports (properly correlated to the materials) available to the Consultant upon request. Mill test reports will be accepted in lieu of mill inspection.

**1.6 DESIGN**

- .1 Determine structural properties and capacity of decking in accordance with CSA S136-01, Cold Formed Steel Structural Members.

- .2 Areas shaded on roof plans indicate extent of additional snow piling. Roof deck shall be designed, manufactured and erected to support basic specified as well as additional snow loading.
- .3 Under live load, the deck shall not have a deflection between consecutive supports, exceeding  $1/360^{\text{th}}$  of the span for roof deck supporting plaster or other finished ceilings, such as drywall,  $1/240^{\text{th}}$  of span of roof deck in other areas.
- .4 Where deck has been designed to act as a diaphragm to resist lateral loads, as indicated on the structural drawings, provide transverse puddle welds, longitudinal puddle welds, and button punched side laps as indicated on the structural drawings.
- .5 In areas where deck has not been specified to act as a diaphragm, provide the following minimum deck connections:

Attach to supporting steel with 20mm diameter fusion welds. (effective diameter to be minimum 13mm).

Transverse puddle welds shall be spaced at 300mm on centre maximum.

Side laps to be button punched at 600mm on centre maximum.
- .6 Anchor deck to supporting framework to resist uplift forces stated in the National Building Code of Canada, and local building codes. Dead loads may be deducted from gross uplift forces in accordance with the National Building Code of Canada and local building codes.
- .7 In cases where deck forms part of a fire rated assembly, ensure that the installation of the deck meets with the minimum requirements of such an assembly as specified in Underwriters Laboratories test design specification. Verify, before erection of deck, that work specified in other sections, as a part of the entire assembly, will be installed to meet validating specification for ceiling-roof assembly.
- .8 Span metal deck units continuous over at least three or more supports wherever possible. Increase thickness of metal to compensate for continuity wherever fewer than three supports may occur.

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

- .1 Ship, store and install metal deck to prevent damage to the finish, denting, deformation and rusting, by both careful handling and physical protection. Replace deck that has suffered damage.
- .2 Store deck in stacks raised clear of ground, with panels separated by wood blocking, covered with waterproof material leaving space for air circulation, and tilted to drain water.
- .3 Secure units to framing with temporary fastenings, until they are permanently welded in place, to ensure against displacement from all causes.



- .4 Secure loose bundles of deck in place.
- .5 Deliver bearing plates and anchors supplied by this Section for installation by other Sections as directed by installer and to meet construction schedule.

**PART 2: PRODUCTS**

**2.1 MATERIALS**

- .1 Roof Deck: Metal deck shall have deck flutes at 150mm centres, and shall be formed from sheet steel conforming to the requirements of CSSBI 10M (latest edition) zinc coated structural quality sheet steel for roof deck, Grade 'A', with a minimum zinc coating designation of ZF075 Wiped Coat Finish, and a nominal base steel thickness as specified on the structural drawings.
- .2 Zinc-Rich Paint: Conforming to CAN/CGSB-1.81-(latest edition).

**PART 3: EXECUTION**

**3.1 FABRICATION**

- .1 Include in Work of this Section sheet steel angles, curbs, cover plates, cell closures, fasteners, stiffeners and accessories, all as required. Fabricate sheet metal accessories of same material and finish as deck and in not less than 1.22mm thick material.
- .2 Fabricate metal deck to meet specified requirements of CSA S136-01 and to support superimposed loading as shown on Structural Drawings.
- .3 Form metal deck units to provide male and female interlocking side lap joints..
- .4 Fabricate units to provide for joints between abutting panel ends with:
  - .1 50 overlap, swaged and sized to provide smooth joint.
  - .2 Ends squared and finished to ensure minimum space between panels.
- .5 Provide for ribs to bear on beams parallel to flutes when tops of such beams are at same elevation as deck bearing.
- .6 Incorporate reinforcing stiffeners for unsupported edges of metal deck.
- .7 Holes in Deck:
  - .1 Incorporate holes in deck as required for services. Verify size and location of holes before commencing fabrication.

- .2 For holes greater than 450mm in dimension across flutes, separate framing is included under Work of another Section.
- .3 Steel deck contractor shall reinforce all openings in deck 450mm in size or smaller.

### **3.2 ERECTION**

- .1 Erect deck by its fabricator.
- .2 Include hoisting and erection equipment in Work of this Section.
- .3 Level and align deck units with panels parallel to each other and perpendicular to supports. Locate panel ends only over supports and to provide minimum 45mm bearing. Install steel packing to level units if necessary. Install cover plates to provide full extent of deck surface to support roofing over each area, including expansion joints and intersections of panels that span in different directions.
- .4 Lap ends of panels no less than 50mm.
- .5 Reinforce cell elements at top and bottom by a continuous web where they are cut longitudinally 50mm or more from a vertical web.
- .6 Deck contractor shall supply and install closures and cover plates at edges of roof deck. Provide deck closures at all areas where deck edges are weak.
- .7 Secure closures, plates and accessories by either sheet metal screws or welding.
- .8 Install interior cell closures in flutes intersecting vertical surfaces exposed to view, at tops of interior walls and partitions extended to deck, at intersections of roof deck with exterior walls, and as otherwise indicated on drawings. Secure cell closures by welding, sheet metal screws or adhesive as suitable for material.
- .9 Wedge the flutes of the steel roof deck under wood sleepers and metal curbs carrying roof top units.
- .10 No mechanical or electrical equipment/accessories shall be hung from the steel deck.
- .11 Hangers for suspension of ceiling are to be attached to the structural steel framing members. These may, however, be attached in between the framing members to the side of the deck flutes and by looping and tying around, but on no account should these hangers be punched through the bottom of the flutes.

**3.3            ADJUSTMENT AND CLEANING**

- .1      Touch-up adjacent primed surfaces burned, scratched or otherwise damaged during erection with prime paint to match shop coat, when erection is completed.
- .2      Paint over bare areas on galvanized surfaces and welds with zinc rich paint.
- .3      Replace dented, punctured or weld-perforated deck where exposed to view.

**END OF SECTION**

1 General

1.1 **SECTION INCLUDES**

- .1 Design, labour, Products, equipment and services necessary for the miscellaneous and metal fabrication Work in accordance with the Contract Documents.

1.2 **REFERENCES**

- .1 ANSI, H35.1M Alloy and Temper Designation Systems for Aluminum (Metric).
- .2 ASTM A53, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
- .3 ASTM A123, Specification for Zinc (Hot Dip Galvanized) Coatings on Iron & Steel Products.
- .4 ASTM A153, Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- .5 ASTM A480/A480M-15, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
- .6 ASTM A307, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
- .7 ASTM A653/A653M, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.
- .8 CISC/CPMA 1.73a, A Quick-Drying One-Coat Paint for Use on Structural Steel.
- .9 CAN/CSA-G40.20/G40.21-M, General Requirements for Rolled or Welded Structural Quality Steel/ Structural Quality Steels.
- .10 CAN/CSA S16.1-M, Limit States Design of Steel Structures.
- .11 CSA S136.1-M, Commentary on CAN/CSA S136-M, Cold Formed Steel Structural Members.
- .12 CSA W47.1, Certification of Companies for Fusion Welding of Steel Structures.
- .13 CSA W48, Filler Metal and Allied Materials for Metal Arc Welding.
- .14 CSA W59-M, Welded Steel Construction (Metal Arc Welding).
- .15 CAN/CSA W117.2-M, Safety in Welding, Cutting and Allied Processes.
- .16 CAN/CGSB 1.40-M, Primer, Structural Steel, Oil Alkyd Type.

- .17 CGSB 1-GP-181, Organic Zinc Rich Primer.
- .18 CGSB 85-GP-16M, Painting Galvanized Steel.
- .19 NAAMM, The National Association of Architectural Metal Manufacturers.
- .20 Steel Structures Painting Council (SSPC), Steel Structures Painting Manual, Vol. 2.

### 1.3 DESIGN REQUIREMENTS

- .1 Design details and connections, where not shown on Drawings, in accordance with CAN/CSA-S16.1 and CSA S136.1.

### 1.4 SUBMITTALS

- .1 Shop drawings:
  - .1 Submit shop drawings for fabrication and erection of miscellaneous and metal items in accordance with Section 01 33 00 indicating:
    - .1 Materials, core thicknesses, class of finish (AMP 555), connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.
    - .2 Ensure shop drawings are of one uniform size and based on field measurements.

### 1.5 QUALITY ASSURANCE

- .1 Retain a Professional Engineer, licensed in the Province of Ontario, with experience in Work of comparable complexity and scope, to perform the following services as part of the Work of this Section:
  - .1 Design metal fabrication items that are required to resist live, dead, lateral, wind, or seismic loads.
  - .2 Review, stamp, date, and sign shop drawings.
- .2 Workmanship: Fabricate Work of this Section to meet the required class of workmanship indicated below in accordance with AMP 555, Section 8.
  - .1 Class 2: for use on exposed to view (at a distance) fabricated items.
  - .2 Exposed surfaces retain mill marks and moderate irregularities not visible by naked eye at 10 metres. Ensure burrs and sharp edges are filed down or ground off.
  - .3 Exposed welds are ground with uniform sized cove.
  - .4 Minor distortions are permitted.
  - .5 Exposed joints have a maximum gap of 1.5 mm.
- .3 Execute welding by firms certified in accordance with CSA W47.1 Division 1 or 2.1. Ensure welding operators are licensed per CSA W47.1 for types of welding required by Work.

- .4 Perform stainless steel work in accordance with NAAMM, Code of Standard Practice for the Metal Industry, Workmanship, Class 1.

2 Products

2.1 **MATERIALS**

- .1 General:
  - .1 All materials under Work of this Section, including but not limited to, primers and paints are to have low VOC content limits.
  - .2 Unless detailed or specified herein, standard products will be acceptable if construction details, and installation meet intent of Drawings and Specifications.
  - .3 Include all materials, products, accessories, and supplementary parts necessary to complete assembly and installation of Work of this Section.
  - .4 Incorporate only metals that are free from defects which impair strength or durability, or which are visible. Install only new metals of best quality, and free from rust or waves and buckles, and that are clean, straight, and with sharp defined profiles.
- .2 Structural shapes, plates, and similar items: CAN/CSA-G40.20/G40.21-M, Grade 350W. Hollow structural sections: CAN/CSA-G40.20/G40.21-M, Grade 350W, Class H.
- .3 Galvanized sheet steel: ASTM A653/A653M Grade A, Z275 Commercial Quality zinc coating, size and shape as shown.
- .4 Stainless steel sheet and plate: ASTM A480/A480M, Type 316L, finish to AISI No. 4. Size as shown.
- .5 Protection Posts: ASTM A53/A53-M, Schedule 40 standard weight steel pipe in quantity and sizes shown.
- .6 Welding materials: CSA W48 and CSA W59-M.
- .7 Fasteners: Conforming to ASTM A307, Grade A, in areas not exposed to view, use unfinished bolts with hexagon heads and nuts. In areas exposed to view, use bolts, nuts, washers, rivets, lock washers, anchor bolts, machine screws and machine bolts Z275 zinc coated in accordance with ASTM A653/A653M. Supply bolts of lengths required to suit thickness of material being joined, but not projecting more than 6 mm beyond nut, without the use of washers.
- .8 Primer paint: CAN/CGSB-1.40-M or CPMA 1.73a.

- .9 Galvanized primer paint: Inorganic zinc rich primer. For use on galvanized fabrications where touch up is to remain unpainted in finished work; Carbozinc 11WB by Carboline Company, Catha-Coat 305 by Devoe Coatings or Zinc Clad XI by Sherwin Williams.
- .10 Drilled inserts: Mega by ITW Construction Products or HSL by Hilti Inc. heavy-duty anchors, sizes as shown.

## **2.2 FABRICATION**

- .1 Verify dimensions of existing Work before commencing fabrications and report any discrepancies to the Consultant.
- .2 Fit and assemble Work in shop where possible. Execute Work in accordance with details and reviewed shop drawings.
- .3 Use self-tapping shake-proof screws on items requiring assembly by screws or as indicated. Use screws for interior metal work. Use welded connections for exterior metal Work unless otherwise found acceptable by the Consultant.
- .4 Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush. Seal exterior steel fabrications against corrosion in accordance with CAN/CSA S16.1-M.
- .5 Execute shop welding to requirements specified.
- .6 Carefully make and fit details. Take special care with exposed finished Work to produce a neat and correct appearance to the Consultant's acceptance.
- .7 Assemble members without twists or open joints.
- .8 Correctly size holes for connecting Work of other trades where such can be determined prior to fabrication. Where possible, show holes on shop drawings. Place holes not to cause appreciable reduction in strength of member.
- .9 Draw mechanical joints to hairline tightness and seal countersunk screw and access holes for locking screws with metal filler where these occur on exposed surfaces.

## **2.3 FABRICATED ITEMS**

- .1 Refer to Drawings for details of metal fabrication work and related items not specifically listed in this Section.
- .2 Where work is required to be built into work of other Sections supply such members to respective Sections.

- .3 Provide metal fabrication items indicated below and items not indicated to be supplied under other Sections. The following items includes miscellaneous and metal fabrication including but not limited to the items listed below.
- .4 Lintels: Fabricated from CAN/CSA-G40.20/G40.21-M, Grade 350W, size and location as shown, width to be not less than 25 mm less than width of wall and extend 200 mm beyond opening at each end. Unless otherwise shown, fabricate lintels in block walls of steel sections. Prime and paint all exposed surfaces, colour to be determined by Architect at a later date.
- .5 Masonry lateral support angles:
  - .1 Supply only, to Section 04 20 00 for installation, all horizontal lateral support anchors at top of non-load-bearing masonry walls.
  - .2 Refer to Structural Drawings for size and spacing of required support anchors. Provide drilled holes as required for anchorage.
  - .3 Galvanized for all exterior wall and unheated and high humidity locations.
- .6 Shelf Angles: Of size indicated on Drawings and as specified in structural steel specifications, with adjustable inserts for vertical adjustment and slotted holes for horizontal; galvanized.
- .7 Steel ladders:
  - .1 Fabricate complete with steel stiffeners, rungs, angle rails, bent plate straps or angle brackets as shown or as provided in shop drawings.
  - .2 Provide safety cages around ladders, where indicated on Drawings and in accordance with Ministry of Labour requirements.
  - .3 Provide hot dipped galvanized exterior ladders. Prime and paint regular steel interior ladders, colour to be selected by Architect at a later date.
- .8 Bollards:
  - .1 Provide protection posts as indicated on drawings. Posts to be 200 mm diameter or as noted on drawings with a wall thickness of 8 mm (min.). Place posts into a 1500 mm foundation (where indicated), fill with 20 Mpa concrete and round top. Project pipes 914 mm above finished grade. Finish prime coat.
  - .2 Material: Type galvanized steel.
  - .3 Finish: Primed and painted in colour to be selected by Architect.
- .9 Brake shape trim elements:
  - .1 Provide brake shape trim elements around overhead doors and entrance tower openings as indicated on drawings.
  - .2 Material: Type 316L Stainless steel.
  - .3 Finish: Primed and painted in colour to be selected by Architect.



- .10 Miscellaneous steel brackets, supports and angles:
  - .1 Supply and install or supply for installation by trades responsible, all loose steel brackets, supports and angles where indicated, except where such brackets, supports and angles are specified under work of other Sections. Drill for countersunk screws, expansion anchors and anchor bolts.
  - .2 Unless otherwise specified, prime paint for interior installation, galvanized finish for exterior installation.

## 2.4 **ANCHORS AND FASTENING**

- .1 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.
- .2 Use self-drilling expansion type concrete anchors for attaching to masonry and concrete.
- .3 Do not secure items to steel deck.
- .4 Use steel beam clamps of two bolt design to transmit load to beam web. Do not use C and I clamps.

## 2.5 **WELDING**

- .1 Perform welding by electric arc process.
- .2 Execute welding to avoid damage or distortion to Work. Execute welding in accordance with following standards:
  - .1 CSA W48 - for Electrodes. If rods are used, only coated rods are allowed.
  - .2 CSA W59-M and CSA W59S1-M for design of connections and workmanship.
  - .3 CAN/CSA W117.2-M - for safety.
- .3 Thoroughly clean welded joints and expose steel for a sufficient distance to perform welding operations. Finish welds smooth. Supply continuous and ground welds which will be exposed to view and finish paint.
- .4 Test welds for conformance and remove Work not meeting specified standards and replace to Consultant's acceptance.

## 2.6 **SHOP PAINTING**

- .1 Clean steel to SSPC SP6 and remove loose mill scale, weld flux and splatter.
- .2 Shop prime steel with one coat of primer paint to dry film thickness of 0.07 mm. Paint on dry surfaces, free from rust, scale, grease. Do not paint when temperature is lower than 7 deg C. Paint items under cover and leave under cover until primer is dry. Follow paint manufacturer's recommendations regarding application methods, equipment, temperature, and humidity conditions.

- .3 Shop prime galvanized steel in accordance with CGSB 85-GP-16M.
- .4 Clean but do not paint surfaces being welded in field.
- .5 Do not paint surfaces embedded in concrete, but clean as if they were to be primed.
- .6 Do not prime steel to be fireproofed or to receive intumescent paint coating.
- .7 Do not prime machine finished surfaces but apply an effective anti-rust compound.
- .8 Take precautions to avoid damage to adjacent surfaces.

## 2.7 HOT DIP GALVANIZING

- .1 After fabrication, hot dip galvanize specific miscellaneous steel items as indicated. After galvanizing, plug relief vents air tight with appropriate aluminum plugs as suitable and required for intended metal fabricated item. Straighten shapes and assemblies true to line and plane after galvanizing. Repair damaged galvanized surfaces with zinc rich primer in accordance with manufacturer's printed directions.
- .2 Hot-dip galvanize members in accordance with requirements of the following ASTM, with minimum coating weights or thicknesses as follows:
  - .1 Rolled, pressed and forged steel shapes, plates, bars and strips: ASTM A123; average weight of zinc coating per square/metre of actual surface, for 4.8 mm and less thickness members 600 g/m<sup>2</sup> for 6 mm and heavier members 640 g/m<sup>2</sup>.
  - .2 Iron and steel hardware: ASTM A153; minimum weight of zinc coating, in ounces per square foot of surface, in accordance with ASTM A153, Table 1 for the various classes of materials used in the Work.

## 3 Execution

### 3.1 EXAMINATION

- .1 Examine previously installed Work, upon which this Section depends, verify dimensions and condition of existing Work, and coordinate repairs, alterations, and rectification if necessary. Commencement of Work of this Section is deemed to signify acceptance of existing, prior conditions.
- .2 Obtain Consultant's written approval prior to field cutting or altering of structural members.

**3.2 ERECTION**

- .1 Install metal fabrications in accordance with reviewed shop drawings and manufacturer's written instructions.
- .2 Fit joints and intersecting members accurately. Make Work in true planes with adequate fastenings. Build and erect Work plumb, true, square, straight, level and accurate to sizes detailed, free from distortion or defects detrimental to appearance or performance.
- .3 Perform drilling of concrete and steel as required to fasten Work of this Section.

**3.3 TOUCH UPS**

- .1 Paint bolt heads, washers, nuts, field welds and previously unpainted items. Touch up shop primer damaged during transit and installation, with primer to match shop primer.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

- .1 Labour, Products, equipment and services necessary for rough carpentry Work in accordance with the Contract Documents.

1.2 **REFERENCES**

- .1 ASTM A153, Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- .2 ASTM A325, Specification for Bolts Quenched/Tempered Steel Nominal Thread Diameter M16 - M36 For Structural Steel Joints.
- .3 ASTM A653, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .4 ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
- .5 ASTM F1667, Driven Fasteners: Nails, Spikes and Staples.
- .6 CAN/CSA O80 Series M, Wood Preservation.
- .7 CSA O121-M, Douglas Fir Plywood.
- .8 CAN/CSA O141, Softwood Lumber.
- .9 CSA O151-M, Canadian Softwood Plywood.
- .10 NLGA, Standard Grading Rules for Canadian Lumber, National Lumber Grades Authority.

1.3 **QUALITY ASSURANCE**

- .1 Lumber identification: Grade stamp of an agency certified by the Canadian Lumber Standards Accreditation Board.
- .2 Plywood identification: Grade mark in accordance with applicable CSA standards.
- .3 Lumber quality: Carefully select individual pieces so that knots and obvious defects will not interfere with placing bolts, proper nailing or making proper connections.
- .4 Moisture Content of wood at time of construction shall be 19% maximum.

- .5 Each piece of fire-retardant treated lumber shall be shop marked with the pressure treatment brand and ULC monogram respectively, in accordance with CAN/CSA O80-M.
- .6 Dimensions of lumber shall conform to dressed sizes specified in CAN/CSA-0141 unless actual dimensions are otherwise indicated or specified.
- .7 Dimensional references to lumber on Drawings and in Specifications are to nominal sizes unless actual dimensions are indicated. Such actual dimensions shall be dry size.
- .8 Lumber defects: Discard wood with defects which will render a piece unable to serve its intended function. Lumber will be rejected by consultant for excessive warp, twist, bow, crook, mildew, fungus, or mould, as well as for improper cutting and fitting, whether or not it has been installed.

#### 1.4 **ENVIRONMENTAL REQUIREMENTS**

- .1 When it is required that wood maintain dimensional stability and tolerances to ensure accurate installation of later work, store and install it only in dry areas, and where no further installation of moist materials is contemplated.

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

- .1 Store materials in a dry area. Cover materials with tarpaulins or polyethylene sheets to prevent moisture absorption and impairment of structural and aesthetic properties. Vent to allow air movement. Tie covering to keep in place.

### 2 Products

#### 2.1 **MATERIALS**

- .1 General: All materials under Work of this Section, including but not limited to, adhesives are to have low VOC content limits.
- .2 Lumber: Softwood, G4S, moisture content 19% or less at time of installation, in accordance with the following:
  - .1 Lumber shall be of same species and grade, equally seasoned and shall be processed and stamped at same mill.
  - .2 CSA O141 and NLGA Standard Grading Rules for Canadian Lumber.
  - .3 Board quality: Construction or better.
  - .4 Dimension quality:
    - .1 Structural joists, planks, and framing: No. 1 Select Structural.
    - .2 Light framing: Construction.

- .3 Plywood: CSA O121-M, G1S, T & G, standard construction, laminated with waterproof adhesive, exterior grade, Thickness as indicated on drawings.
- .4 Sheathing: Douglas Fir, CSA 0121-M or CSA O151-M; Select-Tight Face, exterior grade, T & G.
- .5 Roof lumber: NLGA, Construction grade light framing, Jack Pine, S4S, pressure treated to CAN/CSA-O80 series using copper based waterborne preservative treatment, impregnated to a net retention of 4 kg/ m<sup>3</sup> of preservative unless otherwise specified by preservative manufacturer.
- .6 Surface applied wood preservative: Green coloured copper napthenate or 5% pentachlorophenol solution, water repellant preservative or same copper-based preservative as used for shop impregnation, in accordance with CAN/CSA O80.
- .7 Fire retardant treatment of lumber and plywood (interior and protected locations): 'Dricon FRT' fire retardant treatment by Biewer Lumber or approved alternative, conforming to ASTM E84, to provide a flame spread rating of 25 or less.
- .8 Rough hardware: Conforming to ASTM F1667; Nails, bolts, screws, anchors, expansion shields, and other fastenings required to frame and fix rough carpentry as follows:
  - .1 Nails, spikes and staples: Spiral type.
  - .2 Bolts: ASTM A325; 12.7 mm diameter minimum with nuts and washers unless noted otherwise.
  - .3 Screws: Countersunk head, full thread type.
  - .4 Proprietary fasteners: Toggle bolts, expansion shields, lag bolts, screws, inorganic fibre plugs, recommended for purpose by manufacturer.
  - .5 Galvanize rough hardware used in fire treated wood and hardware exposed to the atmosphere.
- .9 Fasteners for use in pressure treated wood: Provide hot dipped galvanized fasteners complying to ASTM A153 and connectors in accordance with ASTM A653, Class G185 for non-structural members. Provide type 304 or 316 stainless steel fasteners and connectors for use in Structural, pressure treated wood.

3 Execution

3.1 **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.

### 3.2 GENERAL

- .1 Lay out work carefully and to accommodate work of others. Cut and fit accurately: erect in position indicated by Drawings.
- .2 Install rough carpentry to allow for expansion and contraction of the materials.
- .3 Cut work into lengths as long as practicable and with square ends. Align, level, square, plumb, and secure work permanently in place. Brace work temporarily as required. Join work only over solid backing.
- .4 Bore holes true to line and to same size as bolts. Drive bolts into place for snug fit, and use plates or washers for bolthead and nut bearings. Turn up bolts and lag screws tightly when installed, and again just before concealed by other work or at completion of Work.
- .5 Provide anchors, bolts, and inserts required for attachment of the work of this Section, to those performing the work of other Sections and who are responsible for their installation.
- .6 Do not attach work by wood plugs or blocking in concrete or masonry. Use lead shields, expansion shields, or similar methods only as approved by consultant.

### 3.3 MISCELLANEOUS WOODWORK

- .1 Fit and install wood furring, strapping, grounds and blocking. Adequately size, correctly place and conceal members for finishes, fitments and for Work under other Sections. Do not assume that Drawings show required work exactly or completely. Anchor wood members securely in place.
- .2 Install rough bucks, nailing strips and linings to rough openings as required for backing for frames and other Work.
- .3 Except where steel supports are specifically shown, provide wood blocking and supports in metal stud partitions for fastening of items such as casework and other wall mounted accessories. Have respective trades approve the location of such wood blocking.
- .4 Bolt wood blocking or nailing strips to steel framing.
- .5 Align and plumb faces of furring and blocking to tolerance of 1:600.
- .6 Use fire retardant lumber for blocking/framing in ceiling\ spaces, partitions and bulkheads.

3.4            **ROOF WOODWORK**

- .1      Install continuous wood nailers around roof perimeters, curbs and roof openings larger than 150 x 150 mm, and at edges of insulation as detailed.    Install cut cant strips and continuous nailers on copings and curbs as detailed.
- .2      Install wood backing, dressed, tapered and recessed slightly below top surface of roof insulation and roof hopper.

3.5            **BACKBOARDS**

- .1      Install plywood backboards, primed and painted white on both sides, with fire retardant paint.
- .2      Use minimum 19 mm thick plywood on 19 x 38 mm furring around perimeter and at maximum 300 mm intermediate spacing.

3.6            **FASTENERS**

- .1      Frame, anchor, fasten, tie and brace members for required strength and rigidity.
- .2      Use hot dipped galvanized fasteners for exterior Work and Work below grade.
- .3      Countersink bolts and bolt heads as required for clearance of other Work.
- .4      Size fasteners to penetrate base member by half of fastener length minimum. Minimize splitting of wood members by staggering nails in direction of grain.
- .5      For plywood use spiral, annular or resin coated nails and staples.

3.7            **SURFACE-APPLIED WOOD PRESERVATIVE**

- .1      Treat raw surfaces, drilled holes and cut ends of pressure treated wood with 2 coats of wood preservative immediately after cutting.
- .2      Apply preservative by dipping, by brush or by pouring into plugged holes to completely saturate surface.

END OF SECTION



1 General

1.1 **SECTION INCLUDES**

- .1 Labour, Products equipment and services necessary for the finish carpentry Work in accordance with the Contract Documents.

1.2 **REFERENCES**

- .1 ANSI A208.1, Particleboard.
- .2 ANSI A208.2, Medium Density Fibreboard for Interior Use.
- .3 ANSI/NEMA LD 3, High-Pressure Decorative Laminates.
- .4 ASTM F1667, Driven Fasteners: Nails, Spikes and Staples.
- .5 Architectural Woodwork Manufacturers Association of Canada (AWMAC).
- .6 Architectural Woodwork Standards (AWS) - Quality Standards for Architectural Woodwork.
- .7 CSA O115-M, Hardwood and Decorative Plywood.
- .8 CAN/CSA O141, Softwood Lumber.
- .9 CSA O151-M, Canadian Softwood Plywood.
- .10 National Hardwood Lumber Association (NHLA) Rules for the Measurement and Inspection of Hardwood and Cypress.
- .11 National Lumber Grades Authority (NLGA) Standard Grading Rules for Canadian Lumber.

1.3 **SUBMITTALS**

- .1 Shop drawings: Submit shop drawings of finish carpentry Work in accordance with Section 01 33 00 indicating materials, thicknesses, sizes, finishes, wood species, grades, profiles, connection attachments, shop jointing, field jointing, reinforcing, anchorage, fastener types and sizes, location of exposed fastenings, mechanical and electrical service routes, service outlets, cutout locations, and sizes. Include erection drawings, plans, elevations, sections, and details as applicable.
- .2 Samples: Submit samples of the following in accordance with the requirements of Section 01 33 00:
  - .1 Two representative pieces of each type of wood to receive a stained or natural finish.

- .2 Two representative pieces of each type of wood finished as specified.
- .3 Two of each colour, pattern, gloss, and texture of plastic laminate, in manufacturer's standard tag size.
- .4 Two samples of laminated plastic joints, edging, cutouts and postformed profiles.
- .5 Two of each solid surface, in 100 x 75 x 10 mm samples.
- .6 Two samples of melamine surfaced board, edging and postformed profiles.
- .7 One of each item of finish carpentry hardware.

#### 1.4 **QUALITY ASSURANCE**

- .1 Execute Work of this Section by member of AWMAC, with 5 years' experience in finish carpentry Work of comparable complexity and scope. Submit proof of experience upon Consultant's request.
- .2 Fabricate finish carpentry Work in accordance with AWS Quality Standards, Premium Quality materials and installation unless otherwise indicated. Perform Work in accordance with the definition of Good Workmanship as defined in the AWS Quality Standards.
- .3 Remove and replace finish carpentry Work which does not conform to the AWS Quality standards or as amended by these Specifications.
- .4 Mock-up:
  - .1 Shop fabricate one mock-up of a base cabinet, wall cabinet, and counter top for each type of surfacing specified, complete with hardware and shop applied finishes, installed in location acceptable to Consultant.
  - .2 Arrange for Consultant's review and acceptance, allow 48 hours after acceptance before proceeding with Work.
  - .3 When accepted, mock-up will demonstrate minimum standard for this work. Mock-up may remain as part of Work if accepted by Consultant. Remove and dispose of mock-ups which do not form part of Work.

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

- .1 Deliver, store, and handle finish carpentry in accordance with the AWS Quality Standards. Control the temperature and humidity in accordance with the AWS recommendations, before, during, and after finish carpentry delivery, and also during storage and installation.
- .2 Cover finished plastic laminated work with heavy kraft paper or put in cartons during shipment. Protect installed surfaces by approved means. Do not remove until immediately before final inspection.

1.6 **EXTENDED WARRANTY**

- .1 Submit a extended warranty for plastic laminate work of this Section in accordance with General Conditions, except that warranty period is extended to 2 years from date of Substantial Performance of the Work.
  - .1 Warrant against defects in material and workmanship including but not limited to opening of joints, cracking, shrinkage, warpage, and delamination of plastic laminate.
  - .2 Coverage: Complete replacement including affected adjacent Work.

2 Products

2.1 **MATERIALS**

- .1 General: All materials under Work of this Section, including but not limited to, adhesives and mastics, are to have low VOC content limits.  
SEE ARCHITECTURAL DRAWINGS for Millwork Material Finish Schedule.
- .2 Concealed framing lumber and plywood:
  - .1 Eastern Spruce, Balsam Fir, or Jack Pine, to CAN/CSA O141, NLGA, and AWS Custom Grade, S4S, average moisture content 7% +/- 2% at installation.
  - .2 Softwood plywood: CSA O151-M; 19 mm unless indicated otherwise, (G2S).  
Provide exterior grade at stainless steel counters or counters with plumbing fixtures.
- .3 Hardwood lumber: Maple, unless otherwise indicated, to NHLA and AWS Premium Grade, S4S, average moisture content 7% +/- 2% at installation.
- .4 Softwood plywood: CSA O151-M; 19 mm unless indicated otherwise, (G2S).
- .5 Medium Density Fibreboard (MDF): ANSI A208.2; omnidirectional, light coloured with uniform density throughout 'Superior MDF' by G-P Flakboard Ltd. or 'Panfibre Excel MDF' by Uniboard Canada Inc., meeting the following minimum criteria:
  - .1 Density: 740 kg/m<sup>3</sup>.
  - .2 Internal bond: 0.8 N/mm<sup>2</sup>.
  - .3 Modulus of rupture: 30 N/mm<sup>2</sup>.
  - .4 Modulus of elasticity: 3400 N/mm<sup>2</sup>.
  - .5 Face screw holding: 1450 N.
  - .6 Core screw holding: 1300 N.
  - .7 Moisture content: 4-7%
- .6 Thermofoil coating, provide thermofoil coating from a reputable manufacturer c/w heat shields adjacent to all ranges, and dishwashers. Colour shall be "White"

- .7 Draw bolts and splines: Type as recommended by fabricator.
- .6 Nails and staples: Conforming to ASTM F1667; Size and type to suit application, galvanized for exterior work, interior humid areas and for treated lumber; plain finish elsewhere.
- .7 Bolts, nuts, washers, blind fasteners, lags and screws: Size and type to suit application. Stapling is not acceptable.
- .8 Adhesive and bituminous mastic: Selected by the millwork fabricator with low VOC content.
- .9 Miscellaneous metals: In accordance with Section 05 50 00.
- .19 Fire retarded coating: Provide clear fire retardent coating to decorative wood panels as indicated. Two component, VOC free coating providing Class A Flame Spread rating to ASTM E84. 'Safecoat Clear Fire Retardant Coating' as manufactured by Quantum Group of Companies or approved alternative.
- .10 Finishing: In accordance with Section 09 91 00.

## 2.2 **HARDWARE**

- .1 The following hardware is the minimum quality standard for the work of this Section. Alternatives may be considered provided they are approved by Consultant prior to ordering of products.  
If not otherwise noted on ARCHITECTURAL DRAWINGS.
- .2 Drawer slides: Full extension, 8400 Series by Knappe & Vogt.
- .3 Pilasters: Clear anodized aluminum recessed shelf standards with 12 mm divisions, Model 233 by Knappe & Vogt.
- .4 Clips: Bright zinc plated, adjustable height shelf supports, Model 256 by Knappe & Vogt.
- .5 Cabinet hinges: Heavy duty, concealed 170 degree, clip, self closing, Model UC71650180 by Blum.
- .6 Drawer and cabinet pulls: 10 mm dia. x 106 mm wide, stainless steel with matt finish, 115.61.601 by Hafele.
- .7 Magnetic catches: Model 918 by Knappe & Vogt.
- .8 Locks: Cam locks/deadbolt locks complete with lock core by Hafele, type to suit application and installation.

- .9 Closet rail: 27 mm (1-1/16") diameter wardrobe rail stainless steel finish >Model 660 Round Tubing' and tubing flange >Model 734 CHR' by Knape & Vogt.  
Note, length of wardrobe rail to suit overall width of all closets.

## **2.3 FABRICATION**

- .1 Be responsible for methods of construction and for ensuring that materials are rigidly and securely attached and will not be loosened by the work of other sections.
- .2 Coordinate locations of concealed supports and blocking with other parts of Work. Provide cutouts for outlet boxes and other fixtures.
- .3 Fabricate work in a manner which will permit expansion and contraction of the materials without visible open joints. Conceal joints and connections in wherever possible.
- .4 Set nails and countersink screws, apply wood filler to indentations, sand smooth and leave ready to receive finish.
- .5 Mitre exposed corners, no end grain shall be visible in completed installation.
- .6 Finish millwork in accordance with Section 09 91 00. Finished millwork shall be free from bruises, blemishes, mineral marks, knots, shakes and other defects and shall be selected for uniformity of colour, grain and texture.
- .7 Shelving to cabinetwork to be adjustable unless otherwise noted.
- .8 Recess shelf standards, unless noted otherwise. Stagger recessed shelf standards on opposite sides of divider.
- .9 Do not exceed maximum 760 mm unsupported span for 19 mm thick shelving. House fixed shelving into gables and divisions.
- .10 Shop assemble finish carpentry to accommodate delivery and handling and to ensure passage through building openings.
- .11 Shop install cabinet hardware for doors, shelves and drawers. Recess shelf standards unless noted otherwise.
- .12 Fabricate base from paint grade wood 100 mm high x 16 mm thick, finished in accordance with Section 09 91 00.
- .13 Fabricate sills, screens, frames and moldings to profiles shown.

3 Execution

3.1 **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.

3.2 **INSTALLATION**

- .1 Install Work in accordance with AWS Quality Standards and tolerances for Architectural Woodwork. Set and secure finish carpentry in place, rigid, plumb, square, and level.
- .2 Scribe and cut as required, fit to abutting walls, and surfaces, fit properly into recesses and to accommodate columns, fixtures, outlets, or other projecting, intersecting or penetrating objects leaving a 0.8 mm gap maximum.
- .3 Coordinate cutouts for plumbing fixtures, inserts, appliances, outlet boxes, and other fixtures, in finish carpentry. Round internal corners of cut-outs and seal exposed cores.
- .4 Form joints to conceal shrinkage.
- .5 Install draw bolts and splines in laminated plastic countertop joints at maximum spacing 450 mm o.c., and 75 mm from edge. Make joints flush, hairline butt joints.
- .6 Install finishing hardware accurately and securely in accordance with manufacturer's directions, adjust and clean.
- .7 Install prefinished millwork at locations shown on drawings. Position accurately, level, plumb straight.
- .8 Apply bituminous coating over wood framing members in contact with masonry or cementitious construction.
- .9 Melamine panels: Assemble melamine millwork using dowelled/wafered-and-glue construction. Installed melamine panels shall not show any exposed fasteners on finished/exposed surfaces.
- .10 Mouldings: Install in locations indicated on Drawings in accordance with manufacturer's recommendations. Fill holes with wood putty and sand for finishing material.
- .11 Install solid surfacing in accordance with manufacturer's instructions.

- .12 Install wood panelling in locations indicated on drawings and ensuring that it is securely fastened in true vertical and horizontal manner.
- .13 Install window sills level, plumb and even in locations as indicated and ensure that sills are securely fastened.
- .14 Fastening:
  - .1 Coordinate wall securement, anchorage, and blocking for finish carpentry items.
  - .2 Position items of finished carpentry work accurately, level, plumb, true and fasten or anchor securely.
  - .3 Design and select fasteners to suit size and nature of components being joined. Use proprietary devices as recommended by manufacturer.
  - .4 Provide heavy duty fixture attachments for wall mounted cabinets.
  - .5 Set finishing nails to receive filler. Where screws are used to secure members, countersink screw in round cleanly cut hole and plug with wood plug to match material being secured.
- .15 Remove and replace damaged, marked, or stained finish carpentry.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

- .1 Labour, Products equipment and services necessary for spray applied waterproofing Work in accordance with the Contract Documents.

1.2 **REFERENCES**

- .1 ASTM C836, Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course.
- .2 ASTM E96, Standard Test Methods for Water Vapor Transmission of Materials.

1.3 **SUBMITTALS**

- .1 Product data:
  - .1 Submit manufacturer's Product data in accordance with Section 01 33 00 indicating:
    - .1 Materials list of items to be provided under this Section.
    - .2 Manufacturer's specifications and other data needed to ensure compliance with the specified requirements including but not limited to installation details and physical properties.
    - .3 Manufacturer's current recommended installation procedures.
  - .2 Shop drawings:
    - .1 Submit shop drawings in accordance with Section 01 33 00 indicating:
      - .1 Adjacent construction and typical details, dimensions, thickness, crack and joint treatment, method of attachment, protection and penetration details.
      - .2 Location of each membrane penetration.
- .3 Certificates:
  - .1 Submit certifications for items required at least 4 weeks prior to installation of Work of this Section.
  - .2 Submit manufacturer's certification that waterproofing system materials and accessories supplied are compatible, meet Specification requirements and that installer is licensed/approved by membrane manufacturer.
  - .3 Submit manufacturer's certification that waterproofing components are approved for use as complete waterproofing system.
  - .4 Submit Contractor's certification that waterproofing installers and quality control supervisors meet Specification requirements. Submit names of successful membrane installations in which certified personnel have performed tasks of comparable complexity and scope within preceding 5 years.
  - .5 Submit inspection reports and certification by manufacturer confirming that installations are in accordance with manufacturer's requirements.



**1.4 QUALITY ASSURANCE**

- .1 Perform Work of this Section by company, approved by Product manufacturer and having 5 years recent experience in Work of comparable complexity and scope.
- .2 Applicator qualifications:
  - .1 Applicator shall have at written approval from the manufacturer as recommended for the installation of spray-applied waterproofing.
  - .2 Applicator shall designate a single individual as project foreman who shall be on site at all times during installation.
- .3 Mock-up:
  - .1 Construct one 1 m<sup>2</sup> mock-up of waterproofing system in a location acceptable to the Consultant. Show stages of application and crack and joint preparation and treatment.
  - .2 Obtain Consultant's acceptance. Accepted mock-up may become part of the Work. Mark mock-up to Consultant's acceptance and match remainder of work to accepted mock-up. Remove unacceptable mock-up.
- .4 Pre-installation meeting: Arrange with Consultant and manufacturer's representative to inspect substrates and review drawings and specifications affecting work of this Section, verify all conditions, review installation procedures, and coordinate scheduling with interfacing portions of the Work minimum 48 hours in advance of installation.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver materials to job site in manufacturer's unopened containers with all labels intact and legible at time of use.
- .2 Maintain the products in accord with manufacturer's recommendations with proper precautions to ensure fitness of material when installed.
- .3 Comply with pertinent provisions of Section 01 60 00.

**1.6 SITE CONDITIONS**

- .1 Maintain air and substrate temperature at waterproofing installation area above 40EF for 24 h before, during and 4 hrs after installation.
- .2 Do not apply waterproofing in wet weather.

**1.7 EXTENDED WARRANTY**

- .1 Submit a extended written warranty for fluid applied waterproofing in accordance with the General Conditions, except that warranty period is extended to 5 years from date of Substantial Performance of the Work.
  - .1 Warrant Work against defects including adhesive failure, cohesive failure, waterproofing failure, and water leakage.

- .2 Coverage: Complete replacement including effected adjacent Work.

## 2 Products

### 2.1 MATERIALS

- .1 All materials under Work of this Section, including but not limited to, sealants and primers are to have low VOC content limits.
- .2 Spray applied waterproofing: ASTM E96, Type 1, 100% rubber copolymer liquid applied membrane which is non-toxic and non-carcinogenic. Rub-R-Wall by Advanced Coatings or approved alternative.
- .3 Concrete repair, mastic, backer rod, sealants, primers, elastomeric sheet, protection boards and other accessory materials: As recommended by manufacturer.

## 3 Execution

### 3.1 EXAMINATION

- .1 Verify condition of previously installed Work upon which this Section depends. Verify conformance with manufacturer's requirements. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.

### 3.2 SUBSTRATE PREPARATION AND PROTECTION

- .1 Allow concrete substrates to cure 24 to 48 hours prior to surface preparation.
- .2 Verify substrate surfaces are solid, free from surface water, frozen matter, dust, oil, grease, scaling or laitance, projections and foreign matter detrimental to the adhesion of the hot rubberized asphalt.
- .3 Clean all surfaces to receive membrane system in accord with manufacturer's instructions; vacuum clean or blow clean with oil-free compressed air all surfaces to receive waterproofing membrane and accessories. Protect adjacent surfaces not being waterproofed.
- .4 Rout, clean, prepare and detail surface cracks form tie holes, honeycombed areas, and other voids and holes which may impair performance of waterproofing membrane in accord with manufacturer's instructions; install backer rod where required.
- .5 Clean metal surfaces to bright metal by wire brushing or mechanical etching; scuff-sand lead flashing and plastic surfaces..

- .6 Install detail cants, detail coats, joint and crack treatments, and liquid flashings in accord with manufacturer's instructions.
- .7 Allow detail applications to cure in accord with manufacturer's instructions prior to general application of membrane.
- .8 Prime surfaces in accordance with manufacturer's instructions.
- .9 Supply and install temporary protection to adjacent surfaces to prevent damage resulting from Work of this Section.

### 3.3 **APPLICATION**

- .1 Apply waterproofing in accordance with manufacturer's instructions.
- .2 Grid surfaces to assure proper coverage rates and verify membrane wet-film mil thickness with gauges as work progresses.
- .3 Apply membrane in uniform passes by spray to wet film thickness of 60 - 70 mils on vertical surfaces unless more stringent requirements are indicated in submitted data.
- .4 Spray the top of the footing 75 mm away from the wall, do not spray the entire top surface of the footing.
- .5 Continue membrane up wall to a minimum of 150 mm above final grade line or previously determined elevation.
- .6 Ensure complete coverage to substrate, around flashings and protrusions and at changes in direction of surface. Re-spray thin spots and voids to obtain proper thickness. Work material into any fluted rib forming indentations.
- .7 Feather terminating edge when entire area cannot be completed in one day; clean area 150 mm wide along terminating edge of membrane with Xylene solvent on clean white rags prior to start-up on next working day; overlap existing work by 150 mm with new work.
- .8 Allow minimum 15-minute cure time before application of protection board, insulation, drainage board. Ensure proper initial placement, without overlap of protection boards.

### 3.4 **FIELD QUALITY CONTROL**

- .1 Do not cover or permit to be covered any portion of the membranes until they have had full cure of 48 hours and been inspected by the Consultant or by an inspection agency appointed by the Consultant.

**3.5 PROTECTION AND CLEAN-UP**

- .1 Promptly remove overspray of membrane system material from adjacent surfaces with cleaner approved by membrane manufacturer. Leave work area in broom clean condition.
- .2 Prohibit traffic over completed work and protect against work overhead until protection course is installed.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

- .1 Labour, Products, equipment and services necessary for the thermal insulation Work in accordance with the Contract Documents.

1.2 **REFERENCES**

- .1 CAN/ULC-S702, Mineral Fibre Thermal Insulation for Buildings.
- .2 CAN/ULC-S704, Thermal Insulation, Polyurethane and Polyisocyanurate, Boards, Faced.

1.3 **SUBMITTALS**

- .1 Product data: Submit manufacturer's Product data in accordance with Section 01 33 00 indicating characteristics, performance criteria, and limitations. Indicate installation requirements and techniques, storage, and handling criteria and installation procedure acceptable to manufacturer.
- .2 Certification: Submit installer's certification verifying compliance with specification requirements.

1.4 **QUALITY ASSURANCE**

- .1 Qualifications: Execute Work of this Section by company specializing in thermal insulation Work with minimum of three years, recent, documented experience, on Work of comparable complexity and scope.

2 Products

2.1 **MATERIALS**

- .1 All materials under Work of this Section, including but not limited to, adhesives are to have low VOC content limits.
- .2 Batt Insulation: CAN/ULC-S702, Type 1, friction fit. 'ComfortBatt' by Roxul, or approved alternative.
- .3 Semi-rigid insulation: Semi-rigid mineral wool conforming to CAN/ULC-S702, Type 1, minimum density 70 kg/m<sup>3</sup>, thickness as indicated. 'CavityRock MD' by Roxul.
- .4 Cavity wall insulation: Mineral wool fibre insulation conforming to CAN/ULC-S702, Type 1, minimum density 100 kg/m<sup>3</sup>, thickness as indicated. 'CavityRock DD' by Roxul.

- .5 Polyisocyanurate Board Insulation: CAN/ULC S704; Type 2, Class C, Rigid polyisocyanurate foam core board to meet specified requirements, faced both sides with glass fibre reinforced polymer facers or foil faces. 'Energy Shield' by Atlas Roofing Corporation or approved alternative.
- .6 Acoustic Insulation: In accordance with Section 09 21 16.
- .7 Insulation retainers: In accordance with Section 04 20 00.
- .8 Spray Foam Insulation: CAN/ULC S770-09; Walltite XL01 by BASF.

3 Execution

3.1 **EXAMINATION**

- .1 Verify condition of previously installed Work upon which this Section depends. Report defects to consultant. Commencement of Work means acceptance of existing conditions.
- .2 Ensure substrate surfaces are dry, clean, suitable to receive adhesive and free from other deleterious substances.

3.2 **INSTALLATION**

- .1 Install thermal insulation in longest panel sizes possible in accordance with manufacturer's instructions.
- .2 Butt insulation with moderate contact and, cut and fit them tightly around other construction elements. Offset single layer vertical joints and both vertical and horizontal joints in multiple layer applications.,
- .3 Make thermal insulation continuous, maintain thermal protection continuity and secure to prevent displacement. Ensure that insulation is tight to substrate without air gaps.
- .4 Cut and fit thermal insulation tightly around electrical boxes, plumbing and heating pipes and ducts, exterior doors and windows, and other protrusions.
- .5 Leave 75 mm separation between thermal insulation and heat emitting devices such as recessed light fixtures.
- .6 Cut and trim thermal insulation neatly to fit spaces; do not excessively compress insulation to fit. Install only thermal insulation boards which are free from chipped or broken edges.
- .7 Pack miscellaneous cavities with insulation to maintain continuity of thermal barrier.
- .8 Arrange for Consultant to review thermal insulation before it is enclosed.

- .9 Ensure compatibility and continuity of the vapour barrier at smoke seal and firestop location.

### 3.3 **SECUREMENT**

- .1 Batt insulation: Install batt insulation in partitions, between studs, and as indicated on Contract Drawings and in accordance with the manufacturer's instructions. Fill stud cavities to full height of partitions and carefully cut and fit batt insulation around services and protrusions.
- .2 Cavity wall insulation:
  - .1 Provide insulation tight to the inner wythe starting at the base of the wall in parallel courses with tight butt joints. Stagger end joints in adjacent course.
  - .2 Provide finish work level, plumb and true.
  - .3 Provide securement for cavity wall insulation with wedge type retainers in accordance with manufacturer's written instructions.
- .3 Rigid insulation: Apply adhesive to thermal insulation foam boards in accordance with manufacturer's recommendations. Omit adhesive bonding of foam board insulation over expansion and control joints.
- .4 Perimeter foundation insulation:
  - .1 Exterior application: unless otherwise indicated, extend boards from finish grade down to top of footing. Install on exterior face of perimeter foundation wall with clips and adhesive. Protect entire face of insulation exposed to backfill with protection board. Terminate protection board 100 mm below finish grade level.
- .5 Underslab insulation:
  - .1 Install insulation boards in locations shown in accordance with manufacturer's instructions.
  - .2 Protect insulation board from damage by placing 200 mm layer of 19 mm crusher-run limestone over insulation board.
  - .3 In drainage trenches, place insulation board to size and location as shown in Contract Drawings, with joints butted tight.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

- .1 Labour, Products, equipment and services necessary for vapour retarders Work in accordance with the Contract Documents.

1.2 **REFERENCES**

- .1 ASTM E1643, Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
- .2 ASTM E1745, Standard Specification for Water Vapour Retarders used in contact with Soil or Granular Fill under Concrete Slabs.
- .3 CAN/CGSB 19.21-M, Sealing and Bedding Compound, Acoustical.
- .4 CAN/CGSB-51.34-M, Vapour Barrier, Polyethylene Sheet, for Use in Building Construction.

1.3 **SUBMITTALS**

- .1 Product data:
  - .1 Submit duplicate copies of manufacturer's Product data in accordance with Section 01 33 00 indicating:
    - .1 Performance criteria, compliance with appropriate reference standard, characteristics, and limitations.
    - .2 Product transportation, storage, handling and installation requirements.
- .2 Samples: Submit following samples in accordance with Section 01 33 00:
  - .1 Two 300 x 300 mm samples of vapour retarders.
  - .2 Two samples, 300 mm long, of fastening bar.
  - .3 Duplicate samples of pipe and conduit boot.

1.4 **QUALITY ASSURANCE**

- .1 Mock-up:
  - .1 Construct one 10 m<sup>2</sup> mock-up of each type vapour retarder in location acceptable to Consultant indicating as a minimum one lap joint, one inside corner, one window interface, and one electrical box.
  - .2 Arrange for Consultant's review and acceptance.
  - .3 Mock-up may remain as part of Work if accepted by Consultant. Remove and dispose of mock-ups which do not form part of Work.



1.5 **SITE CONDITIONS**

- .1 Do not install the Work of this Section outside of environmental ranges as recommended by manufacturer without Consultant's and Product manufacturer's written acceptance.
- .2 Supply and install temporary protection and facilities to maintain Product manufacturers, and above specification, environmental requirements before, during, and after installation.

2 **Products**

2.1 **MATERIALS**

- .1 All materials under Work of this Section, including but not limited to, primers and sealants are to have low VOC content limits.
- .2 Membrane vapour retarder: 1.0 mm thick, single-ply, self-adhering, self-sealing, rubberised asphalt, bonded to a cross-laminated high density polyethylene film.
  - .1 'CCW 705' by Carlisle Coatings & Waterproofing.
  - .2 'Blueskin SA' by Henry Company Canada Inc.
  - .3 'Sopraseal Stick 1100 T' by Soprema.
  - .4 'Exo-Air 110' by Tremco.
  - .5 'Air-Shield' by W. R. Meadows.
- .3 Primer:
  - .1 'CCW-AWP Primer' by Carlisle Coatings & Waterproofing.
  - .2 'Aquatac' by Henry Company Canada Inc.
  - .3 'Elastocol Stick H20' by Soprema.
  - .4 'ExoAir WB Primer' by Tremco
  - .5 'Mel-Prime Water Base' by W.R. Meadows.
- .4 Mastic:
  - .1 'CCW 704 Mastic' by Carlisle Coatings & Waterproofing.
  - .2 'Polybitume 570-05' by Henry Company Canada Inc.
  - .3 'Sopramastic' by Soprema.
  - .4 'Acoustical Sealant' by Tremco
  - .5 'Sealtight Pointing Mastic' by W.R. Meadows.
- .5 Fastening bar: Continuous 25 mm wide x 3 mm thick aluminum bar, predrilled for mechanical attachment.
- .6 Fasteners: As specified herein or manufacturer's recommended fastener for attaching to Substrate.
- .7 Sheet vapour retarder 'Super Six' Polyethylene film to CAN/CGSB-51.34, 0.15 mm (6 mil) thick.

- .8 Joint sealing tape: Air resistant pressure sensitive adhesive tape, type recommended by sheet vapour retarder manufacturer, 50 mm wide for lap joints and perimeter seals, 25 mm wide elsewhere.
- .9 Sealant: CAN/CGSB 19.21; One-part, non-sag, non-bleeding, non-drying, non-hardening, sealant shall remain tacky for permanent bonding to all surfaces; 'Tremco Acoustical Sealant' by Tremco Ltd. or approved alternative.
- .10 Vapour retarder (under slab): ASTM E1745, Class A, 0.38 mm (15 mil) thick; 'Stego Wrap Vapor Barrier' by Stego Industries or 'Perminator' by W.R. Meadows.
  - .1 Joint sealing tape: High density polyethylene tape with pressure sensitive adhesive with minimum width 100 mm. Type recommended by sheet vapour retarder manufacturer.
  - .2 Pipe and conduit boots: Construct pipe and conduit boots from vapour retarder material and pressure sensitive tape as recommended by manufacturer.

### 3 Execution

#### 3.1 EXAMINATION AND COORDINATION

- .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..
- .2 Verify that existing substrates to receive vapour retarder are clean, dry, sound, smooth, and continuous.
- .3 Coordinate installation of vapour retarders with work of other Sections to achieve a vapour tight building envelope.

#### 3.2 SHEET VAPOUR RETARDER INSTALLATION

- .1 Ensure substrates and services are installed and inspected prior to installation of retarder.
- .2 Install sheet vapour retarder on the warm side of roof assembly, prior to installation of roof insulation to form a continuous vapour retarder.
- .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.

- .5 At exterior surface openings, cut vapour retarder to form openings and ensure material is lapped and sealed to frame.
- .6 Ensure continuity of vapour retarder is maintained at junctures with other materials.
- .7 At perimeter seals, seal perimeter of sheet vapour retarder as follows:
  - .1 Apply continuous bead of sealant to substrate at perimeter of sheets.
  - .2 Lap sheet over sealant and press into sealant bead.
  - .3 Install fasteners through lapped sheets at sealant bead into substrate.
  - .4 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.
- .8 Seal lap joints of sheet vapour retarder as follows:
  - .1 Attach first sheet to substrate.
  - .2 Apply continuous bead of sealant over solid backing at joint.
  - .3 Lap adjoining sheet minimum 150 mm and press into sealant bead.
  - .4 Install fasteners through lapped sheets at sealant bead into substrate.
  - .5 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.
- .9 Seal electrical switch and outlet device boxes that penetrate vapour retarder as follows:
  - .1 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.

### 3.3 MASTIC AND PRIMER

- .1 Fill substrate voids, gaps, depressions, cracks, and joints with mastic until continuous, smooth, substrate for vapour retarder is achieved.
- .2 Prime substrate surfaces to receive vapour retarder in accordance with manufacturer's instructions, at recommended application rate, allow to dry. Vary coverage to suit surface porosity.
- .3 Prime surfaces. Re-prime surfaces if not covered with vapour retarder within 4 hours.

### 3.4 UNDER SLAB VAPOUR RETARDER INSTALLATION

- .1 Install sheet vapour retarder under the floor slab prior to installation of floor slab, to form a continuous vapour retarder in accordance with ASTM E1643 and manufacturer's written instructions.
- .2 Lap vapour barrier over footings and seal to foundation walls.
- .3 Overlap joints 150 mm and seal with manufacturer approved sealing tape.
- .4 Seal all penetrations (including conduits and pipes) with manufacturer's pipe boot.

- .5 Use sheets of largest practical size to minimize joints.
- .6 Inspect for continuity. Repair punctures and tears with sealing tape before work is concealed.
- .7 Ensure continuity of vapour retarder is maintained at junctures with other materials.

### 3.5 **MEMBRANE VAPOUR RETARDER INSTALLATION**

- .1 Install mastic where required to ensure integrity of vapour retarder installation at protrusions and other complex details.
- .2 Install vapour retarder in accordance with manufacturer's instructions in locations indicated.
- .3 Lap vapour retarder ends and edges 50 mm minimum. Roll vapour retarder and laps for continuous adhesion over entire substrate area; use manufacturer's recommended roller.
- .4 Extend vapour retarder as required to connect to roof parapets, windows, doors frames, aluminium work and other components of Work comprising vapour retarder system.
- .5 Cut and fit vapour retarder as required for passage of protrusions, ensuring continuous adherence to substrate.
- .6 At end of days' Work, trowel mastic water cut-off along uppermost edge of incomplete vapour retarder assembly, to prevent loss of adhesion and damage to vapour retarder.

### 3.6 **FASTENING BARS**

- .1 Supply and install continuous mechanical fastening bar to clamp vapour retarder both sides of unfilled gaps, cracks, and joints.

### 3.7 **FIELD QUALITY CONTROL**

- .1 Inspect vapour retarder continuity immediately prior to installation of subsequent construction. Repair punctures, rips and tears to ensure continuity of vapour retarder.
- .2 Where punctures and tears are extensive, replace entire damaged section.
- .3 Do not cover or permit to be covered any portion of vapour retarder until it has been inspected by consultant.

END OF SECTION

1 General

**1.1 SECTION INCLUDES**

- .1 Surface preparation.
- .2 Application of an underslab vapour retarder.

**1.2 RELATED SECTIONS**

- .1 Section 03 30 00 - Concrete.
- .2 Section 07 10 00 – Dampproofing and Waterproofing.
- .3 Section 09 65 00 - Resilient Flooring.

**1.3 REFERENCES**

- .1 ASTM D1709 - 09 Standard Test Methods for Impact Resistance of Plastic Film by the Free-Falling Dart Method.
- .2 ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
- .3 ASTM E154 - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs.
- .4 ASTM E1643 - Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
- .5 ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.
- .6 ASTM F1249-01 Standard Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor.

**1.4 SUBMITTALS**

- .1 Comply with Section 01 33 00 - Submittal Procedures.
- .2 Submit manufacturer's product data and application instructions.

**1.5 QUALITY ASSURANCE**

- .1 Use an experienced installer and adequate number of skilled personnel who are thoroughly trained and experienced in the application of the vapour retarder.
- .2 Obtain vapour retarder materials from a single manufacturer regularly engaged in manufacturing the product.
- .3 Provide products which comply with all state and local regulations controlling use of volatile organic compounds (VOCs).

**1.6 PRECONSTRUCTION MEETING**

- .1 Pre-Construction Meeting: Convene one week prior to installation of underslab vapour retarder. Attendees to be as follows: - Architect, Engineer, General Contractor, Vapour Retarder Installer, and Vapour Retarder Manufacturer to discuss the application in detail.

**1.7 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- .2 Store materials in a clean, dry area in accordance with manufacturer's instructions.
- .3 Protect materials during handling and application to prevent damage or contamination.
- .4 Ensure membrane is stamped with manufacturer's name, product name, and membrane thickness at intervals of no more than 220cm (85").

**1.8 ENVIRONMENTAL REQUIREMENTS**

- .1 Product not intended for uses subject to abuse or permanent exposure to the elements.
- .2 Do not apply on frozen ground..

**2 Products**

**2.1 MANUFACTURER**

- .1 W. R. MEADOWS OF CANADA, 70 Hannant Court, Milton, Ontario, Canada L9T 5C1. (800) 563-3618. Fax (905) 878-4125. Web Site: [www.wrmeadows.com](http://www.wrmeadows.com).

**2.2 MATERIALS**

- .1 Plastic Vapour Retarder
  - .1 PERMINATOR 15 mil by W. R. MEADOWS.

**2.3 ACCESSORIES**

- .1 Seam Tape
  - .1 High Density Polyethylene Tape with pressure sensitive adhesive. Minimum width 4" (100 mm).
  - .1 Perminator Tape by W.R. Meadows.
- .2 Pipe Collars
  - .1 Construct pipe collars from vapour retarder material and pressure sensitive tape per manufacturer's instructions.

**3 Execution**

**3.1 SURFACE PREPARATION**

- .1 Prepare surfaces in accordance with manufacturer's instructions.
- .2 Level, tamp, or roll earth or granular material beneath the slab base.

**3.2 EXAMINATION**

- .1 Examine surfaces to receive membrane. Notify architect if surfaces are not acceptable. Do not begin surface preparation or application until unacceptable conditions have been corrected.

**3.3 APPLICATION**

- .1 Install the vapour retarder membrane in accordance with manufacturer's instructions and ASTM E 1643-98.
- .2 Unroll vapour retarder with the longest dimension parallel with the direction of the pour.
- .3 Lap vapour retarder over footings and seal to foundation walls.
- .4 Overlap joints 152mm (6") and seal with manufacturer's tape.
- .5 Seal all penetrations (including pipes) with manufacturer's pipe boot.
- .6 No penetration of the vapour retarder is allowed except for reinforcing steel and permanent utilities.
- .7 Repair damaged areas by cutting patches of vapour barrier, overlapping damaged area 152mm (6") and taping all four sides with tape.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

- .1 Labour, Products equipment and services necessary for spray applied air/vapour barrier Work in accordance with the Contract Documents.

1.2 **SUBMITTALS**

- .1 Product data:
- .1 Submit manufacturer's Product data in accordance with Section 01 33 00 indicating:
    - .1 Materials list of items to be provided under this Section.
    - .2 Manufacturer's specifications and other data needed to ensure compliance with the specified requirements including but not limited to installation details and physical properties.
    - .3 Manufacturer's current recommended installation procedures.
  - .2 Shop drawings: Submit shop drawings in accordance with Section 01 33 00 indicating locations and extent of air/vapour barrier system including details for terminations flashings, penetrations, window and door openings and treatment of substrate joints and cracks.
  - .3 Certificates:
    - .1 Submit manufacturer's certification that air/vapour barrier system materials and accessories supplied are compatible, meet Specification requirements and that installer is licensed/approved by membrane manufacturer.
    - .2 Submit manufacturer's certification that air/vapour barrier components are approved for use as complete air/vapour barrier system.
    - .3 Submit inspection reports and certification by manufacturer confirming that installations are in accordance with manufacturer's requirements.

1.3 **QUALITY ASSURANCE**

- .1 Qualifications: Perform Work of this Section by a company that has a minimum of five years proven experience in installations of a similar size and nature and that is approved by manufacturer.
- .2 Mock-up:
- .1 Construct one 10 m<sup>2</sup> mock-up of spray applied air/vapour barrier in location acceptable to consultant.
  - .2 Demonstrate verify details, tie-ins and to demonstrate the required quality of materials and installation.
  - .3 Arrange for Consultant's review and acceptance, allow 48 hours after acceptance before proceeding with Work.
  - .4 Mock-up may remain as part of Work if accepted by consultant. Remove and dispose of mock-ups which do not form part of Work.
  - .5 Upon acceptance, mock-up shall serve as a minimum standard of quality for the balance of the work of this Section.



- .3 Pre-installation meetings:
  - .1 Minimum 48 hours in advance of installation, arrange a meeting with manufacturer's representative, Consultant and all Subtrades affected by the work of this Section. Agenda should include but not be limited to the following:
  - .2 Review of submittals
  - .3 Review of surface preparation, minimum curing period and installation procedures
  - .4 Review of special details and flashings.
  - .5 Sequence of construction, responsibilities and schedule for subsequent operations.
  - .6 Review of inspection, testing, protection and repair procedures.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver materials to job site in manufacturer's unopened containers with all labels intact and legible at time of use..
- .2 Maintain the products in accord with manufacturer's recommendations with proper precautions to ensure fitness of material when installed.
- .3 Comply with pertinent provisions of Section 01 60 00.

#### 1.5 SITE CONDITIONS

- .1 Maintain air and substrate temperature at air/vapour barrier installation area above -4 degrees Celsius (25 degrees Fahrenheit) for 24 h before, during and 24 hrs after installation.
- .2 Do not apply air/vapour barrier in wet weather.

### 2 Products

#### 2.1 MATERIALS

- .1 All materials under Work of this Section, including but not limited to, sealants and primers are to have low VOC content limits.
- .2 Spray applied air/vapour barrier: One component, water-based coating, 100% silicone elastomeric air and weather-barrier. No primer required. 'Defendair 200' by Dow Corning or 'Air-shield LMP' by WR Meadows.
- .3 Joint Treatment:
  - .1 Joint Tape: Self-adhered fiberglass mesh tape as recommended by weather barrier manufacturer.
  - .2 Joint Compound: Fluid-applied, vapour permeable, elastomeric flashing material; trowel applied.

- .4 Flashing: Vapour permeable fluid-applied elastomeric flashing.
- .5 Sealant: Elastomeric; non-vapor permeable sealant; compatible with weather barrier

### 3 Execution

#### 3.1 EXAMINATION

- .1 Verify condition of previously installed Work upon which this Section depends. Verify conformance with manufacturer's requirements. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.
- .2 New concrete should be cured for a minimum of 14 days and must be dry before membrane installation.
- .3 Verify that existing substrates to receive air/vapour barrier are clean, dry, sound, smooth, continuous, sound and free of voids, spalled areas, loose aggregate, and sharp protrusions. Remove contaminants such as grease, oil and wax from exposed surfaces. Remove dust, dirt, loose stone and debris. Use repair materials and methods that are acceptable to membrane manufacture.
- .4 Coordinate sealing of interruptions in, and protrusions through air/vapour barrier. Verify that other Work items projecting through air/vapour barrier are in place and are securely installed.

#### 3.2 SUBSTRATE PREPARATION AND PROTECTION

- .1 Verify substrate surfaces are solid, free from surface water, frozen matter, dust, oil, grease, scaling or laitance, projections and foreign matter detrimental to the adhesion of the hot rubberized asphalt.
- .2 Clean all deck surfaces to receive membrane system in accord with manufacturer's instructions; vacuum clean or blow clean with oil-free compressed air all surfaces to receive air/vapour barrier membrane and accessories. Protect adjacent surfaces not being waterproofed.
- .3 Rout, clean, prepare and detail surface cracks form tie holes, honeycombed areas, and other voids and holes which may impair performance of air/vapour barrier membrane in accord with manufacturer's instructions; install backer rod where required.
- .4 Clean metal surfaces to bright metal by wire brushing or mechanical etching; scuff-sand lead flashing and plastic surfaces.
- .5 Install detail cants, detail coats, joint and crack treatments, and liquid flashings in accord with manufacturer's instructions.
- .6 Allow detail applications to cure in accord with manufacturer's instructions prior to general application of membrane.

- .7 Joints between panels of exterior grade gypsum, plywood and other panel type substrates shall be sealed prior to the application of membrane.
- .8 Prime surfaces in accord with manufacturer's instructions. Apply primer to all areas to receive transition membrane.
- .9 Supply and install temporary protection to adjacent surfaces to prevent damage resulting from Work of this Section.

### 3.3 **APPLICATION**

- .1 Apply air/vapour barrier in accordance with reviewed shop drawings and manufacturer's written instructions in locations indicated.
- .2 Grid surfaces to assure proper coverage rates and verify membrane wet-film mil thickness with gauges as work progresses.
- .3 Apply membrane in uniform passes by spray to recommended wet film thickness unless more stringent requirements are indicated in submitted data.
- .4 Extend air/vapour barrier as required to connect to other components of Work comprising air/vapour barrier system.
- .5 Ensure complete coverage to substrate, around flashings and protrusions and at changes in direction of surface. Re-spray thin spots and voids to obtain proper thickness. Work material into any fluted rib forming indentations.
- .6 Seal around masonry reinforcing or ties and all penetrations with termination mastic.

### 3.4 **FIELD QUALITY CONTROL**

- .1 Do not cover or permit to be covered any portion of the membranes until they have had full cure of 48 hours and been inspected by the Consultant or by an inspection agency appointed by the Consultant.

### 3.5 **PROTECTION AND CLEAN-UP**

- .1 Promptly remove overspray of membrane system material from adjacent surfaces with cleaner approved by membrane manufacturer. Leave work area in broom clean condition.
- .2 Prohibit traffic over completed work and protect against work overhead until protection course is installed.

END OF SECTION

1 General

**1.1 SECTION INCLUDES**

- .1 Design, labour, Products, equipment and services necessary for metal siding and soffit Work in accordance with the Contract Documents.

**1.2 REFERENCES**

- .1 ANSI B18.6.4, Screws, Tapping and Metallic Drive, Inch Series, Thread Forming and Cutting.
- .2 ASTM A653/A653M, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.
- .3 ASTM C920, Specification for Elastomeric Joint Sealants.
- .4 CAN/CGSB-1.40-M, Primer, Structural Steel, Oil Alkyd Type.
- .5 CAN/CSA-G40.20/G40.21M, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steels.
- .6 CSA S136, Cold Formed Steel Structural Members.
- .7 CSA S136.1, Commentary on CAN/CSA S136-M, Cold Formed Steel Structural Members.

**1.3 DESIGN REQUIREMENTS**

- .1 Design metal siding and soffit system in accordance with CSA S136, S136.1, and to withstand live, dead, lateral, wind, seismic, handling, transportation, and erection loads.
- .2 Design metal siding and soffit system in accordance with following Climatic Design Data for **Orangeville** contained in Ontario Building Code.
  - .1 Design Temperature: January 1%, July 2 ½%.
  - .2 Wind (Hourly Wind Pressures): 1 in 50 year occurrence.
  - .3 Earthquake: Seismic Data as listed.
- .3 Design metal siding and soffit system to limit deflection under design loads, to L/240.
- .4 Design metal siding and soffit system to prevent restriction of thermal induced movement which would induce deformation such as warping, buckling, and failure of joint seals and fasteners. Design metal siding and soffit system to prevent vibration when subject to the effects of wind.
- .5 Design miscellaneous, additional structural framing members and sag rods, required to complete metal siding and soffit system, where not indicated on Contract Drawings.

## **1.4 SUBMITTALS**

- .1 Product data:
  - .1 Submit copies of manufacturer's Product data in accordance with Section 01300 indicating:
    - .1 Performance criteria, compliance with appropriate reference standard, characteristics, limitations.
    - .2 Product transportation, storage, handling and installation requirements.
- .2 Shop drawings: Submit shop drawings indicating dimensions, profiles, Products, wall elevations, details, arrangements of sheets and joints, thicknesses, dimensions, locations of supports and fasteners and special shapes in accordance with Section 01300.
- .3 Samples: Submit samples 600 x 600 mm samples of siding and soffit system showing fully assembled components including but not limited to face sheets, sub-girts, and concealed sealant. Sample to be fabricated using exact colour and gauges specified in accordance with Section 01300.
- .4 Reports: Submit written field inspection and test report results after each inspection.

## **1.5 QUALITY ASSURANCE**

- .1 Retain a licensed Professional Engineer, registered in Province of Ontario, to perform following services for metal siding and soffit Work:
  - .1 Design of metal siding and soffit Work.
  - .2 Review, stamp, and sign shop drawings.
  - .3 Conduct shop and field inspections and prepare and submit inspection reports.
- .2 Mock-up:
  - .1 Fabricate, deliver, and erect one full scale 1200 mm wide x 1800 mm high mock-up panel of metal siding and soffit construction, in location acceptable to Consultant.
  - .2 Demonstrate finish, colours, and quality of workmanship.
  - .3 Mock-up may form part of final Work, if acceptable to Consultant. Remove and dispose of mock-ups which do not form part of Work.
- .3 Pre-installation meeting: Arrange with manufacturer's representative, Contractor, and Consultant to inspect substrates, and to review installation procedures 48 hours in advance of installation.

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

- .1 Stockpile panels tilted to provide water run-off, free from ground contact on firm, level, non-staining supports extending full width of sheet and spaced not more than 450 mm apart. Cover components with opaque polyethylene sheet. Vent to allow air movement.

## 1.7 EXTENDED WARRANTY

- .1 Submit warranty for metal siding and soffit Work in accordance with General Conditions, except that warranty period is extended to 3 years.
  - .1 Against warping, twisting, joint, finish failure and water penetration.
  - .2 Coverage: Complete replacement including affected adjacent parts.

## 2 Products

### 2.1 MATERIALS

- .1 **Metal siding and soffit:** ASTM A653/A653M, Z275 galvanized steel, 0.76 mm minimum base metal thickness.  
See Material Legend on Architectural drawings A-303 through to A-310.  
CL7015R profile by VicWest Steel, 24 Ga, exposed fasteners.  
Finish: Vicwest Steel. Types as follows:
  - .1 Type 1: Stone Grey '56071' or as noted on architectural drawings.  
**Metal roofing:**  
See Material Legend on Architectural drawings A-303 through to A-310.  
CL815R profile by VicWest Steel, 24 Ga, exposed fasteners.  
Finish: Vicwest Steel. Types as follows:
  - .1 Type 1: Grey Berry '55090' or as noted on architectural drawings.
- .2 Structural shapes, plates, sag rods, and similar items: CAN/CSA-G40.20-G40.21-M, Grade 300W.
- .3 Hollow structural sections: CAN/CSA-G40.20/G40.21-M Grade 350W, Class H.
- .4 Z girts and C channels: CAN/CSA S136-M; Minimum 1.2 mm thick, Z275 galvanized. Depth as indicated on Contract Drawings.
- .5 Fascia, trim, closures, and flashings: Material, finish, colour, and fasteners to match siding and soffit material, 0.76 mm minimum base metal thickness minimum.
- .6 Screw fasteners: ANSI B18.6.4, stainless steel Type 304. Exposed locations: With coloured nylon heads to match metal siding and soffit.
- .7 Primer paint: CAN/CGSB-1.40-M.
- .8 Isolation coating: Black bituminous coating, acid and alkali resistant material. '410-02' by Bakor Inc. or approved alternative.
- .9 Joint backing: Product as recommended by and soffit sealant manufacturer.
- .10 Siding and soffit sealant: ASTM C920, Type S, Grade NS; One-part, ultra-low modulus, moisture curing silicone sealant, 790 Silicone by Dow Corning or Spectrem 1 by Tremco Ltd. Colour: As selected by Consultant.
- .11 Thermal Separation: Continuous 3 mm thick x 38 mm wide self adhering cork.

3 Execution

3.1 **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.

3.2 **STRUCTURAL FRAMING**

- .1 Supply and install miscellaneous, additional structural framing members, required to complete metal siding and soffit system, where not indicated on Contract Drawings.

3.3 **GIRTS AND CHANNELS**

- .1 Notch Z girts and C channels as required to allow drainage of cavity.
- .2 Install Z girts, fastened into structural framing beneath. Orient Z girts to drain water from cavity.
- .3 Install C channels to frame openings such as doors, windows, and louvre openings, and orient channel webs to form heads, jambs and sills of openings.

3.4 **FASCIA, TRIM, CLOSURES, AND FLASHINGS**

- .1 Install fascia and trim including inside and outside corners, flashing, edgings, cap strips, drips, under-sill trim, fillers, closure strips, starter strips, and window or door trim, carefully formed and profiled.

3.5 **METAL SIDING AND SOFFIT**

- .1 Install metal siding vertically and soffit in accordance with reviewed shop drawings and manufacturer's written instructions.
- .2 Install metal siding and soffit in one piece, full height, except as indicated otherwise.
- .3 Maintain joints in exterior siding and soffit, plumb, true to line, tight fitting, hairline joints.
- .4 Attach metal siding and soffit system components to prevent warping, buckling, and deformation induced by restriction of thermal induced movement.
- .5 Install corner pieces, closures, flashings, etc, where shown and where required. Provide formed steel closures around opening.
- .6 Bed flashings, closures, and corner pieces in sealant to provide a weathertight installation.

**3.6 JOINT BACKING AND SEALANT**

- .1 Prepare substrate surface and mask as recommended by sealant manufacturer.
- .2 Install joint backing and sealant at siding and soffit system joints and perimeter for weathertight installation. Tool sealant to concave profile.

**3.7 TOUCH UP**

- .1 Touch up marred surfaces with air dry formulation to match pre-finished siding and soffit if approved by Consultant, otherwise remove and replace damaged metal siding and soffit.
- .2 Clean and touch up marred galvanized surfaces after installation, with zinc rich primer.

END OF SECTION



## 1. **GENERAL**

### 1.1. RELATED WORK

- |        |                  |                                |
|--------|------------------|--------------------------------|
| 1.1.1. | Section 01 00 10 | General Instructions           |
| 1.1.2. | Section 01 33 00 | Submittal Procedure            |
| 1.1.3. | Section 01 35 30 | Health and Safety Requirements |
| 1.1.4. | Section 01 45 00 | Quality Control                |
| 1.1.5. | Section 06 10 00 | Rough Carpentry                |
| 1.1.6. | Section 07 60 00 | Flashing and Sheet Metal       |
| 1.1.7. | Section 07 90 00 | Joint Protection               |

### 1.2. REFERENCE STANDARDS

- 1.2.1. Use latest version of listed standards.
- 1.2.2. Perform roofing and sheet metal work in conformance with the roofing manufacturer's written recommendations as well as the requirements of the ULC laboratories Class C, and Canadian Roofing Contractor's Association (CRCA).
- 1.2.3. CGSB 37-GP-56M Membrane Modified, Bituminous, Prefabricated, and Reinforced for Roofing.
- 1.2.4. CAN/ULC-S704 Standard for Thermal Insulation, Polyurethane and Polyisocyanurate, Board, Faced.
- 1.2.5. ASTM D 6162, Standard Specification for SBS Modified Bitumen Sheet Materials using a combination of polyester and fibreglass reinforcement.
- 1.2.6. ASTM D 6164, Standard Specification for SBS Modified Bitumen Sheet Materials using polyester reinforcement.
- 1.2.7. CSA A123.21, Standard Test Method for the Dynamic Wind Uplift Resistance of Membrane-Roofing Systems.
- 1.2.8. CSA A123.23, Product Specification for Polymer-modified Bitumen Sheet, Prefabricated and Reinforced.

### 1.3. SUMMARY

- 1.3.1. Work of this section includes installation of 2-ply Modified Bitumen membrane roofing on steel deck, including but not limited to the following:
  - 1.3.1.1. Self-adhesive vapour retarder
  - 1.3.1.2. Polyiso insulation boards in Adhesive
  - 1.3.1.3. Composite panel of high density polyisocyanurate insulation board and Base Sheet in adhesive
  - 1.3.1.4. Self-adhesive Base Sheet Flashing

1.3.1.5. Self-adhesive Cap and Cap Sheet Flashing

**1.4. COMPATIBILITY**

- 1.4.1. Provide all materials by same manufacturer when possible.

**1.5. TECHNICAL DOCUMENTS**

- 1.5.1. Submit two (2) copies of the most current technical data sheets. These documents must describe the materials' physical properties.

**1.6. QUALITY ASSURANCE AND ENVIRONMENTAL MANAGEMENT**

- 1.6.1. Provide proof of manufacturer's ISO 9001 and ISO 14001 Certifications.

**1.7. CONTRACTOR QUALIFICATIONS**

- 1.7.1. Provide work by roofing contractors and sub-contractors with operating license.
- 1.7.2. Employ roofing contractors and sub-contractors who are registered with manufacturer's quality program and provide the architect with a certificate to this effect before beginning any roofing work.

**1.8. PRE-INSTALLATION MEETING**

- 1.8.1. Hold a pre-installation meeting prior to start of waterproofing works, with the roofing contractor's representative, the manufacturer and the owner. The purpose of this meeting is to review particular installation conditions to each project. Establish a report for this meeting.

**1.9. STORAGE AND DELIVERY**

- 1.9.1. Deliver and store materials in dry location in their original packaging, displaying the manufacturer's name, product name, weight, and reference standards, as well as all other indications or references considered standard.
- 1.9.2. Store adhesives and waterproofing mastics at minimum 5 °C. Store adhesives and solvent-based mastics at sufficiently high temperatures to ensure ease of application.
- 1.9.3. Keep membrane materials stored in rolls standing on end, selvage edge up elevated from moisture at temperatures no less than 5 °C.
- 1.9.4. Avoid material overloads that may affect the structural integrity of specific roof areas.

**1.10. WARRANTY**

- 1.10.1. The membrane manufacturer will issue a written document in the owner's name, valid for a twenty [20], year period, stating that they will repair any leaks in the roofing membrane to restore the roofing system to a dry and watertight condition, to the extent that membrane manufacturing or installation defects caused water infiltration. The

warranty must cover for the entire cost of the repair(s) during the entire warranty period. The warranty must be transferable, at no extra cost, to subsequent building owners starting from the date of acceptance.

- 1.10.2. The contractor will provide a warranty for this project, valid for a period of two (2) years covering labour, materials and workmanship for entire area of roofing project

## **2. PRODUCTS**

### **2.1. PRIMER**

- 2.1.1. Stabilised primer used to enhance adhesion of membranes.
- 2.1.2. Specified product: ELASTOCOL STICK by SOPREMA (for self adhesive membranes)

### **2.2. VAPOUR RETARDER**

- 2.2.1. Self-adhesive air/vapour barrier membranes composed of bitumen modified with thermoplastic polymers and high-density polyethylene film. The width of the membrane shall be 1,14 meters (45 inches) to allow the membrane to fit on the top flute of most structural steel decks. The self-adhesive under face is covered with a silicone release sheet. Water vapour permeability: 0.92 ng/Pa•s•m<sup>2</sup> (0.016 Perm)
- 2.2.2. Specified product: SOPRAVAP'R by SOPREMA or approved equivalent.

### **2.3. INSULATION ADHESIVE**

- 2.3.1. Description: Low-rise two-part urethane adhesive with no solvents. Allows a complete cure in few minutes, with no temperature restrictions
- 2.3.2. Specified product: DUOTACK INSULATION ADHESIVE by SOPREMA or approved equivalent.

### **2.4. INSULATION**

- 2.4.1. Closed-cell, polyisocyanurate foam insulation board laminated with with a polymer-coated fibreglass facer., meeting requirements of CAN/ULC-S107-M87, ASTM E119, ASTM C1289-95 and FM Standard 4450/4470. Conforming to CAN/ULC-S770
- 2.4.2. Specified product: SOPRA-ISO PLUS and SOPRA-ISO PLUS TAPERED by SOPREMA or approved equivalent

### **2.5. HIGH DENSITY POLYISOCYANURATE INSULATION OVERLAY BOARD WITH LAMINATED BASE SHEET MEMBRANE**

- 2.5.1. SBS modified base sheet membrane and polyester reinforcement, factory-laminated on a high density polyisocyanurate insulation board. Board measures 0.91 m x 2.44 m (3 ft x 8 ft). Top surface sanded. Membrane side lap is 60% self-adhesive and 40% thermofusible. 7.0 mm thick.
- 2.5.2. Specified product: 2-1 SOPRASMART BOARD SANDED by SOPREMA or approved equivalent.

## **2.6. COVER STRIP**

- 2.6.1. Membrane strip of 330 mm (13 in) made of SBS modified bitumen with a composite reinforcement. Top surface sanded, underface covered with silicone release film. The strip ensures watertightness in the end laps.
- 2.6.2. Specified product: SOPRALAP Stick by SOPREMA or approved equivalent.

## **2.7. MEMBRANES**

### **2.7.1. Roof membrane Base Sheet Flashing:**

- 2.7.1.1. CGSB 37-GP-56M, Type 2, Class C, Grade 2 (CSA A123.23, Type C, Grade 3)
- 2.7.1.2. Roofing membrane with fibreglass & polyester reinforcement to ASTM D6162 and SBS modified bitumen. Top face sanded, under side self-adhesive. Top face marked with three (3) distinctive blue chalk lines to ensure proper roll alignment.
- 2.7.1.3. Specified product: SOPRAPLY STICK DUO by SOPREMA or approved equivalent.

### **2.7.2. Cap sheet and Cap Sheet Flashing:**

- 2.7.2.1. CGSB 37-GP-56M, Type 1, Class A, Grade 2 (CSA A123.23, Type C, Grade 1)
- 2.7.2.2. ULC certifications, Class C
- 2.7.2.3. Roofing and flashing cap sheet membrane with a heavy-duty composite reinforcement and SBS modified bitumen to ASTM D6162. Top face covered with ceramic granules, under face with silicone release film.
- 2.7.2.4. Specified products: SOPRAPLY STICK TRAFFIC CAP by SOPREMA or approved equivalent.

## **2.8. WATERPROOFING MASTICS**

- 2.8.1. Waterproofing products: Mastic made of synthetic rubbers, plasticized with bitumen and solvents.
- 2.8.2. Specified product: SOPRAMASTIC by SOPREMA.
- 2.8.3. Specified product: SOPRAMASTIC ALU by SOPREMA. (for exposed areas)

## **2.9. WATERPROOFING OF PENETRATIONS**

- 2.9.1. Description: One component polyurethane /bitumen resin to waterproof roof penetrations and complex details.
- 2.9.2. Specified product: Alsan Flashing and Alsan Flashing reinforcement by Soprema

# **3. EXECUTION**

## **3.1. SURFACE EXAMINATION AND PREPARATION**

- 3.1.1. Complete surface examination and preparation in conformance with manufacturer's recommendations, particularly for fire safety precautions.
- 3.1.2. Do not begin any work before surfaces are smooth, dry, and exempt of ice and debris. Do not use calcium or salt for ice or snow removal.
- 3.1.3. Do not install materials during rain or snowfall.

## **3.2. METHOD OF INSTALLATION**

- 3.2.1. Install roofing elements on clean and dry surfaces, in conformance with manufacturer's recommendations.
- 3.2.2. Complete installation in a continuous fashion as surfaces are prepared and weather conditions permit.
- 3.2.3. Ensure watertight conditions for roofs at all times, including protection during installation work by other trades and progressive protection as work is completed (e.g. vents, drains, etc.)

## **3.3. CLEANING**

- 3.3.1. Immediately before roofing materials are applied, clean decks of roughness, rubbish, dust, dirt, oil, grease, snow and ice.

### **3.4. EQUIPMENT FOR WORK EXECUTION**

- 3.4.1. Maintain all roofing equipment and tools in good working order.
- 3.4.2. Use tools recommended by membrane's manufacturer.

### **3.5. INSTALLATION OF GYPSUM SHEATHING**

- 3.5.1. Lay sheathing board with tightly butted joints. Longitudinal joints must be at right angles to flute direction. Joints occurring along widths of board to be continuously supported on top flute of metal deck.
- 3.5.2. Mechanically fasten sheathing to deck with self-tapping, non-corroding screws, spaced evenly to each board and to only top flutes. Use 8 fasteners per 4' x 8' panels and 12 fasteners per corner panels
- 3.5.3. Ensure sheathing is immediately protected with membrane

### **3.6. INSTALLATION OF VAPOUR RETARDER**

- 3.6.1. Beginning at the bottom of the slope, without adhering the membrane, unroll onto the substrate for alignment. Do not immediately remove the silicone release sheet.
- 3.6.2. Align the roll parallel to the corrugations of the steel deck. Make sure the membrane overlaps are supported along their entire length.
- 3.6.3. Peel back one end of the silicone release sheet and adhere this part of the membrane to the substrate. Peel back the remaining release sheet at a 45° angle to avoid wrinkles in the membrane.
- 3.6.4. If the membrane is not properly aligned, do not try to adjust it. Instead, cut the roll and start again, making sure that it is properly aligned and that it overlaps the end of the misaligned piece by 150 mm.
- 3.6.5. Overlap adjacent membranes by 75 mm. Overlap end laps by 150 mm. Stagger end laps by at least 300 mm.

### **3.7. INSULATION INSTALLATION**

- 3.7.1. Install insulation with adhesive in conformance with manufacturer's written recommendations.
- 3.7.2. Install only as much insulation as can be covered in the same day.
- 3.7.3. Install insulation in two layers and stagger seams between layers.

- 3.7.4. Around the drains lower insulation by 1" to create a sump 4' X 4' in area. Bevel the edge of the 3" insulation on a 45° angle.
- 3.7.5. Install tapered insulation in adhesive where indicated on drawings.

### **3.8. POLYISOCYANURATE INSULATION BOARD WITH LAMINATED BASE SHEET MEMBRANE**

- 3.8.1. Install composite board with adhesive in continuous strips spaced 30 cm (12 in) on the field. Decrease the spacing between ribbons to a minimum of 15 cm (6") at the perimeter and 10 cm (4") at the corners.
- 3.8.2. Adhere the first 60 mm (2.5 in) of the self-adhesive side and end laps by removing the silicone release paper and using a membrane roller, then heat-weld the last 40 mm (1.5 in) (self-adhesive, heat-welded side laps).
- 3.8.3. Seal end laps by installing a 330-mm (13-in) wide protection strip centered on the joint.
- 3.8.4. All boards must be evenly and tightly butted together
- 3.8.5. Avoid forming wrinkles, swelling or fishmouths

### **3.9. BASE-SHEET FLASHING INSTALLATION**

- 3.9.1. Apply primer to the substrate at a rate of .25 L/m<sup>2</sup>. Primer should be dry before installation of Base Sheet
- 3.9.2. Install base sheet flashing in one- (1) metre widths to cover roofing substrate over 100 mm. Overlap side laps by 75 mm. Stagger side laps by at least 100 mm from base sheet overlaps on roof to avoid excessive layering.
- 3.9.3. Apply base sheet flashing directly onto substrate by removing silicone release sheet. Proceed from top to bottom. Once in place, apply pressure manually in a uniform fashion to obtain homogenous adherence over entire surface. Preferably seal seams with rubber roller. Nail outside edge at 300 mm o/c.
- 3.9.4. Avoid forming wrinkles, air pockets or fishmouths.
- 3.9.5. Always seal overlaps at the end of the workday.

### **3.10. ROOFING CAP SHEET INSTALLATION**

- 3.10.1. Apply self-adhesive membrane primer to the area to be covered.
- 3.10.2. Starting at drain, Unroll the cap sheet membrane on the base sheet, taking care to align the edge of the first selvedge with the edge of the roof.

- 3.10.3. Cut off corners at end laps at areas to be covered by the next roll.
- 3.10.4. Each selvedge will overlap the previous one laterally along lines provided for this purpose, and will overlap by 150 mm (6 in) at the ends. Space end laps a minimum of 300 mm (12 in).
- 3.10.5. Remove the silicone release film, pressing down the membrane using a membrane roller to ensure good adhesion.
- 3.10.6. Adhere the first part of the self-adhesive side laps using a membrane roller, then heat-weld the last part (self-adhesive, heat-welded side laps).
- 3.10.7. Apply adhesive for the first 125 mm (5 in) of the end laps using a steel trowel with 5 mm (3/16 in) notches.
- 3.10.8. Complete the application by welding the last 25 mm (1 in) of the overlap to the field surface, using an electric hot-air welder and a membrane roller.
- 3.10.9. Immediately after placing the cap sheet membrane, apply pressure on the whole surface with a membrane roller to ensure complete and uniform adherence.
- 3.10.10. Repeat these steps to install the other membranes.
- 3.10.11. Avoid the formation of wrinkles, swellings or fishmouths.

### **3.11. CAP SHEET FLASHING INSTALLATION**

- 3.11.1. Install this cap sheet in one-metre-wide strips (3.25 ft).
- 3.11.2. Each selvedge will overlap the previous one laterally along lines provided for this purpose and will overlap by 150 mm (6 in) the field surface. Membranes for flashings must be spaced at least 100 mm (4 in) with respect to the cap sheet membranes on the field surface, to avoid areas of excessive membrane thickness.
- 3.11.3. Cut off corners at end laps of areas to be covered by the next roll.
- 3.11.4. Use a chalk line to draw a straight line on the field surface 150 mm. from the upstands and parapets.
- 3.11.5. Prime the surface of the upstand and allow to dry.
- 3.11.6. Position the pre-cut membrane piece. Peel back 100 to 150 mm. (4 to 6 in.) of the silicone release paper to hold the membrane in place at the top of the upstand. As you progressively remove the paper, use the aluminum applicator to ensure good adherence and a perfect transition between the upstand and the field surface.
- 3.11.7. Apply primer before installing the next strip.



- 3.11.8. Smooth the entire membrane surface with a roller for full adhesion.
- 3.11.9. Adhere the first 50 mm (2.0 in) of the self-adhesive side laps using a membrane roller, then heat-weld the last 50 mm (2.0 in) (self-adhesive, heat-welded side laps).
- 3.11.10. Apply adhesive for the first 125 mm (5 in) of the end lap using a steel trowel with 5 mm (3/16 in) notches.
- 3.11.11. Finish by heat-welding the last 25 mm. (1 in.) to the existing surface with an electric hot-air welder and roller. Provide a smooth application, free of wrinkles, fishmouths or air pockets.

### **3.12. WATERPROOFING OF PENETRATIONS**

- 3.12.1. Ensure substrate is clear of loose granules and all foreign substances that can impair adhesion.
- 3.12.2. Apply a base coat of liquid waterproofing
- 3.12.3. Trim reinforcing material to conform to shape of penetrations and embed in base coat.
- 3.12.4. Apply a second coat fully saturating the reinforcement.
- 3.12.5. To add colour or match existing granules, apply a thin coat of liquid waterproofing and embed granules before it dries.

**END OF SECTION**

1 General

1.1 **SECTION INCLUDES**

- .1 Labour, Products, equipment and services necessary for flashing and sheet metal Work in accordance with the Contract Documents.

1.2 **REFERENCES**

- .1 ASTM A653/A653M, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.
- .2 ASTM C920, Specification for Elastomeric Joint Sealants.
- .3 CRCA Roofing Manual, Canadian Roofing Contractors Association.

1.3 **SUBMITTALS**

- .1 Shop drawings:
  - .1 Submit shop drawings in accordance with Section 01 33 00 indicating:
    - .1 Proposed method of shaping, forming, jointing.
    - .2 Fastening, and application of flashing and sheet metal Work.
- .2 Samples:
  - .1 Submit following samples in accordance with Section 01 33 00:
    - .1 50 x 50 mm samples of sheet metal material, colour and finish.
    - .2 Representative sample section of prepainted metal flashing illustrating S locking jointing method, minimum 600 mm long..

2 Products

2.1 **MATERIALS**

- .1 All materials under Work of this Section, including but not limited to, sealants and paints are to have low VOC content limits.
- .2 Prepainted sheet steel: ASTM A653/A653M; Classification LFQ, Grade A, Z275 zinc coating designation, 0.60 mm minimum base steel thickness, commercial quality, prefinished with Perspectra Series coating system by U.S. Steel Canada, or WeatherX by Vicwest Steel. Colour as selected by consultant.
- .3 Plastic cement: Trowel grade asphalt mastic.
- .4 Sealant: ASTM C920, Type S, Grade NS, Class 25; High-performance, medium-modulus, one-part, neutral-cure silicone sealant. 'CWS' by Dow Corning or approved alternative.

- .5 Cleats and starter strips: Starter strips to be continuous, of same material as flashing used, 1.2 mm thick.
- .6 Fasteners: Flat head roofing nails of length, type and thickness suitable for metal flashing application.
- .7 Washers: of same material as sheet metal, 1 mm thick with rubber packings.
- .8 Touch-up paint: Same colour and material as prepainted sheet steel, as recommended by prefinished coating manufacturer.

## 2.2 **FABRICATION**

- .1 Fabricate copings, flashings, curb counter flashings, starter strips, scuppers and miscellaneous flashings in accordance with CRCA and to details shown.
- .2 Form prepainted sheet material at shop to shapes shown. Make end joints where adjacent lengths of metal flashing meet, in accordance with jointing method specified.
- .3 Form pieces in 2400 mm maximum practical lengths. Make allowance for expansion at joints.
- .4 Hem exposed edges 13 mm minimum on underside for appearance and stiffness. Mitre and seal corners with sealant.
- .5 Reglets and Cap flashing: Form flashings as detailed and in accordance with CRCA. Provide slotted fixing holes and steel/plastic washer fasteners.
- .6 Scuppers:
  - .1 Form scuppers from prefinished steel sheet metal.
  - .2 Sizes and profiles as indicated.
  - .3 Provide necessary fastenings.

## 3 Execution

### 3.1 **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.

**3.2            INSTALLATION**

- .1      Install coping flashings, curb counter flashings, starter strips, scuppers and miscellaneous flashings to details shown on the Contract Drawings and in accordance with CRCA.
- .2      Use concealed fasteners where indicated.
- .3      Apply isolation coating to metal surfaces in contact with concrete or mortar.
- .4      Install continuous starter strips to present a true, non-waving, leading edge. Anchor to back-up for a rigid, secure installation.
- .5      Counterflash bituminous flashings at intersections of roof with vertical surfaces and curbs. Flash joints using S-lock forming tight fit over hook strips.
- .6      Make end joints using an S lock joint. Execute by inserting end coping length in 25 mm deep S lock formed in end of adjacent length. Extend concealed portion of S lock 25 mm outwards and nail to substrate. Face nailing of joints will not be permitted.
- .7      Seal where necessary to form weathertight seal between flashing and adjoining surfaces and between flashing and other Work. Sealing Work consists of bedding between members where possible. Tool sealant to concave profile where exposed.
- .8      Insert metal flashing under cap flashing to form weathertight junction.
- .9      Caulk flashing at cap flashing with sealant.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

- .1 Labour, Products, equipment and services necessary for firestopping and smoke seals Work in accordance with the Contract Documents.

1.2 **REFERENCES**

- .1 ASTM C303, Standard Test Method for Dimensions and Density of Preformed Block and Board Type Thermal Insulation.
- .2 ASTM C920, Standard Specification for Elastomeric Joint Sealants.
- .3 ASTM C1104, Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation.
- .4 ASTM E814, Test Method for Fire Tests of Through-Penetration Fire Stops.
- .5 ASTM E2174, Standard Practice for On-Site Inspection of Installed Fire Stops.
- .6 ASTM G21, Standard Test for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- .7 CAN/CGSB 19.13, Sealing Compound, One Component, Elastomeric, Chemical Curing.
- .8 CAN/ULC S102, Surface Burning Characteristics of Building Materials and Assemblies.
- .9 CAN/ULC S114, Standard Method of Test for Determination of Non-Combustibility in Building Materials.
- .10 CAN/ULC S115, Standard Method of Fire Tests of Firestop Systems.
- .11 CAN/ULC S129, Standard Method Of Test For Smoulder Resistance Of Insulation (Basket Method).
- .12 CAN/ULC S702, Thermal Insulation, Mineral Fibre for Buildings.

1.3 **DEFINITIONS**

- .1 Fire Separation: A construction assembly, plane or device, either vertical or horizontal, which is required to prevent the passage of fire and smoke for a prescribed period of time. Proof of compliance to required time rating shall be by ULC, Warnock Hersey (or similar approved) certification or shall be as listed in the Ontario Building Code Supplementary Standard SB-2.

- .2 Smoke Separation: A construction assembly, plane or device, either vertical or horizontal, which is not required to prevent the passage of fire for a prescribed period of time but is required to prevent the passage of smoke. A "Smoke Separation" is also known as a "Fire Separation with No Rating" or a "Zero Hour Rated Separation".
- .3 Non-Rated Separation: A construction assembly, plane or device, either vertical or horizontal, which is not required to prevent the passage of fire for a prescribed period of time and is not required to prevent the passage of smoke.

#### 1.4 **SYSTEM DESCRIPTION**

- .1 Firestopping and smoke seals: ULC or Intertek Testing Services listed Products and systems in accordance with CAN/ULC S115 suitable to actual application and installation conditions.
- .2 Firestop applications that exist for which no ULC or cUL tested system is available through a manufacturer, a manufacturer's engineering judgment derived from similar ULC or cUL system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineer judgment drawings must follow requirements set forth by the International Firestop Council.
- .3 Firestop and smoke seal system shall achieve a fire resistance rating and smoke seal rating equal to that of assemblies into which they are installed.
- .4 Provide smoke sealants over firestopping materials or combination smoke seal/firestop seal material to form air tight barriers to retard the passage of gas and smoke.
- .5 Firestopping and smoke seals located at movement joints shall be designed with movement capability.
- .6 Provide penetration firestoppping with mould and mildew resistance rating of 0 in accordance with ASTM G21.
- .7 Firestopping and smoke seals within mechanical and electrical assemblies shall be provided as part of the work of Divisions 21, 22, 23, 26, 27, and 28 respectively.

#### 1.5 **SUBMITTALS**

- .1 Product data:
  - .1 Submit copies of manufacturer's Product data in accordance with Section 01 33 00 indicating:
    - .1 Performance criteria, compliance with appropriate cUL or ULC reference standard, characteristics, limitations.
    - .2 Product transportation, storage, handling and installation requirements.

- .3 Submit firestop and smoke seal manufacturer's Product data for materials and prefabricated devices, including manufacturer's printed installation instructions.
- .2 Shop drawings:
  - .1 Submit shop drawings in accordance with Section 01 33 00 indicating:
    - .1 Fire rated and smoke sealed systems for each typical application.
    - .2 Construction details, accurately reflecting actual job conditions.
    - .3 ULC or Intertek Testing assembly listing.
    - .4 Each floor and wall assembly requiring firestop system with each corresponding ULC firestop system.
- .3 Certification:
  - .1 Submit certified documentation from manufacturer for each worker performing Work of this Section.
  - .2 Submit installer's and Product manufacturer's certification verifying compliance with the Contract Documents and conformance with ASTM E814 and CAN/ULC S115.

#### 1.6 **QUALITY ASSURANCE**

- .1 Installers qualifications: Perform Work of this Section by a company that has a minimum of five years proven experience in the installation of firestopping and smoke seal Work of a similar size and nature and that is approved by manufacturer. Submit to Consultant, applicator's current certificate of approval by the material manufacturer as proof of compliance.
- .2 Manufacturer's direct representative and/or fire protection specialist shall be on-site during initial installation of firestop systems to train appropriate contractor personnel in proper selection and installation procedures conforming to manufacturer's written recommendations published in their literature and drawing details.
- .3 Pre-construction meetings: Arrange with manufacturer's representative, Contractor, Consultant and Field Engineer to determine responsibility for handling such issues as FT rated partitions, firestop custom details, compatibility, mixed penetrations, and to review installation procedures 48 hours in advance of installation.

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

- .1 Deliver materials to Place of Work in manufacturer's unopened containers, containing classification label with labels intact and legible at time of use.
- .2 Do not use damaged or adulterated materials exceeding their expiry date.

#### 1.8 **SITE CONDITIONS**

- .1 Conform to manufacturer's requirements and maintain a minimum temperature of 5<sup>0</sup> C for a minimum period of 24 h before application, during, and until application is fully cured.

- .2 Maintain sealant at a minimum 18E C for best workability.

## 2 Products

### 2.1 **ACCEPTABLE MANUFACTURERS**

- .1 Acceptable manufacturers of rated systems include:
  - .1 AD Fire Protection Systems Inc.
  - .2 Hilti Canada Corporation.
  - .3 3M Canada Inc.
  - .4 Tremco Ltd.

### 2.2 **GENERAL SYSTEM REQUIREMENTS**

- .1 All materials under Work of this Section, including but not limited to, primers and sealants are to have low VOC content limits.
- .2 Do not use Products containing asbestos.
- .3 Firestopping components shall not contain volatile solvents or require special application to protect plastic pipe from firestopping compound.
- .4 Provide smoke seal sealant in following colour: Rust Red, unless indicated otherwise.
- .5 Smoke sealant for overhead and vertical joints for floor to be self-levelling and non-sagging sealant.
- .6 Smoke sealant at vertical through penetrations in areas with floor drains shall be waterproof type.

### 2.3 **MATERIALS**

- .1 Following materials have been provided for convenience. Contractor shall provide complete system with all components and accessories as required for fire resistant and smoke seal installation.
- .2 Firestop sealant: single component, low modulus, silicone rubber, moisture curing sealant to ASTM C920, ULC labelled to CAN/ULC S115.
- .3 Pre-Installed firestop devices for use with non-combustible and combustible pipes, conduit and/or cable bundles penetrating concrete floors and walls.
  - .1 Cast-in place firestop device complete with aerator adaptor when used in conjunction with aerator system. Model CP 680-P by Hilti or approved alternative.
  - .2 Cast-in place firestop device for use with noncombustible penetrants. Model CP 680-M by Hilti or approved alternative.



- .3 Speed sleeve for use with cable penetrations. Model CP 653 by Hilti or approved alternative.
- .4 Firestop block. Model CFS-BL by Hilti or approved alternative.
- .4 Re-penetrable, round cable management devices for use with new or existing cable bundles penetrating walls:
  - .1 Speed sleeve with integrated smoke seal fabric membrane. Model CP 653 by Hilti or approved alternative.
  - .2 Firestop Sleeve. Model CFS-SL SK by Hilti or approved alternative.
  - .3 Retrofit sleeve for use with existing cable bundles. Model CFS-SL RK by Hilti or approved alternative.
  - .4 Gangplate for use with multiple cable management devices. Model CFS-SL GP by Hilti or approved alternative.
  - .5 Gangplate Cap for use at blank openings in gangplate for future penetrations. Model CFS-SL GP CAP by Hilti or approved alternative.
- .5 Firestop insulation: to CAN/ULC S702, Type 2; mineral fibre manufactured from rock or slag, suitable for manual application.
  - .1 Density: Minimum 64 kg/m<sup>3</sup> when tested to ASTM C303.
  - .2 Combustibility: Noncombustible to CAN/ULC S114.
  - .3 Melt temperature: >1175 degrees C.
  - .4 Surface burning characteristics: to CAN/ULC S102, maximum flame spread of 0, smoke developed of 0.
  - .5 Moisture Absorption: 0.04 percent when tested to ASTM C1104.
  - .6 Smoulder Resistance: 0.01 percent when tested to CAN/ULC S129.
- .6 Damming, back-up, supports, and anchorage: In accordance with manufacturer's fire rated systems and to acceptance of authorities having jurisdiction.
- .7 Primer: As recommended by firestopping sealant manufacturer.

### 3 Execution

#### 3.1 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.
- .2 Verify that substrates and surfaces to receive firestopping and smoke seals are clean, dry, and frost free.

#### 3.2 PREPARATION

- .1 Prepare, modify, and adjust void sizes, proportions, and conditions to conform to fire rated and smoke sealed assembly requirements such as assembly opening size and dimensional restrictions.

- .2 Clean surfaces to remove material detrimental to bond including dust, paint, rust, oil, grease, moisture, frost and other foreign matter to manufacturers recommendations.
- .3 Mask adjacent surfaces to avoid spillage and over-coating of adjacent surfaces. Remove stains from adjacent surfaces.

### 3.3 **INSTALLATION**

- .1 Install firestopping and smoke seal systems in accordance with reviewed Shop Drawings, manufacturer's instructions and fire rated assembly to establish continuity and integrity of fire separations.
- .2 Install firestop insulation in compacted thicknesses required by ULC design. Compress insulation approximately 50 percent.
- .3 Install primers as recommended by firestop and smoke seal Product manufacturers.
- .4 Install temporary forming, damming, back-up as required, remove after materials have achieved initial cure and will resist displacement.
- .5 Install firestop and smoke seal filler in horizontal joints providing 25% compression fit.
- .6 Use resilient, elastomeric firestopping and smoke seal systems in following locations:
  - .1 Openings and sleeves for future use.
  - .2 Penetration systems subject to vibration or thermal movement.
  - .3 Penetration systems in acoustical containment enclosures.
- .7 Trowel and tool exposed firestop and smoke seal. Product surfaces to uniform, smooth finish..
- .8 Seal joints to ensure an air and water resistant seal capable of withstanding compressions and extensions due to thermal wind or seismic joint movement.
- .9 Taped joints will not be acceptable.
- .10 Repair damaged fire stopped and smoke sealed surfaces to acceptance of Consultant.
- .11 Identify each firestop and smoke seal penetration assembly with permanent label listing following:
  - .1 Assembly and rating in hours.
  - .2 Date of installation.
  - .3 Installing company's name and telephone number.
- .12 Do not cover materials until full cure has taken place.

3.4 **INSPECTION AND TESTING**

- .1 Inspection of through-penetration firestopping shall be performed in accordance with ASTM E2174 to ensure that firestopping and smoke seals have been installed in accordance with Contract documents and to tested and listed firestop system.

3.5 **CLEAN-UP**

- .1 Clean all surfaces adjacent to sealed holes and joints to be free of excess firestop materials and soiling as work progresses.
- .2 Remove excess materials and debris immediately after application.

3.6 **SCHEDULE OF FIRESTOP AND SMOKE SEAL LOCATIONS**

- .1 Following firestop and smoke seal location schedule is included for convenience and may not be complete. Examine Contract Drawings and other specification sections and determine entire extent of Work of this Section. Generally provide systems with required fire and smoke ratings at following locations:
  - .1 Gaps at intersections of fire-resistance rated walls and partitions.
  - .2 Control and sway joints in fire-resistance rated walls and partitions.
  - .3 Gaps at top of fire-resistance rated partitions and walls.
  - .4 Penetrations through fire-resistance rated walls and partitions including mechanical and electrical services and openings and sleeves for future use.
  - .5 Penetrations through fire-resistance rated floor slabs, ceilings, and roofs.
  - .6 Gaps at edge of floor slabs at exterior walls.
  - .7 Perimeter of retaining angles on rigid ducts greater than 0.012 m<sup>2</sup>, firestopping material between retaining angle and fire separation and between retaining angle and duct, on each side of fire separation.
  - .8 Where indicated on drawings.
  - .9 At non-rated assemblies that require a smoke seal.
  - .10 Where required by Ontario Building Code.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

- .1 Labour, Products, equipment and services necessary for sealant Work in accordance with the Contract Documents.
- .2 Work of this Section does not include sealants in firestopping and smoke sealed assemblies.
- .3 Work of this Section does not include sealant work identified in individual specification sections.

1.2 **REFERENCES**

- .1 ASTM C834, Specification for Latex Sealants.
- .2 ASTM C920, Specification for Elastomeric Joint Sealants.
- .3 ASTM C1330, Specification for Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants.

1.3 **SUBMITTALS**

- .1 Product data: Submit copies of Product data in accordance with Section 01 33 00 describing type, composition and recommendations or directions for surface preparation, material preparation and material installation.
- .2 Samples:
  - .1 Submit following samples in accordance with Section 01 33 00.
    - .1 Two samples of sealant/caulking, for colour selection.
    - .2 Two samples of back-up material and primer for physical characteristics.

1.4 **QUALITY ASSURANCE**

- .1 Qualifications: Work of this Section shall be executed by trained applicators approved by sealant manufacturer and having a minimum of 5 years proven experience.

1.5 **SITE CONDITIONS**

- .1 Do not install materials when ambient air temperature is less than 5EC, when recesses are wet or damp.
- .2 Install materials to manufacturer's recommendations.

1.6 **DELIVERY, STORAGE AND HANDLING**

- .1 Arrange delivery of materials in original, unopened packages with labels intact, including batch number, and ensure that on-site storage is kept to a minimum. Do not store materials on site where there exists any danger of damage from moisture, direct sunlight, freezing and other contaminants.

1.7 **EXTENDED WARRANTY**

- .1 Submit an extended warranty for Sealant Work in accordance with General Conditions, except that warranty period is extended to 2 years from date of Substantial Performance of the Work.
  - .1 Warrant against leakage, cracking, crumbling, melting, shrinkage, running, loss of adhesion and staining adjacent surfaces.
  - .2 Coverage: Complete replacement including affected adjacent Work.

2 **Products**

2.1 **MATERIALS**

- .1 General:
  - .1 All materials under Work of this Section, including but not limited to, primers and sealants are to have low VOC content limits.
  - .2 Use materials as received from manufacturers, without additives or adulterations. Use one manufacturer's Product for each kind of Product specified.
- .2 Sealant **Type A**: ASTM C920, Type S, Grade NS, Class 25; One-part, non-sag type, silicone sealant, in standard colours selected.
  - .1 'DC CWS' by Dow Corning Inc.
  - .2 'Sikasil 305CN' by Sika.
  - .3 'Tremsil 400' by Tremco..
- .3 Sealant **Type B**: ASTM C920, Type S, Grade NS; One-part mildew-resistant silicone, in standard colours selected.
  - .1 '786 Mildew Resistant Silicone Sealant' by Dow Corning Inc.
  - .2 'Sikasil GP Mildew Resistant' by Sika.
  - .3 'Tremsil 200 Silicone Sealant' by Tremco Ltd.
- .4 Sealant **Type C**: ASTM C834; Pure acrylic siliconized sealant; in standard white colour (paintable).
  - .1 'Tremflex 834 Silconized Sealant' by Tremco Ltd.

2.2 **ACCESSORIES**

- .1 Primers: Type recommended by material manufacturers for various substrates, primers to prevent staining of adjacent surfaces encountered on project.

- .2 Joint backing: ASTM C1330; Round, solid section, closed cell, skinned surface, soft polyethylene foam gasket stock, compatible with primer and sealant materials, 30 to 50% oversized, Shore A hardness of 20, tensile strength 140 to 200 kPa. Bond breaker type surface.
- .3 Bond breaker: Type recommended by material manufacturers.
- .4 Void filler around the window frames to be one part expanding polyurethane foam.
- .5 Cleaning agents: As recommended by material manufacturer, non-staining, harmless to substrates and adjacent finished surfaces.

### 2.3 **MIXING**

- .1 Follow manufacturers instructions on mixing, shelf and pot life.

## 3 Execution

### 3.1 **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.

### 3.2 **PREPARATION**

- .1 Protect adjacent exposed surfaces to prevent smearing, staining or other damage, by masking or other means, prior to performing Work. Make good any damage caused by sealant application. Remove protection upon completion and clean adjacent, exposed surfaces of any compound deposited upon such surfaces.
- .2 Erect scaffolding and rigging required to perform sealant Work in accordance with reviewed Shop Drawings.
- .3 Prepare joints to receive sealants to manufacturer's instructions. Ensure that joints are clean and dry and ferrous surfaces are free from rust and oil.
- .4 Clean recesses to receive sealant, to be free of dirt, dust, loose material, oil, grease, form release agents and other substances detrimental to sealant's performance.
  - .1 Remove lacquer or other protective coatings from metal surfaces, without damaging metal finish, using oil-free solvents. Remove rust, mill scale and coatings from ferrous metals by wire brush, grinding or sand blasting.
  - .2 Ensure recess is dry.
  - .3 Do not apply sealants to joint surfaces treated with sealer, curing compound, water repellent, or other coatings. Remove incompatible coatings as required.

- .5 Ensure that all materials in contact with sealant are compatible. Test substrate for adhesion.
- .6 Depth of recess: Maintain depth to 2 joint width up to a maximum of 13 mm and not less than 6 mm at centre of joint. For greater depth, use joint backing under. Where recess is less than specified depth, cut back surface of recess to specified recess depth.
- .7 Install polyethylene backing rod in joints 6 mm or more in width. Roll backing rod into joint. Do not stretch or bend backing rod. Install bond breaker to back of recess.
- .8 Prime sides of recess, in accordance with sealant manufacturer's instructions.
- .9 Condition products for use in accordance with manufacturer's recommendations.

### 3.3 **INSTALLATION**

- .1 Apply sealant immediately after adjoining Work is in condition to receive such Work. Apply sealant in continuous bead using gun with correctly sized nozzle. Use sufficient pressure to evenly fill joint.
- .2 Ensure sealant has full uniform contact with, and adhesion to, side surfaces of recess. Superficial painting with skin bead is not acceptable. Tool sealant to smooth surface, free from ridges, wrinkles, sags, air pockets, embedded impurities, dirt, stains or other defects.
  - .1 At recesses in angular surfaces, finish sealant with flat profile, flush with face of material at each side.
  - .2 At recesses in flush surfaces, finish compound with concave face, flush with face of material at each side.
- .3 Make sealant bead uniform in colour.
- .4 Cure sealants in accordance with sealant manufacturer's instructions. Do not cover up sealants until proper curing has taken place.
- .5 Immediately remove excess compound or droppings which would set up or become difficult to remove from adjacent finished surfaces, using recommended cleaners, as work progresses. Do not use scrapers, chemicals or other tools which could damage finished surfaces. Remove defective sealant.
- .6 Clean recesses and re-apply sealant.
- .7 Remove masking tape immediately after joints have been sealed and tooled.

3.4 **CLEANING**

- .1 Clean surfaces adjacent to joints, remove sealant smears or other soiling resulting from application of sealants. At metal surfaces, remove residue. Do not mar or damage finishes on materials adjacent to joints. Repair or replace marred or damaged materials.

3.5 **SCHEDULE OF LOCATIONS**

- .1 Following sealant location schedule is included for convenience and may not be complete. Examine Contract Drawings and other specification sections and determine entire extent of Work of this Section. Generally, seal following locations:
  - .1 Concrete, masonry and wood to metal.
  - .2 Wood to masonry and concrete.
  - .3 Metal to metal.
  - .4 All dissimilar materials.
  - .5 Where 'sealant' or 'caulking' is indicated on drawings.
- .2 Sealant **Type A**:
  - .1 Exterior joints between masonry and steel or aluminum.
  - .2 Exterior joints between masonry and shelf angle.
  - .3 Exterior joints between steel or aluminum and concrete or masonry.
  - .4 Interior and exterior control joints, except in floors.
  - .5 Door frames, louvre frames, interior and exterior side.
  - .6 Protrusions through interior and exterior walls and floors, interior and exterior side, except where fire rated seals are required.
  - .7 Seal thresholds.
- .3 Sealant **Type B**:
  - .1 Control joints in tiled areas.
  - .2 Between vanity and tile.
  - .3 Between vanity and mechanical fixtures/fittings.
  - .4 Between access panels and tile.
  - .5 Between tiles and adjacent materials.
- .4 Sealant **Type C**:
  - .1 Perimeter of kitchen counters.
  - .2 Perimeter of interior windows.
  - .3 Perimeter of firehose cabinets.
  - .4 Junction between drywall and masonry.

END OF SECTION



1 General

1.1 **SECTION INCLUDES**

- .1 Labour, Products, equipment and services necessary for the metal doors and frames  
Work in accordance with the Contract Documents.

1.2 **REFERENCES**

- .1 ASTM A653/A653M, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.
- .2 ASTM A568/A568M, Specification for General Requirements for Steel, Carbon and High-Strength Low-Alloy, Hot-Rolled Sheet and Cold-Rolled Sheet.
- .3 CAN4-S104M, Standard Method for Fire Test of Door Assemblies.
- .4 CAN4-S105M, Standard Specification for Fire Door Frames, Meeting the Performance Required by CAN4-S104M.
- .5 CAN/CGSB-1.198, Cementitious Primer, (for Galvanized Surfaces).
- .6 CGSB 41-GP-19Ma, Rigid Vinyl Extrusions for Windows and Doors.
- .7 CAN/ULC-S702, Thermal Insulation, Mineral Fibre for Buildings.
- .8 CSA W47.1, Certification of Companies for Fusion Welding of Steel Structures.
- .9 CSA W59-M, Welded Steel Construction (Metal Arc Welding).
- .10 NFPA 80, Standard for Fire Doors and Other Opening Protectives.

1.3 **DESIGN REQUIREMENTS**

- .1 Design exterior frame assemblies to accommodate expansion and contraction when subjected to minimum and maximum surface temperature of -35 degrees Celsius to 35 degrees Celsius.

1.4 **SUBMITTALS**

- .1 Product data: Submit manufacturer's Product data in accordance with Section 01 33 00 indicating door and frame construction.
- .2 Shop drawings:
  - .1 Submit shop drawings in accordance with Section 01 33 00 for each type of door and frame indicating:
    - .1 Thickness and type of steel.
    - .2 Thickness and type of core.

- .3 Thickness and type of steel stiffeners and location of them within the door.
- .4 Thickness and type of metal facing on edges of door and method of fastening.
- .5 Location of mortises, reinforcement, anchorages, joining, welding, sleeving, exposed fasteners, openings and arrangement for hardware.
- .2 Include schedule identifying each unit with door marks and numbers relating to numbering on Contract Drawings and in door schedule. Indicate doors and frames to be fire rated.

## 1.5 QUALITY ASSURANCE

- .1 Perform Work in accordance with requirements by a member of the Canadian Steel Door and Frame Manufacturers Association.
- .2 Label and list fire rated doors and frames by an organization acceptable to authorities having jurisdiction and accredited by the Standards Council of Canada in conformance with CAN4-S104M and CAN4-S105M for ratings indicated, Labelling shall be in accordance with NFPA 80.

## 2 Products

### 2.1 ACCEPTABLE MANUFACTURERS

- .1 Baron Metal Industries Inc.
- .2 Daybar Industries Limited
- .3 Fleming Doors Products.
- .4 Vision Hollow Metal Ltd.

### 2.2 MATERIALS

- .1 General: All materials under Work of this Section, including but not limited to, primers are to have low VOC content limits.
- .2 Steel: ASTM A568/A568M, Class 1; Commercial grade steel, hot dip galvanized to ASTM A653/A653M, ZF120 galvanized coating.
- .3 Minimum base steel thickness:
  - .1 Frames 1.6 mm
  - .2 Typical doors 1.2 mm
  - .3 Lock/strike reinforcements 1.6 mm
  - .4 Hinge reinforcements 2.7 mm
  - .5 All other reinforcement 1.6 mm
  - .6 Top and bottom channels 1.2 mm
  - .7 Glazing stops 0.9 mm

- .8 Guard boxes 0.9 mm
- .9 Jamb spreaders 0.9 mm
- .4 Top caps and thermal breaks: CGSB 41-GP-19Ma; Rigid PVC extrusions.
- .5 Primer: CAN/CGSB 1.198.
- .6 Core material:
  - .1 Interior doors: Mineral fibre insulation with a minimum face density of 24 kg/m<sup>3</sup>.
  - .2 Exterior doors: Rigid poly/isocyanurate, closed cell insulation, 32 kg/m<sup>3</sup>, thermal value: RSI 1.9.
  - .3 Fire rated doors: Mineral fibre insulation to CAN/ULC S702, Type 1A; 24 kg/m<sup>3</sup>.
- .7 Screws: Stainless steel screws with countersunk flat head.
- .8 Door silencers: Type 6-180, black neoprene.
- .9 Frame anchors:
  - .1 Frames in masonry: 1.2 mm minimum, adjustable T-strap jamb anchors.
  - .2 Labelled frames: In accordance with ULC requirements.
- .10 Floor anchors: 1.6 mm minimum adjustable floor clip angles with 2 holes for anchorage to floor.
- .11 Labels for fire doors and door frame: Brass plate, riveted to door and door frame.
- .12 Glass and glazing: In accordance with Section 08 80 00.

## 2.3 **FABRICATION**

- .1 General
  - .1 Fabricate doors and frames in accordance with reviewed shop drawings.
  - .2 Welding: CSA W59-M to produce a finished unit with no visible seams or joints, square, true and free of distortion.
  - .3 Welding: Continuous unless specified otherwise. Execute welding by a firm fully acceptable to the Canadian Welding Bureau to requirements of CSA W47.1.
  - .4 Form profiles accurately to details shown on Contract Drawings.
  - .5 Ream and remove burrs from drilled and punched holes.
  - .6 Grind welded corners and joints to a flat plane and fill with metallic filler and sand to a uniform smooth finish. Apply one coat of primer.
  - .7 Provide weather strip for exterior doors in accordance with Section 08700 and door manufacturer.

- .2 Frames, windows, and screens:
  - .1 Fabricate frames of welded construction. Cut mitres and joints accurately and weld continuously on inside of frame profile. Exterior frames to be thermally broken.
  - .2 Construct large frame sections with provision for on Site assembly to suit Site conditions.
  - .3 Blank, reinforce, drill and tap frames for mortised, templated hardware. Protect mortised cut-outs with guard boxes.
  - .4 Reinforce frames where required for surface mounted hardware.
  - .5 Reinforce frames over 1200 mm wide with roll formed steel channels or hollow structural sections specified in Section 05 50 00 and as indicated on drawings.
  - .6 Furnish exterior door frames with a continuously welded integral steel weather drip at head of frame.
  - .7 Prepare each door opening for single stud rubber door silencers, 3 for single door openings located in strike jamb, and 2 for double door openings located in head.
  - .8 Install 2 channel or angle spreaders per frame, to ensure correct frame alignment. Install stiffener plates or spreaders between frame trim where required, to prevent bending of trim and to maintain alignment when setting in place.
  - .9 Form channel glazing stops minimum 16 mm height, accurately cut, mitred, fitted and fastened to frame sections with stainless steel counter-sunk, flat head screws spaced at maximum 450 mm throughout and 50 mm from each end.
- .3 Anchorage:
  - .1 Anchor units to floor and wall construction. Locate each wall anchor immediately above or below each hinge reinforcement on hinge jamb and directly opposite on strike jamb, minimum number of anchors for each jamb:
    - .1 Frames up to 2285 mm 3 anchors.
    - .2 Frames from 2285 mm to 2440 mm 4 anchors.
  - .2 Where frames are to be set in masonry or concrete, supply adjustable anchors to trade installing frame.
- .4 General Door Requirements:
  - .1 Hollow steel construction, flush swing type, of sizes to conform to details, schedules and reviewed shop drawings with provisions for cut-outs for glass and reinforced to receive hardware fastenings.
  - .2 Blank, reinforce, drill and tap doors for mortised, templated hardware. Where required, reinforce doors for surface mounted hardware and door closers.
  - .3 Reinforce oversized doors with steel channels and plates specified in Section 05 50 00 and as indicated on drawings.
  - .4 Where openings are required, form integral cut-outs with framing, glass stop moldings and division bars.
  - .5 Bevel both stiles of single doors 1 in 16.
  - .6 Reinforce doors with galvanized metal stiffeners at 150 mm o.c.

- .5 Interior Doors:
  - .1 Supply and install inverted, recessed, mechanically interlocked with tack welded channels at top and bottom of doors.
  - .2 Fabricate doors with joints between front and back panels meeting on stile edges. Make joints mechanically interlocked and tack welded for entire height of door. After welding has been completed, grind joints smooth to match metal. Ensure that no filler is used in joints.
  - .3 Fill hollow space within door and vertical stiffeners from top to bottom with mineral fibre batt insulation.
- .6 Exterior Doors:
  - .1 Supply and install inverted, recessed, mechanically interlocked with tack welded channels at top and bottom of doors. Supply and install PVC top caps.
  - .2 Fabricate doors with joints between front and back panels meeting on stile edges. Make joints mechanically interlocked and tack welded for entire height of door. After welding has been completed, grind joints smooth to match metal. Ensure that no filler is used in joints.
  - .3 Fill hollow space within door from top to bottom with rigid polyisocyanurate insulation.
- .7 Fire Rated Doors:
  - .1 Supply and install inverted, recessed, spot welded channels at top and bottom of doors. Supply and install steel flush top caps on exterior doors.
  - .2 Fabricate doors with joints between front and back panels meeting on stile edges. Make joints mechanically interlocked and tack welded for entire height of door. After welding has been completed, grind joints smooth to match metal. Ensure that no filler is used in joints.
  - .3 Fabricate doors to achieve fire rating as indicated on drawings and in accordance with ULC. Provide ULC label plate on door at hinged edge midway between top hinge and head of door.

3 Execution

3.1 **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.

3.2 **HOLLOW METAL DOOR, FRAME, WINDOW AND SCREEN INSTALLATION**

- .1 Install hollow metal doors, frames, windows, and screens plumb, square, level, secure, and at correct elevation.
- .2 Install doors clear of floor finishes, and with the correct rebate opening for the door installation. Install door silencers.

- .3 Secure anchorages and connections to adjacent construction. Brace frames rigidly in position while building-in. Remove temporary steel shipping jamb spreaders. Install wood spreaders at third points of frame rebate height to maintain frame width. Supply and install vertical supports as indicated on drawings for openings over 1200 mm in width. Remove wood spreaders after frames have been built-in.
- .4 Allow for structural deflection and prevent structural loads from being transmitted to hollow metal frames.
- .5 Touch-up areas where galvanized coating has been removed or damaged with primer.
- .6 Install fire rated doors and frames in accordance with requirements of NFPA 80.

### 3.3 **ADJUSTING AND CLEANING**

- .1 Adjust doors for smooth and balanced door movement.
- .2 Clean doors, frames and screens.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

- .1 Labour, Products, equipment and services necessary for the wood doors Work in accordance with the Contract Documents.

1.2 **REFERENCES**

- .1 ANSI A208.1, Particleboard.
- .2 AWMAC, Architectural Woodwork Manufacturers' Association of Canada. Quality Standards for Architectural Woodwork.
- .3 CSA O112 Series, Wood Adhesives.
- .4 CAN4 S104-M, Standard Method for Fire Tests of Door Assemblies.
- .5 CAN4 S105-M, Fire Door Frames.
- .6 NFPA 80, Standard for Fire Doors and Other Opening Protectives.

1.3 **SUBMITTALS**

- .1 Shop drawings: Submit shop drawings of wood doors in accordance with Section 01300 indicating detail thicknesses, core construction, veneers, finish, door sizes, quantities, fastenings and finishes.
- .2 Samples: Submit the following samples in accordance with Section 01300:
  - .1 Two minimum 300 x 300 mm door samples for each type of finish and cut-away corners showing construction and materials.

1.4 **QUALITY ASSURANCE**

- .1 Perform Work in accordance with requirements of AWMAC, Quality Standards for Architectural Woodwork, Premium Grade, except as indicated otherwise.
- .2 Label and list fire rated doors by an organization accredited by the Standards Council of Canada in conformance with CAN4 S104-M and CAN4 S105-M for ratings indicated.

1.5 **DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver, store, and handle wood doors in accordance with the AWMAC Quality Standards amended as follows:
  - .1 Wrap wood doors individually in protective wrapping for shipment and Site storage.
  - .2 Handle wood doors carefully to prevent damage; replace damaged doors.

- .3 Store doors flat on a dry, level surface. Ventilate and maintain recommended relative humidity before, during and after installation.

## 2 Products

### 2.1 MATERIALS

- .1 General: All materials under Work of this Section, including but not limited to, adhesives are to have low VOC content limits.
- .2 Wood doors (solid core):
  - .1 5 ply wood door: As manufactured by Lambton Doors.
  - .2 Core: To ANSI A208.1, minimum density 513 kg/m<sup>3</sup> minimum, sanded faces, of thickness to fill void. Extruded particle board cores (PC\_ Standard series with voids are not permitted.
  - .3 Rails:
    - .1 Top: 35 mm structural composite lumber.
    - .2 Bottom: 35 mm structural composite lumber.
  - .4 Stiles
    - .1 16 mm hardwood laminated to 19 mm structural composite lumber.
    - .2 Edge detail: AWMAC No.2.
  - .5 Crossbanding: 1.6 mm thick minimum wood-based composite.
  - .6 Door facing: 1.5 mm White Birch (rotary) veneer in **Lambton 'PLS-110'**
- .3 Wood doors (fire rated):
  - .1 'Fire Door' by Lambton Doors.
  - .2 Core: Fire rated mineral core.
  - .3 Internal blocking: AWMAC Option #3; Manufacturers' standard fire-resistant blocking.
  - .4 Rails:
    - .1 Top: 20 mm minimum.
    - .2 Bottom: 45 mm, 70 mm where drop seal occurs, minimum.
  - .5 Stiles:
    - .1 Hinge: 19 mm minimum.
    - .2 Lock: 19 mm minimum..
  - .6 Crossbanding: 1.5 mm thick HDF composite.
  - .7 Door facing: 1.5 mm White Birch (rotary) veneer in **Lambton 'PLS-110'**
- .4 Edge finish: To match door facings.
- .5 Adhesive: CSA O112 Series, Type I; Waterproof.
- .6 Grilles: Corrosion resistant steel with baked enamel finish. Model 61DG Series by Nailor Industries Inc or approved alternative by Hart and Cooley.
- .7 Door Frames:
  - .1 Metal door frames in accordance with Section 08 11 13.
  - .2 Wood door frames in accordance with Section 08 21 00.
- .8 Glass and glazing: In accordance with Section 08 80 00.



## **2.2 FABRICATION**

- .1 Fabricate doors to sizes indicated on drawings.
- .2 Fabricate doors square, true, and free from distortion waves, ridges or core ghost lines. Factory machine doors for finish hardware and flooring.
- .3 Fabricate doors using hot press construction technology. Bond stiles and rails to core using adhesive. Sand for uniform thickness. Laminate door facing and trim, to assembled core in hot press.
- .4 Cut and bevel stile edges as follows:
  - .1 Lock side: 3 mm in 50 mm.
  - .2 Hinge side: 1.5 mm in 50 mm.
- .5 Finish wood doors in factory and deliver to site ready for hanging.

## **2.3 FIRE RATED DOORS**

- .1 Fabricate and label fire rated wood doors with fire protection rating indicated on door schedule.

## **3 Execution**

### **3.1 INSTALLATION**

- .1 Install doors plumb, rigid, square, clear of floor finishes, and with correct rebate opening for door installation.
- .2 Conform to requirements of AWMAC Quality Standard, for wood door installation.

- .3 Install door grilles plumb and level, where indicated.

### 3.2 FIRE RATED DOORS

- .1 Install fire rated doors in accordance with the requirements of ULC and NFPA 80.

### 3.3 ADJUSTING AND CLEANING

- .1 Replace the following wood doors:
  - .1 Warped more than 3 mm, measured at any point on door, relative to perfectly flat surface.
  - .2 Core telegraphing visible at 1500 mm distance, under final Site lighting conditions.
- .2 Adjust doors for smooth and balanced door movement.

END OF SECTION

## PART 1. GENERAL

### 1.1 RELATED SECTIONS

- .1 Section 01 33 00 – Documents and samples to be submitted.
- .2 Section 01 74 21 – Construction and demolition waste management and disposal.
- .3 Section 01 78 00 – Documents and items to submit upon work completion.
- .4 Section 05 50 00 – Metalwork – Springs and rail brackets: Galvanized steel, type and dimensions that meet the installation requirements.
- .5 Section 08 80 50 – Glazing.
- .6 Section 16, with regards to power supply, connections and cables.

### 1.2 REFERENCES

- .1 The Aluminum Association Inc. (AA).
  - Aluminum Association Designation System for Aluminum Finishes-[DAF 45-03].
- .2 American Society for Testing and Materials International, (ASTM).
  - ASTM A1008/A1008M-[02e1], Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
  - ASTM D523-[99(R1999)], Test Method for Specular Gloss.
  - ASTM D822-[01], Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings.
  - ASTM C518-91, Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
  - ASTM A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - ASTM E283, Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
- .3 Canadian General Standards Board (CGSB).
  - CAN/CGSB-1.105-[M91], Quick Drying Primer.
  - CAN/CGSB-1.213-[95], Etch Primer (Pretreatment Coating) for Steel and Aluminum.
  - CAN/CGSB 1-1.181-[99], Ready-Mixed Organic Zinc-Rich Coating.
  - CAN/CGSB 51-GP-21M, Thermal Insulation, Urethane and Isocyanurate, Unfaced.
  - CAN/CGSB-51.26-M86, Thermal Insulation, Urethane and Isocyanurate, Boards, Faced.
- .4 Canadian Standards Association (CSA)/CSA International.
  - CAN/CSA-G164-M92 (C2003), Hot Dip Galvanizing of Irregularly Shaped Articles.

- .5 Environmental Choice Program  
(PCE). · CCD-016-[97], Thermal  
insulation. · CCD-047a-  
[98], Coatings, paints. · CCD-048-  
[95], Recycled water-borne surface  
coatings.

### 1.3 DESCRIPTION OF THE WORKS

#### .1 Design requirements

- Exterior doors and associated rails shall be designed to withstand a wind load of 1 kPa, with a deflection in the horizontal plane that does not exceed 1/240 of the width of the door opening.  
They shall be designed to comply with industry standards (DASMA).
- Sectional doors shall have a thermal resistance value (RSI) of 2.81, according to standard ASTM C-518-91.
- The doors and associated rails shall be designed to withstand at least 1 000 operating cycles per year and shall have a global lifetime of 10 years.

### 1.4 DOCUMENTS/SAMPLES TO SUBMIT

#### .1 Specification sheets

Submit the products specification sheets and the manufacturer's data and documentation in accordance with Section 01 33 00.

#### .2 Shop Drawings

Submit the required shop drawings in accordance with Section 01 33 00 – Documents  
Samples to be submitted.

Shop drawings shall indicate: the door type, dimensions and service specifications; the materials; the type of operating mechanism; the location and details of the glazing; the details of hardware and accessories; and the required clearances and electrical connections.

#### .3 Submit the installation instructions provided by the manufacturer.

### 1.5 CLOSE OUT DOCUMENTS

- .1 As Built Shop Drawings & Literature.
- .2 Operation and maintenance manuals for the overhead doors as specified herein.

## 1.6 QUALITY ASSURANCE

- .1 Test reports: Submit test reports certifying that the products, materials and equipment comply with the physical characteristics and performance criteria laid down in the provisions.
- .2 Qualifications; Installation shall only be by an Authorized Garex Distributor in accordance with the manufactures as Built Shop Drawings and written instructions.

## PART 2. PRODUCTS

### 2.1 SECTIONAL OVERHEAD DOORS (FULL-VIEW ALUMINUM)

.1 "Standard of Acceptance", **Model GX-175-FV**, as manufactured by Garex Garage Doors. Garex is a Canadian Owned & Operated Company.

Contact : Louis Pouliot 418.744.3317 x 2226

. 2 Alternates will be considered provided they meet the minimum requirements within, and they are approved & accepted in writing prior to tender closing.

### 2.2 DOORS

- .1 The doors shall be manufactured with colour- BLACK ANODIZED Tubular aluminum rails c/w double end styles, double top & bottom rail.
- .2 Glazed panels: 3 mm tempered double-glazed sealed (18mm nominal thickness) units mounted on a stainless steel spacer. The glass is inserted into a colour matched PVC frame, eliminating the need for plastic glass retainer stops. The glass is inserted into a preassembled aluminum frame and the window unit is a integral part of the complete door assembly.
- .3 Kicks proof panels; made of two (2) rolled sheet steel by adhesive on plywood core. The kick proof panel is inserted into a colour matched PVC frame. The panel is inserted slide into a preassembled aluminum frame as a complete unit is a integral part of the complete door assembly.

### 2.3 WEATHERSTRIPPING

- .1 PVC weatherstripping, full width at the top and bottom of each section to ensure thermal break and airtightness according to standard ASTM E-283.
- .2 U-Shaped extruded neoprene weatherstripping (full width), to be installed in bottom extrusion of each door
- .3 Aluminum perimeter weatherseal c/w high quality vinyle to be on to installed on jambs to ensure a weathertight seal against the door face.

### 2.4 INDUSTRIAL HARDWARE

- .1 75mm (3in) in Track & Hardware, galvanized steel at 2.6mm (12guage) thick. Please reference the Architectural Drawings for hardware configuration.
- .2 Continuous angle, 2.75 mm (12 gauge) thick.

- .3 25mm (1in) Galvanized Solid Shaft c/w 50,000 cycle torsion springs, fitted with brackets in accordance with the manufacturers specifications
- .4 Adjustable top roller brackets : 2.6mm (12 guage) thick, galvanized steel.
- .5 75mm (1in) Rollers: Hardened steel, oil lubricated, free lateral movement, ball bearing,
- .6 Double End Hinges, 2.6mm (12 guage), galvanized steel hinges, galvanized steel, in accordance with the manufacturer's specification.
- .7 Aircraft cable, galvanized steel, in accordance with the manufacturer's specifications.
- .8 Reinforcing Struts : Doors 3708 mm and over shall be provided with horizontal reinforcing struts. In accordance with the manufactures specifications.
- .9 Precision bearing: High-quality ball bearing for doors over 300 kg (600lbs)
- .10 Pusher springs.

## 2.7 ELECTRIC OPERATOR

- .1 **Manaras Rapido RSI** Operators as shown on the drawings (**Model Rapido RSH**) . Speed Management Feature provides enhanced performance and speed with slow start & slow stop capabilities. The maximum door speed is 19.3 ips (average 12.4 ips) on the open & 12ips (average 9.4 ips) on the close.  
  
**Preferred Alternative for electric operator : PRO-HBHE 3/4HP 115V 1ph ARBRE 1-1/4 in., Bearing, Frein Solenoide.**
- .2 Jackshaft Operator : Manaras Opera industrial duty logic control type operator with on board radio receiver, model Rapido RSH (Model Rapido RSH ) to NEMA 1, shall be equipped with an adjustable friction clutch, time delay on reverse, solenoid brake, integral enclosure containing the control, floor level disconnect and emergency manual chain hoist with electrical interlock.
- .3 Provide Separate Control Panel complete step- up Transformer to achever 600 Volt power supply with OPEN/CLOSE/STOP Push Button Station.
- .4 Entrapment Protection : Provide two (2) only Thru- Beam Photoelectric Eyes per operator. Locate the Photoelectric Eyes at different heights to ensure that they will hit Emergency Vehicles.
- .5 Provide one (1) only 3 - Button Transmitter per door. Program each transmitter to operate all (3) doors.
- .6 Reversing Safety Edge : Provide Manaras Sensedge along the bottom edge of door to reverse on contact with an object. **Hose type pneumatic safety edges will not be accepted.** Power to the safety edge shall be supplied through reelite.
- .7 Spreader Bar : between the drive sprocket and shaft to sprocket to ensure that the drive chain stays taught

- .8 Electric motors, control devices, remote control stations with push buttons, relays and other electrical devices: CSA-approved.
- .9 Electrical power supply: 600 Volt, 3 Phase
- .10 Power Supply and fused disconnect located within 5'0 of the operator by Division 16. Wiring from the fused disconnect to the operator & low voltage wiring by the door contractor. Co-ordinate the location of the disconnect with the General Contractor & Door Contractor.

## **PART 3. EXECUTION**

### **3.1 EXAMINATION**

- .1 Prior to commencement of work, thoroughly examine opening frames and frame extensions to receive the doors and related components for installation. Ensure that the opening frames are square and plumb. Ensure that the floor is level and square to the building lines. So that the door will properly seal against the door and frame
- .2 Proceed with installation of the doors when site conditions are satisfactory for the installation.

### **3.2 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: Comply with the manufacturer's written requirements, recommendations and specifications, including technical bulletins and installation instructions provided in the product catalogs and on packaging cartons, as well as indications found on specification sheets.

### **3.3 INSTALLATION**

- .1 Install doors and related hardware parts according to the manufacturer's instructions.
- .2 Secure rails and door openers properly and fix the brackets to the load-bearing framework.
- .3 Touch up the areas where the galvanized finish has been damaged during assembly with primer.
- .4 Install electrical motors, control devices, control stations with push buttons, relays and other electrical equipment required for the operation of the doors.
- .5 Lubricate springs and adjust moving parts to ensure smooth operation of doors.
- .6 Adjust weatherstripping to ensure proper weathertightness.
- .7 Adjust doors to ensure smooth operation.

### 3.4 ADJUSTMANT AND CLEANING

- .1 Inspection of the doors and provide a complete operating test in the presence of the Owner and the Consultant prior to occupancy. Any defects noted shall be corrected immediately. Once the installation of doors is completed, clean the site to remove all dirt and debris resulting from construction work.
- .2 Remove all traces of paint, caulking, epoxy resin and filler. Clean the doors.
- .3 Clean glazing with a nonabrasive approved cleaning product.
- .4 When installation work is completed, removed from site all surplus materials, waste materials, tools and safety barriers.

**END OF SECTION**



1 General

1.1 **SECTION INCLUDES**

- .1 Design, labour, Products, tool, equipment and services necessary for Aluminum Work in accordance with the Contract Documents.

1.2 **REFERENCES**

- .1 AAMA 611, Voluntary Standards for Anodized Architectural Aluminum.
- .2 AAMA CW-10, Care and Handling of Architectural Aluminum from Shop to Site.
- .3 AAMA/WDMA/CSA 101/I.S.2/A440, Standard Specification for Windows, Doors, and Unit Skylights.
- .4 ANSI H35.1M, Alloy and Temper Designation Systems for Aluminum (Metric).
- .5 ASTM A167, Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.
- .6 ASTM B209M, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .7 ASTM B221M, Specification for Aluminum-Alloy Extruded Bars, Rods, Wires, Profiles and Tubes.
- .8 ASTM C920, Specification for Elastomeric Joint Sealants.
- .9 ASTM E283, Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
- .10 ASTM E330, Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
- .11 ASTM E331, Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference.
- .12 ASTM F738M, Specification for Stainless Steel Metric Bolts, Screws, and Studs.
- .13 CAN/CGSB 1.108-M, Bituminous Solvent Type Paint.
- .14 CAN/CGSB-82.1-M, Sliding Doors.
- .15 CAN/ULC S702, Thermal Insulation, Mineral Fibre, for Buildings.
- .16 NFRC 100, Procedure for Determining Fenestration Product U-factors.

- .17 NFRC 200, Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence.

### 1.3 **DEFINITION(S)**

- .1 Aluminum Work: Shall mean aluminum curtainwall, entrances, vestibules, screens, doors, and framing mentioned in Part 2 of this Specification Section.

### 1.4 **DESIGN REQUIREMENTS**

- .1 Design Aluminum Work to meet requirements of AAMA/WDMA/CSA 101/I.S.2/A440, ASTM E283, ASTM E330, ASTM E331, NFRC 100, NFRC 200 and to meet performance and energy requirements specified herein and as required by authorities having jurisdiction.
- .2 Design Aluminum Work in accordance with following Climatic Design Data for the Municipality contained in the Ontario Building Code:
  - .1 Design temperature: January 1%, July 2 1/2%.
  - .2 Hourly wind pressures: 1 in 50 year occurrence.
- .3 Design Aluminum Work to accommodate following without producing detrimental effect:
  - .1 Cyclic 40 degree Celsius daily thermal swing of components.
  - .2 Cyclic, dynamic loading and release of loads such as wind loads.
  - .3 13 mm vertical deflection in supporting structure and movement of supporting structure due to live, dead load, and creep or deflections, seismic load, sway displacement and similar items.
- .4 Design complete aluminum window systems, including glazing, to meet the following performance criteria:
  - .1 Ontario Building Code SB-10 Requirements for Heated Conditioned Space Climate Zone based on project location.
- .5 Design complete aluminum entrance door systems, including glazing, to meet the following performance criteria:
  - .1 Ontario Building Code SB-10 Requirements for Heated Conditioned Space Climate Zone based on project location.
- .6 Design to prevent accumulation of condensate on interior side of Aluminum Work framing under the following service conditions:
  - .1 Interior temperature: 25 degree Celsius.
  - .2 Exterior temperature: -20 degree Celsius.
  - .3 Interior RH: 35%.

- .7 Design windows in accordance to AAMA/WDMA/CSA -101/I.S.2/ A440, to the following performance levels:
  - .1 Performance class: CW.
  - .2 Minimum performance grade (PG): 35.
  - .3 Minimum positive design pressure: 1680 Pa.
  - .4 Minimum negative design pressure: - 1680 Pa.
  - .5 Minimum water penetration test pressure: 290 Pa.
  - .6 Minimum air infiltration/exfiltration: A3.
  - .7 Condensation resistance: I57.
- .8 Restrict air infiltration/exfiltration, through Aluminum Work in accordance with ASTM E283 at pressure differential as indicated:
  - .1 Curtainwalls and entrance assemblies:  $0.0003 \text{ m}^3/\text{s m}^2$  at differential of 300 Pa.
  - .2 Doors (per door):  $2.78 \text{ m}^3/\text{h m}$  per linear metre of crack at differential of 75 Pa.
- .9 Design and detail controlled drainage path to actively discharge water, which enters into or forms within Aluminum Work, to exterior; prevent accumulation or storage of water within Aluminum Work. Prevent water from entering interior when tested in accordance with ASTM E331.
- .10 Design and detail air barrier, vapour retarder, and rainscreen products and assemblies into continuous and integrated Aluminum Work envelope. Optimize Aluminum Work design to align envelope layers and to minimize thermal bridges.
- .11 Prevent deflection and permanent or progressive glazing displacement. Restrict horizontal and vertical mullion deflection to less than  $L/175$  and 19 mm maximum for heights under 4115 mm and  $L/240$  and 25 mm maximum for heights over 4115 mm.
- .12 When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span in accordance with ASTM E330.
- .13 Design anchorage inserts for installation as part of other Sections of Work. Design anchorage assemblies to accommodate construction and installation tolerances.
- .14 Provide all reinforcing within aluminum members as required by design and OBC to provide structurally sound assembly. In any case, mullion size shall not be increased due to provision of reinforcing.
- .15 Design Aluminum Work and connections to substrate where the bottom of the Aluminum Work extends to a point below 1070 mm above finished floor level and separates a floor level from an adjacent interconnected space to withstand the required guard and handrail loads in accordance with the OBC and applicable local regulations. When requested by Consultant, provide a letter signed and sealed by a

Professional Engineer certifying that the Aluminum Work conforms to the OBC requirements.

- .16 Design operable windows within reach of occupants with limiting stops conforming to requirements of OBC.

## 1.5 SUBMITTALS

- .1 Shop drawings:
  - .1 Submit shop drawings in accordance with Section 01 33 00 indicating:
    - .1 Plans, sections, details, type of extrusions, profiles, finishes, panels, spandrels, operating components, doors, related flashings, closures, fillers, and end caps, and sealants.
    - .2 Products and glazing types.
    - .3 Anchorage inserts, system installation tolerances.
    - .4 Section and hardware reinforcement, anchorage, assembly fixings.
    - .5 Detailing, locations, and allowances for movement, expansion, contraction
    - .6 Path of cavity drainage and air pressure equalization.
- .2 Samples:
  - .1 Submit two samples of following in accordance with Section 01 33 00.
    - .1 250 mm long samples of each type of extrusion and finish.
    - .2 250 x 200 mm samples of insulating glass unit.
    - .3 One complete corner detail of door frame, glazing, and finish for each door type.
    - .4 Each door hardware item for Consultant's approval.
    - .5 250 x 200 mm sample of aluminum panel.
    - .6 200 x 200 mm sample of insect screen for operable windows for Consultant's approval of fibreglass mesh.
- .3 Reports:
  - .1 Submit substantiating engineering data, and independent test results of pre-tested, Aluminum Work to substantiate compliance with the design criteria including air leakage and water penetration conforming to ASTM E283 and ASTM E331.
  - .2 Submit documentation to substantiate ten years of experience in Aluminum Work manufacture and installation.
- .4 Close-out submittals: Submit Aluminum Work data for incorporation into the Operations and Maintenance Manual as part of Section 01 78 23.

1.6 **QUALITY ASSURANCE**

- .1 Retain a Professional Engineer, licensed in Province of Ontario, with experience in Aluminum Work of comparable complexity and scope to perform the following services as part of the Work of this Section:
  - .1 Design of Aluminum Work.
  - .2 Review, stamp, and sign shop drawings.
  - .3 Conduct on-Site inspections and prepare and submit inspection reports.
- .2 Mock-up:
  - .1 Fabricate, deliver, and erect one, full scale mock-up of each type of Aluminum Work, in location acceptable to Consultant.
  - .2 Demonstrate full range of Products, finishes, textures, quality of fabrication, and workmanship.
  - .3 Mock-up may form part of final Work, if acceptable to Consultant. Remove and dispose of mock-ups which do not form part of Work.

1.7 **DELIVERY, STORAGE, AND HANDLING**

- .1 Handle Aluminum Work in accordance with AAMA CW-10.
- .2 Protect aluminum surfaces with strippable coating. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather. Do not remove before final cleaning of building.

1.8 **EXTENDED WARRANTY**

- .1 Submit a extended warranty for Aluminum Work in accordance with General Conditions, except that warranty period is extended to 5 years.
  - .1 Warrant against failure to meet the design criteria and requirements such as interior leakage, insulating glass unit failure, finish degradation, frame condensation.
  - .2 Coverage: Complete replacement including affected adjacent Work.

2 **Products**

2.1 **ACCEPTABLE MANUFACTURER(S) AND SYSTEM(S)**

- .1 Curtain Wall: 'RainBlade by Alumicor Limited, or, approved alternative requires approval by Architect.  
Exterior Anodize Colour: Medium Bronze (28)  
Interior Anodize Colour: Light Bronze (75)
- .2 Operable Windows: 'Univent 1350-operable" by Alumicor Limited, or, approved alternative requires approval by Architect.  
Exterior Anodize Colour: Medium Bronze (28)  
Interior Anodize Colour: Light Bronze (75)

.3 Aluminum doors:

.1 Interior:

- .1 'Canadiana' by Alumicor Limited.  
Interior Anodize Colour: Light Bronze (75)

.2 Exterior:

- .1 'Therma Porte 7700' by Alumicor Limited.  
Exterior Anodize Colour: Medium Bronze (28)

Approved alternatives for interior and exterior doors requires approval by Architect.

2.2 **MATERIALS**

- .1 All materials under Work of this Section, including but not limited to, sealants are to have low VOC content limits.
- .2 Aluminum extrusions and channels: ASTM B221 and ANSI H35.1 AA6063 alloy, T6 temper.  
.1 Profile and dimensions: Refer to Contract Drawings.  
.2 Thermal breaks in frame members: Vertically aligned with glazing.
- .3 Aluminum sheet: ASTM B209 and ANSI H35.1 AA1100 aluminum alloy, H14 temper, minimum 1.29 mm for sheets less than 610 mm wide and minimum 2.05 mm for sheets of a greater dimension.
- .4 Reinforcements and anchors: ASTM A167, Type 304 to AISI No. 2B finish. Size as shown.
- .5 Glass and glazing materials: As specified in Section 08 80 00.
- .6 Spandrel panel airseal backpan: ASTM A653/A653M; 0.9 mm thick, Z275 galvanized steel sheet. To be primed as recommended by manufacturer and painted colour as selected by Consultant at a later date.
- .7 Airseal and Aluminum Work sealant: ASTM C920, Type S, Grade NS, Class 100/50; One-part, low-modulus, moisture-curing, silicone. 'Dow Corning 790' by Dow Corning; 'Spectrem 1' by Tremco. Verify compatibility with insulating glass unit manufacturer's secondary sealant. Colour as selected by Consultant. Primer as recommended by manufacturer.
- .8 Frame sealant: Type as recommended by the Aluminum Work manufacturer.
- .9 Joint backing: Closed cell foam polyethylene rod, outsized minimum 30-50% larger than joint width and compatible with joint sealant. Product as recommended by sealant manufacturer.

- .10 Airseal transition membrane: 'Soprseal Stick 1100' by Soprema Inc., 'Exoair 110' by Tremco or 'Air-Shield' by W.R. Meadows. Membrane to come complete with applicable primer.
- .11 Anchors, clips, and angles: Extruded aluminum or stainless steel.
- .12 Shims and blocking for frame: Rigid plastic, wood is not permitted.
- .13 Flashings, closures and trim: 1.0 mm minimum aluminum sheet, finish to match curtain wall extrusion finish.
- .14 Screws, bolts and other fasteners: ASTM F738M; Stainless Steel Type 304.
- .15 Isolation coating: CAN/CGSB-1.108-M; Bitumastic coating, acid and alkali resistant material.
- .16 Spandrel panel insulation: CAN/ULC S702; Semi-rigid mineral fibre.
  - .1 Type 703 by Owens-Corning.
  - .2 CurtainRock by Roxul Inc.
  - .3 Thickness: As required to fill void.
  - .4 Insulation fasteners: Stik-Clip with retaining washer.
- .17 Spray Foam Insulation: CFC free, polyurethane foam in place, closed cell low expansion, one component, minimum density 15 kg/m3.
  - .1 'ENERFOAM' by Dow Chemical Canada.
  - .2 'IPF All Weather Pro' by Rivenco Industries.
- .18 Door hardware: Manufacturer's standard heavy-duty hardware, based on the following:
  - .1 Hinging device: extruded aluminum continuous gear hinge or 1 1/2 pair of heavy-duty stainless-steel butts complete with back up plates.
  - .2 Closing device: LCN 4040 Series closers with back up plates.
  - .3 Pull handles: Alumicor 1180, 25 mm diameter, anodized aluminum offset pull handles. Finish same as door finish.
  - .4 Push bars (for doors without panic hardware): Alumicor 246, 25 mm diameter, anodized aluminum push bar. Finish same as door finish.
  - .5 Locking (basic locking): Adams Rite MS1850S Dead Lock with manufacturers standard cylinder on exterior and thumbturn on interior.
  - .6 Locking (panic hardware): Von Duprin 33/35A series rim panic (for all single doors) and Von Duprin 3547 vertical rod panic (for all double doors).
  - .7 Hold open devices (where required): Glynn Johnson GJ104S for door stop only applications. Finish: SP313- Dark Bronze;  
Glynn Johnson GJ104H Heavy Duty for applications that require both a stop and hold open. Finish: US 32D- Satin Stainless Steel

- .19 Insect screen (windows): Extruded aluminum frames containing heavy duty, fine fibreglass mesh in accordance with AAMA/WDMA/CSA 101/I.S.2/A440. Screen to be retained in place with turn clip type fixings. Provide samples for the Consultant's approval.
- .20 Weatherstripping: Durable, non-absorbing material resistant to deterioration by aging and weathering.

### 2.3 **FABRICATION**

- .1 Fabricate sections true to detail, free from defects impairing appearance, strength and durability. Fabricate extrusions with sharp, well defined corners.
- .2 Fabricate Aluminum Work in accordance with reviewed shop drawings and manufacturer's written instructions.
- .3 Fabricate, fit, and secure framing joints and corners accurately, with flush surfaces, and hairline joints. Apply frame sealant at joints for weatherproof seams.
- .4 Conceal anchors, reinforcement and attachments from view. Fabricate reinforcement in accordance with design requirements.
- .5 Do not expose manufacturer's identification labels on aluminum assemblies.
- .6 Fabricate continuous sill flashings with intermediate anchor clips, and joint reinforcing, form to profile shown. Fabricate filler and closure pieces as necessary for a complete and weather tight installation.
- .7 Certify aluminum windows as complying with the AAMA/WDMA/CSA 101/I.S.2/A440 design criteria and requirements using an easily removable label located on the inside face of glazing.
- .8 Position operable windows on main frame to provide direction of opening specified, free and smooth operation, without binding or sticking against main frame members.
- .9 Fabricate doors and frames complete with internal reinforcements, cut-outs, and recesses to accommodate finish hardware. Reinforce cut-outs to assure adequate strength.
- .10 Fabricate Aluminum Work closures and trim from aluminum sheet. Form to profile shown. Make weathertight.
- .11 Double weatherstrip doors. Install weatherstripping in specially extruded ports and secure to prevent shrinkage or movement.
- .12 Fabricate glazing recess with drainage to exterior.



**2.4 ALUMINUM DOORS**

- .1 Fabricate doors of welded construction.
- .2 Glazing stop: Aluminum, square, snap-on type, designed for glazing system.

**2.5 INFILL (SPANDREL) PANELS**

- .1 Fabricate insulated spandrel panel, inner facing of 20 gauge aluminum sheet. Wrap edges with aluminum sheet, enabling installation and minor movement of perimeter seal.
- .2 Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.
- .3 Place insulation within panel, adhered to exterior face of interior panel sheet over entire area of sheet with impale fasteners.
- .4 Provide integral reinforcing and stiffeners as required to reinforce panel against deflection caused by wind and suction loads.
- .5 Provide spacers as necessary to separate dissimilar metals.
- .6 Ventilate and pressure equalize the air space outside the exterior surface of the insulation, to the exterior.
- .7 Arrange fasteners and attachments to ensure concealment from view.
- .8 Glass panels: Consists of 6 mm thick spandrel glass to the exterior with insulated backpan to the inside. Insulation shall be 75 mm thick, retained with stick clips. Seal all joints in shop with high grade butyl sealant, including perimeter seal at backpan. Backpan to be primed and painted same colour as adjacent wall or colour as selected by Architect.
- .9 Metal panels: Consists of an exterior prefinished flush aluminum panel with panel stiffeners as required, to match colour of window framing, with 75 mm thick insulation core and galvanized sheet back-pan. Backpan to be primed and painted same colour as adjacent wall or colour as selected by Architect.

**2.6 FINISH**

- .1 Extrusion finish: Clear anodized to AAMA 611 per Aluminum Association Designation System for Aluminum Finishes AA-M12C22A31.
- .2 Doors: Clear anodized to AAMA 611 per Aluminum Association Designation System for Aluminum Finishes AA-M12C22A31.
- .3 Panel and sheet finish: As indicated on drawings to match adjacent extrusion finish.

3 Execution

3.1 **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.

3.2 **INSTALLATION**

- .1 Install Aluminum Work in accordance with reviewed shop drawings, manufacturer's instructions, AAMA/WDMA/CSA 101/I.S.2/A440 and to meet requirements of authorities having jurisdiction.
- .2 Install Aluminum Work in accordance with reviewed shop drawings and manufacturer's written instructions.
- .3 Install Work of this Section securely, in correct location, level, square, plumb, at proper elevations, free of warp or twist.
- .4 Apply isolation coating at 0.8 mm dry film thickness to prevent corrosive or electrolytic action between dissimilar materials such as aluminum to concrete, masonry, galvanized steel and similar conditions.
- .5 Install flashings, closures, and trim pieces.
- .6 Fill voids between aluminum framing and adjacent construction with foam insulation.
- .7 Install sills in maximum lengths possible. For sills over 1200 mm in length, maintain 3 mm to 6 mm space at each end.
- .8 Refer to Contract Drawings for glazing type locations. Install glazing in accordance with Section 08 80 00.
- .9 Spandrel panels:
  - .1 Set spandrel back pans to framing, apply sealant to cover screw heads to maintain air tight seal between back pans and framing.
  - .2 Adhere stick clips to metal back pans at 300 mm o.c. both ways. Apply insulation adhesive over entire surface of barrier and around clips held with adhesive.
  - .3 Cut insulation slightly over-size and press insulation boards firmly to barrier impaling them on clips without bending clips. Butt insulation boards tightly. install retainers to clips.

- .10 Automatic door operators to be supplied and installed by Section 08 71 13. Install doors and hardware to manufacturers' written instructions. Clean and adjust hardware for correct performance.
- .11 Install aluminum door manufacturer's standard weatherstripping at door frame perimeter. Install weatherstripping throughout entire length and width of doors at jambs and heads.
- .12 Install doors and hardware to manufacturers' written instructions. Clean and adjust hardware for correct performance.
- .13 Adjust operable parts for correct function.
- .14 Remove damaged or unacceptable Products and assemblies from Site and replace to Consultant's acceptance.
- .15 Install glass presence markers, in two cross stripes extending from diagonal corners. Maintain markers until final clean-up.

### **3.3 ERECTION TOLERANCES**

- .1 Tolerances: Non-cumulative.
  - .1 Maximum variation from plumb: 1.5 mm/3 m non-cumulative or 12 mm/30 m, whichever is less.
  - .2 Maximum misalignment of two adjoining members abutting in plane: 0.8 mm.
  - .3 Vertical and horizontal positions: +/- 3 mm.
  - .4 Racking of face: 6 mm, nil in elevation.
  - .5 Operable components: Consistent with smooth operation and weatherproof performance.
  - .6 Maximum perimeter sealant joint between Aluminum Work and adjacent construction: 13 mm.

**3.4 GLAZING PERIMETER AIRSEAL**

- .1 Install glazing perimeter airseal at entire perimeter of each insulating glass unit to achieve an airseal from insulating glass unit to curtain wall frame. Do not obstruct path of cavity drainage and air pressure equalization.
- .2 Perform sealant work in accordance with manufacturer's written requirements.

**3.5 AIRSEAL TRANSITION MEMBRANE**

- .1 Install primer and airseal transition membrane in accordance with manufacturer's instructions. Install airseal transition membrane into extrusion reglet as indicated on drawings. If there is no extrusion reglet, mechanically fasten airseal transition membrane to frame with batten bar fastened at 150 mm o.c.
- .2 Overlap airseal transition membrane 75 mm minimum and lap in direction of waterflow.
- .3 Coordinate airseal transition to adjacent parts of Work.

**3.6 JOINT BACKING AND ALUMINUM WORK SEALANT**

- .1 Prepare substrate surface and mask as recommended by sealant manufacturer.
- .2 Install joint backing and sealant at Aluminum Work and perimeter joints for weather tight installation in accordance with sealant manufacturer's instructions. Tool sealant. Remove excess sealant.

**3.7 FIELD QUALITY CONTROL**

- .1 Test sliding doors in accordance with ASTM E1105 for water penetration.
  - .1 Procedure A: test sliding door at 700 Pa, for uniform static air pressure difference for 15 minutes by applying water at a minimum rate of 3.4 L/m<sup>2</sup> minute.
  - .2 Procedure B: test sliding door at 700 Pa, for static air pressure difference for 4 cycles of 5 minutes each by applying water at a minimum rate of 3.4 L/m<sup>2</sup> minute.
  - .3 Failure criteria as per ASTM E1105.

**3.8            CLEANING**

- .1      Maintain Aluminum Work, inside and outside, in clean condition throughout construction period.
- .2      Remove labels, protective material, and glass presence markers from prefinished surfaces.
- .3      Remove AAMA/WDMA/CSA 101/I.S.2/A440 certification labelling when directed by Consultant, in writing.
- .4      Wash Aluminum Work with solution of mild detergent in warm water, with particular attention to recesses and corners.    Wipe surfaces clean and dry.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

- .1 Labour, Products, equipment and services necessary for finish hardware Work in accordance with the Contract Documents.

1.2 **REFERENCES**

- .1 BHMA, Builders Hardware Manufacturing Association.
- .2 NFPA 80, Standard for Fire Doors and Other Opening Protectives.

1.3 **SUBMITTALS**

- .1 Product data: Submit manufacturer's Product data in accordance with Section 01 33 00 indicating compliance with reference standards, transportation, storage, handling and installation requirements.
- .2 Shop Drawings:
  - .1 Submit Shop Drawings and 3 complete hardware lists in accordance with Section 01 33 00 indicating:
    - .1 Door locations, sizes, hardware manufacturer's catalogue numbers, finish symbols and quantities required.
    - .2 Locations and mounting heights of each type of hardware.
  - .2 Supply templates and required information to door and frame manufacturer to enable accurate sizes, locations of cut-outs and reinforcement for hardware.
  - .3 Submit templates to required trade to arrange for provisions for accurate setting and fitting of hardware.
- .3 Samples:
  - .1 Submit 2 samples in accordance with Section 01 33 00 of each item that is different from hardware specified and include manufacturer's parts lists and installation instructions.
  - .2 Submit hardware component samples illustrating style, colour and finish. Tag samples identifying applicable Specification article number, brand name and number, finish, building location, date and catalogue number.
  - .3 Do not order hardware until samples have been accepted. Submit new samples to replace rejected samples. Supply hardware and finishes identical to each accepted sample.
- .4 Closeout submittals:
  - .1 Submit the following in accordance with Section 01 78 23 for each Product for incorporation into Operation and Maintenance Manual:
    - .1 Maintenance data.
    - .2 Operating instructions and safety precautions.
    - .3 Parts list with name and address of supplier.
    - .4 Lubrication schedule and type of lubricant recommended.
    - .5 Keys, tools and special devices.

- .6 Inspection procedures related to preventive maintenance.

#### 1.4 **QUALITY ASSURANCE**

- .1 General:
  - .1 Manufacturers: Companies specializing in manufacturing door hardware and registered with BHMA.
  - .2 Hardware supplier: Company specializing in supplying commercial door hardware and acceptable to manufacturer.
- .2 Certifications:
  - .1 Employ an Architectural Hardware Consultant to inspect completed installation and certify that hardware has been installed in accordance with manufacturer's printed instructions, Authorities having Jurisdiction and as specified.
  - .2 Submit manufacturer's certificate that finish hardware and fire rated hardware meets specified requirements.

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

- .1 Be responsible for packaging of hardware, on a set by set basis. As material is received from various manufacturers identify it to correspond to Hardware List symbols.
- .2 Label packages legibly, indicating manufacturer's number, types, sizes, opening number and Hardware List reference number. Wrap hardware and include in package, screws, bolts and fastening necessary for correct installation. If hardware package is not complete, pay additional charges incurred by installer.
- .3 Deliver hardware to Site packaged, labelled and cross-referenced to hardware list for each item and its scheduled installation location.
- .4 Accept Products of this Section on Site and ensure that each item is undamaged.
- .5 Catalogue and store hardware in secure area.

#### 2 **Products**

##### 2.1 **GENERAL**

- .1 Aluminum door hardware: Supplied and installed under the Work of Section 08 44 00.

- .2 Carefully check and verify Hardware List against Contract Drawings to ensure that hardware listed can be used as specified. Inform Consultant of concerns regarding quality, quantity, operation or function of hardware selected:
  - .1 Verify hand of doors, examine details on Contract Drawings and at Site to ensure hardware supplied can be correctly installed and is correct for Work as constructed.
  - .2 Select hardware in accordance with applicable codes and regulations and to approval of local Fire Marshal.
  - .3 Replace and pay for defective hardware including hardware which was incorrectly selected, and remedial and installation costs.
- .3 Ensure that hardware selected will function correctly, meets Contract requirements and Ontario Building Code and authorities having jurisdiction.
- .4 Ensure that each hardware item is of same type, design and by same manufacturer.
- .5 Manufacturer's names or trademarks are not permitted on exposed surfaces of hardware.
- .6 Include in packing slip a list of parts, name of supplier and door number in which lock is to be installed.
- .7 Hardware for fire rated and labelled door and frame assemblies: ULC listed or as accepted by authorities having jurisdiction.
- .8 Fire rated assemblies:
  - .1 Hardware: Selected and installed in accordance with applicable codes and regulations, NFPA-80 and to approval of Ontario Fire Marshal.
  - .2 Fire rated doors: ULC labelled hardware. Submit written certification of conformance to ULC requirements for each type of hardware prior to delivery.
  - .3 Locksets and latchsets on fire rated doors: 19 mm throw minimum.
- .9 Permanent Cores shall be provided by Royal Security Solutions, per the Municipality's Standards. General Contractor shall provide temporary construction cores for use during construction.

## **2.2 ACCESSORIES**

- .1 Items to be attached to masonry or concrete with expandable shields, lag screws, bolts or other fastening devices as required. Exposed screws: Stainless steel, Phillips or Robertson heads.

## **2.3 FINISHES**

- .1 Metal finishes: Free from defects, clean, unstained and of a uniform colour for each type of finish required. Exposed surfaces and anchors: Specified finish symbol of item.



3 Execution

3.1 **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.

3.2 **INSTALLATION**

- .1 Install hardware in accordance with reviewed Shop Drawings, manufacturer's installation instructions, and applicable Codes and regulations.
- .2 Install hardware in accordance with hardware templates.
- .3 Adjust fixed and operable hardware for correct clearances and function.
- .4 Mount hardware measured from finished floor to centre of hardware, unless indicated otherwise or required by Code:
  - .1 Top hinge: 250 mm from head of door to top.
  - .2 Bottom hinge: 265 mm from finished floor to bottom of hinge.
  - .3 Intermediate hinge: Equal distance between top and bottom hinge.
  - .4 Locksets, latchsets: 1000 mm.
  - .5 Panic device crossbar: 1000 mm.
  - .6 Push plates: 1100 mm to bottom of plates.
  - .7 Guard bars: 1100 mm.
  - .8 Door pulls: 1100 mm to bottom of pulls.
  - .9 Blank strike: 1450 mm.
  - .10 Blank fronts: 1450 mm.
- .5 Include for supply and installation of wiring for electric strikes from electrical junction box to electric strike hardware.
- .6 Locate door stops to contact doors 75 mm from latch edge.
- .7 Install hardware and trim square and plumb to doors.
- .8 Replace wrappings for hardware provided by manufacturer after installation.
- .9 Safeguard keys to keep them out of unauthorized hands, tag them with door number, and deliver them to person designated by Consultant at building completion.

3.3 **FIELD QUALITY CONTROL**

- .1 Have hardware inspected after installation by hardware supplier's representative, obtain certification in writing that hardware has been supplied and installed in accordance with Specifications and hardware manufacturer's instructions and is functioning correctly.

- .2 Inspect fire rated openings to ensure they are installed in compliance with NFPA 80 requirements and Authorities having Jurisdiction.
- .3 Test access control system and electrified hardware devices for proper operation. Verify electric door release hardware operates properly upon activation of fire alarm system.

#### 3.4 **ADJUSTING**

- .1 Verify under work of this Section, that installed hardware functions properly.
- .2 Adjust hardware so that latches and locks operate smoothly and without binding, and closers act positively with the least possible resistance in use. Lubricate hardware if required by manufacturer's instructions.
- .3 Adjust doors with self-closing devices or automatic closing devices for proper operation after the HVAC system is balanced and adjusted. Verify spring power of non-sized door closers is properly adjusted.

#### 3.5 **CLEANING**

- .1 Remove wrappings at completion of the Project and clean hardware in accordance with manufacturer's instructions.

#### 3.6 **HARDWARE SCHEDULE**

- .1 Hardware groups/schedule: To be prepared with direction from the Client/Municipality and to be paid under the "Cash Allowance".

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

- .1 Design, labour, Products, tool, equipment and services necessary for automatic door equipment work in accordance with the Contract Documents.

1.2 **REFERENCES**

- .1 ANSI/BHMA A156.19, Power Assist and Low-Energy Power-Operated Doors.

1.3 **DESIGN REQUIREMENTS**

- .1 Design handicap door system comprising of low energy power operator with touchless infrared sensor system as defined in ANSI/BHMA A156.19.
- .2 Design system operator to open if touchless infrared sensor system is activated. Actuated door shall open slowly to back check (80°) in 3 to 6 seconds and to full open position in 4 to 7 seconds. Door shall remain open for period set to suit requirements (period of 5 to 30 seconds). After time delay door shall close by spring in door operator from 90° to 10° in 3 to 6 seconds from 10° to fully closed in 1-1/2 to 2 seconds.

1.4 **SUBMITTALS**

- .1 Product data: Submit duplicate copies of manufacturer's Product data in accordance with Section 01 33 00 indicating performance criteria, compliance with appropriate reference standard(s), characteristics, limitations, trouble-shooting protocol, transportation, storage, handling and installation requirements.
- .2 Shop drawings: Submit shop drawings in accordance with Section 01 33 00 indicating all connections, attachments, reinforcing, anchorage and location of exposed fastenings.

1.5 **EXTENDED WARRANTY**

- .1 Submit an extended warranty for automatic door equipment in accordance with General Conditions, except that warranty period is extended to 2 years.
  - .1 Warrant against failure to meet design criteria and requirements.
  - .2 Coverage: Complete replacement including affected adjacent Work.

2 Products

2.1 **ACCEPTABLE MANUFACTURER(S) AND SYSTEM(S)**

- .1 Heavy Duty Door Operator: Design is based on self-contained, low pressure electro-hydraulic power. Operator to be as manufactured by one of the following:
  - .1 PowerSwing by Besam of Canada.
  - .2 Magic Force by Stanley Canada Inc.
  - .3 Senior/Middle/Astro Swing by Dor-O-Matic.
  - .4 ED700 by Dorma Automatics.
- .2 Door operating equipment shall be complete with electro mechanical motor gear box. Provide 3 position (off-on) switch. System shall operate between -30 deg C and 50 deg C.

2.2 **REQUIREMENTS**

- .1 Functional Requirements:
  - .1 Equipment shall be designed to operate swing doors up to weight of 100 kg.
  - .2 Opening Speed:
    - .1 Door shall be field adjusted to back check as required in Table 1 of ANSI/BHMA A156.19.
    - .2 Opening speed to fully open shall be 4 seconds or longer.
- .2 Hold Open: Door shall be field adjusted to remain fully open for not less than 5 seconds or more than 30 seconds.
- .3 Closing Speed:
  - .1 Doors shall be field adjusted to close 90° to 10° in 3 seconds or longer as required in Table 1 of ANSI/BHMA A156.19.
  - .2 Doors shall close from 10° to fully closed in not less than 1.5 seconds.
  - .3 Force required to prevent door from opening or closing shall not exceed 7 kg applied 25 mm from latch edge of door at any point in opening or closing cycle.
  - .4 During power failure, doors shall open with manual pressure not exceeding 11.3 kg at point 25 mm from latch edge of door.
  - .5 Doors shall be equipped with signs visible from either side, instructing user as to operation and function of door.
- .4 Requirements:
  - .1 Provide header complete with full housing, finish shall match door frame finish.
  - .2 Locations of automatic door operators to conform to requirements of the Ontario Building Code (OBC).
  - .3 Operator shall be activated by touchless infrared sensor as indicated.
  - .4 Switches shall bear universal handicap logo visible to all types of traffic.

3 Execution

3.1 **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.

3.2 **INSTALLATION**

- .1 Install automatic door operators, controls and accessories for doors indicated in accordance with reviewed shop drawings and manufacturer written instructions.
- .2 Installation of automatic door operators to be in accordance with requirements of the Ontario Building Code (OBC).
- .3 Doors shall operate manually as though equipped with manual door closers, without damage to automatic door components, in event of power failure or in event of power termination.
- .4 Co-ordinate this work with Section 08 44 00.
- .5 Power supply to each door operator and wiring shall be provided by Division 26 - Electrical. Make connections at operators and at control panel and supply and install each electrical work between operators and activating controls. Comply with requirements of Division 26 - Electrical. All wiring shall be concealed and where exposed shall be run in conduit. Location of exposed wiring shall be subject to Consultant's approval.

3.3 **ADJUSTMENT AND CLEANING**

- .1 Test and adjust operators and controls smooth and proper operation.
- .2 Upon completion of Work of this Section, remove from Site all debris, equipment and excess material resulting from Work of this Section.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

- .1 Design, labour, Products, equipment, tools, and services necessary for glass and glazing Work in accordance with the Contract Documents.

1.2 **REFERENCES**

- .1 ASTM C920, Specification for Elastomeric Joint Sealants.
- .2 ASTM D2240, Test Method for Rubber Property - Durometer Hardness.
- .3 CAN/CGSB-12.1-M, Tempered or Laminated Safety Glass.
- .4 CAN/CGSB-12.3-M, Flat, Clear Float Glass.
- .5 CAN/CGSB-12.8, Insulating Glass Units.
- .6 CAN/CGSB-12.9-M, Glass, Spandrel.
- .7 CAN/CGSB-12.11-M, Wired Safety Glass.
- .8 CAN/CGSB-12.20-M, Structural Design of Glass for Buildings.
- .9 Glass Association of North America (GANA) Glazing Manual.
- .10 NFPA 80, Standard for Fire Doors and Other Opening Protectives.

1.3 **DESIGN REQUIREMENTS**

- .1 Glass Design:
  - .1 Design glass using a probability of breakage of 8 lites per 1000 at the first application of design load.
  - .2 Design glass to CAN/CGSB-12.20-M. Perform stress analysis. Design units to accommodate live, dead, lateral, wind, seismic, handling, transportation, and erection loads.
  - .3 Perform a thermal stress analysis on each glass unit with Low-E coating and provide heat strengthening and/or tempered units as necessary to prevent thermal breakage.
  - .4 Perform a thermal stress analysis on each insulating thermal unit and provide heat strengthening and/or tempered units as necessary to prevent thermal breakage.
  - .5 Where required, design glazing units so as not to allow thermal stress fracture due to heat build-up behind insulating units.

- .2 Structural Glazing:
  - .1 Carry out design of structural silicone joints by rational analysis including all movements specified herein. Maximum stress shall not exceed 138 kPa (20 psi) in tension or shear for short term loading. Maximum stress in shear for long term loading due to the dead load of glass shall not exceed 7 kPa (1 psi) or the limit imposed by sealant manufacturer, whichever is less.
  - .2 The joint shall be essentially rectangular in shape and shall include no internal corners which could precipitate tearing or create high local stresses.
  - .3 Single Source Responsibility for Sealants, Gaskets and Other Glazing Accessories: In order to ensure consistent quality of performance, provide all glazing sealants and seals from a single manufacturer.
  - .4 Preconstruction Compatibility and Adhesion Testing: Submit to sealant manufacturer, samples of each glass, gasket, glazing accessory and glass-framing member that will contact or affect glazing sealants for compatibility and adhesion testing. Schedule submission of test samples to provide sufficient time for testing and analysis of results to prevent delay in the progress of work.
- .3 Limit glass deflection to flexural limit of glass with full recovery of glazing materials.
- .4 Utilize inner light of multiple light sealed units for continuity of air and vapour seal.

#### 1.4 SUBMITTALS

- .1 Shop drawings: Submit shop drawings in accordance with Section 01 33 00 for fabrication and erection of glazing elements indicating materials, thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.
- .2 Samples:
  - .1 Submit following samples in accordance with Section 01 33 00.
  - .2 Submit one sample of each type of glass.
    - .1 300 x 300 mm of each type of insulating glass unit, complete with each different Low-E coating.
    - .2 300 x 300 mm of each colour of spandrel glass.
- .3 Certificates: Submit manufacturer's certification that glass and glazing materials are compatible.
- .3 Submit compatibility and adhesion test reports from sealant manufacturer indicating that glazing materials were tested for compatibility and adhesion with glazing sealants. Include sealant manufacturer's interpretation of test results relative to sealant performance and recommendations for primers and substrate preparation needed for adhesion.
- .4 Compatibility test report from manufacturer of insulating glass edge sealant, indicating that glass edge sealants were tested for compatibility with other glazing materials including sealants, setting blocks, edge blocks and any other material that contacts or can affect the edge seal.

- .5 IGMA Compliance Audit: Submit in accordance with Section 01 78 23, a written certification of successful completion of a Compliance Audit within the last six months.

## 1.5 **QUALITY ASSURANCE**

- .1 Insulating glass unit fabricators shall be a certified member of the Insulating Glass Manufacturer's Alliance (IGMA). IGMA members must participate in the certification program and shall have successfully passed a Compliance Audit within the last six months.
- .2 Installers qualifications: Perform Work of this Section by a company that has a minimum of five years proven experience in the installation of glazing units of a similar size and nature.

## 1.6 **SITE CONDITIONS**

- .1 Glaze with compounds, sealants, or tapes only when glazing surfaces are at temperatures over 4 degrees Celsius, and when positive that no moisture is accumulating on them from rain, mist, or condensation.
- .2 When temperature of glazing surfaces is below 4 degrees Celsius, obtain from Consultant approval of glazing methods and protective measures which will be used during glazing operations.

## 1.7 **EXTENDED WARRANTY**

- .1 In accordance with Section 08 44 00.

## 2 **Products**

### 2.1 **ACCEPTABLE MANUFACTURERS**

- .1 Glass manufacturers:
  - .1 AGC Flat Glass.
  - .2 Cardinal Glass Industries.
  - .3 Guardian Industries.
  - .4 PPG Industries Ltd.
  - .5 Viracon Inc.
  - .6 Guardian Glass

### 2.2 **MATERIALS**

- .1 All materials under Work of this Section, including but not limited to, primers, coatings, sealers, sealants, adhesives and cleaners are to have low VOC content limits.
- .2 Float glass (**FGL**): CAN/CGSB-12.3-M; clear, glazing quality, minimum 6 mm thick. Clear or tinted as indicated. Heat strengthened as required.



- .3 Tempered glass (**TGL**): CAN/CGSB-12.1-M, Type 2, Class B, Category II, clear or colour as indicated in Low-E coating or opaque, minimum 6 mm thick or 4mm (dark gray) / 3mm (clear) thick for apparatus bay door lites.
- .4 Fire-lite glass (**FIGL**): ULC Standard CAN4-S104, S106, NFPA 80, 257, FireLite® as manufactured by Nippon Electric Glass Company, Ltd., 5 mm thick or as otherwise noted on Door Schedule, clear polished glass. 1 Hour Fire Resistance Rating Required
- .5 Spandrel glass (**SGL**): CAN/CGSB-12.9-M, 6 mm thick unless otherwise indicated, with water-based silicone emulsion coating applied to backside, 'Opaci-Coat 300' by ICD High Performance Coatings or approved alternative.  
Colour: #3 – 820 Harmony Grey
- .5 Tempered Low Iron Glass (**TLIGL**): Clear, glazing quality, minimum thicknesses as indicated, low iron content, tinted : 'Graylite II' by PPG, AGC, or Guardian Industries.
- .5 Low Iron Glass (**LIGL**): Clear, glazing quality, minimum thicknesses as indicated, low iron content, tinted: 'Graylite II' by PPG, AGC, or Guardian Industries.
- .6 Insulating glass units: To CAN/CGSB-12.8-M and IGMA requirements utilizing approved metallic stainless steel edge spacer. Dual seal with a PIB primary seal and silicone secondary seal.
- .7 Argon gas: 100% pure. Argon gas to be used to fill air space at all insulated glass units.
- .8 Low-E coating (Soft coat): High performance sputtered low-E coating. Provide insulating glass units with low-E coating edge deletion and low-E coating. Apply low-E coating to second surface unless otherwise indicated. 'Solarban 60' by PPG substrate. 4mm th. Where used in apparatus bay overhead doors.
- .9 Glazing types:
  - .1 **Type 1:** (Double glazing): **TLIGL** outside, air space, **LGIL** inside. Standard throughout unless noted otherwise. 25 mm overall thickness. With Low-E Coating
  - .2 **Type 2:** (Double glazing): **TGL** outside, air space, **TGL** inside. At exterior doors, thickness to suit alum. door manufacturer glazing width. With Low-E Coating
  - .3 **Type 3:** (Double glazing): **TGL** outside, air space, **TGL** inside. 4mm th. Panes. At exterior O/H doors. Thickness to suit O/H doors. With Low-E Coating
  - .3 **Type 4:** **FIGL** used at interior glass lites in fire-rated doors.
  - .4 **Type 5:** **SGL** where indicated.
  - .5 **Type 6:** **TGL** opaque 6mm thick (privacy glass) in Office Room(s) side-lites, or as noted on architectural drawings.
- .10 Glazing and rebate primers, sealants, sealers, and cleaners: Compatible with each other. Type as recommended by glass manufacturer.

- .11 Glazing sealant: Silicone sealant as recommended by glazing manufacturer. Verify compatibility with insulating glass unit secondary sealant.
- .12 Glazing Sealant (Structural Glazing):
  - .1 Silicone, One Part in accordance with ASTM C920, Type S or M, Grade NS, Class 25.
  - .2 Structural glazing tensile bead: 'Spectrem 2 Sealant' by Tremco or 'Dow 795' by Dow Corning.
  - .3 Structural glazing weather bead: 'Spectrem 2 Sealant' by Tremco or 'Dow 795' by Dow Corning.
  - .4 Structural glazing (factory glazed): Two-part, neutral cure silicone sealant, 'Proglaze II' by Tremco or 'Dow 983' by Dow Corning.
  - .5 Colour to be selected later by consultant.
- .13 Heel & toe bead: Silicone sealant as recommended by glazing manufacturer.
- .14 Glazing gasket: 'Visionstrip' by Tremco Ltd., extruded composite glazing seal, size as recommended by manufacturer.
- .15 Glazing tape: 'Polyshim II' glazing tape EPDM shim.
- .16 Glazing splines: EPDM or neoprene, extruded shape to suit glazing channel retaining slot, colour as selected.
- .17 Setting blocks (regular): EPDM, 80 - 90 Shore A durometer hardness to ASTM D2240, sized to suit glazing method, glass unit weight and area.
- .18 Setting Block (Structural Glazing): Silicone setting blocks with Shore, Type A durometer hardness of 85, plus or minus 5 to ASTM D2240, sized to suit glazing method, glass unit weight and area.
- .19 Edge blocks: EPDM, 60-70 Shore A Durometer hardness, sized with 3 mm clearance from glass edge and spanning glass thickness(es). Capable of withstanding weight of glass unit, self-adhesive on face.
- .20 Glass presence markers: Easily removable, non-residue depositing.
- .21 Screws, bolts and fasteners: Type 304 stainless steel.

## 2.3 **FABRICATION**

- .1 Verify glazing dimensions on Site.
- .2 Clearly label each glass lite with maker's name and glass type. Ensure labels are easily removable, non-residue depositing type. Do not remove labels until after Work is accepted by consultant.

- .3 Fabricate glazing not less than 3 mm smaller than rebate size in either dimension; allow for edge spacers, shims, and setting blocks as necessary.
- .4 Work shall have smooth finished surfaces free from distortion and defects detrimental to appearance and performance.
- .5 Carefully make and fit details. Take special care with exposed finished Work to produce a neat and correct appearance to the Consultant's acceptance.
- .6 Fabricate argon filled thermal units with air space filled minimum 90% with argon gas.

3 Execution

3.1 **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.
- .2 Verify that openings for glazing are correctly sized and within tolerance.
- .3 Verify that surfaces of glazing channels or recesses are clean, free of obstructions, and ready to receive glazing.

3.2 **PREPARATION**

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

3.3 **INSTALLATION**

- .1 Provide glazing in accordance with IGMA recommendations. Provide continuous contact between glazing tapes and gasket to the glazing.
- .2 Install glazing to the Work of Sections 08 11 13 and 08 44 00.
- .3 Provide neat, straight sight lines. Trim excess glazing material flush with top of stops and fixed leg of frames.
- .4 Remove protective coatings, glazing stops, clean rebate and glass contact surfaces with solvent, wipe dry.

- .5 Apply primer/sealer to contact surfaces, prior to glazing.
- .6 Apply glazing tape as per manufacturer's instructions including recommended corner sealant.
- .7 Use setting blocks at 1/4 points and spacers to centre glass unit in frame.
- .8 Install glazing in accordance with reviewed shop drawings and manufacturer's written instructions. Install glazing with full contact and adhesion at perimeter. Maintain edge clearance recommended by glass manufacturer.
- .9 Apply a continuous heel bead of sealant around perimeter of inboard lite of the sealed unit and the metal framing.
- .10 Re-install glazing stops ensuring continuous contact and rattle-free installation. Do not distort glass. Trim tape protruding more than 2 mm above stop.
- .11 Install glazing gasket in accordance with manufacturer's recommendations.
- .12 Do not cut or abrade tempered, heat treated, or coated glass.
- .13 Install glass presence markers in two cross stripes extending from diagonal corners. Maintain markers until final clean-up.
- .14 Remove, dispose of, and replace broken, cut, abraded glass, and defective glass including but not limited to production dimples, 'tiger-stripping', chips, cracks, etc.
- .15 Exterior glass: Glaze units with gasket on exterior side and glazing tape on interior side. Seal gap between glazing and stop with sealant to depth equal to bite of frame. Apply cap head of sealant along void between stop and glazing, to uniform line, flush with sight line. Tool or wipe sealant surface smooth.
- .16 Exterior glass (Structural Glazing): Glaze units in accordance with reviewed shop drawings and in accordance with manufacturer's written instructions.
- .17 Interior glass: Glaze interior glass using glazing gasket glazing tape.
- .18 Wire glass: Install wired glass in fire rated metal doors with 5 mm gap between glazing stops, in accordance with ULC and NFPA 80 requirements. Strike and point exposed joints between metal and glass.

3.4            **CLEANING**

- .1            Immediately remove sealant and compound droppings from finished surfaces.
- .2            Remove labels, protective material, and glass presence markers from prefinished surfaces.
- .3            Clean glass surfaces with cleaning agents and methods in accordance with Manufacturer's written instructions.

END OF SECTION

Thickness (inches)	Installation Angle (90° Vertical)	Transmittance UV %	Transmittance Visible %	Transmittance Total Solar %	Exterior Solar Reflectance %	Exterior Visible Reflectance %	Interior Visible Reflectance %	U-Value (Winter Nighttime) (Btu/hr*F)	U-Value(Summer Daytime) (Btu/hr*F)	Shading Coefficient (SC)	Solar Heat Gain Coefficient (SHGC)	Relative Heat Gain (RHG)	Light To Solar Gain (LSG)	Thermal Stress Risk (if annealed glass)
Graylite® II 6mm   Air (5%) / Argon (95%) Mix 1/2" (12.7mm)   Solarban® 60 on Clear 6mm (3)														
1 "	90	1	7	4	5	4	8	0.24	0.22	0.13	0.11	28.7	0.64	High



## Specifications



### Insulating Unit Construction

**Graylite® II 6mm | Air (5%) / Argon (95%) Mix 1/2" (12.7mm) | Solarban® 60 on Clear 6mm (3)**

**Outdoor Lite:** Graylite® II 6mm

**Indoor Lite:** Clear with a third surface Solarban® 60

**Vitro Approved Manufacturers/Where to Buy Vitro Products:** Vitro Certified™ Network

**Certification:** Vitro lite(s) are Cradle to Cradle certified by McDonough Braungart Design Chemistry, LLC (MBDC [www.mbdc.com](http://www.mbdc.com))

**Graylite® II:** Graylite® II tinted glass delivers a dark gray to black appearance and very low visible light transmittance.

**Solarban® 60:** Solarban® 60 glass is a mid-range MSVD solar control low-e glass. Though the coating is transparent (on clear or Starphire® Ultra-Clear glass), it can also be paired with, or applied directly on most Vitro tinted glasses in an insulating glass unit.

The results represent Center-of-Glass performance data based on ANSI/NFRC 100 and ANSI/NFRC 200 Environmental Design Conditions utilizing the LBNL Window 7.3 software program according to the procedures in ANSI/NFRC 100, ANSI/NFRC 200, and NFRC 300. Performance data is based on representative samples of factory production. Actual values may vary slightly due to variations in the production process. This data is to be used for comparison purposes and should not be considered a contract. For configurations that include diffuse components, performance results cannot be verified and should only be used as a general indication of performance. It is the recipient's responsibility to ensure the manufacturability of the above glazing configurations as well as evaluating appropriate design considerations such as wind and snow load analysis, thermal stress analysis, and local building code compliance. Vitro makes no warranty or guarantee as to the results obtained by the user and assumes no responsibility for the accuracy of the data from non-Vitro manufacturers utilized in the above simulations. Vitro recommends that a full size mock-up be reviewed under the specific job-site conditions and retain the mock-up as a basis of acceptable product.

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 Glass colors represented are approximate.

While Vitro has made a good faith effort to verify the reliability of this computer based tool, it may contain unknown programming errors that may result in incorrect results. The user is encouraged to use good judgment and report any questionable results to Vitro for evaluation. The applicability and subsequent results of data simulated by this tool will be compromised if the user fails to input the correct information. Vitro makes no warranty or guarantee as to the results obtained by the user of this tool and assumes no responsibility for the accuracy of the data from non-Vitro manufacturers available for simulations in this program.

1 General

1.1 **SECTION INCLUDES**

- .1 Design, labour, Products, equipment and services necessary for gypsum board Work.

1.2 **REFERENCES**

- .1 ASTM A653/A653M, Specification for Steel Sheet, Zinc-coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.
- .2 ASTM C475, Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
- .3 ASTM C645, Specification for Nonstructural Steel Framing Members.
- .4 ASTM C665, Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
- .5 ASTM C754, Specification for Steel Framing Members to Receive Screw-Attached Gypsum Board.
- .6 ASTM C834, Standard Specification for Latex Sealants.
- .7 ASTM C840, Specification for Application and Finishing of Gypsum Board.
- .8 ASTM C1002, Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
- .9 ASTM C1177, Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
- .10 ASTM C1178, Specification for Glass Mat Water-Resistant Gypsum Backing Board.
- .11 ASTM C1278, Specification for Fiber-Reinforced Gypsum Panel.
- .12 ASTM C1396, Specification for Gypsum Board.
- .13 ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials.

1.3 **DESIGN REQUIREMENTS**

- .1 Design ceiling suspension system in accordance with manufacturer's printed directions and ASTM C754.

- .2 Design ceiling system for adequate support of electrical fixtures as required by the current bulletin of the Electrical Safety Authority.
- .3 Design hanger anchor and entire suspension system static loading not to exceed 25% of their ultimate capacity including lighting fixture dead loads.
- .4 Design suspension system to support weight of mechanical and electrical items such as air handling boots and lighting fixtures, and with adequate support to allow rotation/relocation of light fixtures.
- .5 Design subframing as necessary to accommodate, and to circumvent, conflicts and interferences where ducts or other equipment prevent the regular spacing of hangers.
- .6 Design steel stud framing system for wall assemblies with a height greater than 3000 mm and those assemblies incorporating non-standard gypsum board assemblies including, but not limited to cement board.

#### 1.4 **REGULATORY REQUIREMENTS**

- .1 Provide fire separations and fire protection exactly as specified in test design specification that validates the specified rating. Verify that work specified in other Sections, as a part of the entire assembly, meets applicable validating test design specification.

#### 1.5 **SUBMITTALS**

- .1 Product data:
  - .1 Submit copies of manufacturer's Product data in accordance with Section 01 33 00 indicating:
    - .1 Performance criteria, compliance with appropriate reference standard, characteristics, and limitations.
    - .2 Product transportation, storage, handling and installation requirements.
- .2 Shop Drawings: Submit Shop Drawings in accordance with Section 01 33 00 indicating wall assemblies, suspension systems, adjacent construction, elevations, sections and details, dimensions, thickness, finishes and relationship to adjacent construction.
- .3 Certifications: Submit written certification stating that suspended ceiling system is designed for adequate support of electrical fixtures as required by the current bulletin of the Electrical Safety Authority.



1.6 **QUALITY ASSURANCE**

- .1 Qualifications: Execute the Work of this Section by skilled, qualified, and experienced workers trained in the installation of the Work of this Section.
- .2 Retain a Professional Engineer, licensed in Province of Ontario, with experience in Work of comparable complexity and scope, to perform following services as part of Work of this Section:
  - .1 Design of wall systems with height greater than 3000 mm and at non-standard gypsum board assemblies including, but not limited to, assemblies incorporating cement board.
  - .2 Design of suspended gypsum board assemblies.
  - .3 Review, stamp, and sign Shop Drawings and design calculations.
  - .4 Conduct shop and on-site inspections, prepare and submit written inspection reports verifying that this part of Work is in accordance with Contract Documents and reviewed Shop Drawings.

1.7 **SITE CONDITIONS**

- .1 Do not begin Work of this Section until:
  - .1 Mechanical and electrical Work above the ceiling is complete.
  - .2 Substrate and ambient temperature is above 15 degrees Celsius.
  - .3 Relative humidity is below 80 %.
  - .4 Ventilation is adequate to remove excess moisture.
- .2 Install temporary protection and facilities to maintain Product manufacturer's, and above specification, environmental requirements 24 h before, during, and 24 h after installation.

2 **Products**

2.1 **MATERIALS**

- .1 General: All materials under Work of this Section, including but not limited to, sealants, adhesives, and primers are to have low VOC content limits.
- .2 Steel framing: ASTM C754; ASTM A653/A653-M, Z275; cold rolled, galvanized steel sheet.
  - .1 Bailey Metal Products Limited.
  - .2 Corus Metal Profiles.
- .3 Steel studs and track runners: ASTM C645; Galvanized steel studs and runners, 32 mm wide x depth as indicated on Contract Drawings. Formed from galvanized steel sheet, thicknesses as follows:
  - .1 Studs less than 3000 mm: Minimum 0.53 mm (25 ga.).

- .2 Studs greater than 3000 mm and non-standard assemblies: Minimum 0.91 mm (20 ga.), unless stud thickness of greater thickness is required to accommodate intended condition.
- .3 Track runners and ancillary components to match stud thickness.
- .4 Main carrying channels: ASTM C645; Formed from galvanized steel sheet, 38 x 19 mm cold rolled, channels.
- .5 Resilient channel: ASTM C645; 0.5 mm thick galvanized metal, 57 mm wide x 12 mm deep for walls and ceiling to reduce sound transmission.
- .6 Furring channels: ASTM C645; Formed from galvanized steel sheet, 22 mm winged flange type, cold rolled.
- .7 Furring channels (hat type): ASTM C645; 0.5 mm base steel thickness, galvanized. 70 mm wide x 22 mm deep hat shaped channel.
- .8 Heavy duty furring channels: ASTM C645; 0.9 mm steel thickness, galvanized hat shaped channel with a wider and deeper size as required by manufacturers.
- .9 Hanger wires: 4.1 mm minimum diameter galvanized pencil rod.
- .10 Tie wire: 1.6 mm thick minimum diameter, soft annealed, galvanized steel wire.
- .11 Corner bead, casing bead, and special shapes: Formed from 0.6 mm thick minimum, galvanized steel sheet, designed to be concealed by joint compound.
- .12 Control joint strip: Roll formed from galvanized steel sheet, with a tape protected recess, 6 mm wide x 11 mm deep.
- .13 Screw fasteners: ASTM C1002 Type S; Corrosion resistant.
- .14 Concrete anchors: tie wire sleeve anchors, 'Redi-Drive Anchors' by ITW Red Head or approved alternative.
- .15 Acoustic/Fire insulation: ASTM C665, Paperless, semi-rigid, spun mineral fibre mats, of thickness as indicated on Contract Drawings, 'Sustainable Insulation, NoiseReducer' by CertainTeed, 'EcoTouch Quiet Zone Pink Fiberglas Acoustic Insulation' by Owens Corning Inc. or 'Roxul AFB' by Roxul Inc.
- .16 Acoustical sealant:
  - .1 Non-rated assemblies: ASTM C834; Acrylic, mould resistant sealant, paintable. 'Smoke and Acoustic Sealant CP506' by Hilti or approved alternative. Colour – White.
  - .2 Fire-rated assemblies: ASTM E84; Acrylic based firestop sealant, colour: red or white as selected by Consultant. 'Flexible Firestop Sealant CP606' by Hilti or approved alternative. Colour-Red.

- .17 Gypsum board: ASTM C1396; gypsum board 12.7 mm thick of maximum practical lengths to minimize end joints, unless indicated otherwise. Furnish Board by Certainteed Gypsum Canada, CGC Inc., or G-P Products.
- .18 Fire rated gypsum board: ASTM C1396; gypsum board 15.9 mm thick of maximum practical lengths to minimize end joints, unless indicated otherwise. Furnish Type X Board by Certainteed Gypsum Canada, CGC Inc., or G-P Products.
- .19 Moisture and mould resistant board: 12.7 mm thick of maximum practical lengths to minimize end joints, unless indicated otherwise; 'M2Tech Moisture and Mould Resistant' by Certainteed Gypsum Canada, 'Sheetrock Mold Tough' by CGC Inc. or 'DensArmor Plus High Performance Interior Panel' by G-P Products.
- .20 Tile Backer: Water resistant tile backer board meeting ASTM C1178 or ASTM C1278, thickness as indicated. 'Diamondback Tile Backer' by Certainteed Gypsum Canada, 'Fibrock Aqua-Tough Underlayment' by CGC Inc. or 'Dens Shield' by G-P Products.
- .21 Primer: Where indicated by board manufacturer, provide primer as required to achieve finishes as defined in ASTM C840.
- .22 Joint reinforcing tape:
  - .1 Standard gypsum board: ASTM C475; 50 mm wide x 0.25 mm thick, perforated paper, with chamfered edges.
  - .2 Moisture resistant and tile backer boards: ASTM C475; fibreglass mat joint tape as recommended by board manufacturer to suit location.
- .23 Bonding adhesive: Type for purpose intended and as recommended and approved by manufacturer.
- .24 Joint and patching compound: ASTM C475; Asbestos-free, supplied by manufacturer of gypsum board used.
- .25 Fast setting patching compound: ASTM C475; Asbestos-free, Sheetrock or Durabond by CGC Inc., 'Moisture and Mold Resistant Setting Compound with M2Tech' by Certainteed Gypsum Canada or approved alternative.
- .26 Access doors: Supplied by other Sections for installation as part of the Work of this Section.

3 Execution

3.1 **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.

3.2 **SUSPENSION FRAMING**

- .1 Install ceiling systems in accordance with reviewed Shop Drawings and manufacturer's written instructions.
- .2 Install hanger wires plumb and securely anchored to the building structural framing, independent of walls, pipes, ducts, and metal deck; install additional framing and hangers to bridge interference items.
- .3 Install hanger wires at 1200 mm maximum centres along carrying channels, not less than 25 mm, and not more than 150 mm from channel ends.
- .4 Install additional hangers at lighting fixture and ductwork locations. Do not attach hanger wires to mechanical or electrical equipment. Do not support mechanical and electrical fixtures and fitting on ceiling without the ceiling manufacturer's written acceptance.
- .5 Install main carrying channels transverse to structural framing members. Lap main carrying channels 200 mm minimum at splices and wire each end with two loops and prevent clustering or lining-up of splices.
- .6 Install furring channels at 400 mm o.c., not less than 25 mm, and not more than 150 mm from perimeter walls, at openings, at interruptions in ceiling continuity, and at change in plane. Install furring channels to a tolerance of 3 mm maximum in 3600 mm.
- .7 Install additional main carrying and furring channels to frame and to reinforce openings such as recessed lighting fixtures, access hatches, ceiling grilles, outlet boxes, ventilating outlets, and similar items.

3.3 **STEEL STUDS AND FURRING**

- .1 Install steel studs and furring in accordance with reviewed Shop Drawings and manufacturer's written instructions.
- .2 Install steel stud partitions to underside of structure unless indicated otherwise.
- .3 Install track runners at floors, ceilings, and underside of structure; align track runners accurately and secure to structure at 600 mm centres maximum.

- .4 Install double top track runner assembly to prevent the transmission of structural loads to steel studs.
- .5 Install steel studs vertically at 400 mm o.c., unless otherwise indicated, and not more than 50 mm from abutting walls, at openings, and at each side of corners. Install studs securely to track runners.
- .6 Schedule and coordinate steel framing installation with mechanical and electrical services installation.
- .7 Install full height, double studs at door and service openings, fastened together and stiffened back to the structure to prevent vibration when doors close.
- .8 Provide double studs boxed together at all openings, sill, head and jambs and at door jambs, fastened together and stiffened back to the structure to prevent vibration. At each opening exceeding 900 mm in width, double studs shall be 20 ga. extending to structure above, and adequately anchored at each end. Provide steel studs above and below openings spaced at 400 mm oc maximum. All metal stud partitions above doors and screens over 1220 mm wide shall be secured to structure over and reinforced with sway bracing to stabilize walls to prevent lateral movement.
- .9 Erect three studs at corner and intermediate intersections of partitions. Space 50 mm apart and brace together with wired 19 mm channels.
- .10 Stiffen partitions over 2440 mm high or 3000 mm long, or both, with horizontal bracing extended for full length of partitions. Provide one line of bracing in partitions. Space lines to provide equal unbraced panels. Provide bracing for portions of partitions over door openings in partitions over 3000 mm high, and bracing both above and below openings in partitions located no greater than 150 mm from top and bottom of opening, and extending two stud spaces beyond each edge of opening for both doors and windows. Wire tie or weld bracing to studs.
- .11 Frame control joints using back to back double studs at abutting structural elements, at dissimilar backup interface, at dissimilar walls and ceilings, at structural expansion and control joints, at door and other openings, and at 9000 mm maximum spacing in continuous runs. Install control joint strips and secure in place.
- .12 Install additional support framing at openings and cutouts for built-in equipment, upper cabinet support, access panels and similar items.

- .13 Attach to framing adequate steel reinforcing members or an 18 ga. steel stud mounted horizontally and notched around furring members to support the load of, and to withstand the withdrawal and shear forces imposed by, items installed upon the work of this Section. Such items include, but are not restricted to, coat hooks, washroom accessories, handrail anchors, rub rails, grab bars, guards, wall-hung cabinets and fitments, shelving, curtain and drape tracks; Owner supplied equipment; and minor mechanical and electrical work. Heavy mechanical and electrical equipment shall be self-supporting in Divisions 21, 22, 23 and 26.
- .14 Provide for support and incorporation of flush-mounted and recessed mechanical and electrical equipment and fixtures only after consultation and verification of methods with those performing the work of Divisions 21, 22, 23 and 26.
- .15 Install cross bracing in accordance with the steel stud manufacturer's recommendations.

#### 3.4 **FIRE RATED ASSEMBLIES**

- .1 Install Products in fire rated assemblies in strict accordance with applicable ULC tested and approved designs.
- .2 Stiffen fire rated walls over 3.66 m high, where linear length of wall is greater than 2.44 m between perpendicular wall supports, with diagonal bracing above the ceiling extending perpendicular to wall at a 45-degree angle to structure above. Locate diagonal bracing at maximum 2.44 m o.c.
- .3 Where double layers of gypsum board are shown, and required for fire rating, screw first layer to studs and furring and laminate the second layer to the first using joint filler as an adhesive. Stagger joints between first and second layers.

#### 3.5 **ACOUSTICAL INSULATION**

- .1 Install acoustic insulation in partitions, between steel studs, and as indicated on Contract Drawings and in accordance with the manufacturer's instructions. Fill stud cavities to full height of partitions and carefully cut and fit acoustic insulation around services and protrusions.

#### 3.6 **ACOUSTICAL SEALANT**

- .1 Install acoustical sealant to acoustically insulated partitions in accordance with the manufacturer's instructions and Contract Drawings.
- .2 Install acoustical sealant under floor runner track, at partition perimeter both sides and at openings, cut-outs, and penetrations, concealed from view in the final installation.

- .3 Install firestop fill material behind fire rated acoustical sealant and provide firestop identification tag.
- .4 Smooth acoustical sealant with trowel prior to skin forming.

**3.7 GYPSUM BOARD**

- .1 Comply with ASTM C840. Install gypsum board in accordance with reviewed Shop Drawings and manufacturer's written instructions.
- .2 Install gypsum board vertically or horizontally, whichever results in fewer end joints. Locate end joints over supporting members.
- .3 Install gypsum board in lightly butted contact at edges and ends and with 1.6 mm maximum open space between boards; do not force gypsum board into place. Do not install imperfect, damaged, or damp boards.
- .4 Install gypsum board butting paired tapered edge joints, and mill-cut or field-cut end joints; do not place tapered edges against cut edges or ends.
- .5 Install vertical joints minimum 300 mm from the jamb lines of openings and stagger vertical joints over different studs on opposite sides of partitions.
- .6 Do not locate joints within 200 mm of corners or openings, except where control joints occur at jamb lines or where openings occur adjacent to corners. Where necessary, place a single vertical joint over the centre of wide openings.
- .7 Install gypsum board over concrete and concrete masonry units with adhesive as recommended by gypsum board manufacturer where indicated on Drawings.
- .8 Cut, drill and patch gypsum board as may be necessary to accommodate the Work of other trades.
- .9 Fire Separations:
  - .1 Construct gypsum board assemblies, where located, in accordance with tested assemblies to obtain required or indicated fire rated assemblies. As a minimum fire separations shall consist of metal framing covered on both sides by fire-rated gypsum board.
  - .2 Install assemblies tightly to enclosing constructions to maintain integrity of the separations. Install casing beads at all perimeter edges.

### 3.8 CORNER, CASING BEADS AND TRIM

- .1 Corner reinforcing bead: Install along all external angles, erect plumb, level and with a minimum of joints. Secure with screws at 225 mm o.c. apply filler over flanges flush with nose of the bead and extending at least 75 mm onto surface of board each side of corner. When filler dries, apply a thin coat of topping cement and blend onto adjoining surfaces.
- .2 Casing bead: Install where wallboard butts against a surface having no trim concealing the juncture and where shown on drawings. Erect casing beads plumb or level, with minimum joints, and secure with screws at 300 mm o.c. apply filler over flange flush with bead and extending at least 75 mm onto surface of board. When dry, apply a thin coat of topping cement and blend onto adjoining surfaces.
- .3 Recess channels and trim: Install recess channels and special metal trim where shown. Secure to substrate. Provide casing beads full height on wallboard edges at recess channels and metal trim.

### 3.9 JOINT TAPING AND FINISHING

- .1 Install reinforcing tape and a minimum of 3 coats of joint compound over gypsum board joints, metal trim and accessories, and screw fasteners in accordance with the gypsum board manufacturer's instructions.
- .2 Fill gaps between, and any imperfections in, gypsum boards with joint compound, allow to dry, and sand smooth ready for painting.
- .3 Install finished gypsum board Work smooth, seamless, plumb, true, flush, and with square, plumb, and neat corners.
- .4 Finish gypsum board in accordance with ASTM C840 to the following grades:
  - .1 Level 0: No taping, finishing, or accessories required. Use above suspended ceilings and within other concealed spaces, unless the assembly is fire rated, sound rated, sound or smoke controlled, or unless the space serves as an air plenum.
  - .2 Level 1: At joints and interior angles embed tape in joint compound. Leave surface free of excess joint compound. Tool marks and ridges are acceptable. Use above suspended ceilings and within other concealed spaces if the gypsum board assembly is fire rated, sound rated, sound or smoke controlled, or the space serves as an air plenum.
  - .3 Level 2: At joints and interior angles embed tape in joint compound with one separate coat of joint compound applied over joints, angles, fastener heads, and accessories. Use for water resistant gypsum board indicated for use as a substrate for ceramic tile.



- .4 Level 3: At joints and interior angles embed tape in joint compound with two separate coats of joint compound applied over all joints, angles, fastener heads, and accessories. Apply joint compound smooth and free of tool marks and ridges. Use where heavy grade wall coverings are the final decoration.
- .5 Level 4: At joints and interior angles embed tape in joint compound with three separate coats of joint compound applied over all joints, angles, fastener heads, and accessories. Apply joint compound smooth and free of tool marks and ridges. Use for all locations except those indicated for other finish levels.
- .6 Level 5: At joints and interior angles embed tape in joint compound with three separate coats of joint compound applied over all joints, angles, fastener heads, and accessories. Apply a thin skim coat of joint compound, or a material manufactured especially for this purpose, to the entire surface. Leave surface smooth and free of tool marks and ridges. Use where semi-gloss or gloss finish coatings are the final decoration.

**3.10 ACCESS DOORS**

- .1 Install access doors, supplied as part of other parts of the Work, in accordance with manufacturer's written instructions.

**3.11 SITE TOLERANCES**

- .1 Install metal support systems to ensure that, within a tolerance of +3 mm and -1.5 mm for plaster thickness, finish surfaces will be flat within 3 mm under a 3 m straightedge, and with no variation greater than 1.5 mm in any running 300 mm, and that surface planes shall be within 3 mm of dimensioned location.

**3.12 REPAIR**

- .1 Make good cut-outs for services and other work, fill in defective joints, holes and other depressions with joint compound.
- .2 Make good defective work, and ensure that surfaces are smooth, evenly textured and within specified tolerances to receive finish treatments.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

- .1 Labour, Products, equipment and services necessary for tile Work in accordance with the Contract Documents.

1.2 **REFERENCES**

- .1 ANSI A108/A118/A136.1, Installation of Ceramic Tile.
- .2 ANSI A137.1, Specifications for Ceramic Tile.
- .3 ASTM C144, Specification for Aggregate for Masonry Mortar.
- .4 CAN/CSA A3000, Cementitious Materials Compendium.
- .5 CAN/CGSB 25.20, Surface Sealer for Floors.
- .6 TTMAC Specification Guide 09300 Tile Installation Manual.
- .7 TTMAC, Maintenance Guide.

1.3 **SUBMITTALS**

- .1 Product data:
  - .1 Submit copies of manufacturer's Product data in accordance with Section 01 33 00 indicating:
    - .1 Performance criteria, compliance with appropriate reference standard, characteristics, limitations and warranties.
    - .2 Product transportation, storage, handling and installation requirements.
- .2 Shop drawings:
  - .1 Submit shop drawings in accordance with Section 01 33 00 indicating:
    - .1 Tile layout, patterns, and colour arrangement.
    - .2 Perimeter conditions, junctions with dissimilar materials.
    - .3 Setting details.
- .3 Samples:
  - .1 Submit following sample panels in accordance with Section 01 33 00.
    - .1 Each colour, texture, size, and pattern of tile.
    - .2 Adhere tile samples to 400 x 400 x 12.5 mm thick cement board complete with selected grout colour in joints.

- .4 Certificates: Submit manufacturer's certificates stating that materials supplied are in accordance with this specification.
- .5 Closeout submittals: Submit recommended maintenance instructions and listing of recommended maintenance Products for incorporation into Operations and Maintenance Manuals in accordance with Section 01 78 23.

#### 1.4 **QUALITY ASSURANCE**

- .1 Perform Work of this Section by a company that is a member in good standing of the Terrazzo Tile and Marble Association of Canada with proven, acceptable experience on installations of similar complexity and scope.
- .2 Shower area system:
  - .1 All work related to the shower area system is to be carried out by a single Contractor who is to be responsible for the complete installation of the system from the concrete surface to the completed finished installation.
  - .2 This work is not to be divided to multiple contractors.

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

- .1 Deliver materials in adequate crates or containers with manufacturer=s name and product description clearly marked.
- .2 Handle and store tiles in a manner to avoid chipping, breakage or the instruction of foreign matter. Take precautions to protect the mortar and grout admixtures from freezing or from excessive heat.

#### 1.6 **SITE CONDITIONS**

- .1 Do not install Work of this Section outside of the following environmental ranges without the Consultant's and Product manufacturer's written acceptance:
  - .1 Ambient air and surface temperature: 15<sup>0</sup>C to 45<sup>0</sup>C.
  - .2 Precipitation: None.
- .2 Install temporary protection and facilities to maintain the Product manufacturer's, and specified, environmental requirements for 7 Days before, during, and 7 Days after installation.

#### 1.7 **MAINTENANCE**

- .1 Submit extra tile amounting to 5% of gross area covered, allowing proportionately for each pattern and type specified and which are part of the same Production run as installed Products. Store maintenance Products as directed by the Consultant.

1.8           **EXTENDED WARRANTY**

- .1       Submit a extended written warranty for shower area system in accordance with the General Conditions, except that warranty period is extended to 10 years.
    - .1       Warrant Work against water leakage and failure to perform.
    - .2       Coverage: Complete replacement including effected adjacent Work.
- 2           Products

2.1           **MATERIALS**

- .1       General: All materials under Work of this Section, including but not limited to, sealants, adhesives, and sealers are to have low VOC content limits.
- .2       Tile:
  - .1       To ANSI A137.1.
  - .2       Supply coves, caps, inside and outside corners and bullnose tile as required.
  - .3       Where unfinished tile edge is exposed, supply cap to Consultant=s selection.
  - .4       Refer to Room Finish Schedule for tile types.
- .3       Ceramic Tile Base: Cove base tile to match floor tile.
- .4       Ceramic Thresholds: Match floor tile, full width of door openings, at junction of ceramic tile and carpet and resilient floor materials.
- .5       Floor Divider Strip: Stainless steel edge, continuous at all exposed tile edges, depth as required to suit tile thickness. Schiene-E= by Schluter Systems or approved alternative.
- .6       Wall edge protection and tile cap: Aluminum edge protection with trapezoid-perforated anchoring leg and an anodized finish, continuous at all exposed tile edges, depth as required to suit tile thickness. >Jolly= by Schluter Systems or approved alternative.

2.2           **ACCESSORIES**

- .1       Cement: CAN/CSA A3000, Type GU.
- .2       Sand: ASTM C144.
- .3       Water: Potable and free of minerals and other contaminants which are detrimental to mortar and grout mixes.
- .4       Polymer additive: Keralastic by Mapei Inc or approved alternative by Flextile Ltd. or Laticrete International.
- .5       Thin-set mortar: 2 component to ANSI A108/A118/A136.1:

- .1 'Kerabond with Keralastic Latex Additive' by Mapei Inc. or approved alternative by Flextile Ltd. or Laticrete International unless otherwise recommended by grout manufacturer to suit tile size or application.
- .2 White coloured mortar shall be provided at appropriate tile types including, but not limited to; glass tile, light coloured marble, green marble and light coloured granite.
- .6 Primer: To meet specified requirements of adhesive manufacturer.
- .7 Cleaner: In accordance with TTMAC's requirements and as recommended by tile manufacturer.
- .8 Crack-isolation system: Flexible, thin, fabric-reinforced, peel and stick membrane meeting ANSI A118.12 cut into strips to suit joints. 'Mapeguard 2' by Mapei Inc., or approved alternative by Laticrete International Inc. Provide manufacturer approved primer.
- .9 Waterproof Membrane: Waterproof Membrane System made from black, cold-applied, self-curing, liquid rubber polymer and an integral reinforcing fabric. '9235 Waterproofing' by Laticrete International Inc. or approved alternative by Mapei Inc.
- .10 Shower area system: Provide the following system for use at shower areas as manufactured by Laticrete or Mapei Inc.:
  - .1 Adhesive: Polymer fortified, thin-set mortar complete with antimicrobials. '254 Platinum' by Laticrete.
  - .2 Mortar bed: Factory mixed blend of portland cement and aggregates with latex admixture '226 thick bed mortar with 3701 admixture' by Laticrete or approved alternative.
  - .3 Waterproofing: Single component, self curing liquid rubber polymer. 'Hydro Ban' by Laticrete.
  - .4 Finish: As indicated on Interior Design drawings or schedule.
  - .5 Epoxy grout: High performance sanded epoxy grout 'SpectraLOCK Pro Grout' by Laticrete in colour as selected by Consultant.
- .11 Grout: Polymer modified cement-based grouts exceeding 10,000 psi compressive strength. Power Grout by TEC or approved alternative. Grout colour: To be selected by the Consultant from the manufacturer's full colour range.
- .12 Sealer: CAN/CGSB-25.20, penetrating, type as recommended by tile manufacturer.
- .13 Joint backing: Round, closed cell, foam rod, oversized by 30% to 50%, Shore A hardness of 20, tensile strength 140 to 200 kPa.
- .14 Tile sealant: In accordance with Section 07 92 00.

2.3           **MIXES**

- .1    Levelling bed mix:
  - .1     1 part Portland cement.
  - .2     4 parts sand.
  - .3     1 part water (including polymer additive), adjusted for water content of sand.
  - .4     1/10 part polymer additive.

3            Execution

3.1          **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.

3.2          **SURFACE PREPARATION**

- .1    Clean and dry surfaces thoroughly. Remove oil, wax, grease, dust, dirt, paint, tar, primers, form release agents, curing compound, and other foreign material from substrate surfaces which may prevent or reduce adhesion.
- .2    Neutralize any trace of strong acids or alkali from the substrate.

3.3          **CONTROL JOINTS**

- .1    Provide control, expansion and isolation joints in accordance with TTMAC specification 301MJ and as indicated on drawings. Install in locations indicated on drawings and specified herein.
- .2    Continue control, construction, and cold joints in the structural substrate up through the tile finish, and align with mortar joints where possible. Review joint locations on Site with the Consultant.
- .3    Install joint widths to match grout joint widths, except where a minimum width is indicated.
- .4    Install control joints in the following typical locations:
  - .1     Aligned over changes in type of substrate.
  - .2     At the restraining perimeters such as walls and columns.
  - .3     Interior areas (not subject to sunlight): 6 mm minimum width, at 7320 mm o.c. maximum.
  - .4     Interior areas (subject to sunlight): 6 mm minimum width, at 3660 mm o.c. maximum.
  - .5     As indicated on the Contract Drawings.

- .5 Seal control joints in accordance with Section 07 92 00.

### 3.4 **LEVELLING BED**

- .1 Install a levelling bed on uneven substrate surfaces, level and plumb substrates in accordance with the following tolerances:
  - .1 Vertical surfaces: 3 mm in 2.4 m maximum .
  - .2 Horizontal surfaces: 6 mm in 3 m from finished levels of the surface, or better.
- .2 Clean structural substrate control joints and blow-clean with compressed air. Grout fill control joints flush to slab with levelling bed.

### 3.5 **SHOWER AREA SYSTEM**

- .1 Install "226" and "3701" by Laticrete mortar bed over "254" by Laticrete thin set adhesive on uneven substrate surfaces, level and plumb substrates in accordance with manufacturer's written instructions and having the following tolerances:
  - .1 Vertical surfaces: 3 mm in 2.4 m maximum.
  - .2 Horizontal surfaces: 6 mm in 3 m from finished levels of the surface, or better.
- .2 Provide slopes to drains as indicated on drawings.
- .3 Apply 'Hydro Ban' by Laticrete waterproofing with a spray applicator on prepared substrate to a total dry film thickness of 0.8 mm in accordance with manufacturer's printed directions. Carry up walls to 50 mm high.
- .4 Install finish materials after site inspection by manufacturer, ensuring that materials have been installed correctly and in accordance with manufacturers written instructions. Provide written inspection report verifying manufacturers warranty of system.
- .5 Apply 'SpectraLOCK Pro' by Laticrete grout for shower area system in accordance with epoxy grout manufacturer's directions to produce watertight, filled joints without voids, cracks and excess grout. Thoroughly compact and tool grout. Finish grout flush to edge thickness of tile and remove excess grout with soft burlap or sponge moistened with clean water.

### 3.6 **CRACK ISOLATION**

- .1 Apply crack-isolation system over shrinkage and non-structural hairline cracks and "spiderwebbing" cracks in structural concrete floor slabs or in concrete topping on structural concrete floor slabs.

- .2 Apply liberal coat of primer with brush or roller over cracks, slightly wider than width of membrane. Roll out enough membrane to cover crack; cut and imbed while liquid is wet. Roll membrane to ensure adhesion.

### 3.7 **WATERPROOFING MEMBRANE**

- .1 Apply with a trowel on prepared substrate to a total dry film thickness of 1.143 mm in accordance with manufacturer's printed directions. Carry up walls to 150 mm high.

### 3.8 **GENERAL INSTALLATION REQUIREMENTS**

- .1 Install tiles in accordance with manufacturer's instructions and TTMAC Specification Guide 09300 Tile Installation Manual. Manufacturer's installation instructions govern over TTMAC Installation Manual.
- .2 Lay out Work to produce a symmetrical pattern with minimum amount of cutting. Ensure cut tile at room perimeter and at joints is not less than 2 full sizes.
- .3 Install trim to be placed under tile in locations indicated on Drawings.
- .4 Set tiles in place and rap or beat with a beating block as necessary to ensure a proper bond and to level surface. Align tile for uniform joints and allow to set until firm. Clean excess mortar from surface of tile with a wet cloth or sponge while mortar is fresh.
- .5 Adjust joints between units uniform, plumb, straight, even, and true, with adjacent tile flush. Align grout joints in both directions unless indicated otherwise.
- .6 Align floor, base and wall grout joints.
- .7 Install tile accessory fittings for a complete and fully coordinated tile assembly.
- .8 Install wall tile full height unless indicated otherwise.
- .9 Do not place tile, trim, and accessories over control, expansion, or isolation joints. Stop materials in either side on joints and provide control, expansion and isolation joints as specified.
- .10 Cut and fit tile neatly around piping, fittings, joints, projections and around recesses items e.g. washroom accessories. Where surface mounted equipment and accessories are installed on tile surfaces, extend tile over surfaces. Cut edges smooth, even, and free from chipping; chipped and broken edges are not acceptable.
- .11 Do not proceed with grouting until minimum 48 hours after tile has set, to prevent displacement of tiles.



- .12 Apply grout in accordance with grout manufacturer's directions to produce watertight, filled joints without voids, cracks and excess grout. Thoroughly compact and tool floor grout. Finish grout flush to edge thickness of tile and remove excess grout with soft burlap or sponge moistened with clean water.

### 3.9 **CLEANING**

- .1 Clean off excess grout with soft burlap or sponge moistened with clean water.
- .2 Polish floor and wall tile after grout has cured in accordance with TTMAC recommendations in the Maintenance Guide; do not use acid for cleaning.
- .3 Apply 2 coats of sealer to floor tile in accordance with sealer manufacturer's printed directions.
- .4 Re-point joints after cleaning as required to eliminate imperfections, then re-clean as necessary. Avoid scratching tile surfaces.

### 3.10 **JOINT BACKING AND TILE SEALANT**

- .1 Install joint backing under sealant as necessary.
- .2 Install tile sealant around piping and fittings extending through tiled surfaces.
- .3 Seal tile control joints.
- .4 Seal internal tile to tile junctions. Tool to a smooth, flush surface, free from air bubbles and contamination.

### 3.11 **PROTECTION**

- .1 Prevent traffic over tiled areas, and protect tiled assemblies from weather, freezing, and water immersion, for 72 hours minimum, after final installation.
- .2 Prevent direct impact, vibration and heavy hammering on adjacent and opposite walls for 24 hours minimum, after final installation.
- .3 Cover work temporarily with building paper properly lapped and taped at joints until work has been approved by Consultant.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

- .1 Labour, Products, equipment, and services necessary for detectable/tactile tiles  
Work in accordance with the Contract Documents.

1.2 **REFERENCES**

- .1 ASTM C1028, Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method.
- .2 ISO 23599, Assistive Products for Blind and Vision-Impaired Persons - Tactile Walking Surface Indicators.

1.3 **DESIGN REQUIREMENTS**

- .1 Design detectable tile system conforming to ISO 23599.

1.4 **SUBMITTALS**

- .1 Product data:
  - .1 Submit copies of manufacturer's Product data in accordance with Section 01 33 00 indicating:
    - .1 Performance criteria, compliance with appropriate reference standard, characteristics, limitations, and warranties.
    - .2 Product transportation, storage, handling, and installation requirements.
  - .2 Shop drawings:
    - .1 Submit shop drawings in accordance with Section 01 33 00 indicating:
      - .1 Perimeter conditions, junctions with dissimilar materials.
      - .2 Setting details.
  - .3 Samples:
    - .1 Submit two 300 x 300 mm samples of each type of detectable/tactile warning surfaces in accordance with Section 01 33 00.
  - .4 Closeout submittals: Submit recommended maintenance instructions and listing of recommended maintenance Products for incorporation into Operations and Maintenance Manuals in accordance with Section 01 78 23.

1.5 **DELIVERY, STORAGE AND HANDLING**

- .1 Deliver materials in adequate crates or containers with manufacturer's name and product description clearly marked.

- .2 Handle and store tiles in a manner to avoid chipping or breakage. Take precautions to protect the adhesives from freezing or from excessive heat.

#### 1.6 **SITE CONDITIONS**

- .1 Do not install Work of this Section outside of the following environmental ranges without the Consultant's and Product manufacturer's written acceptance:
  - .1 Ambient air and surface temperature: Minimum 40°F.
  - .2 Precipitation: None.
- .2 Install temporary protection and facilities to maintain the Product manufacturers, and specified, environmental requirements for 7 Days before, during, and 7 Days after installation.

#### 1.7 **MAINTENANCE**

- .1 Submit extra tile amounting to 5% of gross area covered, allowing proportionately for each pattern and type specified and which are part of the same Production run as installed Products. Store maintenance Products as directed by the Consultant.

### 2 **Products**

#### 2.1 **MATERIALS**

- .1 All materials under Work of this Section, including but not limited to, sealants and adhesives are to have low VOC content limits.
- .2 Vitrified Polymer Composite (VPC) Tile: 5 mm thick epoxy polymer tiles with ultra violet stabilized coating employing aluminum oxide particles in truncated domes providing a slip resistance of not less than 0.80 to ASTM C1028. Tile shall incorporate an in-line pattern of truncated domes measuring nominal 5 mm high x 23 mm base diameter x 11 mm top diameter, spaced 60 mm o.c. diagonally and 42 mm side by side; "VPC Surface Applied Armor-Tile" as manufactured by Engineered Plastics Inc. or approved alternative in colour to be selected.
- .3 Fasteners: Colour matched, corrosion resistant, flat head drive anchor as recommended by tile Manufacturer.
- .4 Adhesive: Bonding adhesive 'Armor-Bond' by Engineered Plastics Inc. or approved alternative.
- .5 Sealant: 'Armor-Seal' by Engineered Plastics Inc. or approved alternative.

3 Execution

3.1 **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.

3.2 **PREPARATION**

- .1 Prepare substrate using steel aggregate blast method and vacuum substrate free of debris and dust.
- .2 Fill minor cracks and voids and prime surfaces in accordance with manufacturer's recommendations.
- .3 Project adjacent surfaces from damage resulting from this Work. Mask and/or cover adjacent surfaces, fixtures, and equipment as necessary.
- .4 Clean, prime and seal surfaces as recommended by detectable tile manufacturer.

3.3 **CAST-IN-PLACE INSTALLATION**

- .1 Install cast-in-place tile in accordance with manufacturers written instructions and in coordination with Division 3.
- .2 Ensure concrete has been poured and finished true and smooth to required dimensions and slope prior to tile placement.
- .3 Place tile into fresh concrete and tamp to ensure that top of domes are level to adjacent concrete. Do not step on tiles.
- .4 Provide a 9.5 mm radius edge around tile perimeter flush to field level while concrete is still workable.
- .5 Do not allow walking, leaning or external forces be placed on tile. Provide two suitable weights of 25 lb each placed on each tile as necessary to ensure solid contact of underside of tile to concrete.
- .6 Remove protective plastic wrap from tile following concrete curing stage, using a sharp knife, tight to concrete/tile interface. Concrete bleed under plastic can be removed with a soft brass wire brush without damage to the tile surface.

**3.4 CLEANING AND PROTECTION**

- .1 Clean tiles in accordance with manufacturer's written instructions.
- .2 Prevent traffic over new installed detectable tiles, and protect from weather, freezing, and water immersion, for 24 hours minimum, after final installation.
- .3 Cover work temporarily with plywood until work has been approved by Consultant.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

- .1 Design, labour, Products, equipment and services necessary for acoustical ceilings Work in accordance with the Contract Documents.

1.2 **REFERENCES**

- .1 ASTM A653/A653M, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .2 ASTM C635, Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
- .3 ASTM C636, Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.
- .4 ASTM C645, Specification for Non-Load Bearing (Axial) Steel Studs, Runners (Tracks), and Rigid Furring Channels for Screw Application of Gypsum Board.
- .5 ASTM E1264, Classification for Acoustical Ceiling Products.

1.3 **DESIGN REQUIREMENTS**

- .1 Design ceiling suspension systems in accordance with ASTM C636 and manufacturer's printed directions.
- .2 Design tile ceiling system for adequate support of electrical fixtures as required by the current bulletin of the Electrical Safety Authority. Acoustic panel system is not designed to carry the weight of electrical equipment.
- .3 Design hanger anchor and entire suspension system static loading not to exceed 25% of their ultimate capacity including lighting fixture dead loads.
- .4 Design tile suspension system to support weight of mechanical and electrical items such as air handling boots and lighting fixtures, and with adequate support to allow rotation/relocation of light fixtures. Acoustic panel system is not designed to carry the weight of mechanical and electrical equipment.
- .5 Design subframing as necessary to accommodate, to avoid conflicts and interferences where ducts or equipment prevent regular spacing of hangers.

1.4 **SUBMITTALS**

- .1 Shop drawings:
  - .1 Submit shop drawings in accordance with Section 01 33 00 indicating:
    - .1 Suspension system layout including hangers and supports for acoustic tile system.

- .2 Acoustic panel system including suspension system, hangers, supports and panel sizes and locations.
  - .3 Conditions at abutting, intersecting, and penetrating construction.
  - .4 Dimensioned locations of lighting fixtures, diffusers, sprinkler heads and other items that pierce the ceiling plane.
- .2 Samples:
- .1 Submit following samples in accordance with Section 01 33 00:
    - .1 One full-size sample of each type of tile panels to be used.
    - .2 One of each type of suspension system members.
- .3 Certificates: Submit written certification stating that suspended ceiling system is designed for adequate support of electrical fixtures as required by the current bulletin of the Electrical Safety Authority.

## 1.5 **QUALITY ASSURANCE**

- .1 Mock-up:
- .1 Construct one 10 m<sup>2</sup> mock-up for each type of ceiling system incorporating typical light fixture and other typical mechanical and electrical fixtures.
  - .2 Test the adequacy of the suspension system to support the fixtures without deflection of ceiling or failure of hanging wire anchorage. Supply copy of Test Results to Consultant.
  - .3 Change materials and installation methods if tests indicate proposed system is inadequate and re-test as necessary until system approved.
  - .4 Give early notice to Consultant and Mechanical and Electrical Trades and co-operate with them in selecting suitable location for sample ceiling and timing of installation and test.
  - .5 Do not commence general installation work until sample ceiling approved, then install ceiling to conform with approved samples.
  - .6 Mock-up may form part of final Work, if acceptable to Consultant. Remove and dispose of mock-ups which do not form part of Work.

## 1.6 **SITE CONDITIONS**

- .1 Do not install the Work of this Section until:
- .1 Mechanical and electrical Work above the ceiling is complete.
  - .2 Relative humidity is below 80 %.
  - .3 Ventilation is adequate to remove excess moisture.
  - .4 Areas are closed and protected against weather, and maintained at no less than 10 degrees C.
- .2 Install temporary protection and facilities to maintain Product manufacturer's, and above specification, environmental requirements 24 h before, during, and after installation.

1.7           **MAINTENANCE**

- .1       Submit extra acoustic ceilings amounting to 4% of gross ceiling area, allowing proportionately for each pattern and type specified to nearest full carton. Submit Products which are part of same production run as installed Products. Store maintenance Products as directed by consultant.

1.8           **DELIVERY, STORAGE AND HANDLING**

- .1       Transport, handle and store material in manner to prevent warp, twist, damage to panel edges and surfaces in accordance with Manufacturer's recommendations.
- .2       Any warped and/or damaged panels and trim shall be rejected and be replaced by new, straight, undamaged, and acceptable material at no cost to Owner.
- .3       Bent, twisted, or otherwise damaged Tee grid suspension components shall not be used under any circumstances. Replace such damaged items with new undamaged material at no additional cost to Owner.
- .4       Store material in warm, dry place away from water and the elements. Protect against undue loading stresses and shock.
- .5       All packaged material shall be delivered in original manufacturers wrappers and containers with labels and seals intact. All cartons shall bear U.L. label.

2            Products

2.1          **MATERIALS**

- .1       Galvanized steel sheet: ASTM A653/A653-M, Z275; cold rolled, galvanized steel sheet.
- .2       Main carrying channels: ASTM C645; Channels formed from galvanized steel sheet, 38 x 19 mm cold rolled.
- .3       Subframing: ASTM C645; Channels formed from galvanized steel sheet, dimensions and spans as required.
- .4       Hangers: 2.6 mm minimum diameter, galvanized steel wire.
- .5       Tie wire: 1.6 mm minimum diameter, soft annealed galvanized steel wire.
- .6       Concrete anchors: tie wire sleeve anchors, 'Redi-Drive Anchors' by ITW Red Head or approved alternative.
- .7       Wall mouldings and accessories, including but not limited to, corner caps, edge mouldings, panel hold over clip, metal closures, and trim. Finish and colour: same as main tees.



- .8 Exposed main, cross tees, and relocatable cross tees: ASTM C635, 38 mm high steel, bulb tee design double steel web, rectangular single spans without exceeding a deflection of 1/360 of the span. Splices to be integral and reversible; cross tee interlocking into main tee. Colour and finish: Manufacturer's standard white.
  - .1 Suspension system:
    - .1 'Prelude XL' 15/16" Exposed Tee by Armstrong World Industries Inc.
    - .2 'GWDX' 15/16" by CGC Inc.
    - .3 'EZ Stab Classic' 15/16" by Certainteed Architectural.
- .9 **See Ceiling Schedule on Architectural drawings A-222 through to A-225 for all ceiling material types, finishes and colours.**  
**Noted as types: C1, C2, C3, C4, C5, C7, C8, C9, C10, C11 & C12.**
- .10 Trim:
  - .1 Trim Channel: Extruded aluminum, alloy 6063.
  - .2 Hanging Clip: Commercial quality aluminum.
  - .3 T-Bar Connector Clip: Commercial quality aluminum.
  - .4 Splice Plate: Galvanized steel.
  - .5 Finish: Factory-applied baked polyester paint finish.
  - .6 'Axiom Knife Edge Trim' by Armstrong or approved alternative.
- .11 Wall mouldings: To match acoustical ceiling suspension system.

### 3 Execution

#### 3.1 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.

#### 3.2 SUSPENSION SYSTEM

- .1 Coordinate locations and openings of mechanical and electrical services support, and penetration through the acoustical ceilings. Coordinate field conditions, clearances, measurements, and mechanical and electrical services testing and commissioning, above the acoustical ceilings.
- .2 Install hanger wires plumb and securely anchored to the building structural framing, independent of walls, pipes, ducts, and metal deck; install additional framing and hangers to bridge interference items.
- .3 Install acoustical ceiling systems in accordance with manufacturer's written instructions, reviewed shop drawings, and ASTM C636, listed in order of precedence.
- .4 Install hanger wires at 1200 mm maximum centres along carrying channels, not less than 25 mm, and not more than 150 mm from channel ends.

- .5 Install additional hangers at lighting fixture and air distribution ductwork locations. Do not attach hanger wires to mechanical or electrical equipment. Do not support mechanical and electrical fixtures and fitting on ceiling without the ceiling manufacturer's written acceptance.
- .6 Install acoustical ceiling suspension system to a tolerance of 1:1200 of span and 0.4 mm maximum between adjacent metal members. Tolerances are not cumulative. Refer to Electrical Contract Drawings for fixture layout.
- .7 Do not bend or twist hangers as a means of levelling. Form double loops tightly and lock to prevent vertical movement or rotation within the loop.
- .8 Install edge moulding at intersection of ceiling and vertical surfaces.
- .9 Centre acoustical ceiling suspension systems on room axis; install equal border pieces. Install hangers onto the ends of main tee runners at not more than 150 mm from ends of runners, adjacent and perpendicular to walls.
- .10 Support the suspension system independently of walls, columns, ducts, pipes and conduits.
- .11 Install main runners in maximum available lengths. Layout joints in suspension members to avoid the perimeters of recessed fixtures. Lock grid members to form a rigid assembly. Install additional tee, suspension system framing around recessed fixtures, diffusers, grilles and other items for a complete assembly.

### **3.3 ACOUSTIC LAY-IN TILES**

- .1 Install acoustic tile in grid and trim system openings supported by bottom flanges of members. Provide special shapes and sizes to provide a complete installation by cutting tile to fit into openings. Fit tile moderately tight between upright legs of members.
- .2 Carefully cut and trim acoustic tiles to accommodate items piercing the finished ceiling plane.
- .3 Remove and replace acoustic tiles with broken edges, or damaged, marked, discoloured, soiled, or stained faces.

### **3.4 ADJUSTMENTS AND CLEANING**

- .1 Clean soiled or discoloured surfaces of exposed work on completion of work.
- .2 Replace components which are visibly damaged, marred or uncleanable.

END OF SECTION

## 1 GENERAL

### 1.1 GENERAL PROVISIONS

- .1 Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

### 1.2 DESCRIPTION OF WORK

- .1 **Work Included:** Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
  - i. Rubber Tile Flooring
  - ii. Substrate Preparation
- .2 **Related Work:** The following items are not included in this Section and are specified under the designated Sections:
  - iii. Section 03 30 00 CAST-IN-PLACE CONCRETE for concrete substrate; slab surface tolerances
  - iv. Section 06 10 00 ROUGH CARPENTRY for plywood substrate and surface tolerances
  - v. Section 09 69 00 ACCESS FLOORING for resilient floor covering for access panels
- .3 **References (Industry Standards):**
  - vi. ASTM International (ASTM):
    - a. ASTM D2047, Standard Test Method for Static Coefficient of Friction as Measured by the James Machine
    - b. ASTM E648, Standard Test Method for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source ASTM D2240, Standard Test Method for Rubber Property – Durometer Hardness
    - c. ASTM F970, Standard Test Method for Static Load Limit
    - d. ASTM F970 (Modified), Modified Test Method for Max weight Limit
    - e. ASTM F1515, Standard Test Method for Measuring Light Stability of Resilient Flooring by Color Change

- f. ASTM E90, Standard Test Method for Laboratory Measurement of Air-borne Sound Transmission Loss of Building Partitions and Elements
- g. ASTM E492, Standard Test Method for Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using the Tapping Machine
- h. ASTM E2179, Standard Test Method for Laboratory Measurement of the Effectiveness of Floor Coverings in Reducing Impact Sound Transmission Through Concrete Floors
- i. ASTM F710, Standard Practice for Preparing Concrete to Receive Resilient Flooring
- j. ASTM F1482, Standard Guide to Wood Underlayments products Available for Use Under Resilient Flooring
- k. ASTM F1869, Standard Test Method for Measuring Moisture Vapor Emissions Rate of Concrete Subfloor using Anhydrous Calcium Chloride
- l. ASTM F2170, Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs using in situ Probes.
- vii. **National Fire Protection Association (NFPA):**
  - a. NFPA 253, Test Method for Critical Radiant Flux of Floor Covering Systems Using a Radiant Energy Source

### 1.3 SUBMITTALS

- .1 **General:** Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures.
- .2 **Product Data:** Submit manufacturer's technical data sheet, care & maintenance document, submittal and/or warranty for each material and accessory proposed for use (available at [www.roppe.com](http://www.roppe.com)).
- .3 **Samples:** Submit representative samples of each product specified for verification, in manufacturer's standard size samples of each resilient product color, texture and pattern required.

1.4 **QUALITY ASSURANCE**

- .1 **Manufacturer Qualifications:** Provide resilient flooring materials manufactured in the United States of America by a firm with a minimum of 10 years' experience with resilient flooring materials of type equivalent to those specified.
  - i. Provide resilient flooring products, including wall base, accessories, and sub-floor preparation products from one manufacturer to ensure color matching and compatibility.
  - ii. Manufacturer shall be capable of providing technical training and technical field service representation.
- .2 **Installer Qualifications:** Installer must be professional, licensed, insured, and familiar with the resilient flooring material to be installed. Project Managers or Field Supervisors must be  
INSTALL (International Standards & Training Alliance) certified CFI (Certified Floor-covering Installers) Certified and/or an FCICA (The Flooring Contractors Association) CIM (Certified Installation Manager) for the requirements of the project.
- .3 **Sustainable Design Requirements:**
  - iii. Rubber Tile that has a published EPD.
  - iv. Rubber Tile that has a published HPD.
  - v. Rubber Tile and accessories that are easily cleaned and do not require coatings and stripping, or use chemicals that may be hazardous to human health.
  - vi. Rubber Tile is SCS FloorScore® Certified and meets California Specifications Section 01350.
  - vii. Rubber Tile manufactured in a Facility that is ISO 14001 Certified.
  - viii. Rubber Tile free of materials known to be teratogenic, mutagenic or carcinogenic including halogens, asbestos and chlorines.

1.5 **DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver materials in labeled packages. Store and handle in strict compliance with manufacturer's recommendations. Protect from damage due to weather, excessive temperatures, and construction operations.

- .2 Deliver materials sufficiently in advance of installation to condition materials to the required temperature for 48-hours prior to installation.

## 1.6 PROJECT CONDITIONS

- .1 Install Rubber Tile after other finishing operations, including painting, have been completed.
- .2 Maintain temperature at service levels and/or the ambient temperature must remain steady ( $\pm 10^{\circ}$  F) between  $65^{\circ}$  F and  $85^{\circ}$  F for at least 48-hours prior to, during and until substantial completion.
- .3 Maintain relative humidity at service levels, or between 40% and 65% RH.
- .4 Avoid conditions in which dew point causes condensation on the installation surface.

## 1.7 WARRANTY

- .5 Provide manufacturer's standard limited commercial warranty to cover manufacturing defects

## 2 PRODUCTS

### 2.1 MANUFACTURER

- .1 Basis-of-Design: Roppe Corporation | 1602 N Union St. | Fostoria, OH 44830 | P: (800) 537-9527
- .2 Substitutions: No substitutions permitted.

### 2.2 PRODUCTS

- .1 TUFLEX RUBBER TILE FLOORING- noted as RF-1 on the Architectural drawings:
  - i. Roppe Tuflex Spartus Rubber Tile Flooring can be used in interior or exterior applications.
  - ii. Roppe **Tuflex Spartus** Rubber Tile Flooring colour: 936 Dusk
  - iii. Roppe Tuflex Rubber Tile Flooring, Specify Dimensions: Interlocking:  $25 \frac{3}{4}"$  x  $25 \frac{3}{4}"$  x  $\frac{3}{8}"$  (9mm)
  - iv. Thickness:  $\frac{3}{8}"$  (9 mm)

- v. Surface Finish: Smooth
- vi. ASTM D2047, Static Coefficient of Friction; > 0.8
- vii. ASTM F648/NFPA 253, Critical Radiant Flux; Class 1, > 0.45 W/cm<sup>2</sup>
- viii. ASTM F970, Static Load Limit; Passes 250 PSI
- ix. ASTM F970, Modified Static Load Limit; Passes 1,000 PSI
- x. ASTM F1515, Light Stability: Passes  $\Delta E < 8$
- xi. ASTM E492, Acoustical (Impact Insulation Class) Impact; IIC 52 (6" concrete, no drop ceiling), 67 IIC (6" concrete, with drop ceiling).
- xii. ASTM E90, Acoustical (Sound Transmission Class) STC 52 (6" concrete, no drop ceiling), STC 63 (6" concrete, with drop ceiling)
- xiii. ASTM E2179, Effectiveness of Floor Covering;  $\Delta IIC$  22
- xiv. Tuflex Spartus Rubber Tile is free of PVC.
- xv. Tuflex Spartus Rubber Tile is Phthalate-free.
- xvi. Tuflex Spartus Rubber Tile has a documented EPD (Environmental Product Declaration).
- xvii. Tuflex Spartus Rubber Tile has a documented HPD (Health Product Declaration v2.1).
- xviii. Tuflex Spartus Rubber Tile can be viewed on mindfulMaterials website.
- xix. Tuflex Spartus Rubber Tile is manufactured in a facility that is ISO 14001:2015 Compliant.
- xx. Tuflex Spartus Rubber Tile is FloorScore Certified.
- xxi. Tuflex Spartus Rubber Tile contains no crumb rubber.
- xxii. Tuflex Spartus Rubber Tile is Red List Chemical free.
- xxiii. Tuflex Spartus Rubber Tile is made in the USA.
- xxiv. Tuflex Rubber Tile is 100% Recyclable using the Roppe Impact Program.
- xxv. Tuflex Spartus Rubber Tile is designed for a 'Circular Economy'.
- xxvi. Tuflex Spartus Rubber Tile carries a 10 year Limited Warranty when installed following the manufacturer's installation instructions and adhesive recommendations.

## **2.3 INSTALLATION AND MAINTENANCE MATERIALS**

- .1 Moisture Mitigation:** Moisture testing is required for all Tuflex Rubber Tile installations. Mitigation should be performed if results indicate high levels of moisture. Recommended Moisture Mitigation Product:
- i. Excelsior MM-100, Moisture Mitigation provided by Roppe
    - a. Unit Size: 2.5 Gallons
    - b. Coverage: 1000 square feet per unit with one coat
    - c. MM-100 is a water, solvent and VOC free, polyurethane-based moisture mitigation product used to treat concrete slabs with excessive moisture levels beyond what flooring adhesives allow.
    - d. MM-100 can block moisture up to 20 lbs. MVER or 99% RH.
    - e. MM-100 is a single component product, eliminating extensive mix times and concerns regarding pot life.
    - f. MM-100 does not require aggressive concrete preparation, such as shotblasting or diamond grinding.
    - g. MM-100 is not recommended as a moisture mitigation system over a non-porous substrate. The substrate should be porous as per ASTM F3191 with 90% of the original substrate exposed.
    - h. MM-100 is a two coat system that is incredibly easy to apply and does not require any specialized equipment, its excellent coverage rates also make it incredibly cost effective.
    - i. Despite being a two coat system, MM-100 is incredibly fast drying.
    - j. Flooring or subsequent coatings can be installed in less than two hours.
    - k. Backed by a 10 year material and labor warranty, MM-100 is a fast and easy solution for the moisture issues that commonly plague flooring installations.
- .2 Substrate Preparation Products:** Substrates should be prepared to properly receive the resilient flooring products being specified. Trowelable leveling and patching compounds that are latex-modified, Portland cement based or blended hydraulic cement based formulation. Recommended Substrate Preparation Products:
- ii. Excelsior NP-230, Non-Porous Substrate Primer provided by Roppe
    - a. Unit Size: 2.5 Gallons



- b. Coverage: 1000 Square Feet per unit with one coat
  - c. Used over MM-100 to promote adhesion of cementitious materials
  - d. Single component and fast drying to allow for quick and easy installation
  - e. Contains an aggregate to provide mechanical bond for cementitious materials
- iii. Excelsior CP-300, Cementitious Patch provided by Roppe
  - a. Unit Size: 10 lb. Unit
  - b. Coverage: 33 Square Feet per unit @ 1/8"
  - c. Doesn't require primer over porous substrates
  - d. Install flooring in as little as 30 minutes
- iv. Excelsior SU-310, Self-Leveling Underlayment provided by Roppe
  - a. Unit Size: 50 lb. Bag
  - b. 5500 PSI Compressive Strength after 28 days
  - c. Install flooring within 12 hours
  - d. Pumpable

**.3 Adhesives:** Adhesives should be selected based on the site conditions and use of the space being installed. Recommended Adhesive Products:

- v. Excelsior MS-700, Modified Silane Wet-Set Adhesive provided by Roppe
  - a. Unit Size: 3 Gallon
  - b. Coverage: 480-705 Square Feet per unit
  - c. Standard installations over porous and non-porous substrates
  - d. Excellent green grab
  - e. Hard set adhesive adding to dimensionally stable materials
  - f. Excellent sheer strength
  - g. Approved for Hill-Rom Beds
  - h. Superior bond strength
  - i. Great for environments with topical moisture
  - j. Great for exterior applications
  - k. Installation Limits, Indoor Installations only
    - (1) 95% RH, ASTM F2170
    - (2) 10 lbs. MVER, ASTM F1869

- vi. Excelsior EW-710, Epoxy Wet-Set Adhesive provided by Roppe
  - a. Unit Size: 1 Gallon
  - b. Coverage: 120 – 135 Square Feet per unit
  - c. Standard installations over porous and non-porous substrates
  - d. Excellent green grab
  - e. Hard set adhesive adding to dimensionally stable materials
  - f. Excellent sheer strength
  - g. Approved for Hill-Rom Beds
  - h. Superior bond strength
  - i. Great for environments with topical moisture
  - j. Great for exterior applications
  - k. Installation Limits, Indoor Installations only
    - (1) 90% RH, ASTM F2170
    - (2) 6 lbs. MVER, ASTM F1869
    - (3) 7-10 pH

**.4 Maintenance Materials:** Proper maintenance of the installation is critical to the long term performance of the flooring products being specified. Using the appropriate chemicals to maintain the product according to the environment in which it is specified is critical. Recommend maintenance products:

- vii. Excelsior NC-900, All Purpose Neutral Cleaner
  - a. For initial maintenance
- viii. Excelsior CM-910, Cleaner Maintainer
  - a. For initial and routine maintenance
- ix. Excelsior PF-960, Performance Finish provided by Roppe
  - a. For initial maintenance
- x. Excelsior PR-930, Performance Remover
  - a. For heavy cleaning and restorative maintenance

### 3 EXECUTION

#### 3.1 GENERAL

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**.1 General Contractor Responsibilities:**

- i. Supply a safe, climate controlled building and subfloor as detailed in Roppe Technical Data Sheets.
- ii. Ensure substrate meets the requirements of ASTM F710, Roppe Technical Data Sheets and Excelsior Technical Data Sheets.
- iii. Provide a secure storage area that is maintained permanently or temporarily at normal operating temperature and humidity conditions between 65° F and 85° F and between 40% and 65% relative humidity, for at least 48-hours prior to and during the application of the flooring, so the flooring contractor can acclimate the flooring materials per manufacturer's instructions.
- iv. Provide an installation area that is weather tight and maintained either permanently or temporarily at ambient service temperature and humidity. Normal operating temperature and humidity conditions are between 65° F and 85° F and between 40% and 65% relative humidity, for at least 48-hours prior to and during the application of the flooring per the manufacturer's instructions.
- v. Ensure areas with direct prolonged exposure to sunlight are protected with protective UVA/UVB restrictive coatings or films.
- vi. Areas of the flooring that are subject to direct sunlight through doors or windows should have them covered using blinds, curtains, cardboard or similar for the time of the installation and 72-hours after the installation to allow the adhesive to cure. Note: These areas should be installed using wet adhesives only.
- vii. Conduct initial maintenance prior to final usage per the Roppe Care & Maintenance Documents. Do not conduct initial maintenance until adhesive has cured per the adhesive technical data.

**.2 Flooring Contractor Responsibilities:**

- viii. Provide trained installers that are professional, licensed, insured and familiar with the resilient flooring material to be installed.
- ix. Ensure installers or installation teams meet one of the following requirements:
  - a. Have completed INSTALL (International Standards & Training Alliance) or CFI (Certified Floorcovering Installers) training programs and/or are certified by INSTALL or CFI.

- b. Are being supervised by Project Managers or Field Supervisors that are INSTALL (International Standards & Training Alliance) certified.
- c. CFI (Certified Floorcovering Installers) Certified and/or an FCICA (The Flooring Contractors Association) CIM (Certified Installation Manager).
- x. Follow all requirements in the appropriate Roppe and/or Excelsior Technical Data Sheets, Care & Maintenance Documents, Warranties and other technical documents or instructions.

### 3.2 EXAMINATION

- .1 **General:** Follow guidelines laid out in Division 01, Section 01 71 00 – Examination and Preparation, as well as Section 01 43 00 – Quality Assurance.
- .2 **Verification of Conditions:** Inspect all substrates to ensure they are clean, smooth, permanently dry, flat, and structurally sound. Confirm all areas are properly sealed and acclimated per manufacturer's requirements.
- .3 **Verification of Products:** In accordance with manufacturer's installation requirements, visually inspect material for size, color or visual defects prior to installing. Any material that is incorrect or visually defective shall not be installed.

### 3.3 SUBSTRATE PREPARATION

- .1 **General:** Follow guidelines laid out in Division 01, Section 01 71 00 – Examination and preparation. All work required, ensuring substrate or subfloor meets manufacturers' guidelines are the responsibility of the general contractor.
- .1 **Preparation:** Ensure substrate meets the requirements of ASTM F710 for concrete substrates and ASTM F1482 for wood substrates and/or Roppe Technical Data Sheets and Excelsior Technical Data Sheets.
  - i. Substrates must be free of visible water or moisture, dust, sealers, paint, sweeping compounds, curing compounds, residual adhesives and adhesive removers, concrete hardeners or densifiers, solvents, wax, oil, grease, asphalt, visible alkaline salts or excessive efflorescence, mold, mildew and any other extraneous coating, film, material or foreign matter.
  - ii. It is recommended that all substrates have a floor flatness of FF32 and/or flatness tolerance of 1/8" in 6' or 3/16" in 10'.

- iii. Acclimate all products to be used during the installation and the installation environment prior to installation according to the manufacturers written instructions

**.2 Concrete Substrates:**

- iv. **Moisture Testing:** Perform moisture testing per the manufacturer's recommendations to determine conditions, it is recommended to treat new and existing slabs a little bit different to ensure adequate conditions exist for installation.
  - a. New Slabs on all grade levels: it is recommended to perform ASTM F2170 Relative Humidity testing no more than a week prior to installation too determine the levels present and when to proceed with the installation.
  - b. Existing Slabs on all grade levels: in addition to ASTM F2170 testing, existing slabs that have previously had floor covering installed, must be tested to ASTM F1869 Calcium Chloride test kits to determine the MVER of the concrete.
- v. Mechanically remove contamination on the substrate that may cause damage to the flooring material, this includes paint, permanent and non-permanent markers, pens, crayons, etc. Leaving these on the substrate or marking with them on the back of the material could cause bleed through and damage the flooring.
- vi. Fill cracks, holes, depressions and irregularities in the substrate to prevent transferring through to the surface of the resilient flooring. Use a high-quality Portland cement based product such as Excelsior installation products provided by Roppe.
- vii. Do not install material over expansion joints.

**3.4 INSTALLATION**

- .1 General:** Follow all relevant guidelines detailed in Division 01, as well as flooring and adhesive manufacturer's technical data sheets.
- .2 Rubber Tile:** Install material in accordance with manufacturer's recommendations:
  - i. Select the appropriate adhesive for the application and job site conditions.

- ii. Install material according to directional arrows on the back of the material and do not reverse tiles.
- iii. Ensure material is rolled appropriately into the adhesive using a 100 lb. three section roller.

### 3.5 CLEANING & MAINTENANCE

- .1 **General:** Clean up installation area and sweep, dust or wipe material to remove any dirt, dust or debris.
- .2 **Initial Maintenance:** Conduct initial maintenance per the manufacturer's recommended procedures stated in the Maintenance Documents. All documentation is available upon request or from the Roppe website: [www.roppe.com](http://www.roppe.com) Excelsior Cleaning and Maintenance products are the recommended products for use. All can be found linked to the product on the Roppe website or at [www.excelsiorproducts.net](http://www.excelsiorproducts.net).
- .3 **Regular Maintenance:** Advise & train Owner on proper regular maintenance to be performed on regular intervals as needed. Insufficient cleaning will reduce the wear life of the flooring. The amount of maintenance depends directly upon the amount of dirt and particulates the floor is subjected to.

### 3.6 CLOSEOUT ACTIVITIES

- .1 **General:** Follow all federal, state and local requirements and Division 01 Section 01 76 00 – Protecting Installed Construction and Section 01 78 00 – Closeout Submittal requirements for these activities.
- .2 **Protection:** Protect newly installed material with construction grade paper or protective boards, such as Masonite or Ram Board, to protect material from damage by other trades. Be sure all construction debris is swept up and removed prior to the protective material being installed and does not get trapped underneath. Limit usage and foot traffic according to the adhesive's requirements. When moving appliances or heavy furniture, protect wall base from scuffing and tearing using temporary floor protection as well.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

- .1 Labour, Products, equipment, and services necessary for epoxy flooring Work in accordance with the Contract Drawings.

1.2 **SUBMITTALS**

- .1 Product data: Submit manufacturer's Product data in accordance with Section 01 33 00 indicating:
  - .1 Two copies of manufacturer's Product data on characteristics, performance criteria, and limitations.
  - .2 Preparation, installation requirements and techniques, Product storage, and handling criteria.
- .2 Samples: Submit duplicate samples of each type and colour of epoxy flooring mounted on 250 x 200 mm hardboard in accordance with Section 01 33 00.
- .3 Reports: Submit manufacturer's acceptance of substrate prior to installation in writing. Submit verification of moisture content of floor prior to installation.
- .4 Close-out submittals: Submit maintenance data for incorporation into Operations and Maintenance manuals.

1.3 **QUALITY ASSURANCE**

- .1 Perform Work of this Section by a company that has a minimum of five years proven experience in installations of a similar size and nature and that is approved by manufacturer. Submit to Consultant, applicator's current certificate of approval by the material manufacturer as proof of compliance.
- .2 Mock-up:
  - .1 Construct one 1 m<sup>2</sup> mock-up of each type and colour of epoxy flooring in location acceptable to Consultant.
  - .2 Arrange for Consultant's review and acceptance, allow 48 hours after acceptance before proceeding with Work.
  - .3 Mock-up may remain as part of Work if accepted by Consultant. Remove and dispose of mock-ups which do not form part of Work.
  - .4 Upon acceptance, mock-up shall serve as a minimum standard of quality for the balance of the work of this Section.
- .3 Pre-installation meetings: Arrange with manufacturer's representative and Consultant to inspect substrates, and to review installation procedures 48 hours in advance of installation.

#### 1.4 SITE CONDITIONS

- .1 Do not install the Work of this Section outside of the following environmental ranges without Product manufacturer's written acceptance:
  - .1 Ambient air and surface temperature: 15°C to 30°C.
  - .2 Relative Humidity: In accordance with manufacturers' requirements.
  - .3 When no dust is being raised.
  - .4 In well-ventilated and broom clean areas.
- .2 Do not apply epoxy flooring over materials that contain over 4% moisture.
- .3 Install temporary protection and facilities to maintain the Product manufacturers, and the above specification, environmental requirements for 24 hours before, during, and 24 h after installation.
- .4 Post do not enter and appropriate warning signs at conspicuous locations.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Package, seal and label each epoxy flooring material to show manufacturers and product name, and colour.
- .2 Store materials at site in an area specifically set aside for purpose that is locked, ventilated, and maintained at a minimum temperature of 16°C.
- .3 Ensure that health and fire regulations are complied with in storage area, and during handling and application.

#### 1.6 EXTENDED WARRANTY

- .1 At completion of this work, provide a signed Sealant and Waterproofing Association warranty to the Owner covering defects of workmanship and materials for a period of 2 years commencing from Contract Completion. Agree to make good promptly any defects which occur or become apparent within the warranty period in conjunction with the membrane manufacturer's warranty. Defects shall include but not be limited to leakage, deformation, and failure to stay in place. Coverage includes complete replacement including affected adjacent Work at no cost to Owner.

### 2 Products

#### 2.1 MATERIALS

- .1 General:
  - .1 All materials under Work of this Section, including but not limited to, primers and epoxy flooring are to have low VOC content limits.



- .2 Each material used in the application of each flooring system shall be as recommended or manufactured by the supplier of the flooring system.

- .2 Epoxy flooring: Apply to manufacturers recommended thickness.

Colours and finishes: As noted below;

Apparatus Bay Area and all other rooms: 'Stonclad GS' with Stonkote GS4 Topcoat and texture 3 as manufactured by Stonhard or approved alternative by BASF or Sika Construction. Colour: 'Silver Grey' field, with 'Yellow' vehicle guidelines and safety lines as noted on plans. Cover entire floor area for all rooms noted as EP-1 floor finish on the contract documents.

- .3 Primer: As recommended by manufacturer.

### 3 Execution

#### 3.1 EXAMINATION

- .1 Verify condition of previously installed Work upon which this Section depends. Report defects to Consultant. Commencement of Work means acceptance of existing conditions.
- .2 Verify that concrete floor has cured 28 days minimum, and that substrate is acceptable to epoxy manufacturer.
- .3 Test surfaces for moisture content to ensure that they are suitable for application.

#### 3.2 PREPARATION

- .1 Prepare substrate using steel aggregate blast method and vacuum substrate free of debris and dust.
- .2 Fill minor cracks and voids and prime surfaces in accordance with manufacturer's recommendations.
- .3 Protect adjacent surfaces from damage resulting from this Work. Mask and/or cover adjacent surfaces, fixtures, and equipment as necessary.
- .4 Fill open control joints, and other cracks and voids with material compatible with epoxy materials.
- .5 Clean prime and seal surfaces as recommended by epoxy manufacturer.

### 3.3 APPLICATION

- .1 Apply epoxy flooring in accordance with manufacturer's printed instructions. epoxy manufacturer shall supervise application.
- .2 Stop epoxy in a straight line on each side of control joints; fill space over expansion joint with a self-levelling, non-sag polyurethane sealant.
- .3 Apply epoxy with care to ensure that no laps, voids, or other marks or irregularities are visible, and with an appearance of uniform colour, sheen, and texture, all within limitations of materials and areas concerned.
- .4 Match colours and textures of approved samples.
- .5 Make clean true junctions with no visible overlap between adjoining applications of epoxy.
- .6 Chase edge of adjacent floor systems so that epoxy finishes flush with adjacent floor systems.
- .7 Provide 100 mm coved base at room perimeter and at built-in fitment locations. Form cove with 25 mm radius.

### 3.4 SITE TOLERANCES

- .1 Finish surfaces shall be level, or straight where sloped to drains, within a tolerance of 1.5 mm in 3 m, and shall not vary more than 0.8 mm in any running 300 mm.

### 3.5 REPAIR

- .1 Touch-up and refinish minor defective work. Refinish entire coated surface areas where finish is damaged or otherwise unacceptable.

### 3.6 CLEANING

- .1 Remove promptly as work progresses spilled or spattered materials from surfaces of work performed under other Sections. Clean floors on completion of work. Do not mark surfaces while removing.
- .2 Leave storage and mixing areas in same condition as equivalent spaces in project.

### 3.7 PROTECTION

- .1 Erect barriers to prevent the entry and presence of personnel not performing work of this Section during application of epoxy flooring, and for 48 hours following completion of application.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

- .1 Labour, Products, equipment and services necessary for carpet Work in accordance with the Contract Documents.

1.2 **REFERENCES**

- .1 Canadian Carpet Institute (CCI), Contract Carpet Manual, No. 001.
- .2 CGSB 4-GP-36M, Carpet Underlay, Fiber Type.
- .3 CAN/CGSB 4.155-M, Flammability of Soft Floor Covering.

1.3 **SUBMITTALS**

- .1 Product data:
  - .1 Submit two copies of manufacturer's Product data for each product specified in accordance with Section 01 33 00 indicating:
    - .1 Performance criteria, characteristics, and limitations.
    - .2 Product transportation, storage, handling, and installation requirements.
- .2 Shop drawings:
  - .1 Submit shop drawings in accordance with Section 01 33 00 indicating:
    - .1 Carpeted floor areas, carpet selection, pile direction, location and direction of seams, cross joints, and other details required by Consultant to clarify work.
- .3 Samples:
  - .1 Submit following samples in accordance with Section 01 33 00.
    - .1 Submit duplicate 300 mm square pieces of underpad, and carpet specified, 300 mm long pieces of carpet base and cap strip, 150 mm lengths of carpet gripper and binder bars and moulding.
- .4 Certification:
  - .1 Submit certification that carpet has been tested and passed the Indoor Air Quality (IAQ) Carpet Testing Program requirements of the Canadian Carpet Institute.
  - .2 Four weeks after Notification of Award, submit certification from carpet manufacturer that carpet has been ordered.
  - .3 Submit program parameters for recycling.
- .5 Closeout submittals: Submit maintenance and cleaning data for incorporation into Operations and Maintenance Manuals in accordance with Section 01 78 23.

#### 1.4 SITE CONDITIONS

- .1 Do not install Work of this Section when the ambient air and surface temperature is below 18°C or above 40°C without Consultant's and Product manufacturer's written acceptance.
- .2 Supply and install temporary protection and facilities to maintain Product manufacturer's, and above specified environmental requirements for 24 hours before, during, and 24 hours after installation.

#### 1.5 MAINTENANCE

- .1 Submit extra 3% each colour, pattern and type of flooring material required for maintenance use. Extra materials to be from same production run as installed materials and clearly labelled. Provide in one continuous full width roll. Store where directed.
- .2 Upon completion of the work of this Section, bundle and wrap all large remnant pieces of carpet remaining and store where directed by Consultant.

### 2 Products

#### 2.1 MATERIALS

- .1 General: All materials under Work of this Section, including but not limited to, adhesives are to have low VOC content limits.

- .2 Carpet tile: By Centura Tile:  
Series- Frazer  
Colour- 50216: Vandyke Brown  
Size- 19.68" x 19.68"

Refer to Interior Floor Finish Plan & Schedule on Architectural drawings A-216 through to A-220 for carpet tile areas noted as C-1.

- .3 Undercushion: CGSB 4-GP-36M, open cellular rubber reinforced with solid rubber particles bonded to fibreglass/cellulose backing forming a cushion of 6 mm thickness. Undercushion shall meet CAN/CGSB 4.155-M for flame spread and smoke density ratings. Undercushion shall be 'Duracushion' manufactured by Dura Undercushions Ltd. or approved alternative.
- .4 Seaming tape: Types recommended by carpet manufacturer for purpose intended.

- .5 Adhesive connectors (carpet tile): Pressure sensitive adhesive squares/circles for glue-free installation. 'Tac-Tile' by interface, 'Lok Dots' by Shaw Contract Group or approved alternative.
- .6 Binder bars: Anodized aluminum finish, self-gripping bar of type recommended by carpet manufacturer, in colour to match carpet selection.
- .7 Reducing edge strips, thresholds: Nitrile rubber plasticized vinyl, 80-95 Shore A Durometer, adhesive as recommended by manufacturer.
- .8 Carpet cap strip: extruded vinyl, No. 703 manufactured by Finercraft Plastic Products Inc., or approved alternative. Standard colour as selected by Consultant.
- .9 Carpet protection: Non-staining heavy duty kraft paper.
- .10 Concrete skim coat compound: High-performance, rapid-setting cement based skim coating compound. 'Ultra SkimCoat' by Mapei or approved alternative for filling minor voids and leveling existing substrate.

### 3 Execution

#### 3.1 **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.

#### 3.2 **PREPARATION**

- .1 Verify substrate surfaces are solid, free from surface water, dust, oil, grease, scaling or laitance, projections and other foreign matter detrimental to performance.
- .2 Repair depressions and cracks with latex base compound or water putty crack filler. Sweep and vacuum surfaces before laying carpet.
- .3 Pre-condition carpeting following manufacturer's printed instructions.
- .4 Install vinyl carpet cap strip for carpet base before proceeding with carpeting.

#### 3.3 **CARPET GRIPPERS AND BINDER BARS**

- .1 Install carpet grippers to conform to high and low spots in floor, using carpet gripper cement, concrete nails or other approved fastening device.
- .2 Use carpet grippers at walls and vertical surfaces; metal binder bars and mouldings at exposed carpet edges.

### 3.4 UNDERCUSHION INSTALLATION

- .1 Lay undercushion using minimum number of pieces. Secure undercushion to prevent shifting.
- .2 Butt edges firmly together. Lay up to edge of gripper and tape joints. Remove bubbles and slightly stretch.
- .3 Anchor undercushion at projections and where cut to contours.
- .4 Offset undercushion seams minimum 300mm from carpet seams.
- .5 Omit undercushion behind carpet on vertical surfaces.
- .6 Where undercushion is to be installed on or below grade slabs, lay polyethylene film over entire area. Lap joints minimum 150mm and tape to prevent shifting.

### 3.5 CARPET TILE INSTALLATION

- .1 Install floor carpet in accordance with pattern layout and reviewed shop drawings, manufacturer's printed instructions and in accordance with Contract Carpet Manual, Standard for Installation of Textile Floor covering Materials No. 001.
- .2 Cut and install carpet to fit tightly and neatly around perimeter of carpeted areas, around permanent fixtures and around projections through the floor.
- .3 Adhesive connector method:
  - .1 Perimeter tiles shall be cut net to wall, where perimeter tile does not extend to a surface for butting, perimeter tile shall be installed using adhesive.
  - .2 Lay anchor rows, placing adhesive connector at every joint.
  - .3 Install remaining carpet using step method and placing a adhesive connector at every corner.
- .4 Butt all carpet tiles to tight contact to make all joints as inconspicuous as possible.
- .5 Finish installation to present smooth wearing surface free from mis-alignment, lifting, burring and other faults.
- .6 Use material from same dye lot. Ensure colour, pattern, and texture match within any one visual area. Maintain constant pile direction.
- .7 Continue carpeting through passageways and extend carpet into recesses, such as closets, and under movable casework, equipment, and other movable items.
- .8 Terminate carpeting at centerline of door, in closed position, in openings where adjacent floor finish or colour is dissimilar.

**3.6            CLEANING AND PROTECTION**

- .1      Vacuum carpets clean immediately after completion of installation. Protect traffic areas.
- .2      Prohibit traffic on carpet until adhesive is cured.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

- .1 Labour, Products, equipment and services necessary for painting Work in accordance with the Contract Documents.

1.2 **REFERENCES**

- .1 CAN/CGSB 85.10, Protective Coatings for Metals.
- .2 CAN/CGSB-85.100, Painting.
- .3 Master Painters Institute (MPI), Painting Specification Manual.
- .4 SSPC Steel Structures Painting Council, Standards.

1.3 **SUBMITTALS**

- .1 Product data:
  - .1 Submit copies of manufacturer's Product data in accordance with Section 01 33 00 indicating:
    - .1 Performance criteria, compliance with appropriate reference standard, characteristics, limitations.
    - .2 Product transportation, storage, handling and installation requirements.
  - .2 Submit listing of manufacturer's Product types, Product codes, and Product names, number of coats, and dry film thicknesses, corresponding to each Painting Schedule code; submit listing minimum of 8 weeks before materials are required.
- .2 Samples:
  - .1 Submit following samples in accordance with Section 01 33 00.
    - .1 Three 300 x 150 mm drawdowns of each colour minimum 4 weeks before paints are required.
    - .2 Identify each sample with Contract number and title, colour reference, sheen, date, and name of applicator.
- .3 Certificates:
  - .1 Submit certification from paint manufacturer, on company letterhead, indicating each product proposed for use is Manufacture's premium grade, first line Product.
  - .2 Submit certified documentation to confirm each airless spray painter has minimum of 5 years' experience on applications of similar complexity and scope.
  - .3 Submit certified documentation to confirm each worker has Provincial Tradesman Qualification certificate of proficiency.



- .4 Reports:
  - .1 Submit written field inspection and test report results after each inspection.
  - .2 Submit Field Quality Control test result reports for alkali content, substrate moisture, and dry film thickness.
  - .3 Submit electronic moisture meter manufacturer's specifications including tolerances. Submit record of latest meter calibration to meet manufacturer's recommendations.

#### 1.4 **QUALITY ASSURANCE**

- .1 Finishing Work: Perform work to MPI requirements for premium grade.
- .2 Supervision: Have Work supervised by a full-time qualified foreperson who has 10 years minimum experience on Contracts of similar complexity and scope.
- .3 Mock-up:
  - .1 Construct three 4 m<sup>2</sup> mock-ups of different Paint Schedule code systems, selected by Consultant, in locations acceptable to Consultant to demonstrate installation workmanship, colour, and hiding power of Products.
  - .2 Obtain Consultant's acceptance in writing before proceeding with the Work of this Section.
  - .3 Mock-ups may remain as part of the Work if acceptable to Consultant and will serve as a standard for similar code systems.
  - .4 Repaint over mock-ups which do not form part of the Work.

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

- .1 Install correct, safe temporary storage for paint, thinner, solvents, and other volatile, corrosive, hazardous, and explosive materials in accordance with requirements of authorities having jurisdiction.
- .2 Post hazard warning signage in areas of storage and mixing. Install and maintain sufficient CO<sub>2</sub> fire extinguishers of minimum 9 kg capacity, accessible in each storage mixing and storage areas.
- .3 Maintain storage enclosures at minimum 10°C ambient temperature and to manufacturer's instructions.

#### 1.6 **SITE CONDITIONS**

- .1 Apply coatings under the following conditions:
  - .1 Exterior coatings (except Latex): 5° C minimum.
  - .2 Exterior latex coatings: 10°C minimum.
  - .3 24 hours minimum after rain, frost, condensation, or dew.
  - .4 When no condensation is possible (unless specifically formulated against condensation).
  - .5 Interior coatings: 7°C minimum.

- .6 Relative humidity: 85% maximum.
- .7 Not in direct exposure to sun light.
- .2 Maintain temperature conditions indicated above for 24 hours before, during and 24 hours after painting.
- .3 Install clean plywood sheets to protect floors and walls in storage and mixing areas, from paint drips, spatters, and spills.
- .4 Apply sufficient masking, clean drop cloths, and protective coverings for full protection of Work not being painted including, but not limited to, the following:
  - .1 Light fixtures, fire and smoke detectors.
  - .2 Sprinkler heads.
  - .3 Prepainted diffusers and registers.
  - .4 Prepainted equipment.
  - .5 Fire rating labels and equipment specification plates.
  - .6 Finished surfaces.

## 1.7 **ENVIRONMENTAL PERFORMANCE REQUIREMENTS**

- .1 Provide paint products meeting MPI "Green Performance Standard GPS-1-05".

## 1.8 **MAINTENANCE**

- .1 Deliver to Owner's place of storage on completion of work, sealed containers of each finish painting material applied, and in each colour. Label each container as for original, including mixing formula. Provide the following:
  - .1 1 L of extra materials when less than 50 L are used for Project;
  - .2 3.78 L of extra stock when 50 to 200 L are used;
  - .3 7.57 L of extra stock when over 200 L are used.

## 2 **Products**

### 2.1 **MATERIALS**

- .1 Paint:
  - .1 All materials under Work of this Section, including but not limited to, primers, stains, and paints are to have low VOC content limits.
  - .2 Products in accordance with the MPI Painting Specification Manual, Exterior and Interior Systems;
    - .1 For each MPI paint code, manufacture's premium grade, first line Products is to be use.
    - .2 Uniform dispersion of pigment in a homogeneous mixture.
    - .3 Ready-mixed and tinted whenever possible.
  - .3 Products within each MPI paint system code: From single manufacturer.
  - .4 Acceptable manufacturers:
    - .1 Benjamin Moore.

- .2 Dulux Paints/PPG.
- .3 Para Painting & Coatings.
- .4 Sherwin Williams.

- .2 Epoxy floor coating: In accordance with Section 09 67 23.
- .3 Epoxy wall coating: In accordance with Section 09 96 56, if applicable.

## 2.2 COLOUR SCHEDULE

- .1 Consultant will select choice of colours and gloss when compiling a Colour Schedule after award of Contract; allow for colour selection beyond paint manufacturer's standard colour range.
- .2 **Refer to Architectural drawings A-216 through to A-220: Interior Finishes Plan & Schedule for selected colour references.**
- .3 Conform to gloss reflectance definitions listed in MPI Specification Manual.

## 2.3 PAINTING AND FINISHING SCHEDULE

- .1 Refer to Table 1, MPI Painting and Finishing Schedule coded systems, comply with MPI Painting Specification Manual.

Table 1: Painting and Finishing Schedule				
<b>EXTERIOR SUBSTRATES</b>	Typical substrates (Including but not limited to)	MPI Manual Ref.	MPI Finish System Code	Topcoat
Structural steel and metal fabrications		EXT 5.1	EXT 5.1D	Alkyd
Galvanized steel	HM doors & frames	EXT 5.3	EXT 5.3B	Alkyd
<b>INTERIOR SUBSTRATES</b>	Typical substrates (Including but not limited to)	MPI Manual Ref.	MPI Finish System Code	Topcoat
Concrete floors		INT 3.2	INT 3.2C	Epoxy
Concrete block masonry		INT 4.2	INT 4.2A	Latex

Table 1: Painting and Finishing Schedule				
Structural steel (Factory primed)		INT 5.1	INT 5.1R	High performance latex
Steel (High heat)	Boilers, pipes, flues, heat exchangers	INT 5.2	INT 5.2A	Heat resistant enamel
Galvanized steel	Ducts, pipes, metal deck	INT 5.3	INT 5.3A	Latex
Galvanized metal	HM doors & door frames	INT 5.3	INT 5.3B	WB light industrial coating
Dressed lumber	Doors and frames requiring paint finish	INT 6.3	INT 6.3A	High performance latex
Wood paneling & casework	Millwork	INT 6.4	INT 6.4C	Semi-transparent stain
Wood paneling & casework	Millwork	INT 6.4	INT 6.4E	Poly-urethane
Gypsum board,	Drywall, walls, ceilings	INT 9.2	INT 9.2A	Latex
Gypsum board,	Wet areas	INT 9.2	INT 9.2F	Epoxy-modified latex

### 3 Execution

#### 3.1 EXAMINATION

- .1 Verify condition 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 General:
  - .1 Clean substrate surfaces free from, dust, grease, soiling, or extraneous matter, which are detrimental to finish.
  - .2 Patch, repair, and smoothen minor substrate defects and deficiencies e.g. machine, tool and sand paper marks, shallow gouges, marks, and nibs.
  - .3 Clean, sweep, and vacuum floors and surfaces to be painted, debris and dust-free prior to painting.
  - .4 Refer to MPI Painting Specification Manual for surface preparation requirements of substrates not listed here.
- .2 Where finish hardware has been installed remove, store, re-install finish hardware, to accommodate painting. Do not clean hardware with solvent that will remove permanent lacquer finishes.
- .3 Alkali Content tests and neutralization:
  - .1 Test for ph level using litmus paper on dampened substrate.
  - .2 Neutralize surfaces over 8.5 ph with 4% solution of Zinc Sulphate for solvent based systems and tetrapotassium pyrophosphate for latex based systems, to below 8.0 ph, and allow to dry.
  - .3 Brush-off any residual Zinc Sulphate crystals.
  - .4 Coordinate paint system primer / sealer to be alkali-resistant.
- .4 Substrate moisture tests:
  - .1 Test for moisture content over entire surface to be painted, minimum one test/ 2 m<sup>2</sup> in field areas and one test/600 mm along inside corners including at ceiling to wall juncture.
  - .2 If any test registers above 10% allow entire substrate surfaces, within the plane, to dry further before paint system application. Install temporary drying fans if necessary.
  - .3 Re-test employing same criteria.
- .5 Mildew removal: Scrub with solution of trisodium phosphate and sodium hypochlorite (Javex) bleach, rinse with water, and allow to dry completely.
- .6 Cementitious and masonry (Concrete, block):
  - .1 Allow 28 days cure before painting.
  - .2 Coordinate repair of protrusion-chipping and grinding, and honeycomb filling with responsible trades.
  - .3 Remove dirt, loose mortar, scale, powder, efflorescence, and other foreign matter.
  - .4 Remove form oil and grease with trisodium phosphate, rinse, and allow to dry thoroughly.
  - .5 Prepare surfaces in accordance with CAN/CGSB-85.100.
  - .6 Remove rust stains with solution of sodium metasilicate after thorough wetting; allow to dry thoroughly.

- .7 Concrete floors:
  - .1 Allow 28 days cure before painting.
  - .2 Remove contamination, acid etch, rinse with water, and allow to dry completely. Test and adjust for neutral ph.
  - .3 Prepare surfaces in accordance with CAN/CGSB-85.100 acid etch.
- .8 Galvanized steel sheet:
  - .1 Z275 (Satin & Spangled Sheet): SSPC SP7 brush blast.
  - .2 ZF075 (Wiped Coat): Remove contamination, wash with Xylene solvent.
  - .3 Touch-up damaged galvanized areas with organic zinc rich primer.
- .9 Galvanized iron and steel: Prepare galvanized and ungalvanized metal surfaces according to CAN/CGSB-85.10.
  - .1 Unpassivated, unweathered and weathered: Remove contamination, wash with Xylene or Toluol solvent, allow to dry thoroughly. Make paint system primer/sealer an etching type primer.
  - .2 Manufacturer pre-treated (including passivated): SSPC SP7.
  - .3 Touch-up damaged galvanized areas with organic zinc rich primer.
- .10 Structural steel and miscellaneous metal fabrications:
  - .1 Coordinate the following with the responsible trades:
    - .1 Rust, mars, mill scale, and weld-burn touch-ups.
    - .2 Oil, grease, weld flux and other residue removal.
  - .2 Prime paint items, not otherwise indicated to be primed as part of another Section.
  - .3 Touch-up damaged galvanized areas with organic zinc rich primer.
- .11 Wood and Millwork:
  - .1 Wood surfaces to be clean and dry with a moisture content of less than 15%.
  - .2 Remove foreign matter prior to prime coat; spot coat knots, pitch streaks and sappy sections with sealer.
  - .3 Fill nail holes and fine cracks after primer has dried.
  - .4 Backprime interior and exterior woodwork.
- .12 Factory primed surfaces:
  - .1 Touch up damaged areas.
  - .2 Clean as required for top coat.
- .13 Gypsum board:
  - .1 Apply primer/sealer paint to reveal defects and deficiencies and to equalize absorption areas.
  - .2 Coordinate repairs and touch-ups with the responsible trade.
  - .3 Re-prime repairs.
- .14 Coordinate with other trades to prevent:
  - .1 Damage, and inadvertent activation of fire and smoke detectors.

- .2 Odour and dust distribution by permanent HVAC systems including fouling of ducts and filters.

- .15 Field-mix Products in accordance with manufacturer's written instructions.

### 3.3 APPLICATION

- .1 Apply painting systems in accordance with the MPI Painting Specification Manual. Apply each Product to manufacturer's recommended dry film thickness.
- .2 Painting systems listed are required minima, apply additional coats if necessary to obtain substrate hiding acceptable to the Consultant.
- .3 Tint intermediate coats lighter than final top coats for identification of each succeeding coat and to facilitate inspections. Include only manufacturer's recommended reducing and tinting accessories. Do not add adulterants.
- .4 Primer to be specialized primer coating system as required by manufacturer for selected colour. Standard primer being tinted shall be tinted to a maximum of 1.5% by volume.
- .5 Sand lightly between coats to achieve a tooth or anchor for subsequent coats.
- .6 Apply paint uniformly in thickness, colour, texture, and gloss, as determined by the Consultant under adequate illumination and viewed at a distance of 1500 mm. Apply finishes free of defects in materials and application which, in the opinion of the Consultant, affect appearance and performance. Defects include, but are not limited to:
  - .1 Improper cleaning and preparation of surfaces.
  - .2 Entrapped dust, dirt, rust.
  - .3 Alligatoring, blisters, peeling.
  - .4 Scratches, blemishes.
  - .5 Uneven coverage, misses, drips, runs, and poor cutting in.
- .7 Do not apply coatings on substrates which are not sufficiently dry. Unless indicated otherwise, allow each painting system coat to cure dry and hard before following coats are applied.
- .8 Repaint entire areas of damaged or incompletely covered surfaces, to the nearest inside or outside corner; patching will not be permitted.
- .9 Miscellaneous painting requirements:
  - .1 Paint projecting ledges, and tops, bottoms and sides of doors both above and below sight lines to match adjacent surfaces.
  - .2 Paint door frames, access doors and frames, door grilles, prime coated butts, and prime coated door closers to match surface in which they occur.
  - .3 Finish closets and alcoves as specified for adjoining rooms.

- .4 Paint light coves white whether a light lense is installed or not, unless otherwise indicated.
- .5 Paint interior columns to match walls of room.
- .6 Allow for:
  - .1 2 wall colours per room, one ceiling colour per room.
  - .2 Different door colours in each functionally different area.
  - .3 Different colours on both sides of same door.
- .10 Mechanical, electrical, and other painting coordination:
  - .1 Paint mechanical services in accordance with Mechanical Identification Division 21, 22 and 23.
  - .2 Coordinate painting of pipes, ducts, and coverings with the Work of Division 21, 22 and 23 to precede pipe colour banding, flow arrows, and other pipe identification labeling installation.
  - .3 Paint exposed conduit, pipes, hangers, ductwork, grilles, gratings, louvres, access panels, fire hose cabinets, registers, convactor and radiator covers, enclosures, and other mechanical and electrical equipment including services concealed inside cupboard and cabinet Work; apply colour and sheen to match adjacent surfaces, except as noted otherwise.
  - .4 Paint portions of surfaces such as duct interiors, piping, ductwork, hangers, insulation, walls, and similar items, visible through grilles, louvres, convactor covers etc., matte black in colour.
  - .5 Remove the following to accommodate painting, carefully store, clean, then re-install on completion of each area and when dry:
    - .1 Switch and receptacle plates, fittings and fastenings, grilles, gratings, louvres, access panels, convactor covers, and enclosures.

### 3.4 **FIELD QUALITY CONTROL**

- .1 Dry film thickness tests:
  - .1 Test for film thickness over entire surface to be painted, minimum one test/2 m<sup>2</sup> in field areas and one test/600 mm along inside corners including at ceiling to wall juncture.
  - .2 If any test registers below specified thickness, re-apply paint to entire surface to nearest inside and outside corners.
  - .3 If test registers more than 50% above specified thickness, consult with paint manufacturer, determine if problem exists, offer solutions to Consultant, and repair as directed.
  - .4 Re-test employing same criteria after repair.

### 3.5 **CLEANING**

- .1 Remove spilled, splashed, and spattered paint promptly as Work proceeds and on completion of Work. Clean surfaces soiled by paint spillage and paint spatters. Repair or replace damaged Work, as directed by Consultant.



**3.6 PROTECTION**

- .1 Post Wet Paint signs during drying and restrict or prevent traffic where necessary.
- .2 Post sign, after Consultant's inspection and acceptance of each room, reading:  
PAINTING COMPLETE - NO ADMITTANCE WITHOUT CONTRACTOR'S  
PERMISSION.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

- .1 Labour, Products, equipment, and services necessary for compartments and cubicles Work in accordance with the Contract Documents.

1.2 **REFERENCES**

- .1 ANSI/NEMA LD3, High-Pressure Decorative Laminates.
- .2 ASTM A167, Specification for Stainless Steel and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- .3 ASTM A653, Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .4 CAN/CSA B651-M, Barrier Free Design.

1.3 **SUBMITTALS**

- .1 Shop drawings: Submit shop drawings in accordance with Section 01 33 00 indicating fabrication and erection details, plans, elevations, hardware, and installation details.
- .2 Samples:
  - .1 Submit samples in accordance with Section 01 33 00.
    - .1 Submit 300 x 300 mm samples for each colour.
    - .2 Submit samples of each hardware item, including brackets, fastenings, and trim.

1.4 **MAINTENANCE DATA**

- .1 Provide maintenance data for maintenance of finished work for incorporation into Maintenance Manual specified in Section 01 78 23.

1.5 **PROTECTION**

- .1 Cover finished surfaces with heavy Kraft paper or put in cartons during shipment. Protect installed surfaces by approved means. Do not remove until immediately prior to final inspection.

2 Products

2.1 **ACCEPTABLE MANUFACTURERS**

- .1 Floor Mounted Overhead Braced;
  - .1 Solid Phenolic Core by Bradley Corporation.
  - .2 Duraline Solid Phenolic by Bobrick Washroom Equipment of Canada Ltd.
  - .3 Shanahan's Model O.B. Overhead Braced by W.G. Wood Sales Company Limited.
  - .4 Phenolic Partitions by Global Partitions/Watrous.

2.2 **MATERIALS**

- .1 All materials under Work of this Section, including but not limited to, adhesives are to have low VOC content limits.
- .2 Phenolic partitions: 19 mm thick consisting of multiple resin-impregnated kraft paper core with colour and clear melamine surface sheets, fused at high temperature. No brown core permitted.  
Colour/finish to match Panolam's W163 'Looks Likatre' or Pionite's WP110N 'Looks Likatre'.
- .3 Hardware:
  - .1 Hinges: concealed, heavy-duty aluminum or stainless steel casting, self-lubricating inward swing.
  - .2 Slide bolt and keeper: aluminum or stainless-steel casting or extrusion, equipped for emergency access.
  - .3 Doorstop: aluminum or stainless steel casting or extrusion with rubber insert.
  - .4 Connecting brackets: channel shaped, stainless steel extrusion or casting, continuous.
  - .5 Coat hook: combination hook and door bumper, aluminum or stainless-steel casting.
- .4 Stainless steel sheet metal: ASTM A167, Type 304 with No. 4 satin finish.
- .5 Fasteners: Stainless steel tamperproof type screws and bolts.

2.3 **FABRICATION**

- .1 Toilet partitions shall be floor mounted, overhead braced.

- .2 Fabricate stiles and doors of 19 mm thick solid phenolic core and panels and benches of 13 mm thick solid phenolic core with decorative plastic laminate facing. Multiple resin-impregnated kraft and surface sheets shall be fused at high temperature and pressure with all edges finished and polished.
- .3 Unless otherwise indicated or required, doors shall be nominal 610 mm wide, except doors to compartments for the handicapped shall be 810 mm wide.
- .4 Fabricate headrail of brake formed anti-grip 1.5 mm thick clear anodized aluminum.
- .5 Fabricate pilaster boot assembly for bottom, of 1.5 mm thick die formed stainless steel. Fabricate assembly in size to suit pilaster.
- .6 Fabricate wall hung screen panel same as toilet partitions, except size shall be 19 mm thick, 760 mm deep by 1067 mm high unless indicated otherwise.

3 Execution

3.1 **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.

3.2 **INSTALLATION**

- .1 Install compartments and cubicles in accordance with manufacturer's details and reviewed shop drawings, for a secure, plumb, square, and rigid installation.
- .2 Provide connecting brackets and secure to building structure and to pilasters. Insert edge of panels and closure pilasters into brackets and secure with through type sleeve bolt and nut.
- .3 Install doors with 6 mm to 10 mm maximum space between door panel and pilasters.
- .4 Install panels with 6 mm maximum space between panels and walls.
- .5 Install hardware in accordance with manufacturers' instructions and CAN/CSA B651-M.
- .6 Make compartments adjustable with screw jack through steel saddles made integral with pilaster. Conceal fixings with stainless steel shoes.
- .7 Provide for adjustment of floor variations with screw jack through steel saddles made integral with pilaster. Conceal floor fixings with stainless steel boot assemblies.

- .8 Install door tops edges aligned parallel with top edges of side partitions; determine alignment when doors are in closed position.
- .9 Brace through top of pilasters with rectangular shaped anti-grip headrail and fasten with stainless steel sheet metal screws.
- .10 Set panels and doors level and in line, raised approximately 300 mm above finished floor.
- .11 Hang doors to remain stationary at open position.
- .12 Equip each door with hardware. Adjust and align hardware for easy, proper function.
- .13 Provide closure pilasters, as required, at end units of compartment bank.
- .14 Remove and replace damaged components not acceptable to consultant.

**3.3 SCREEN ERECTION**

- .1 Provide urinal stall screens consisting of panel and framing/supports as specified for toilet compartments.
- .2 Anchor screen panels to walls with wall hung urinal screen brackets at height as indicated.

**3.4 CUBICLE BENCH**

- .1 Provide in each compartment 25 mm thick solid phenolic core high pressure plastic laminate bench secured to stainless steel brackets at 406 mm on centre, wall mounted. Ensure brackets are secured to reinforcing in wall.

**3.5 ADJUSTING**

- .1 Adjust operating hardware to work smoothly and without force. Adjust hinges of compartment doors so that all doors remain open to the same degree when unlatched, except doors at handicapped cubicles shall close automatically.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

- .1 Labour, Products, equipment and services for washroom accessories Work in accordance with the Contract Documents.

1.2 **REFERENCES**

- .1 ASTM A167, Specification for Stainless Steel and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- .2 ASTM A312, Specification for Seamless and Welded Austenitic Stainless-Steel Pipes.
- .3 ASTM A653/A653M, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .4 CAN/CSA B651-M, Barrier Free Design.

1.3 **SUBMITTALS**

- .1 Product data: Submit Product data to requirements of Section 01 33 00 indicating each washroom accessory describing size, finish, details of function, attachment methods, hardware and locks, description of rough-in frame, and building-in details of anchors for grab bars.
- .2 Closeout submittals:
  - .1 Submit for each Product operation and maintenance instructions for incorporating into the Operations and Maintenance Manuals in accordance with Section 01 78 23.
  - .1 Supply 2 keys for each lockable washroom accessory.
  - .2 Master key washroom accessories which are keyed.

1.4 **DELIVERY, STORAGE AND HANDLING**

- .1 Deliver materials in sealed cartons and containers with manufacturer's name and product description clearly marked.

1.5 **EXTENDED WARRANTY**

- .1 Submit an extended warranty for washroom accessories Work in accordance with the General Conditions, except that the warranty period is extended to 10 years.
  - .1 Against cracked or scratched mirrors, spoiling or deterioration of silvering or backing, loosening of fastenings or adhesive
  - .2 Coverage: complete replacement including effected adjacent Work.

1.6           **MAINTENANCE**

- .1       Maintenance Tools: Provide special tools necessary for accessing, assembly/disassembly or removal of toilet, bath, and cleaning accessories in accordance with requirements specified in Section 01 78 23.

2            Products

2.1          **MATERIALS**

- .1       Stainless steel:
  - .1       Sheet metal: ASTM A167, Type 304.
  - .2       Tubing: ASTM A312, Type 304.
- .2       Sheet steel: ASTM A653M, Z275; Cold rolled, commercial quality, surface preparation and pretreatment as required for applied finish.
- .3       Fasteners, screws and bolts: ASTM A167, Type 304 stainless steel, tamper-proof.

2.2          **ACCESSORIES**

- .1       Refer to drawings for quantity and location of washroom accessories.
- .2       Surface Mounted Soap Dispenser (**SD-1**):
  - .1       #B-2112 by Bobrick;
  - .2       Locations: Locations as indicated on the Contract Drawings.
  - .3       Frame finish: Type 304 stainless steel satin finish
- .3       Soap Shelf (**SS-1**):
  - .1       #B-296 by Bobrick;
  - .2       Locations: Locations as indicated on the Contract Drawings, mounted at 914mm above finished floor.
  - .3       Frame finish: Type 304 stainless steel satin finish
- .4       Shower Rod & Curtain (**SCR-1**): 'Bobrick' Shower Curtain Rod concealed mounting Model 'B-6147' x 48" c/w 'Bobrick' Shower Curtain '204-2' 60" width w/ '204-1' Shower Curtain Hooks. Rod, curtain & hooks installed such that bottom of curtain is 50mm above the finished floor.
- .5       L-shaped grab bar (**GB-1**):
  - .1       3800-P Series by ASI Group Canada or approved alternative by Bobrick series B-5854.99 ; 38 mm diameter, 1.2 mm thick, 'L' shaped configuration concealed mounting with snap flange, complete with escutcheons.
  - .2       Dimensions: 1016 mm x 762 mm.
  - .3       Finish: Type 304 stainless steel with a satin finish and peened grip.

- .6 Grab bar (**GB-2**):
  - .1 Series B-6806 by Bobrick or #3800-P Series by ASI Group Canada; 38 mm diameter, 1.2 mm thick, concealed mounting with snap flange, complete with escutcheons.
  - .2 Dimensions: 610 mm long.
  - .3 Finish: Type 304 stainless steel with a satin finish and peened grip.
- .7 Mirror (**MIR-2**): 6 mm thick, mirror quality float glass
  - .1 #B-293 by Bobrick or #20655 series by ASI Group Canada; mitred corners welded, and polished smooth. 24" Wide x 36" High
  - .2 Shelf: 1.2 mm thick stainless steel with 19 mm return edge on front. Corners are welded, ground and polished smooth.
  - .3 Dimensions: Sizes and locations as indicated on the Contract Drawings.
  - .4 Frame finish: Type 304 stainless steel satin finish.
- .8 Mirror with shelf (**MIR-1**): 6 mm thick, mirror quality float glass.
  - .1 #B-166 Series by Bobrick 24" Wide x 36" High, corners welded, and polished smooth.
  - .2 Dimensions: Sizes and locations as indicated on the Contract Drawings.
  - .3 Frame finish: Type 304 stainless steel satin finish.
- .9 Folding Shower seat (**FDS-1**):
  - .1 #B-5191 by Bobrick or #8203 Series by ASI Group Canada; surface wall mounted seat with 8 mm thick water-resistant, ivory coloured solid phenolic.
  - .2 Dimensions: 405 mm deep x 460 mm wide.
  - .3 Finish: Type 304 stainless steel frame.
- .10 Adult changing station (**ADCT-1**):
  - .1 Horizontal, Surface mounted, fold down, adult changing station with stainless steel exterior finish and plastic interior with a smooth finish, capable of withstanding 181 kg (400 lbs) and conforming to ASTM.
    - .2 Door to be 1.6 mm (16 gauge) and the flange and cabinet to be 1.3 mm (18 gauge).
  - .3 Changing table to be equipped with a rounded contoured pull handle and gas spring to assist user in opening and closing unit with one hand. Bed liner to be light grey, high impact plastic with smooth fish.
  - .4 Liner to be equipped with an adjustable two-part adult protection safety strap and cam buckle adjustable with one hand.
  - .5 Unit to provide graphic instructions.
  - .6 Finish: Type 304 stainless steel with satin finish.
  - .7 Surface mounted model: #100iSSE-SM by ASI Group Canada or approved alternative.



- .11 Backrest assembly (**BS-1**):
  - .1 Provide barrier-free backrest assemblies for floor mounted water closets.
  - .2 Backrest assembly to be fabricated from 32 mm o.d. stainless steel tubing with a satin finish, concealed mounting with snap on flanges complete with two white solid phenolic component panels.
  - .3 'Model W-1401-T2-8' by ASI Group Canada or approved alternative.
- .12 Coat Hook (**CH-1**):
  - .1 Provide Coat hooks in all washrooms with showers, and on back of door to barrier free washroom & all private offices, mount at 1830mm A.F.F.
  - .2 Polished Satin 304 stainless steel Model "B-6827" by 'Bobrick' or approved equivalent.
- .13 Recessed Paper Towel Dispenser and Waste Receptacle (**PTD-1**):
  - .1 #B-43944 by Bobrick; mitred corners welded, and polished smooth. 17-7/16" Wide x 56-1/4" High
  - .2 Locations: Locations as indicated on the Contract Drawings.
  - .3 Frame finish: Type 304 stainless steel satin-finish.
- .14 Surface-Mounted Multi-roll Toilet Tissue Dispenser (**TPH**):
  - .1 #B-2888 by Bobrick; welded construction, and satin finish.
  - .2 Locations: Locations as indicated on the Contract Drawings.
  - .3 Frame finish: Type 304 stainless steel satin finish.

3 Execution

3.1 **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.

3.2 **INSTALLATION**

- .1 Verify and coordinate templates, inserts, and rough-in frames and verify exact location of washroom accessories for installation.
- .2 Verify there is adequate supports and/or blocking in gypsum wall assemblies prior to installation of washroom accessories.
- .3 Provide fastening and mounting kits for washroom accessories.
- .4 Locate washroom accessories where indicated on Drawings and where directed by Consultant.

- .5 Install washroom accessory fixtures, accessories, and items in accordance with manufacturer's instructions and CAN/CSA B651-M. Provide exposed tamper-proof screws of stainless steel to match units.
- .6 Install washroom accessories plumb, level, and securely and rigidly anchored to substrate surfaces and framing. Adjust accessories for proper operation and verify mechanisms function smoothly.
- .7 Install grab bars to withstand minimum 408 kg downward pull. Provide necessary reinforcements as required.
- .8 Clean and polish exposed surfaces and fill accessories with necessary supplies prior to acceptance by consultant.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

- .1 Phenolic Locker work includes the following:
  - .1 Locker Compartments (various sizes, styles, and tier configurations)
  - .2 Component Accessories
    - .1 Slope Tops
    - .2 Filler Kits
    - .3 Trim Kits for recessed installations
    - .4 Locking Device Options
    - .5 Hooks, Coat Rod Hooks, Coat Rods
    - .6 Number Plates
- .2 Phenolic Bench work includes the following:
  - .1 Solid Phenolic Benches 12" or 18" Width free standing moveable pedestals.
  - .2 Solid Phenolic Benches 12" Width – wall mounted with powder coated brackets & associated mounting hardware.
- .3 Furnish all labour and materials necessary for completion of work in this section as shown on the contract drawings and specified herein.
- .4 Work in this section shall include but is not limited to:
  - .1 Locker Compartments.
  - .2 Hardware for Locker compartments.
  - .3 Shop drawings and working drawings
  - .4 Manufacturer's guarantee
  - .5 Related Work specified elsewhere shall include accessories and anchorage/blocking for attachment of compartments.

1.2 **SUBMITTALS**

- .1 Shop drawings: Submit shop drawings in accordance with Section 01 33 00 indicating fabrication and erection details, plans, elevations, hardware, and installation details.
- .2 Submittal of shop drawings and details for architect's approval.
  - .1 Colors (Doors and End-Cover Panels only) shall be selected from the manufacturer's premium (and/or Designer Black core colours) range of colors.
  - .2 Color samples 300mm x 300mm shall be submitted for approval to the architect
  - .3 Hardware samples shall be submitted for approval to the architect upon request

1.3 **ACCEPTABLE MANUFACTURERS**

- .1 Solid Phenolic Lockers:
  - .1 ASI Storage Solutions
  - .2 Spectrum
  - .3 PSISC

#### 1.4 PRODUCTS

- .1 **LCKR-1** "Single" Tier Solid Phenolic Lockers, each locker shall be 18"W x 24"D x 72"H and shall be the premium or top-line model of the respective manufacturer and shall allow for selection from the premium or top line colours & finishes in addition to all standard colour & finishes and shall include:
  - .1 Surface mount numbered hasp pad for standard Dudley or padlock.
  - .2 Colour & finish selection to be made by Architect.
  - .3 Internal Shelf & Coat Hook in each locker.
  - .4 Sloping tops & finished end gables for all exposed ends.(Provide shop drawings).
- .2 **LCKR-3** "Double" Tier Solid Phenolic Lockers, each locker shall be 18"W x 24"D x 72"H and shall be the premium or top-line model of the respective manufacturer and shall allow for selection from the premium or top line colours & finishes in addition to all standard colour & finishes and shall include:
  - .1 Surface mount numbered hasp pad for standard Dudley or padlock.
  - .2 Colour & finish selection to be made by Architect.
  - .3 Internal Shelf & Coat Hook in each locker.
  - .4 Sloping tops & finished end gables for all exposed ends.(Provide shop drawings).
- .3 **SPB-1** Free standing solid phenolic top bench moveable 18" depth 48" length with 4 legs in stainless steel- polished satin, bolted to floor.
  - .1 Colour & finish selection to be made by Architect. (Provide shop drawings).
- .4 **SPB-2** Free standing solid phenolic top bench moveable 12" depth, 30" length with 4 legs in stainless steel- polished satin.
  - .1 Colour & finish selection to be made by Architect. (Provide shop drawings).

#### 1.5 MAINTENANCE DATA

- .1 Provide maintenance data for maintenance of finished work for incorporation into Maintenance Manual specified in Section 01 78 23.

#### 1.6 PROTECTION

- .1 Cover finished surfaces with heavy Kraft paper or put in cartons during shipment. Protect installed surfaces by approved means. Do not remove until immediately prior to final inspection.

**2.0 EXECUTION**

- .1 Installation:
  - .1 Assemble and Install lockers in accordance with reviewed shop drawings and manufacturer's written instructions.
  - .2 Securely fasten lockers to bases and grounds and nailing strips and to each other when in locker banks.
  - .3 Install trim and closures where indicated and where obstructions occur.
  - .4 Install locker numbers.
  - .5 Upon completion, test doors and adjust for ease of operation.
- .2 Cleaning:
  - .1 Touch up scratches and abrasions to match the original finish. Clean and polish lockers prior to final acceptance by consultant

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

- .1 Labour, Products, equipment and services necessary for miscellaneous specialties Work in accordance with the Contract Documents.

1.2 **SUBMITTALS**

- .1 Product data:
- .1 Submit duplicate copies of manufacturer's Product data for each Product specified in accordance with Section 01 33 00 indicating:
    - .1 Performance criteria, compliance with appropriate reference standard(s), characteristics, and limitations.
    - .2 Product transportation, storage, handling and installation requirements.
  - .2 Shop drawings: Submit shop drawings in accordance with Section 01 33 00 indicating elevations, sections, details, dimensions, materials, gauges, and finishes.
  - .3 Closeout submittals: Submit cleaning and maintenance instructions for miscellaneous specialties for incorporation into Operations and Maintenance Manuals in accordance with Section 01 78 23.

1.3 **DELIVERY, STORAGE, AND HANDLING**

- .1 Package or crate, and brace products to prevent distortion in shipment and handling. Label packages and crates and protect finish surfaces by sturdy wrappings.

2 Products

2.1 **MANUFACTURED UNITS**

- .1 **Janitor's shelf with mop and broom holders and hooks (MHLDR-1):**
- .1 #B-239 x 34 by Bobrick Washroom Equipment of Canada or approved alternative.
  - .2 330 mm H by 205 mm deep. Shelf constructed of minimum 1.2 mm stainless steel, mop, and broom holders to have spring loaded rubber cam to grip handles up to 30 mm in diameter, and stainless-steel hooks positioned below shelf.
  - .3 Finish: Type 304 stainless steel with satin finish. See drawings for locations & quantity.
- .2 **Gear storage (BGR-1):**  
Free standing 610 mm deep x 1830 mm high tubular steel wire shelves with 610 mm wide compartments with full length dividers (quantity of 72).  
Complete with adjustable boot and helmet shelves, adjustable apparel hooks and label holder for each compartment (to be number or labelled later). Free Standing 24" Compartments by Ready Rack inc. or approved alternative by GearGrid Corp.

- .3 **Wall Mounted Hose Reel (HSRL-1):** 'REELCRAFT' Ultimate Duty Dual Pedestal Hose Reel Model '83050 OLP-HTH- 3/4" X 50 ft.  
Supplied & installed by General Contractor c/w mounting hardware.  
Quantity of 4.
- .4 **Flagpole:** Tapered aluminum 6063 T-6 flag poles with heights of (one) 30 ft & (two) 25 ft to be coordinated on site with foundation depths for each pole, based on soils report (General Contractor include in base bid 3 circular foundation concrete piers with rebar at a minimum of 3.650m deep or as determined by P. Eng. Final foundation design to be determine by GC's P. Eng. included in base bid. Provide shop drawings). Wall thickness between 4.8 to 9.5 mm, designed to withstand 110 Mph winds. 14-gauge clear anodized aluminum ball with flush seams. Supply all trucks, internal halyards, cleats, collar, anchor base and accessories. 'Ground set architectural cone tapered aluminum' as manufactured by Ewing or approved alternative by Hollard Supply Inc.  
  
Provide a total of 3 flag poles, where indicated on Site Plan drawings, the 30 ft. flagpole shall be installed in the middle with the two 25 ft. flagpoles on either side.
- .5 **Fire Extinguisher Cabinet:** Model SS2409-5R-VD by Larsen Manufacturing. Semi recessed S.S. Trim. Complete w/ 5LB Extinguisher.  
Total of 12 separate cabinets for the whole building.  
Locations of each unit to be coordinated with Architect and Building Department staff for final PRIOR to final occupancy.
- .6 **Window Blinds (WB-1):** Single Manual Roller Shades by 'Elite in all window locations, where shown on FF&E plan.  
Roller Shades: Blackout, Cassettes: V-90 with Exposed Bottom Rails.  
Provide shop drawings to consultant for review prior to fabrication.
- .7 **Window Film (WF-1):** 'Apex Classic Sand Blasted Window Film by 'Apex Window Films' or approved equivalent during shop drawing process.  
Installed to interior window face only (no exterior window applications) where noted on architectural drawing or as directed by Architect.
- .8 **Snow & Ice Guard:** Aluminum roof snow guards - Model S-5! DualGard Metal Roof Snow Guards by Sky Products Ltd., powder coated to match roof colour.  
See architectural roof plan for location. Install on entire perimeter of metal sloped roofs.  
Shop drawings to be provided.
- .9 **Roof Anchor:** 18" Wrap around structure roof anchor, by Pro-Bel Group Ltd, of Ajax, Ontario. Model FA-PBE76-00H4 1812S-FL2. Quantity of 2.  
See architectural roof plan for locations.  
Shop drawings to be provided.
- .10 **Slide Pole:** Automatic Slide Pole - Model 23 by McIntire Brass Works Inc., Maynard, MA. USA. (617) 547-1819 or emails: sales@slidepole.com  
Quantity of 1.  
See architectural floor plans for location.  
Shop drawings to be provided.

- .11 **Bottle Filling Station & Single ADA Cooler Filtered Refrigerated Light Gray (BFS):** 'ELKAY – Model LZS8WSLK wall mounded unit complete with in-wall carrier & Cane Apron for EZ Gray.  
Quantity of 2. See architectural floor plans for locations.
- .12 **Prefabricated Ladders and Stairs:** Manufactured by Skyline Gorup International.  
www.skylinegroupintl.com : 1-887-417-6336.  
See architectural floor plans and roof plan for locations.  
Shop drawings to be provided.
  - 1. Prefabricated Access Stair: LADDER DOWN-Lifeline Ladder.  
Model: LL10L  
Quantity of 1.
  - 2. Prefabricated Access Ladder: LADDER DOWN-7002 Series.  
Model: LL14C  
Quantity of 2.
  - 3. Prefabricated Roof Hatch Ladder: HATCH-Roof Hatch Access Ladders.  
Model LH18C  
Quantity of 2.
  - 4. Elevator Ladder: HATCH-Roof Hatch Access Ladders.  
Model LH6  
Quantity of 1.
  - 5. Tower Ladder: Fixed Roof Access Ladder- Custom for 3.216 m height flr. to flr.  
Shop drawing to be provided.  
Quantity of 1.
- .13 **Roof Hatch:** Roof hatch Type S, 36"x30" in galvanized steel by Bilco.  
Quantity of 2.
- .14 **Cabinet Workbench 48" x 30" (CW-1):** Nella 30" x 48" Stainless Steel Knockdown Worktable Overhang Edge -Model: 24400.  
18 Gauge, 430 Stainless-Steel, Stainless-Steel bullet feet.  
Quantity of 2.
- .15 **Double Tier 48" x 14" (DT-1):** Nella 48" x 14" x 32" Stainless Steel Double Tier Over Shelf -Model: 23988.  
430 Stainless-Steel  
Quantity of 2.
- .16 **Stair Railing and Glass (interior):** CRL Brushed Stainless Steel -P8 posts fixed fitting railing kit, c/w CLR 316- Brushed Stainless Steel 1-1/2" schedule 40 pipe rail tubing & 3-ply laminated glass panels (frosted finish) by CLR. (1-800-421-6144)  
Shop drawings to be provided for review and approval by the Architect.



3 Execution

3.1 **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.

3.2 **PREPARATION**

- .1 Verify substrate surfaces are solid, free from surface water, dust, oil, grease, projections and other foreign matter detrimental to performance.
- .2 Items to be built-in: Provide information and templates required for installation of 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 in order that they function as intended.
- .3 Verify there is adequate supports and/or blocking in gypsum wall assemblies prior to installation of miscellaneous specialty items as required.

3.3 **INSTALLATION**

- .1 Install miscellaneous specialties level and securely and rigidly anchored to substrate in accordance with authorities having jurisdiction, reviewed shop drawings, and manufacturer's written instructions.
- .2 After installation, adjust miscellaneous specialties in accordance with manufacturer's written instructions.

3.4 **CLEANING**

- .1 Clean and polish exposed surfaces prior to acceptance by consultant.

END OF SECTION

## Part 1- General

### 1.1 SCOPE

#### 1.1.1

To furnish all labor, materials and equipment necessary or required to fully complete the installation of the elevator as shown on the drawings and specifications. This suggested specification is intended to cover the complete installation of the Federal Elevator Serenus Commercial LU/LA Elevator design.

#### 1.1.2

The Elevator Contractor shall report in writing to the General Contractor/Consultant any defects of surfaces or work prepared by other trades which may affect the quality or dimensions of work.

#### 1.1.3

Elevator Contractor shall do all work related to the elevator from the main power disconnect to the finished installation of elevator and accessories except for the items listed in **PART 2 – PREPARATORY WORK BY OTHERS**.

### 1.2 SYSTEM DESCRIPTION

The elevator assembly shall consist of a power unit, car, rail guide system, 1:2 cable hydraulic lifting device, hoistway doors, car doors, control system, signals and alarms, electrical wiring, and parts and accessories necessary to provide required performance, operation, code and safety requirements.

### 1.3 QUALITY ASSURANCE

#### 1.3.1

Installation, elevator, components, accessories and operation must comply with the CSA B44 Elevator Code currently in effect and all other governing Codes and By-laws. All welding of elevator components shall be done by a CWB certified company according to CSA Standards W47.1 and W59. The elevator shall meet or exceed the applicable regulations of all governing agencies and shall be in compliance with the applicable sections of the most current edition of the following codes and standards:

- a) ASME A17.1 "Safety Code for Elevators and Escalators, Section 5.2 Limited Use/Limited Application Elevators".
- b) CSA B44-07 "Safety Code for Elevators, Section 5.2 Limited Use/Limited Application Elevators"

- c) CSA B44.1/ASME A17.5 "Elevator and Escalator Electrical Equipment".
- d) Local codes and regulations, as applicable.

### **1.3.2**

Standards:

- a) To establish a standard for tendering purposes, the Drawings and Specifications are based on Federal Elevator Systems Inc. – LULA Hole-less Hydraulic Elevator(s) rated at 635 kg.
- b) Elevator(s) to be Federal Elevator LULA Elevator(s).
- c) Employ fully trained and licensed mechanics who are regularly employed in this field.
- d) Employ only Elevator Contractors who have been satisfactorily supplying and installing similar elevating equipment over a period of at least the immediate past fifteen years.

### **1.3.3**

Requirements of the Regulatory Agencies:

- a) Fabricate and install Work in compliance with all applicable jurisdictional authorities.
- b) File shop drawings and submissions to local authorities as the information is made available. Company pre-inspection and jurisdictional authority inspections and permits are to be made on a timely basis as required. Work will include all inspections and re-inspections that are required to ensure licenses are issued.

### **1.3.4**

Guarantee:

- a) The Elevator Contractor must guarantee the work and materials and must make good all defects (but not those due to ordinary wear and tear or to improper use or care) which may develop within two (2) year from the date of completion provided same has been properly used, oiled, and cared for by a registered Elevator Contractor through a Code compliant maintenance agreement, and provided all payments due by the terms of the contract have been made in full when due.
- b) Workmanship and any materials supplied and used in this work to be in strict accordance with this specification.

### **1.3.5**

Measurements:

General Contractor to confirm all hoistway measurements and plumb-ness as per Elevator Contractor shop drawings.

## **1.1 MAINTENANCE**

### **1.4.1**

A quality maintenance service consisting of regular examinations at least once every three (3) months, adjustments and lubrication of the elevator equipment shall be provided by the Elevator Contractor after the elevator has been turned over for the owner's use for a period of one of the following:

**Twelve (12) months**

### **1.4.2**

All work shall be performed by competent employees during regular working hours of regular working days. This service shall not cover adjustments or repairs due to negligence, misuse, abuse or accidents caused by persons other than the Elevator Contractor. Only genuine parts and supplies as used in the manufacture and installation of the original equipment shall be provided.

## **Part 2 - Preparatory Work by Others**

### **2.1**

The following preparatory work not included under this contract, but supplied and/or installed by other to accommodate/receive the elevator:

#### **2.1.1**

Machine room to meet all applicable codes and standards.

#### **2.1.2**

Provide a fused disconnect switch with type 'D' fuses for each elevator complete with an auxiliary contact switch and including the wiring from the disconnect switch to the power terminals of each controller. Provide a separate fused disconnect switch for the lights for the lift rated at 120V, 15Amp, including the wiring from the disconnect switch to the light terminals of each controller. Refer to Federal Elevator general layout drawings for permanent power specifications and location of the disconnects.

#### **2.1.3**

Provide a plumb (+/-25.4mm per 30480mm, +/-1" per 100ft of travel), square framed and enclosed legal hoistway, including venting, to the sizes shown. All ledges over 100 mm to be beveled 75° to the horizontal (top and bottom).

#### **2.1.4**

Hoistway and machine room (as required) and all applicable fire ratings in accordance with elevator, safety, electrical and building Codes.

#### **2.1.5**

No conduit, wiring, or piping other than that pertaining to the elevator is permitted in the hoistway or machine room.

#### **2.1.6**

Sleeves for oil and electric ducts from machine room to hoistway as required. All other blockouts, underpinning, pockets, patching, cutouts, grouting and concrete work where required.

#### **2.1.7**

Access to the machine room space as required by the governing Code or Authority Having Jurisdiction.

#### **2.1.8**

Provide machine room ventilation system capable of maintaining the machine room temperature between 5°C and 32°C with the relative humidity not to exceed 95%.

### **2.1.9**

Machine room, in accordance with CAN/CSA-B44-10 Safety Code for Elevators and CAN/CSA C22.1-15 Canadian Electrical Code, shall have legal access, a self-locking self-closing door and a painted concrete floor.

### **2.1.10**

Locate the machine room switch on the lock jamb side of the machine room door along with the elevator and light disconnects where practical.

### **2.1.11**

Provide adequate rail bracket support to suit a maximum rail bracket spacing of 1753 mm. Review the floor spacing chart on the hoistway section and provide additional supports on all floors marked with an asterisk.

### **2.1.12**

Front entrance partition walls are not to be constructed until after door frames are in place. If front walls are poured concrete bearing walls, rough openings are to be provided to accept entrance frame and filled in after frames are set. Entrance frames are not designed to support overhead wall loads. Suitable supports for these loads must be provided. If decorative material is applied to listed/certified frames it shall conform to the requirements of the certifying organization.

### **2.1.13**

Suitable lintels over landing entrances are to be provided and provide rough openings as per elevator contractors' shop drawings.

### **2.1.14**

Barricades or guards shall be provided by others outside of every opening to the hoistway to protect other trades, building occupants or visitors as per the Occupational Health and Safety Act (OSHA). These guards and barricades to be erected, maintained and removed by others.

### **2.1.15**

Provide a dry pit reinforced to support the loads as indicated on these drawings. Pit floor to have a smooth trowel finish free of hollows or bumps. Surface to be level and flat to within  $\pm 1/8"$  in any direction.

### **2.1.16**

Pit must have provisions to be kept clean and dry. A pit drain is strongly recommended. Sump pump external to the shaft, where required. Sump hole to be outside hoistway and 600 mm (24") deeper than pit, with trap and backwater check valve. Pit drain / sump pump (where provided) to have a minimum capacity of 11.4 m<sup>3</sup>/hr (3000 usg/hr) per elevator. Design to handle possible oil in sump discharge for hydraulic elevators.

#### **2.1.17**

Where access to a pit over 900 mm (35") in depth is by means of the lowest hoistway entrance, elevator pit ladder(s) extending a minimum of 1220 mm (48") above the sill of the lowest access door, with centreline of rung 115 mm (4 ½") from wall with 300 mm (12") vertically between rungs. Ladder width is 400 mm (16"). Ladder location as shown on elevator shop drawings. Ladder and attachments shall sustain a minimum load of 135 kg.

#### **2.1.18**

Any cutting, patching, and painting of walls, floors, or partitions together with finish painting of entrance doors and frames.

#### **2.1.19**

Necessary electric power for light, tools, hoists, etc., during installation as well as electric current for starting, testing and adjusting the elevator.

#### **2.1.20**

Pit lighting level to be minimum 100 LX. Pit to contain a 120 VAC light fixture, switch and GFCI convenience outlet. Switch to be accessible from pit access. All conduits in hoistway to be EMT. Light and convenience outlet to be on a dedicated circuit. To be marked by our forces during installation.

#### **2.1.21**

A self-closing, self-latching, fire rated machine room door, a minimum of 750 mm wide x 2030 mm high (30" wide x 80" high) with a minimum of 2286 mm (90") clear height above all equipment.

#### **2.1.22**

Lockable, fused disconnects wired to the elevator controller.

#### **2.1.23**

Machine room lighting level to be 200 LX minimum. Must contain a 120 VAC light fixture, switch and GFCI convenience outlet. Switch to be on the lock jamb side of door. All conduits to be EMT.

#### **2.1.24**

Provide a dedicated (i.e. not part of a telephone system) analogue (i.e. not computerized), tone (i.e. not pulse) telephone line in a jack to the side of our controller. Line must be monitored 24 hours a day, 7 days a week.

#### **2.1.25**

Signals to our controller from smoke detectors in machine room, landings and hoistway. Also, a signal from the General Alarm is required. These signals need to be individual, in the form of a

normally open contact and the wire needs to have a ground and terminated individually in our controller.

#### **2.1.26**

Finished flooring in elevator cab.



Part 3- Submittals

**3.1 SHOP DRAWINGS**

The shop drawings shall show a complete layout of the elevator equipment detailing dimensions, clearances and location of machinery. Including, but not limited to, the following:

**3.1.1**

Drawings showing the dimensions including plans, elevations, and sections to show equipment locations.

**3.1.2**

Load and reaction drawings shall be provided by the elevator manufacturer and detailed on drawings.

**3.1.3**

- a) Submit five (5) copies of all shop drawings for the Architect to review.
- b) Do not commence work until approved drawings have been returned, and all finishes have been confirmed.

**3.2**

Digital samples of all finishes.

## Part 4- Product Data

### 4.1 MANUFACTURER/ ELEVATOR

Elevator shall be the FEDERAL ELEVATOR SERENUS Commercial LU/LA Elevator manufactured by Federal Elevator Systems Inc. Toll Free Number 1 (888) 785-5438 and (905) 458-4015, Fax (905) 670-0017

- a) Hole-less Roped Hydraulic
- b) Rated Load: 635 kg. (1400 lbs.)
- c) Rated Speed: 0.15 m/s.  
(30fpm) Cab Configuration:

**Enter/exit same side: 42" x 60"**  
**(1067mm x 1524mm)**

- d) Car Inside Dimensions:  
**42" x 60" (1067 mm x 1524 mm)**

- e) Hoistway Size: Refer to Architectural Drawings
- f) Operation: Single Automatic Push Button
- g) Car Controls: Illuminated Type with faceplate in Stainless Steel #4 finish.
- h) Hall Call Stations: Illuminated type. Stainless steel #4 Cover Plates.

Hoistway Entrances Size:

**36" x 84" (914 mm wide by 2134 mm high) Stainless**

- k) Entrance Type: Two Speed Sliding (Right)
- l) Door Operator: Automatic operator for hoistway and car. Opening and closing speed to suit handicapped requirements.
- m) Travel: Refer to Architectural Drawings. Maximum 25ft. (7.6m). This measurement may be exceeded dependent on local codes.
- n) Stops: Refer to Architectural Drawings. Six (6) stops inline.
- o) Openings: Refer to Architectural Drawings.
- p) Power Supply:  
**208 VAC, 3 phase, 60 Hertz, 30A**
- q) Lighting Supply: 120 Volts, 60 Hertz, 15 Amp
- r) Jack Type: 1:2 cable hydraulic
- s) Pump Type: 4HP (3kW) dry motor with "super hush" pump unit. Variable Speed Valve.
- t) Car Controller Type: Non-Proprietary Programmable Logic Control (PLC)
- u) Leveling Device Type: Magnetic Sensor
- v) Elevator(s) must comply with the CSA B44 Elevator Code version currently in effect, including

Supplement(s).

## 4.2 CAR CAB SPECIFICATIONS

### 4.2.1

#### SHELL ENCLOSURE:

- 4.2.1 Car Top: Minimum 16 ga. (1.5 mm) steel, white enamel finish
- 4.2.2 Shell Walls: 16 ga. (1.5 mm) steel - cage frame type construction
- 4.2.3 Strike Column: 16 ga. (1.5 mm) Stainless steel #4
- 4.2.4 Fascia: 16 ga. (1.5 mm) Stainless steel #4
- 4.2.5 Car Doors: 16 ga. (1.5 mm) Stainless steel #4 car door

### 4.2.2

#### ARCHITECTURAL FEATURES:

- a) Side Walls: Plastic laminate hang-on panels
- b) Ceiling:  
**Stainless Steel #4 Panel with compact fluorescent down lights (CFLs)**
- c) Front Return: Stainless steel #4
- d) Car Door:  
**Stainless steel #4**
- e) Base:  
**Stainless Steel # 4**
- f) Reveals:  
**Stainless Steel # 4**
- g) Finished Flooring: To be supplied and installed by Flooring Contractor
- h) Hoistway Doors and Frames:  
**Stainless Steel # 4**

### 4.2.3

#### SUPPLEMENTARY FEATURES:

- a) Lighting: four (4) LED potlights. The failure of one lamp shall not cause the remaining lamps to extinguish.
- b) Car sill(s): Extruded Aluminium
- c) Overall Height: 2134 mm (7' 0") (2134 mm clear inside)
- d) Car Operating Station: In compliance with CSA B44 Elevator Code Appendix E for accessibility
- e) Handrail: Located on control wall: 1 ½" round Stainless Steel #4
- f) Pad Hooks: Included
- g) Protective Pads:  
**Yes – One set**

#### **4.2.4**

##### **OTHER CONTROL FEATURES:**

- a) Battery Emergency Power for lowering of elevator and door opening.
- b) Door open button
- c) Phone Button to activate conversation
- d) Run stop Key switch
- e) Access Key switch (if applicable)

#### **4.2.5**

Emergency Car Lighting: The emergency power unit shall illuminate the elevator car and provide current to the alarm bell in the event of normal power failure. The equipment shall comply with the requirements of the current CSA B44 Elevator Code.

#### **4.2.6**

Entrances: Shall be manufactured in accordance with procedures established by fire testing authorities and shall be labelled for a minimum of 1.5 hours.

#### **4.2.7**

Sight Guards: Sight guards shall be furnished on the leading edge of the doors to conceal the hoistway beyond the doors. Finish to match door panels.

#### **4.2.8**

Car Floor Indicator: One (1) to be installed in each car as part of the car station.

#### **4.2.9**

Hall Floor Indicator: None provided.

#### **4.2.10**

Car Lantern and Gong: A directional lantern visible from the corridor to be provided in the car entrance on the strike post side. Provide a visual indicator to indicate the direction of travel of the car and audio signal upon floor arrival, if required by local code.

#### **4.2.11**

Car operating panel shall be hinged and shall consist of metal push button with halo lighting for each landing, emergency alarm, keyed stop switch, door open and close buttons all mounted on (#4 finished) stainless steel panel. The car-operating panel will be engraved with Fireman Service instructions.

#### **4.2.12**

Braille floor designation tags placed beside corresponding floor buttons on the car station.

#### **4.2.13**

Pressure switch.

#### **4.2.14**

Firefighters' Emergency Operation: Provide all requirements for FEO Phase I in each elevator.

#### **4.2.15**

The car will be equipped with a battery powered emergency lowering and door opening device and alarm which is automatically actuated in the event of failure of the normal building power supply. Battery will be rechargeable with an automatic recharging system.

### **4.3 CYLINDER AND PLUNGER (JACK UNIT)**

#### **4.3.1**

The cylinder shall be constructed of steel pipe of a sufficient thickness and suitable safety margin. The top of the cylinder shall be equipped with a cylinder head with an internal guide ring and self-adjusting packing.

#### **4.3.2**

The plunger shall be constructed of a steel shaft of a proper diameter machined true and smooth. The plunger shall be provided with a stop electrically welded to the bottom to prevent the plunger from leaving the cylinder.

### **4.4 ROPED HYDRAULIC FEATURES**

#### **4.4.1**

Safety device: A "slack/broken cable" safety device shall be supplied, which will stop and sustain the elevator and its rated load, if either of the hoisting cables becomes slack or breaks. The safety device shall be resettable by the operation of the elevator in the upward direction. A switch shall be mounted in such a position to sense the operation of the safety device, and will open the safety circuit to the controller to prevent operation of the elevator in either direction.

#### **4.4.2**

Plunger(s), Cylinders(s), and Sheave(s): A sheave shall be located at the top of each plunger and shall be guided through its travel by a set of plunger rails. Each plunger and cylinder shall be installed plumb and shall operate freely with minimum friction.

#### **4.4.3**

Ropes: Minimum two (2) 9.5 mm aircraft cables. Ropes shall be fastened to the top of the cylinder jack stands, travel over the plunger sheave(s) and attach to the bottom of the elevator car frame.

### **4.5 PUMPING UNIT**

- a) The motor shall be the dry type installed above the oil tank.
- b) The controller shall be integrally mounted on the power unit frame.
- c) Control circuitry to be Programmable Logic Controls and be located on the pump unit.

- d) The pump shall be super-hush screw type
- e) The power unit control valve shall be a variable speed proportional valve type that includes all hydraulic control valving inherently.

This valve shall incorporate the following features:

- (i) Up and down acceleration and deceleration speed adjustment for smoother starts and stops.
- (ii) Smooth stops at each landing shall be an inherent feature of the valve.
- (iii) Adjustable pressure relief valve.
- (iv) Manually operating DOWN valve to lower elevator in an emergency.
- (v) Pressure gauge indicating in P.S.I. and Bars.
- (vi) Gate valve to isolate cylinder from pump unit.
- (vii) Negative pressure switch.

#### **4.6 LEVELLING DEVICE**

##### **4.6.1**

The elevator shall be provided with a 2 way-levelling device, which will maintain the car within 1/2" (13 mm) of the landing, by magnetic sensor.

##### **4.6.2**

Leveling device switches shall be located in a position to be inaccessible to unauthorized persons.

##### **4.6.3**

Hoistway car position signals shall be magnetically sensed for quiet operation.

#### **4.7 PIPING**

Pipe of adequate size and thickness shall be installed between the pumping unit and the cylinder head. A shut off valve shall be provided for maintenance and adjusting purposes.

#### **4.8 CONTROLLER**

A microprocessor controller shall be provided, including necessary starting switches of adequate size together with all relays, switches and hardware required to accomplish the operation specified.

Overload protection shall be provided to protect the motor against overloading.

#### **4.9 WIRING**

All wiring and electrical interconnections shall comply with the governing codes. Insulated wiring shall have flame retardant and moisture proof outer covering, and shall be run in conduit, tubing or electrical wire-ways. Travelling cables shall be flexible and suitably suspended to relieve strain on individual conductors.

#### **4.10 HOISTWAY OPERATING DEVICES**

Normal terminal stopping devices shall be provided. When an emergency terminal stopping device is also required, it shall be furnished and the controller switches and circuitry arranged in accordance with the requirements of the CSA B44 Elevator Code.

#### **4.11 PIT SWITCH**

An emergency stop switch shall be located in the pit.

#### **4.12 PIT MAINTENANCE STAND**

Provide a non-removable means to mechanically hold the car above the pit floor to provide an area in the pit for maintenance and inspection as per requirements of the CSA B44 Elevator Code.

#### **4.13 PLATFORM**

The car platform shall have a fabricated frame of formed and structural steel shapes, rigidly welded. Sub-flooring shall be wood floor. The underside of the platform shall be fireproofed. The platform shall be manufactured by a CWB certified shop and be equipped with an aluminum threshold.

#### **4.14 CAR SLING**

##### **4.14.1**

Car sling shall be fabricated from steel members with adequate bracing to support the platform and cab.

##### **4.14.2**

The buffer-striking member on the underside of the car must stop the elevator before the plunger reaches its down limit of travel.

##### **4.14.3**

Guide shoes to be solid slipper type with polyurethane inserts.

#### **4.15 GUIDES**

##### **4.15.1**

Steel 8 lb/ft "T" guide rails and brackets shall be securely fastened to the building structure.

##### **4.15.2**

Brackets shall securely hold the guides in a plumb and true position regardless of car loading.

##### **4.15.3**

Guides shall be bolted through the hoistway enclosure with "back-up" plates, washers and nuts. Subject to architects' alterations and approvals.

#### **4.16 TWO SPEED HORIZONTAL SLIDING HOISTWAY DOOR/ CAB GATE**

##### **4.16.1 CAB DOOR OPERATION**

a) Power operated, two speed horizontal sliding, stainless steel #4 finish or prime coat, panels providing a clear opening of 36" x 80" (914 mm x 2032 mm) shall be provided.

b) Doors on the car and at the hoistway entrances shall be power operated by means of a solid-state 24 volt D.C. operator with smooth quiet belt drive transmission, operable during power failure.

- c) Door operation shall be automatic at each landing with door opening being initiated as the car arrives at the landing and closing taking place after expiration of an adjustable time interval.
- d) All control adjustments shall be potentiometer regulated.
- e) The door shall be equipped with an infrared self-contained light curtain that will stop and reverse the doors should it detect an obstacle.
- f) The car doors shall be equipped with a master door clutch to control the individual landing door electrical-mechanical interlocks.
- g) The car door electric contact shall prevent the elevator from moving away from the landing unless the car door is in the closed position and the controller will monitor the door contacts and register a fault if any have been bypassed.
- h) The car door sill shall be extruded aluminum.

#### **4.16.2 HOISTWAY DOORS**

- a) Two speed horizontal sliding, stainless steel or prime coat, panels providing a clear opening of 36" x 80" (914 mm x 2032 mm) shall be provided at each landing.
- b) Frames shall be of bolted construction for a one-piece unit assembly comprised of head and side jamb sections.
- c) The door assembly shall be 1 1/2 UL/ULC labeled and provided with approved electrical mechanical interlocks.
- d) The landing doorsill shall be extruded aluminum with non-slip wearing surfaces and grooves for door guides.

#### **4.17 TELEPHONE**

##### **4.17.1**

An ADA-approved AUTODIAL telephone shall be furnished and installed beside the car station. A separate phone line to the elevator controller shall be provided by others and located in the elevator machine room under another section of the specifications.



## Part 5- Execution

### 5.1 EXAMINATION

- a) All site dimensions shall be taken to ensure that tolerances and clearances have been maintained and meet local regulations.
- b) Installation will not begin until hoistway and machine room have been properly prepared.

### 5.2 PREPARATION

Pre-inspect the construction and service requirements for "Work by Others." These requirements will be included in drawings, diagrams, engineering data sheets and special instructions before the work commences.

## Part 6- Warranty

### 6.1 WARRANTY

The elevator contractor shall provide free service from date of approval by local authorities based on timeline indicated in section 1.4.1. The entire elevator and all component parts shall carry a LIMITED WARRANTY for a period of two (2) Years. The warranty shall be for the replacement at no cost of defective parts but shall not include the labor costs required to replace the defective part or parts.

## Part 7 - Owner's Instruction & Manual

### 7.1 OWNER'S INSTRUCTION & MANUAL

After installation is completed, the contractor shall instruct the owner in the proper use, operation and maintenance requirements of the elevator. Instructions to also include emergency procedures and safety rules and precautions. The contractor shall also supply the owner with an Owner's Manual detailing the operating, safety, and maintenance procedures of the elevator.

END OF SECTION

**Part 1 General**

**1.1 SECTION INCLUDES**

- .1 Pipe, fittings, valves, and connections for combination sprinkler and standpipe systems.

**1.2 REFERENCES**

- .1 ASME B16.1-2010 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
- .2 ASME B16.11-2009 - Forged Steel Fittings, Socket Welding and Threaded.
- .3 ASME B16.18-2001 (R2005) - Cast Copper Alloy Solder Joint Pressure Fittings.
- .4 ASME B16.22-2001 (R2005) - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- .5 ASME B16.25-2007 - Buttwelding Ends.
- .6 ASME B16.3-2006 - Malleable Iron Threaded Fittings.
- .7 ASME B16.4-2006 - Gray Iron Threaded Fittings, Classes 125 and 250.
- .8 ASME B16.5-2009 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.
- .9 ASME B16.9-2007 - Factory-Made Wrought Steel Buttwelding Fittings.
- .10 ASME B36.10M-2004 (R2010) - Welded and Seamless Wrought Steel Pipe.
- .11 ASTM A47/A47M-99(2009) - Standard Specification for Ferritic Malleable Iron Castings.
- .12 ASTM A53/A53M-10 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- .13 ASTM A135/A135M-09 - Standard Specification for Electric-Resistance-Welded Steel Pipe.
- .14 ASTM A234/A234M-10b - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
- .15 ASTM A795/A795M - 08 Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use.
- .16 ASTM B32-08 - Standard Specification for Solder Metal.
- .17 ASTM B88-09 - Standard Specification for Seamless Copper Water Tube.
- .18 ASTM F438-09 - Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40.
- .19 ASTM F439-09 - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
- .20 ASTM F442/F442M-09 - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR).
- .21 ASTM F493-10 - Standard Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
- .22 AWWA C110/A21.10-08 - Ductile-Iron and Gray-Iron Fittings for Water.

- .23 AWWA C111/A21.11-07 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .24 AWWA C151/A21.51-09 - Ductile-Iron Pipe, Centrifugally Cast.
- .25 CSA (Canadian Standards Association).
- .26 NFPA 13 - Standard for the Installation of Sprinkler Systems, 2010 Edition.
- .27 NFPA 14 - Standard for the Installation of Standpipe and Hose Systems, 2010 Edition.
- .28 NFPA 24 - Standard for the Installation of Private Fire Service Mains and Their Appurtenances, 2010 Edition.
- .29 UL 405-2011 - Standard for Fire Department Connection Devices (5th Edition).

### **1.3 SUBMITTALS FOR REVIEW**

- .1 Product Data: Provide manufacturers catalogue information. Indicate valve data and ratings.
- .2 Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.

### **1.4 CLOSEOUT SUBMITTALS**

- .1 Record Documentation: Record actual locations of components and tag numbering.
- .2 Operation and Maintenance Data: Include installation instructions and spare parts lists.

### **1.5 QUALITY ASSURANCE**

- .1 Products of This Section: Manufactured to local certification requirements.
- .2 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum [five (5)] experience.
- .3 Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years' experience and approved by the General Contractor.

### **1.6 REGULATORY REQUIREMENTS**

- .1 Conform to UL.
- .2 Sprinkler Systems: Conform work to NFPA 13.
- .3 Standpipe and Hose Systems: Conform to NFPA 14.
- .4 Valves: Bear FM or UL label or marking. Provide manufacturer's name and pressure rating marked on valve body.
- .5 Products Requiring Electrical Connection: Listed and classified by ULc or CSA as suitable for the purpose specified and indicated.

### **1.7 DELIVERY, STORAGE, AND PROTECTION**

- .1 Deliver and store valves in shipping containers, with labelling in place.
- .2 Provide temporary protective coating on cast iron and steel valves.
- .3 Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

## Part 2 Products

### 2.1 ABOVE GROUND PIPING

- .1 Steel Pipe: ASTM A53/A53M; Schedule 40 and, black.
  - .1 Steel Fittings: ASME B16.5, steel flanges and fittings or ASME B16.11, forged steel socket welded and threaded.
  - .2 Cast Iron Fittings: ASME B16.1, flanges and flanged fittings or ASME B16.4, threaded fittings.
  - .3 Malleable Iron Fittings: ASME B16.3, threaded fittings.
  - .4 Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, C-shaped elastomeric sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.
  - .5 Mechanical Formed Fittings: Carbon steel housing with integral pipe stop and O-ring pocked and O-ring, uniformly compressed into permanent mechanical engagement onto pipe.
- .2 Copper Tubing: ASTM B88 Type L, hard drawn.
  - .1 Fittings: ASME B16.22, wrought copper and bronze solder joint, pressure type.
  - .2 Joints: AWS A5.8/A5.8M, Classification BCuP-3 or BCuP-4 silver braze.
  - .3 Mechanical Grooved Couplings: Ductile iron housing with alkyd enamel paint coating clamps to engage and lock, C-shaped elastomeric sealing gasket, steel bolts, nuts, and washers.
- .3 CPVC Pipe: ASTM F442, SDR 13.5.
  - .1 Fittings: ASTM F438 Schedule 40, or ASTM F439 Schedule 80, CPVC.
  - .2 Joints: ASTM F493, solvent weld.
- .4 Polybutylene Pipe: SDR 11.
  - .1 Fittings: Polybutylene.
  - .2 Joints: Fusion weld.
- .5 Cast Iron Pipe: AWWA C151/A21.51.
  - .1 Fittings: AWWA C110/A21.10, standard thickness.
  - .2 Joints: AWWA C111/A21.11, rubber gasket.
  - .3 Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, C-shaped composition sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.

### 2.2 PIPE HANGERS AND SUPPORTS

- .1 Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
- .2 Hangers for Pipe Sizes 2 inches and Over: Carbon steel, adjustable, clevis.
- .3 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
- .4 Wall Support for Pipe Sizes to 3 inches: Cast iron hook.
- .5 Wall Support for Pipe Sizes 4 inches and Over: Welded steel bracket and wrought steel clamp.
- .6 Vertical Support: Steel riser clamp.

- .7 Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- .8 Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

## 2.3 GATE VALVES

- .1 Up to and including 2 inches: Bronze body, bronze trim, rising stem, handwheel, solid wedge or disc, threaded ends.
  - .1 Manufacturers:
    - .1 Crane or approved equivalent
- .2 Over 2 inches: Iron body, bronze trim, rising stem pre-grooved for mounting tamper switch, handwheel, OS&Y, solid bronze or cast iron wedge, flanged or grooved ends.
  - .1 Manufacturers:
    - .1 Crane or approved equivalent
- .3 Over 4 inches: Iron body, bronze trim, non-rising stem with bolted bonnet, solid bronze wedge, flanged ends, iron body indicator post assembly.
  - .1 Manufacturers:
    - .1 Crane or approved equivalent

## 2.4 BALL VALVES

- .1 Up to and including 2 inches: Bronze two-piece body, brass, chrome plated bronze, or stainless steel ball, teflon seats and stuffing box ring, lever handle, threaded ends with union.
  - .1 Manufacturers:
    - .1 Crane or approved equivalent
- .2 Over 2 inches: Cast steel body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle or gear drive handwheel for sizes 10" and over, flanged.
  - .1 Manufacturers:
    - .1 Crane or approved equivalent
  - .2 Cast steel body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle or gear drive handwheel for sizes 10" and over flanged.

## 2.5 BUTTERFLY VALVES

- .1 Bronze Body: Stainless steel disc, resilient replaceable seat, threaded or grooved ends, extended neck, handwheel and gear drive and integral indicating device.
  - .1 Manufacturers:
    - .1 Nibco or approved equivalent
- .2 Cast or Ductile Iron Body: Cast or ductile iron, chrome or nickel plated ductile iron or aluminum bronze disc, resilient replaceable EPDM seat, wafer, lug, or grooved ends, extended neck, handwheel and gear drive and integral indicating device
  - .1 Manufacturers:
    - .1 Nibco or approved equivalent

## 2.6 CHECK VALVES

- .1 Up to and including 2 inches Bronze body and swing disc, rubber seat, threaded ends.
  - .1 Manufacturers:
    - .1 Crane or approved equivalent
- .2 Over 2 inches: Iron body, bronze trim, swing check with rubber disc, renewable disc and seat, flanged ends.
  - .1 Manufacturers:
    - .1 Crane or approved equivalent
- .3 4 inches and Over: Iron body, bronze disc, stainless steel spring, resilient seal, threaded, wafer, or flanged ends.
  - .1 Manufacturers:
    - .1 Crane or approved equivalent

## 2.7 DRAIN VALVES

- .1 Compression Stop: Bronze with hose thread nipple and cap.
  - .1 Manufacturers:
    - .1 Crane (or approved equivalent)
- .2 Ball Valve: Brass with cap and chain, 3/4 inch hose thread.
  - .1 Manufacturers:
    - .1 Crane (or approved equivalent)

## Part 3 Execution

### 3.1 PREPARATION

- .1 Ream pipe and tube ends. Remove burrs.
- .2 Remove scale and foreign material, from inside and outside, before assembly.
- .3 Prepare piping connections to equipment with flanges or unions.

### 3.2 INSTALLATION

- .1 Install piping to NFPA 13 for sprinkler systems and NFPA 14 for standpipe and hose systems.
- .2 Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- .3 Install piping to conserve building space, to not interfere with use of space and other work.
- .4 Group piping whenever practical at common elevations.
- .5 Sleeve pipes passing through partitions, walls, and floors.
- .6 Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- .7 Inserts:

- .1 Provide inserts for placement in concrete formwork.
- .2 Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- .3 Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
- .4 Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- .5 Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.
- .8 Pipe Hangers and Supports:
  - .1 Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
  - .2 Place hangers within 12 inches of each horizontal elbow.
  - .3 Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
  - .4 Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
  - .5 Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
  - .6 Provide copper plated hangers and supports for copper piping.
- .9 Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
- .10 Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- .11 Do not penetrate building structural members unless indicated.
- .12 Provide sleeves when penetrating floors and walls. Seal pipe and sleeve penetrations to achieve fire resistance equivalent to fire separation required.
- .13 When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
- .14 Die cut threaded joints with full cut standard taper pipe threads with red lead and linseed oil or other non-toxic joint compound applied to male threads only.
- .15 Install valves with stems upright or horizontal, not inverted. Remove protective coatings after installation.
- .16 Provide butterfly or ball valves for shut-off or isolating service.
- .17 Provide drain valves at main shut-off valves, low points of piping and apparatus.

**END OF SECTION**

**Part 1 General**

**1.1 SECTION INCLUDES**

- .1 Standpipe network.
- .2 Fire hose cabinets.
- .3 Fire department connection.

**1.2 RELATED SECTIONS**

- .1 Section 21 11 00 - Fire Protection Piping.
- .2 Section 21 30 00 - Fire Pumps.
- .3 Section 21 13 00 - Sprinklers.
- .4 Section 23 05 53 - Mechanical Identification.
- .5 Section 26 05 80 - Equipment Wiring: Electrical characteristics and wiring connections.

**1.3 REFERENCES**

- .1 NFPA 14 - Standard for the Installation of Standpipe and Hose Systems, 2010 Edition.

**1.4 SUBMITTALS FOR REVIEW**

- .1 Product Data: Provide manufacturer's catalogue sheet for equipment indicating rough-in size, finish, and accessories.
- .2 Shop Drawings: Indicate supports, components, accessories, and sizes. Submit shop drawings and product data to Owner's insurance underwriter for approval.

**1.5 CLOSEOUT SUBMITTALS**

- .1 Operation Data: Include manufacturer's data.
- .2 Maintenance Data: Include servicing requirements and test schedule.
- .3 Record Documentation: Record actual locations of components.

**1.6 QUALITY ASSURANCE**

- .1 Perform Work to NFPA 14. Maintain one (1) copy on site.
- .2 Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years' experience and approved by the General Contractor and Engineer.
- .3 Certificates: Provide certificate of compliance from authority having jurisdiction indicating approval of field acceptance tests.

**1.7 DELIVERY, STORAGE, AND PROTECTION**

- .1 Deliver and store products in shipping packaging until installation.



## Part 2 Products

### 2.1 FIRE HOSE CABINETS

- .1 Hose Cabinets:
  - .1 Style: Recessed mounted.
  - .2 Tub: 16 gauge thick steel, prepared for pipe and accessory rough-in.
  - .3 Door: 12 gauge thick steel, glazed, with thick wired glass full panel and hinged, positive latch device.
  - .4 Finish: Enameled, colour RED .
- .2 Hose Rack: Steel; with polished chrome finish; stationary and type with pins and water stop.
- .3 Hose: 1-inch diameter 75 ft long, of rubber lined synthetic, linen or polyurethane lined synthetic hose; mildew and rot-resistant.
- .4 Nozzle: Chrome plated brass; combination fog, straight stream, and adjustable shut-off.

### 2.2 VALVES

- .1 Hose Station Valve: Angle type, brass and finish, 1-1/2 inch nominal size.
- .2 Hose Connection Valve: Angle type; chrome plated and finish; 2-1/2 inch size, thread to match fire department hardware, 300 psi working pressure, with threaded cap and chain of same material and finish.
- .3 Pressure Reducing Valve: Angle; brass and finish with inner hydraulic controls; 2-1/2 inch, thread to match fire department hardware, 400 psi inlet pressure, with threaded cap and chain of same material and finish.
- .4 Hose Connection Valve Cabinets: Recessed mounted.
  - .1 Tub: 16 gauge thick steel, prepared for pipe and accessory rough-in.
  - .2 Door: 12 gauge thick steel, glazed, with thick wired glass full panel and hinged, positive latch device.
  - .3 Finish: Enamel RED.

### 2.3 FIRE DEPARTMENT CONNECTION

- .1 Fire Department Connection: Flush mounted wall type, red enamel finish.
- .2 Outlets: Two-way with thread size to suit fire department hardware; threaded dust cap and chain of matching material and finish.
- .3 Drain: 3/4 inch automatic drip, connected to drain and.
- .4 Label: STANDPIPE - FIRE DEPARTMENT CONNECTION.

### 2.4 FIRE EXTINGUISHERS

- .1 Pump Tank: Galvanized steel container with positive displacement pump and discharge hose.
  - .1 capacity with 2A rating.
- .2 Carbon Dioxide: Insulated handle, hose and horn discharge assembly, self-closing lever or squeeze grip operated, insulated handle.

- .1 capacity with 5BC rating.
- .3 Multi-Purpose Dry Chemical: Cartridge operated with hose and shut-off nozzle or integral shut-off nozzle.
- .1 capacity with 1A:10BC rating.

### **Part 3 Execution**

#### **3.1 INSTALLATION**

- .1 Install system to NFPA 14 and manufacturer's written instructions.
- .2 Locate and secure cabinets plumb and level. Establish top of cabinet (inside horizontal surface) 66 inches above finished floor.
- .3 Locate hose station valve in cabinet at 60 inches above floor. Locate hose connection valve below hose station valve and not closer than from side or bottom of cabinet.
- .4 Locate fire extinguisher in cabinet.
- .5 Connect standpipe system to water source ahead of domestic water connection.
- .6 Where static pressure exceeds 100 psi but is less than 100 ps i at any hose station, provide pressure orifice disc in discharge of hose station valve to prevent pressure on hose exceeding 90 psi.
- .7 Where static pressure exceeds 100 psi at any hose station, provide pressure reducing valve to prevent pressure on hose exceeding 90 psi.
- .8 Provide two-way fire department outlet connection on roof.
- .9 Flush entire system of foreign matter.

#### **3.2 FIELD QUALITY CONTROL**

- .1 Test entire system to NFPA 14.
- .2 Test shall be witnessed by authority having jurisdiction.

**END OF SECTION**

**Part 1 General**

**1.1 SECTION INCLUDES**

- .1 Wet-pipe sprinkler assembly.
- .2 Dry-pipe sprinkler assembly.
- .3 System design, installation, and certification.
- .4 Fire department connections.

**1.2 RELATED SECTIONS**

- .1 Section 21 12 00 - Standpipe And Fire Hose.
- .2 Section 23 05 53 - Mechanical Identification.
- .3 Section 23 05 48 - Vibration Isolation.

**1.3 REFERENCES**

- .1 CSA (Canadian Standards Association).
- .2 FM (Factory Mutual) - Approval Guide.
- .3 NFPA 13 - Standard for the Installation of Sprinkler Systems, 2010 Edition.
- .4 NFPA 13R - Standard for the Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height, 2010 Edition.
- .5 UL - Fire Resistance Directory.

**1.4 SYSTEM DESCRIPTION**

- .1 System to provide coverage for entire building.
- .2 Determine volume and pressure of incoming water supply from water flow test
- .3 Interface system with building control system.
- .4 Provide fire department connections where indicated.

**1.5 SUBMITTALS FOR REVIEW**

- .1 Product Data: Provide data on sprinklers, valves, and specialties, including manufacturer's catalogue information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- .2 Shop Drawings:
  - .1 Submit preliminary layout of finished ceiling areas indicating only sprinkler locations coordinated with ceiling installation.
  - .2 Indicate hydraulic calculations, detailed pipe layout, hangers and supports, sprinklers, components and accessories. Indicate system controls.
- .3 **Submit product data, Shop Drawings and hydraulic calculations to authority having jurisdiction and Owner for approval. Submit proof of approval to Consultant.**

## **1.6 SUBMITTALS FOR INFORMATION**

- .1 Manufacturer's Certificate: Certify that system has been tested and meets or exceeds code requirements.

## **1.7 CLOSEOUT SUBMITTALS**

- .1 Operation and Maintenance Data: Include components of system, servicing requirements, record drawings, inspection data, replacement part numbers and availability, and location and numbers of service depot.
- .2 Record Documentation: Record actual locations of sprinklers and deviations of piping from drawings. Indicate drain and test locations.
- .3 Warranty Documentation: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

## **1.8 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Extra Stock Materials:
  - .1 Provide extra sprinklers to NFPA 13.
  - .2 Provide metal storage cabinet located adjacent to alarm valve.
- .2 Tools: Provide suitable wrenches for each sprinkler type.

## **1.9 QUALITY ASSURANCE**

- .1 Products of This Section: Manufactured to certification requirements.
- .2 Perform Work to NFPA 13. Maintain one (1) copy of each document on site.
- .3 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five (5) years' experience.
- .4 Installer Qualifications: Company specializing in performing the work of this section with minimum five (5) years documented experience.
- .5 **Design system under direct supervision of a Professional Engineer experienced in design of this Work and licensed in Ontario.**

## **1.10 REGULATORY REQUIREMENTS**

- .1 Conform to UL.
- .2 Perform Work to NFPA 13.
- .3 Equipment and Components: Bear FM or UL label or marking.
- .4 Products Requiring Electrical Connection: Listed and classified by CSA or ULc as suitable for the purpose specified and indicated.

## **1.11 DELIVERY, STORAGE, AND PROTECTION**

- .1 Store products in shipping containers and maintain in place until installation. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

## Part 2 Products

### 2.1 SPRINKLERS

- .1 Suspended Ceiling: Recessed and Standard pendant type with matching push on escutcheon plate
  - .1 Finish: Chrome plated
  - .2 Escutcheon Plate Finish: Chrome plated.
  - .3 Fusible Link: Fusible solder link type temperature rated for specific area hazard.
- .2 Exposed Area Type: Standard upright type with guard.
  - .1 Finish: Chrome plated.
  - .2 Fusible Link: Fusible solder link type temperature rated for specific area hazard.
- .3 Sidewall Type: Standard or Recessed horizontal sidewall type with matching screw on escutcheon plate and guard.
  - .1 Finish: Chrome plated
  - .2 Escutcheon Plate Finish: Chrome plated
  - .3 Fusible Link: Fusible solder link type temperature rated for specific area hazard.
- .4 Dry Sprinklers: Standard or Recessed pendant type with matching push on escutcheon plate.
  - .1 Finish: Chrome plated
  - .2 Escutcheon Plate Finish: Chrome plated
  - .3 Fusible Link: Fusible solder link type temperature rated for specific area hazard.
- .5 Guards: Finish to match sprinkler finish.
- .6 Spray Nozzles:
  - .1 Brass with solid cone discharge, 90 degrees of arc with blow-off dust cap.

### 2.2 PIPING SPECIALTIES

- .1 Wet Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber faced clapper to automatically actuate water motor alarm and electric alarm, with pressure retard chamber and variable pressure trim with test and drain valve.
- .2 Dry Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber faced clapper to automatically actuate water motor alarm and electric alarm, with accelerator with test and drain valve.
- .3 Flooding Deluge Valve: Gate type valve with rubber faced disc actuated hydraulically with water motor alarm and electric alarm, with alarm testing trim.
- .4 Water Motor Alarm: Hydraulically operated impeller type alarm with aluminum alloy chrome plated gong and motor housing, nylon bearings, and inlet strainer.
- .5 Electric Alarm: Electrically operated chrome plated gong with pressure alarm switch.
- .6 Water Flow Switch: Vane type switch for mounting horizontal or vertical, with two contacts; rated [10] amp at 125 volt AC and [2.5] amp at 24 volt DC.
- .7 Residential Domestic Shut-Off Valve: NFPA 1, bronze and stainless steel construction, with sprinkler check valve assembly and poppet assembly to divert water from domestic system.

- .8 Fire Department Connections: Flush mounted wall type ; chrome plated finish.
  - .1 Outlets: Two-way with thread size to suit fire department hardware; threaded dust cap and chain of matching material and finish.
  - .2 Drain: 3/4 inch automatic drip, connected to drain.
  - .3 Label: "Sprinkler - Fire Department Connection".
- .9 Supervisory Switches:
- .10 Water Level Supervisory Switches
- .11 Room Temperature Supervisory Switches

### **Part 3 Execution**

#### **3.1 INSTALLATION**

- .1 Install to NFPA 13 and to manufacturer's written instructions.
- .2 Install buried shut-off valves in valve box. Provide post indicator.
- .3 Provide approved double check valve backflow preventer and assembly at sprinkler system water source connection.
- .4 Locate fire department connection with sufficient clearance from walls, obstructions, or adjacent siamese connectors to allow full swing of fire department wrench handle.
- .5 Locate outside alarm gong on building wall [as indicated].
- .6 Place pipe runs to minimize obstruction to other work.
- .7 Place piping in concealed spaces above finished ceilings.
- .8 Centre sprinklers in [two (2) directions in ceiling tile and provide piping offsets as required] [one direction only in ceiling tile with location in other direction variable, dependent upon spacing and coordination with ceiling elements].
- .9 Apply masking tape or paper cover to ensure concealed sprinklers, cover plates, and sprinkler escutcheons do not receive field paint finish. Remove after painting. [Replace painted sprinklers].
- .10 Install and connect to fire pump system to NFPA 13.
- .11 Flush entire piping system of foreign matter.
- .12 Install guards on sprinklers where indicated.
- .13 Hydrostatically test entire system.
- .14 Require test be witnessed by authority having jurisdiction.

#### **3.2 INTERFACE WITH OTHER PRODUCTS**

- .1 Ensure required devices are installed and connected as required to fire alarm system.

**END OF SECTION**

**Part 1 General**

**1.1 SECTION INCLUDES**

- .1 Disinfection of potable water distribution.
- .2 Testing and reporting results.

**1.2 RELATED SECTIONS**

- .1 Section 22 10 00 - Plumbing Piping: Disinfection of building domestic water piping system.

**1.3 REFERENCES**

- .1 AWWA B300-10 - Hypochlorites.
- .2 AWWA B303-10 - Sodium Chlorite.
- .3 AWWA C651-05 - Disinfecting Water Mains.

**1.4 SUBMITTALS FOR INFORMATION**

- .1 Test Reports: Indicate results comparative to specified requirements.
- .2 Certificate: Certify that cleanliness of water distribution system meets or exceeds City of Ottawa standards.

**1.5 CLOSEOUT SUBMITTALS**

- .1 Record Documentation:
  - .1 Disinfection report:
    - .1 Type and form of disinfectant used.
    - .2 Date and time of disinfectant injection start and time of completion.
    - .3 Test locations.
    - .4 Initial and 24-hour disinfectant residuals (quantity in treated water) in ppm for each outlet tested.
    - .5 Date and time of flushing start and completion.
    - .6 Disinfectant residual after flushing in ppm for each outlet tested.
  - .2 Bacteriological report:
    - .1 Date issued, project name, and testing laboratory name, address, and telephone number.
    - .2 Time and date of water sample collection.
    - .3 Name of person collecting samples.
    - .4 Test locations.
    - .5 Initial and 24-hour disinfectant residuals in ppm for each outlet tested.
    - .6 Coliform bacteria test results for each outlet tested.

**1.6 QUALITY ASSURANCE**

- .1 Perform Work in accordance with AWWA C651.
- .2 Water Treatment Firm: Company specializing in disinfecting potable water systems specified in this Section with minimum five (5) years' experience.

- .3 Testing Firm: Company specializing in testing and examining potable water systems, certified by the Province of Ontario.
- .4 Submit testing report complete with signature of the firm's authorized representative associated with testing.

## **1.7 REGULATORY REQUIREMENTS**

- .1 Conform to applicable code or regulation for performing the work of this Section.
- .2 Provide certificate of compliance from authority having jurisdiction indicating approval of water system.

## **Part 2 Products**

### **2.1 DISINFECTION CHEMICALS**

- .1 Chemicals: AWWA B300, Hypochlorite or AWWA B303, Sodium Chlorite.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Verify that piping system has been cleaned, inspected and pressure tested.
- .2 Perform scheduling and disinfecting activity with start-up, testing, adjusting and balancing, demonstration procedures, including coordination with related systems.

### **3.2 EXECUTION**

- .1 Provide and attach required equipment to perform the work of this Section.
- .2 Introduce treatment into piping system.
- .3 Maintain disinfectant in system for twenty-four (24) hours.
- .4 Flush, circulate, and clean until required cleanliness is achieved; use municipal domestic water.
- .5 Replace permanent system devices removed for disinfection.

### **3.3 FIELD QUALITY CONTROL**

- .1 Test samples in accordance with AWWA C651.

**END OF SECTION**



**Part 1 General**

**1.1 SECTION INCLUDES**

- .1 Pipe, pipe fittings, valves, and connections for piping systems sanitary sewer, storm water and domestic water risers.
- .2 Section includes: Potable hot and cold-water distribution system within spaces, using crosslinked polyethylene (PEX) tubing and ASTM F1960 cold expansion fittings

**1.2 RELATED SECTIONS**

- .1 Section 23 05 53 - Mechanical Identification.
- .2 Section 23 07 19 - Piping Insulation.

**1.3 REFERENCES**

- .1 ASME B16.18-2001 (R2005) - Cast Copper Alloy Solder Joint Pressure Fittings.
- .2 ASME B16.22-2001 (R2005) - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- .3 ASME B16.23-2002 - Cast Copper Alloy Solder Joint Drainage Fittings - DWV.
- .4 ASME B16.26-2006 - Cast Copper Alloy Fittings for Flared Copper Tubes.
- .5 ASME B16.29-2007 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.
- .6 ANSI/ASME B16.50-2001 (R2008) - Wrought Copper and Copper Alloy Braze-Joint Pressure Fittings.
- .7 ASME B31.9-2011 - Building Services Piping.
- .8 ASME Boiler and Pressure Vessel Code-2010 - BPVC Section IX - Welding and Brazing Qualifications.
- .9 ASTM A53/A53M-10 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- .10 ASTM A74-09 - Standard Specification for Cast Iron Soil Pipe and Fittings.
- .11 ASTM A234/A234M-10b - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
- .12 ASTM A312/A312M-12 - Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless-Steel Pipes.
- .13 ASTM B32-08 - Standard Specification for Solder Metal.
- .14 ASTM B75-02(2010) - Standard Specification for Seamless Copper Tube.
- .15 ASTM B306-09 - Standard Specification for Copper Drainage Tube (DWV).
- .16 ASTM C564-09a - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- .17 ASTM D2235-04(2011) - Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
- .18 ASTM D2241-09 - Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).

- .19 ASTM D2564-04(2009)e1 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
- .20 ASTM D2683-10 - Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.
- .21 ASTM E814-11a - Standard Test Method for Fire Tests of Penetration Firestop Systems.
- .22 ASTM F708-92(2008) - Standard Practice for Design and Installation of Rigid Pipe Hangers.
- .23 ASTM F1281-07 - Standard Specification for Crosslinked Polyethylene/Aluminum/Crosslinked Polyethylene (PEX-AL-PEX) Pressure Pipe.
- .24 AWS A5.8/A5.8M-2004 - Specification for Filler Metals for Brazing and Braze Welding.
- .25 AWWA C105/A21.5-10 - American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
- .26 AWWA C651-05 - Disinfecting Water Mains.
- .27 CAN/CSA-B1800-11 - Thermoplastic nonpressure piping compendium (Consists of B181.1, B181.2, B181.3, B181.5, B182.1, B182.2, B182.4, B182.6, B182.8, B182.11 and B182.13).
- .28 CSA ANSI Z21.22-99(R03)/CSA 4.4-M99(R04) - Relief Valves for Hot Water Supply Systems.
- .29 MSS SP-110-2010 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
- .30 MSS SP-58-2009 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.
- .31 MSS SP-67-2002a - Butterfly Valves.
- .32 NFPA 54 - National Fuel Gas Code, 2009 Edition.
- .33 UL 1479-2003 - Standard for Fire Tests of Through-Penetration Firestops (3rd Edition).

#### **1.4 SUBMITTALS FOR REVIEW**

- .1 Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalogue information. Indicate valve data and ratings.

#### **1.5 CLOSEOUT SUBMITTALS**

- .1 Record Documentation: Record actual locations of valves.

#### **1.6 QUALITY ASSURANCE**

- .1 Perform Work Ontario Building Code standards.
- .2 Valves: Manufacturer's name and pressure rating marked on valve body.
- .3 Identify pipe with marking including size, ASTM material classification, potable water certification and water pressure rating.

#### **1.7 REGULATORY REQUIREMENTS**

- .1 Perform Work to applicable Ontario Building Code plumbing section
- .2 Conform to applicable code for installation of backflow prevention devices.

- .3 Provide certificate of compliance from authority having jurisdiction indicating approval of installation of backflow prevention devices.

## **1.8 DELIVERY, STORAGE, AND PROTECTION**

- .1 Section : Transport, handle, store, and protect products.
- .2 Accept valves on site in shipping containers with labelling in place. Inspect for damage.
- .3 Provide temporary protective coating on cast iron and steel valves.
- .4 Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- .5 Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

## **1.9 ENVIRONMENTAL REQUIREMENTS**

- .1 Ambient Conditions: Do not install underground piping when bedding is wet or frozen.

## **Part 2 Products.**

### **2.1 SANITARY SEWER PIPING, ABOVE GROUND**

- .1 Cast Iron Pipe: CAN/CSA-B70.
  - .1 Fittings: Hubless Cast Iron Pipe Fittings: to FSWW-P-401.
  - .2 Joints: ASTM C564, rubber or compression gaskets.
- .2 Copper Tube: ASTM B306, DWV.
  - .1 Fittings: ASME B16.23 cast bronze.
  - .2 Joints: ASTM B32, soldered or.
- .3 PVC Pipe: CSA-B181.2 and CAN/ULC S102.2, flame spread rating 15.
  - .1 Fittings: CSA-B181.2, socket type and CAN/ULC S102.2, flame spread rating 15.
  - .2 Joints: ASTM D2564 solvent cement and primer.

### **2.2 DOMESTIC WATER PIPING, ABOVE GROUND**

- .1 Tubing (within walls)
  - .1 Material: Crosslinked polyethylene (PEX) manufactured by PEX-a or Engel method
  - .2 Type: Wirsbo AQUAPEX
  - .3 Material Standard: Manufactured in accordance with ASTM F876 and ASTM F877 and tested for compliance by an independent third party agency
  - .4 Standard grade hydrostatic design and pressure ratings from PPI
  - .5 Fire-rated assembly listings in accordance with ANSI/UL 263
    - .1 UL Design No. L557 — 1-hour wood frame floor/ceiling assemblies
    - .2 UL Design No. K913 — 2-hour concrete floor/ceiling assemblies
    - .3 UL Design No. U372 — 1-hour wood stud/gypsum wallboard wall assemblies

- .4 UL Design No. V444 — 1-hour steel stud/gypsum wallboard wall assemblies
- .6 Minimum Bend Radius (cold bending): No less than six times the outside diameter. Use a bend support as supplied by the PEX tubing manufacturer for tubing with a bend radius less than stated.
- .7 Nominal Inside Diameter: Provide tubing with nominal inside diameter, in accordance with ASTM F876 as indicated.
  - .1  $\frac{3}{8}$  inch [9.53mm]
  - .2  $\frac{1}{2}$  inch [12.7mm]
  - .3  $\frac{3}{4}$  inch [19.05mm]
  - .4 1 inch [25.4mm]
  - .5  $1\frac{1}{4}$  inch [31.75mm]
  - .6  $1\frac{1}{2}$  inch [38.1mm]
  - .7 2 inch [50.8mm]
- .2 Fittings
  - .1 Material: Fitting assembly is manufactured from material listed in paragraph 5.1 of ASTM F1960.
  - .2 Material Standard: Comply with ASTM F1960.
  - .3 Type: PEX-a cold expansion fitting.
    - .1 Assembly consists of the appropriate ProPEX insert with a corresponding ProPEX Ring.
- .3 Manifolds
  - .1 Material
    - .1 Type L copper body with UNS 3600 series brass ProPEX outlet connections
    - .2 Engineered Plastic (EP) body with ProPEX outlet connections
  - .2 Manifold Type
    - .1 Uponor ProPEX 1" Copper Manifold
    - .2 Uponor engineered plastic (EP) Manifold
  - .3 All manifolds manufactured with the appropriate-sized ProPEX fittings on the manifold supply inlets.
- .4 Accessories
  - .1 Angle stops and straight stops that are compatible with PEX tubing are supplied by the PEX tubing manufacturer.
  - .2 Bend supports designed for maintaining tight radius bends are supplied by the PEX tubing manufacturer.
  - .3 ProPEX expander tool to install the ASTM F1960 compatible fittings are supplied by the PEX tubing manufacturer.
  - .4 The tubing manufacturer provides clips and/or PEX rails for supporting tubing runs.
  - .5 All horizontal tubing hangers and riser clamps are epoxy-coated material.
- .5 Copper Tubing (main risers): ASTM B88M, Type M, hard drawn.
  - .1 Fittings: ASME B16.18 cast copper alloy.

- .2 Joints: ASTM B32, soldered.
- .6 Stainless Steel Pipe: ASTM A312, Schedule 10, 304L stainless steel, for pipe sizes 3 inches and larger.
  - .1 Fittings: ASTM A774, 304L stainless steel.
  - .2 Joints: ASTM B75, grooved, victaulic mechanical couplings with EPDM Grade E gasket, suitable for operating temperatures up to 230 degrees F.

## **2.3 STORM WATER PIPING, ABOVE GROUND**

- .1 Cast Iron Pipe: CAN/CSA-B70.
  - .1 Fittings: Hubless Cast Iron Pipe Fittings: to FSWW-P-401.
  - .2 Joints: ASTM C564, rubber or compression gaskets.
- .2 Copper Tube: ASTM B306, DWV.
  - .1 Fittings: ASME B16.23 cast bronze.
  - .2 Joints: Joints: AWS A5.8/A5.8M brazed.
- .3 PVC Pipe: CSA-B181.2.
  - .1 Fittings: CSA-B181.2, socket type.
  - .2 Joints: ASTM D2564 solvent cement and primer.

## **2.4 FLANGES, UNIONS, AND COUPLINGS**

- .1 Ferrous Pipe Size 3 inches and Under: Class 150 malleable iron threaded unions.
- .2 Copper Tube and Pipe Size 3 inches and Under: Class 150 bronze unions with soldered joints.
- .3 Ferrous Pipe Size Over 1 inch: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.
- .4 Copper Tube and Pipe Size Over 1 inch: Class 150 slip-on bronze flanges; preformed neoprene gaskets.
- .5 Grooved and Shouldered Pipe End Couplings:
  - .1 Housing: Malleable iron clamps to engage and lock, designed to permit some angular deflection, contraction, and expansion; steel bolts, nuts, and washers; galvanized for galvanized pipe.
  - .2 Sealing gasket: C-shape composition sealing gasket.
- .6 Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

## **2.5 GATE VALVES**

- .1 Gate Valves Up To and Including 2 inches: MSS SP-80, Class 125, bronze body, bronze trim, rising stem, handwheel, inside screw, solid wedge disc, threaded ends.
- .2 Gate Valves 2-1/2 inches and Larger: MSS SP-70, Class 125, iron body, bronze trim, outside screw and yoke, handwheel, solid wedge disc, flanged ends. Provide chain-wheel operators for valves 6 inches and larger mounted over 8 ft above floor.

## **2.6 BALL VALVES**

- .1 Ball Vaves 4 inches and Smaller: MSS SP-110, Class 150 bronze, two-piece body, chrome plated brass ball, regular port, teflon seats and stuffing box ring, blow-out proof stem, lever handle threaded ends with union.

## **2.7 BUTTERFLY VALVES**

- .1 Butterfly Valves 1-1/2 inches and Larger: MSS SP-67, cast or ductile iron body, nickel-plated ductile iron, Buna N seat, lug ends, extended neck, 10 position lever handle and. Provide gear operators for valves 10" and larger, and chain-wheel operators for valves mounted over 8ft above floor.

## **2.8 FLOW CONTROLS**

- .1 Flow Control: Class 125 bronze body with union on inlet, temperature and pressure test plug on inlet and outlet.
- .2 Calibration: Control flow within 5% of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psi.

## **2.9 SWING CHECK VALVES**

- .1 Swing Check Valves Up To and Including 2 inches: MSS SP-80, Class 125, bronze body and cap, bronze swing disc with rubber seat, threaded ends.
- .2 Swing Check Valves 2-1/2 inches and Larger: MSS SP-71, Class 125, iron body, bronze swing disc, flanged ends.

## **2.10 SPRING LOADED CHECK VALVES**

- .1 Spring Loaded Check Valves: Class 125, iron body, bronze trim, stainless steel springs, bronze disc, Buna N seals, wafer style ends.

## **2.11 WATER PRESSURE REDUCING VALVES**

- .1 Water Pressure Reducing Valves Up to 2 inches MSS SP-80, bronze body, stainless steel and thermoplastic internal parts, fabric reinforced diaphragm, strainer, threaded and single union ends.
- .2 Water Pressure Reducing Valves Over 2 inches: MSS SP-85, cast iron body, bronze fitted, elastomeric diaphragm and seat disc, flanged.

## **2.12 RELIEF VALVES**

- .1 Pressure Relief Valves: AGA Z21.22 certified, bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated.
- .2 Temperature and Pressure Relief Valves: CSA ANSI Z21.22/CSA 4.4 certified, bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 degrees F, capacity BPVC Section IV certified and labelled.

## **2.13 STRAINERS**

- .1 Strainers 2 inch and Under: Class 150, threaded bronze body CWP, Y pattern with 1/32 inch stainless steel perforated screen.

- .2 Strainers 2-1/2 inch to 4 inch: Class 125, flanged iron body, Y pattern with 1/16 inch stainless steel perforated screen.
- .3 Strainers 5 inch and Larger: Class 125, flanged iron body, basket pattern with 1/8 inch stainless steel perforated screen.

#### **2.14 FIRE STOP SEALANTS**

- .1 General Purpose Fire Stopping Sealant: Water based, nonslumping, premixed sealant with intumescent properties, rated for 3 hours per ASTM E814 and UL 1479.
- .2 General Purpose Vibration Resistant Fire Stopping Sealant: Silicone based, nonslumping, premixed sealant with intumescent properties, vibration and moisture resistant, rated for three (3) hours per ASTM E814 and UL 1479.
- .3 DWV Plastic Pipe Systems Fire Stopping Sealant: Silicone based, premixed sealant with intumescent properties, vibration and moisture resistant, rated for three (3) hours per ASTM E814 and UL 1479 with metal collars.

### **Part 3 Execution**

#### **3.1 EXAMINATION**

- .1 Verify existing conditions before starting work.
- .2 Verify that excavations are to required grade, dry, and not over-excavated.

#### **3.2 PREPARATION**

- .1 Ream pipe and tube ends. Remove burrs. Remove scale and dirt, on inside and outside, before assembly.
- .2 Prepare piping connections to equipment with flanges or unions.

#### **3.3 INSTALLATION (AQUA PEX TUBING)**

- .1 Wirsbo AQUAPEX Tubing
  - .1 Install Wirsbo AQUAPEX tubing in accordance with the tubing manufacturer's recommendations and as indicated in the installation handbook.
  - .2 Do not install PEX tubing within 6 inches [152 mm] of gas appliance vents or within 12 inches [305 mm] of any recessed light fixtures.
  - .3 Do not solder within 18 inches [457 mm] of PEX tubing in the same waterline. Make sweat connections prior to making PEX connections.
  - .4 Do not expose PEX tubing to direct sunlight for more than 30 days.
  - .5 Ensure no glues, solvents, sealants or chemicals come in contact with the tubing without prior permission from the tubing manufacturer.
  - .6 Use grommets or sleeves at the penetration for PEX tubing passing through metal studs.
  - .7 Protect PEX tubing with sleeves where abrasion may occur.
  - .8 Use strike protectors where PEX tubing penetrates a stud or joist and has the potential for being struck with a screw or nail.
  - .9 Use tubing manufacturer-supplied bend supports where bends are less than six times the outside tubing diameter.

- .10 Minimum horizontal supports are installed not less than 32 inches between hangers in accordance with model plumbing codes and the installation handbook.
- .11 PEX riser installations require epoxy-coated riser clamps installed at the base of the ceiling per floor.
- .12 A mid-story support is required for riser applications.
- .13 Pressurize Wirsbo AQUAPEX tubing with air in accordance with applicable codes or in the absence of applicable codes to a pressure of 25 psi (173 kPa) above normal working pressure of the system.
- .14 Comply with safety precautions when pressure testing, including use of compressed air, where applicable. Do not use water to pressurize the system if ambient air temperature has the possibility of dropping below 32°F (0°C).
- .2 Through-penetration Firestop
  - .1 Ensure compliance of one- and two-hour rated through penetration assemblies in accordance with ASTM E814.

### 3.4 INSTALLATION (PLUMBING PIPING)

- .1 Install to manufacturer's written instructions.
- .2 Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- .3 Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- .4 Install piping to maintain headroom, conserve space, and not interfere with use of space.
- .5 Group piping whenever practical at common elevations.
- .6 Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 23 05 16.
- .7 Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 23 07 19.
- .8 Provide access where valves and fittings are not exposed.
- .9 Establish elevations of buried piping outside the building to ensure not less than 4 f of cover.
- .10 Install vent piping penetrating roofed areas to maintain integrity of roof assembly.
- .11 Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- .12 Provide support for utility meters to requirements of utility companies.
- .13 Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.
- .14 Install bell and spigot pipe with bell end upstream.
- .15 Install valves with stems upright or horizontal, not inverted.
- .16 Pipe vents from gas pressure reducing valves to outdoors and terminate in weather proof hood.
- .17 Sleeve pipes passing through partitions, walls and floors.
- .18 Inserts:



- .1 Provide inserts for placement in concrete formwork.
- .2 Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- .3 Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
- .4 Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- .5 Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

### 3.5 APPLICATION

- .1 Use grooved mechanical couplings and fasteners only in accessible locations.
- .2 Install unions downstream of valves and at equipment or apparatus connections.
- .3 Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- .4 Install ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- .5 Install ball or globe valves for throttling, bypass, or manual flow control services.
- .6 Provide lug end butterfly valves adjacent to equipment when provided to isolate equipment.
- .7 Provide spring loaded check valves on discharge of water pumps.
- .8 Provide flow controls in water recirculating systems where indicated.

### 3.6 ERECTION TOLERANCES

- .1 Establish invert elevations, slopes for drainage to 1/8 inch per ft minimum. Maintain gradients.
- .2 Slope water piping minimum 0.25% and arrange to drain at low points.

### 3.7 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- .1 Disinfect water distribution system to Section 22 05 81.
- .2 Prior to starting work, verify system is complete, flushed and clean.
- .3 Ensure Ph of water to be treated is between 7.4 and 7.6 by adding alkali .
- .4 Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.
- .5 Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15% of outlets.
- .6 Maintain disinfectant in system for twenty-four (24) hours.
- .7 If final disinfectant residual tests less than 25 mg/L, repeat treatment.
- .8 Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.
- .9 Take samples no sooner than twenty-four (24) hours after flushing, from 10% of outlets and from water entry, and analyze to AWWA C651.

### 3.8 SERVICE CONNECTIONS

- .1 Provide new sanitary and storm services. Before commencing work, check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.
- .2 Provide new water service complete with approved water meter with by-pass valves
  - .1 Provide sleeve in wall for service main and support at wall with reinforced concrete bridge. Caulk enlarged sleeve and make watertight with pliable material. Anchor service main inside to concrete wall.
  - .2 Provide 18 gauge galvanized sheet metal sleeve around service main to 6 inch above floor and 6 ft minimum below grade. Size for minimum of loose batt insulation stuffing.

**END OF SECTION**

**Part 1 General**

**1.1 SECTION INCLUDES**

- .1 Roof and floor drains.
- .2 Cleanouts.
- .3 Hose bibs.
- .4 Hydrants.
- .5 Backflow preventers.
- .6 Water hammer arrestors.
- .7 Interceptors.
- .8 Thermostatic mixing valves.
- .9 Catch basins and manhole components.

**1.2 RELATED SECTIONS**

- .1 Section 22 10 00 - Plumbing Piping.
- .2 Section 22 42 02 - Plumbing Fixtures.
- .3 Section 22 47 00 - Plumbing Equipment.

**1.3 REFERENCES**

- .1 ASTM C478-09 - Standard Specification for Precast Reinforced Concrete Manhole Sections.
- .2 AWWA C510-07 - Double Check Valve Backflow Prevention Assembly.
- .3 AWWA C511-07 - Reduced-Pressure Principle Backflow Prevention Assembly.
- .4 ASSE 1011-2004 - Performance Requirements for Hose Connection Vacuum Breakers.
- .5 ASSE 1012-2009 - Performance Requirements for Backflow Preventer with Intermediate Atmospheric Vent.
- .6 ASSE 1013-2009 - Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers.
- .7 ASSE 1019-2004 - Performance Requirements for Vacuum Breaker Wall Hydrants, Freeze Resistant, Automatic Draining Type.
- .8 PDI-G 101-2010 - Testing and Rating Procedure for Hydro Mechanical Grease Interceptors with Appendix of Installation and Maintenance.
- .9 PDI-WH-201-1992 - Water Hammer Arrestors.

**1.4 SUBMITTALS FOR REVIEW**

- .1 Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.
- .2 Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.

**1.5 SUBMITTALS FOR INFORMATION**

- .1 Certificates: Certify that oil interceptors meet or exceed specified requirements.
- .2 Installation Data: Manufacturer's special installation requirements including assembly and support requirements.

**1.6 CLOSEOUT SUBMITTALS**

- .1 Operation Data: Indicate frequency of treatment required for interceptors.
- .2 Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.
- .3 Record Documentation: Record actual locations of equipment, cleanouts, backflow preventers, water hammer arrestors,

**1.7 QUALITY ASSURANCE**

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five (5) years' experience.

**1.8 DELIVERY, STORAGE, AND PROTECTION**

- .1 Accept specialties on site in original factory packaging. Inspect for damage.

**Part 2 Products**

**2.1 ROOF DRAINS**

- .1 Galvanized cast iron drain with sump, removable cast metal domed strainer with vandal proof screws and including the following accessories.
  - .1 Membrane flange and membrane clamp with integral gravel stop.
  - .2 Adjustable under deck clamp.
  - .3 Roof sump receiver.
  - .4 Waterproofing flange.
  - .5 Controlled flow weir.
  - .6 Levelling frame.
  - .7 Adjustable extension sleeve for roof insulation.
  - .8 Perforated or slotted ballast guard extension for inverted roof.
  - .9 Perforated stainless steel ballast guard extension.

**2.2 PARAPET DRAINS**

- .1 Galvanized cast iron body with aluminum flashing clamp collar and nickel bronze grate, flush.

**2.3 DOWNSPOUT NOZZLES**

- .1 Bronze round with straight bottom section.

## 2.4 AREA DRAINS

- .1 Galvanized and cast iron with sump with square and nickel-bronze strainer and membrane flange and clamp with integral gravel stop, including the following accessories:
  - .1 Adjustable under deck clamp
  - .2 Levelling frame.
  - .3 Perforated or slotted ballast guard extension for inverted roof.
  - .4 Perforated stainless steel ballast guard extension.

## 2.5 FLOOR DRAINS

- .1 Floor Drain: Galvanized cast iron two-piece body with double drainage flange, weep holes, reversible clamping collar]round, adjustable nickel-bronze strainer.
- .2 Trench Drain in shower – galvanized. Follow drawings

## 2.6 CLEANOUTS

- .1 Exterior Surfaced Areas: Round cast nickel bronze access frame and non-skid cover.
- .2 Exterior Unsurfaced Areas: Line type with lacquered cast iron body and round epoxy coated gasketed cover.
- .3 Interior Finished Floor Areas: Galvanized] cast-iron body with anchor flange, threaded top assembly, and round gasketed scored cover in service areas and square gasketed depressed cover to accept floor finish in finished floor areas.
- .4 Interior Finished Wall Areas: Line type with lacquered cast iron body and round epoxy coated gasketed cover, and round stainless steel access cover secured with machine screw.
- .5 Interior Unfinished Accessible Areas: Caulked or threaded type with bolted stack cleanouts on vertical rainwater leaders.

## 2.7 HOSE BIBS

- .1 Interior: Bronze or brass with integral mounting flange, replaceable hexagonal disc, hose thread spout, handwheel and removable key, chrome plated where exposed and integral vacuum breaker to ASSE 1011.
- .2 Interior Mixing: Bronze or brass, wall mounted, double service faucet with hose thread spout, integral stops, chrome plated where exposed, with handwheels, and vacuum breaker to ASSE 1011.

## 2.8 RECESSED VALVE BOX

- .1 Washing Machine: Plastic preformed rough-in box with brass valves with wheel handles and socket for 2 inch waste, slip in finishing cover.
- .2 Refrigerator: Plastic preformed rough-in box with brass valves with wheel handle, slip in finishing cover.

## 2.9 BACK WATER VALVES

- .1 Cast Iron: Galvanized cast iron body and cover, brass valve and access cover.
- .2 Plastic: PVC or ABS body and valve, 6-inch extension sleeve and access cover.

## **2.10 BACKFLOW PREVENTERS**

- .1 Reduced Pressure Backflow Preventers: AWWA C510 and AWWA C511, bronze body with bronze internal parts and stainless steel springs, two (2) independently operating, spring loaded check valves and diaphragm type differential pressure relief valve located between check valves; third check valve that opens under back pressure in case of diaphragm failure.
  - .1 Non-threaded vent outlet.
  - .2 Assembled with two (2) gate valves, strainer, and four test cocks.
- .2 Double Check Valve Assemblies: AWWA C510 and AWWA C511, bronze body with corrosion resistant internal parts and stainless steel springs, with two (2) independently operating check valves with intermediate atmospheric vent.

## **2.11 WATER HAMMER ARRESTORS**

- .1 Copper and construction with piston or bellows type sized to PDI WH-201 and pre-charged suitable for operation in temperature range -100 to 300 degrees F and maximum 150 psi working pressure.

## **2.12 SUMPS**

- .1 Epoxy coated fabricated steel with required openings and drainage fittings; 3/8 inch thick checkered steel plate cover with gasket seal frames and anchor bolts.

## **2.13 GREASE INTERCEPTORS**

- .1 Epoxy coated fabricated steel with multi-weir baffle assembly, integral deep seal trap, removable integral flow control sediment bucket.
  - .1 Rough-in: Fully recessed (shallow rough-in).
  - .2 Cover: Steel, epoxy coated, with gasket, securing handle, and enzyme injection port, recessed for floor finish.
  - .3 Unit Rating

## **2.14 THERMOSTATIC MIXING VALVES**

- .1 Chrome plated cast brass body, stainless steel or copper alloy bellows, integral temperature adjustment, check valve on inlets, volume control shut-off valve on outlet, stem thermometer on outlet and strainer stop checks on inlets.

## **2.15 PRESSURE BALANCED MIXING VALVES**

- .1 Valve: Chrome plated cast brass body, stainless steel cylinder, integral temperature adjustment, volume control shut-off valve on outlet, stem thermometer on outlet and strainer stop checks on inlets.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install to manufacturer's written instructions.

- .2 Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.
- .3 Encase exterior cleanouts in concrete flush with grade.
- .4 Install floor cleanouts at elevation to accommodate finished floor.
- .5 Install approved potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibs.
- .6 Pipe relief from backflow preventer to nearest drain.
- .7 Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to sinks and washing machine outlets and.
- .8 Install air chambers on hot and cold-water supply piping to each fixture or group of fixtures (each washroom). Fabricate same size as supply pipe.

**END OF SECTION**

**Part 1 General**

**1.1 SECTION INCLUDES**

- .1 Water heaters.
- .2 Packaged water heating systems.
- .3 Domestic water heat exchangers.
- .4 Water storage tanks.
- .5 Water softeners.
- .6 Pumps.
  - .1 Circulators.
  - .2 Sump Pumps and sewage ejectors.
- .7 Water pressure booster system.

**1.2 SUBMITTALS FOR REVIEW**

- .1 Product Data:
  - .1 Provide dimension drawings of water heaters indicating components and connections to other equipment and piping.
  - .2 Indicate pump type, capacity, power requirements.
  - .3 Provide certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.
  - .4 Provide electrical characteristics and connection requirements.
- .2 Shop Drawings:
  - .1 Indicate heat exchanger dimensions, size of tappings, and performance data.
  - .2 Indicate dimensions of tanks, tank lining methods, anchors, attachments, lifting points, tappings, and drains.

**1.3 SUBMITTALS FOR INFORMATION**

- .1 Installation Data: Manufacturer's special installation requirements

**1.4 CLOSEOUT SUBMITTALS**

- .1 Record Documentation: Record actual locations of components.
- .2 Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.
- .3 Warranty Documentation: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

**1.5 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Section 01 78 40: Maintenance and extra material requirements.
- .2 Spare Parts: Supply two (2) bags of water softener salt.
- .3 Extra Stock Materials: Provide two (2) pump seals.



## 1.6 QUALITY ASSURANCE

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum [five (5)] years' experience.
- .2 Provide pumps with manufacturer's name, model number, and rating/capacity identified.
- .3 Ensure products and installation of specified products are to recommendations and requirements of the following organizations:
  - .1 American Gas Association (AGA).
  - .2 National Sanitation Foundation (NSF).
  - .3 American Society of Mechanical Engineers (ASME).
  - .4 National Board of Boiler and Pressure Vessel Inspectors (NBBPVI).
  - .5 National Electrical Manufacturers' Association (NEMA).
  - .6 Underwriters Laboratories (UL).
- .4 Ensure pumps operate at specified system fluid temperatures without vapour binding and cavitation, are non-overloading in parallel or individual operation, operate within 25% of midpoint of published maximum efficiency curve.

## 1.7 REGULATORY REQUIREMENTS

- .1 Conform to BPVC Section VIII for manufacture of pressure vessels for heat exchangers.
- .2 Conform to BPVC Section VIII for tanks.
- .3 Products Requiring Electrical Connection: Listed and classified by CSA or [ULc and as suitable for the purpose specified and indicated.

## 1.8 DELIVERY, STORAGE, AND PROTECTION

- .1 Provide temporary inlet and outlet caps. Maintain caps in place until installation.

## 1.9 WARRANTY

- .1 Provide a two (2) year warranty to include coverage for failure to meet specified requirements, for domestic water heaters, water storage tanks, packaged water heating systems, sump pumps, in-line circulator and submersible sump pumps.

## Part 2 Products

### 2.1 DOMESTIC HOT WATER STORAGE TANKS

- .1 Manufacturers:
  - .1 To be confirmed
- .2 Tank: Welded steel, ASME labelled for working pressure of 125 psig, steel support saddles, tappings for accessories, threaded connections of stainless steel, access manhole.
- .3 Lining: 0.015 inches self-priming polymer epoxy, continued into flanged connections.
- .4 Openings: Up to 3 inches, copper-silicone threaded; over 4 inches, flanged,
- .5 Accessories: Tank drain, water inlet and outlet, thermometer range of 40 to 200 degrees F, ASME pressure relief valve suitable for maximum working pressure.

## **2.2 DIAPHRAGM-TYPE COMPRESSION TANKS**

- .1 Manufacturers:
  - .1 Refer to equipment list
- .2 Construction: Welded steel, tested and stamped to Section 8D of ASME Code; supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible EPDM diaphragm sealed into tank, and steel legs or saddles.
- .3 Accessories: Pressure gauge and air-charging fitting, tank drain; pre-charge to 12 psig.
- .4 Size: to be confirmed

## **2.3 WATER SOFTENERS**

- .1 Softener Tank: Glass fibre reinforced plastic tank, with glass fibre reinforced plastic brine tank,
- .2 Performance:
  - .1 Refer to equipment list
- .3 Controls: Reinforced plastic control valve cycled to regenerate after adjustable metred quantity of water flow].

## **2.4 IN-LINE CIRCULATOR PUMPS**

- .1 Manufacturers:
  - .1 Refer to equipment list
- .2 Circulator Pump: Bronze casing and impeller, rated for 125 psig working pressure with stainless steel rotor assembly, alloy steel shaft with integral thrust collar and two (2) oil lubricated bronze sleeve bearings, carbon seal rotating against a stationary ceramic seat, and flexible coupling.

- .3 Performance:

## **2.5 SUMP PUMPS**

- .1 Manufacturers:
  - .1 Refer to equipment list
- .2 Pump Type: Vertical centrifugal, direct connected, duplex arrangement.
- .3 Casing: Cast iron volute with radial clearance around impeller inlet strainer.
- .4 Impeller: Cast iron keyed to stainless steel shaft.
- .5 Support: Cast iron pedestal motor support on steel floor plate with gas tight gaskets.
- .6 Bearings: Oil lubricated bronze sleeve spaced maximum 48 inches grease lubricated ball thrust at floor plate.
- .7 Drive: Flexible coupling to vertical, solid shaft ball bearing electric motor.
- .8 Sump: Steel cover plate with steel curb frame for grouting into concrete sump with inspection opening and cover, and alarm fittings.
- .9 Controls (Duplex): Float operated mechanical alternator with float rod, stops, and corrosion resistant float to alternate operation of pumps; cut-in second pump on rising level or lead pump failure.

- .1 Separate pressure switch high level alarm with transformer, alarm bell, and standpipe.
- .2 Extra set of wired terminals for remote alarm circuit.
- .3 Emergency float switch with float rod, stops, and corrosion resistant float to operate both pumps on failure of alternator.
- .10 Performance:

## 2.6 SUBMERSIBLE SUMP PUMPS

- .1 Manufacturers:
  - .1 Refer to equipment list
- .2 Pump Type: Completely submersible, vertical, centrifugal.
- .3 Casing: Cast iron pump body and oil filled motor chamber.
- .4 Impeller: Cast iron shaft.
- .5 Bearings: Ball bearings.
- .6 Sump: Fibreglass basin with steel cover plate.
- .7 Servicing: Slide-away coupling consisting of discharge elbow secure to sump floor, movable bracket, guide pipe system, lifting chain and chain hooks.
- .8 Controls: Integral diaphragm type level controls with separate liquid level control high level alarm.
- .9 Controls: Motor control panel containing across-the-line electric motor starters with ambient compensated quick trip overloads in each phase with manual trip button and reset button.
  - .1 Circuit breaker.
  - .2 Control transformer.
  - .3 Electro mechanical alternator.
  - .4 Hand-off-automatic selector switches.
  - .5 Pilot lights, high water alarm pilot light.
  - .6 Reset button and alarm horn.
  - .7 Mercury switch liquid level controls.
  - .8 Steel shell switch encased in polyurethane foam with cast iron weight for pump on (each pump), pump off (common), and alarm.
- .10 Performance:

## Part 3 Execution

### 3.1 INSTALLATION

- .1 Domestic Water Heat Exchangers:
  - .1 Install domestic water heat exchangers with clearance for tube bundle removal without disturbing other installed equipment or piping.
  - .2 Support unit on pipe stand.
  - .3 Pipe relief valves and drains to nearest floor drain.

- .4 Connect steam branch line from top of main.
- .5 Pipe in flexible manner, pitched with steam flow, with pipe union connections.
- .6 Provide steam pressure gauge at exchanger inlet.
- .7 Provide steam traps and valves as indicated.
- .8 Pitch shell for condensate drain to traps.
- .2 Domestic Hot Water Storage Tanks:
  - .1 Provide steel pipe support, independent of building structural framing members.
  - .2 Clean and flush after installation. Seal until pipe connections are made.
- .3 Pumps:
  - .1 Ensure shaft length allows sump pumps to be located minimum 24 inches below lowest invert into sump pit and minimum 6 inches clearance from bottom of sump pit.
  - .2 Provide air cock and drain connection on horizontal pump casings.
  - .3 Provide line sized isolating valve and strainer on suction and line sized soft seated check valve and balancing valve on discharge.
  - .4 Decrease from line size with long radius reducing elbows or reducers.
  - .5 Support piping adjacent to pump such that no weight is carried on pump casings.
  - .6 Provide supports under elbows on pump suction and discharge line sizes 4 inches and over.
  - .7 Ensure pumps operate at specified system fluid temperatures without vapour binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25% of midpoint of published maximum efficiency curve.
  - .8 Align and verify alignment of base mounted pumps prior to start-up.

**END OF SECTION**

**Part 1 General**

**1.1 SECTION INCLUDES**

- .1 Single phase electric motors.
- .2 Three phase electric motors.

**1.2 REFERENCES**

- .1 ABMA 9-1990(2008) - Load Ratings and Fatigue Life for Ball Bearings.
- .2 ABMA 11-1990 - Load Ratings and Fatigue Life for Roller Bearings.
- .3 CSA-C22.2 No. 100-04 (R2009) - Motors and Generators.
- .4 IEEE 112-2004 - IEEE Standard Test Procedure for Polyphase Induction Motors and Generators.
- .5 NEMA MG 1-2009, Rev 1-2010 - Motors and Generators.

**1.3 SUBMITTALS FOR REVIEW**

- .1 Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.

**1.4 SUBMITTALS FOR INFORMATION**

- .1 Certificate: Provide certificate of compliance indicating approval of high efficiency motors.
- .2 Installation Data: Indicate setting, mechanical connections, lubrication, and wiring instructions.

**1.5 CLOSEOUT SUBMITTALS**

- .1 Operation Data: Include instructions for safe operating procedures.
- .2 Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

**1.6 QUALITY ASSURANCE**

- .1 Manufacturer: Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five years product development, testing, and manufacturing experience.

**1.7 REGULATORY REQUIREMENTS**

- .1 Products Requiring Electrical Connection: Listed and classified by ULc or CSA and as suitable for the purpose specified and indicated.

**1.8 DELIVERY, STORAGE, AND PROTECTION**

- .1 Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering.

## 1.9 WARRANTY

- .1 Provide a two (2) year warranty including coverage for motors larger than 20 HP.

## Part 2 Products

### 2.1 MANUFACTURERS

- .1 Acceptable Manufacturers:
  - .1 Baldor
  - .2 WEG
  - .3 US Motors
  - .4 Approved equivalent

### 2.2 GENERAL CONSTRUCTION AND REQUIREMENTS

- .1 Motors Less Than 250 Watts, for Intermittent Service: Equipment manufacturer's standard and need not conform to these specifications.
- .2 Electrical Service:
  - .1 Motors 1/2 HP and Smaller: 115 volts, single phase, 60 Hz.
  - .2 Motors Larger than 3/4 HP: 208 volts, three phase, 60 Hz.
- .3 Motor Type:
  - .1 Open drip-proof except where specifically noted otherwise.
  - .2 Design motors for continuous operation in 40 degrees C environment.
  - .3 Design for temperature rise to CSA-C22.2 No. 100 and limits for insulation class, service factor, and motor enclosure type.
  - .4 Motors with frame sizes [254T] and larger: Energy Efficient Type.
- .4 Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, power factor, service factor and efficiency
- .5 Wiring Terminations:
  - .1 Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to code, threaded for conduit.
  - .2 For fractional horsepower motors where connection is made directly, provide conduit connection in end frame.

### 2.3 SINGLE PHASE POWER - SPLIT PHASE MOTORS

- .1 Starting Torque: Less than 150% of full load torque.
- .2 Starting Current: Up to seven times full load current.
- .3 Breakdown Torque: Approximately 200% of full load torque.
- .4 Drip-proof Enclosure: Class A 50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.

- .5 Enclosed Motors: Class A 50 degrees C temperature rise insulation, 1.0 Service Factor, prelubricated ball bearings.

## **2.4 THREE PHASE POWER - SQUIRREL CAGE MOTORS**

- .1 Starting Torque: Between 1 and 1-1/2 times full load torque.
- .2 Starting Current: Six times full load current.
- .3 Power Output, Locked Rotor Torque, Breakdown or Pull-Out Torque: NEMA Design B characteristics.
- .4 Design, Construction, Testing, and Performance: Conform to CSA-C22.2 No. 100 for Design B motors.
- .5 Insulation System: NEMA Class B or better.
- .6 Testing Procedure: To IEEE 112. Load test motors to determine free from electrical or mechanical defects in compliance with performance data.
- .7 Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
- .8 Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors imbedded in motor windings and epoxy encapsulated solid state control relay for wiring into motor starter; refer to Section 26 29 23 - Variable Frequency Controllers.
- .9 Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum AFBMA 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt centre line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
- .10 Sound Power Levels: To CSA-C22.2 No. 100.
- .11 Part Winding Start Above 254T Frame Size: Use part of winding to reduce locked rotor starting current to approximately 60% of full winding locked rotor current while providing approximately 50% of full winding locked rotor torque.
- .12 Nominal Efficiency: As scheduled at full load and rated voltage when tested to IEEE 112.
- .13 Nominal Power Factor: As scheduled at full load and rated voltage when tested to IEEE 112.

## **Part 3 Execution**

### **3.1 APPLICATION**

- .1 Single phase motors for shaft mounted fans or centrifugal pumps: Split phase type.
- .2 Motors located in exterior locations, direct drive axial fans, air cooled condensers: Totally enclosed type.

### **3.2 INSTALLATION**

- .1 Install to manufacturer's written instructions.
- .2 Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
- .3 Check line voltage and phase and ensure agreement with nameplate.

### 3.3 NEMA OPEN MOTOR SERVICE FACTOR SCHEDULE

	3600 RPM	1800 RPM	1200 RPM	900 RPM
0.25 HP	1.35	1.35	1.35	1.35
0.50 HP	1.25	1.25	1.25	1.15
0.75 HP	1.25	1.25	1.15	1.15
1 HP	1.25	1.15	1.15	1.15
1.5 HP	1.15	1.15	1.15	1.15

### 3.4 PERFORMANCE SCHEDULE

.1 Three Phase - Energy Efficient, Open Drip-Proof.

	RPM (Syn)	NEMA Frame	Minimum % Efficiency	Minimum % Power Factor
1 HP	1800	143T	82	84
1.5 HP	1800	145T	84	85
2 HP	1800	145T	84	85
3 HP	1800	182T	86	86
5 HP	1800	184T	87	87
7.5 HP	1800	213T	88	86
10 HP	1800	215T	89	85
15 HP	1800	256T	91	85
20 HP	1800	256T	91	86
25 HP	1800	284T	91	85
30 HP	1800	286T	92	88
40 HP	1800	324T	92	83
50 HP	1800	326T	93	85
1.5 HP	3600	143T	82	85
2 HP	3600	145T	82	87
3 HP	3600	145T	84	85
5 HP	3600	182T	85	86
7.5 HP	3600	184T	86	88
10 HP	3600	213T	87	86
15 HP	3600	215T	89	89
20 HP	3600	254T	90	89
25 HP	3600	256T	90	92
30 HP	3600	284T	91	91
40 HP	3600	286T	92	92
50 HP	3600	324T	93	89

END OF SECTION



**Part 1 General**

**1.1 SECTION INCLUDES**

- .1 Positive displacement meters.
- .2 Pressure gauges and Pressure gauge taps.
- .3 Thermometers and thermometer wells.
- .4 Test plugs and kits.
- .5 Static pressure gauges.

**1.2 RELATED SECTIONS**

- .1 Section 23 21 00 - Hydronic Piping: Installation of pressure gauge tappings and thermometer wells.

**1.3 REFERENCES**

- .1 ASME B40.100-2005 - Pressure Gauges and Gauge Attachments.
- .2 ASTM E1-07 - Standard Specification for ASTM Liquid-in-Glass Thermometers.
- .3 ASTM E77-07 - Standard Test Method for Inspection and Verification of Thermometers.
- .4 AWWA C701-07 - Cold-Water Meters, Turbine Type, for Customer Service.
- .5 AWWA C706-10 - Direct-Reading, Remote-Registration Systems for Cold-Water Meters.
- .6 AWWA M6-99 - Water Meters - Selection, Installation, Testing, and Maintenance.
- .7 UL 393-2005 - Standard for Indicating Pressure Gauges for Fire-Protection Service (8th Edition).

**1.4 SUBMITTALS FOR REVIEW**

- .1 Product Data: Provide list which indicates use, operating range, total range and location for manufactured components.

**1.5 CLOSEOUT SUBMITTALS**

- .1 Operation and Maintenance Data:
- .2 Record Documentation: Record actual locations of components and instrumentation.

**1.6 ENVIRONMENTAL REQUIREMENTS**

- .1 Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

**1.7 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Extra Stock Materials:
  - .1 Provide two (2), pressure gauges with pulsation damper and dial thermometers.

**Part 2 Products**

**2.1 POSITIVE DISPLACEMENT METERS (LIQUID)**

- .1 AWWA C700, positive displacement disc type suitable for fluid with bronze case and cast iron bottom cap, hermetically sealed register.
- .2 Meter: Brass body turbine meter with magnetic drive register.
  - .1 Service: Cold water.
  - .2 Accuracy: [1-1/2%].
  - .3 Maximum Counter Reading:
  - .4 Size: 3/4 inch.

**2.2 PRESSURE GAUGES**

- .1 Manufacturers:
  - .1 Ashcroft or approved equivalent product
- .2 Gauge: ASME B40.1, drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.
  - .1 Case: Cast aluminum with phosphor bronze bourdon tube.
  - .2 Size: 90 mm 3-1/2 inch diameter.
  - .3 Mid-Scale Accuracy: 2%.
  - .4 Scale: Both kPa and psia.

**2.3 PRESSURE GAUGE TAPPINGS**

- .1 Gauge Cock: Tee or lever handle, brass for maximum 150 psig.
- .2 Needle Valve: Stainless Steel, 1/4 inch NPT for minimum 150 psig.

**2.4 DIAL THERMOMETERS**

- .1 Manufacturers:
  - .1 Omega or approved equivalent product
- .2 Thermometer: ASTM E1, stainless steel case, bimetallic helix actuated with silicone fluid damping, white with black markings and black pointer hermetically sealed lens, stainless steel stem and stainless steel thermowell.
  - .1 Size: 3 inch diameter dial.
  - .2 Lens: Clear glass.
  - .3 Accuracy: 1%.
  - .4 Calibration: Both degrees C and degrees F..

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Install to manufacturer's written instructions.

- .2 Install positive displacement meters with isolating valves on inlet and outlet. Provide full line size valved bypass with globe valve for liquid service meters.
- .3 Provide one (1) pressure gauge per pump, installing taps before strainers and on suction and discharge of pump. Pipe to gauge.
- .4 Install pressure gauges with pulsation dampers. Provide needle valve to isolate each gauge.
- .5 Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.
- .6 Install thermometers in air duct systems on flanges.
- .7 Install thermometer sockets adjacent to controls systems thermostat, transmitter, or sensor sockets.
- .8 Coil and conceal excess capillary on remote element instruments.
- .9 Provide instruments with scale ranges selected according to service with largest appropriate scale.
- .10 Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- .11 Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.

**END OF SECTION**

**1.1** This section includes specialty items associated with hydronic piping systems.

**Part 2 General**

**2.1 SECTION INCLUDES**

- .1 Expansion tanks.
- .2 Air vents.
- .3 Air separators.
- .4 Strainers.
- .5 Pump suction fittings.
- .6 Combination fittings.
- .7 Relief valves.
- .8 Glycol specialties.

**2.2 RELATED SECTIONS**

- .1 Section 22 42 01 - Plumbing Specialties: Backflow Preventers.
- .2 Section 23 21 00 - Hydronic Piping.

**2.3 REFERENCES**

- .1 ASME Boiler and Pressure Vessel Code-2010 - BPVC Section VIII - Rules for Construction of Pressure Vessels.

**2.4 SUBMITTALS FOR REVIEW**

- .1 Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description, model and dimensions.

**2.5 SUBMITTALS FOR INFORMATION**

- .1 Certificates: Submit inspection certificates for pressure vessels from authority having jurisdiction.
- .2 Installation Data: Indicate hanging and support methods, joining procedures.

**2.6 CLOSEOUT SUBMITTALS**

- .1 Maintenance Contracts:
  - .1 Provide service and maintenance of glycol system for one (1) year from date of substantial completion.
  - .2 Monthly visit to make glycol fluid concentration analysis on site with refractive index measurement instrument. Detail findings with maintenance personnel in writing of corrective actions needed including analysis and amounts of glycol or water added.
- .2 Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

- .3 Record Documentation: Record actual locations of flow controls and flow meters.

## **2.7 QUALITY ASSURANCE**

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five (5) years' experience.

## **2.8 DELIVERY, STORAGE, AND PROTECTION**

- .1 Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- .2 Provide temporary protective coating on cast iron and steel valves.
- .3 Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- .4 Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

## **Part 3 Products**

### **3.1 DIAPHRAGM-TYPE EXPANSION TANKS**

- .1 Manufacturers:
  - .1 Armstrong or approved equivalent product
- .2 Construction: Welded steel, tested and stamped to ASME SEC 8-D; supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible EPDM diaphragm sealed into tank.
- .3 Accessories: Pressure gauge and air-charging fitting, tank drain; precharge to 12 psig.
- .4 Automatic Cold-Water Fill Assembly: Pressure reducing valve, double check back flow preventer, test cocks, strainer, vacuum breaker, and valved by-pass.
- .5 Size:
  - .1 Refer to equipment list

### **3.2 AIR VENTS**

- .1 Float Type:
  - .1 Manufacturers:
    - .1 Maid o the Mist or approved equivalent product
  - .2 Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.

### **3.3 AIR SEPARATORS**

- .1 In-line Air Separators:
  - .1 Manufacturers:
    - .1 Armstrong or approved equivalent product
  - .2 Steel for sizes 2 inch and larger; tested and stamped to ASME SEC 8-D; for 125 psig operating pressure.

### 3.4 STRAINERS

- .1 Strainers: Size 2 inch and Under:
  - .1 Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen.
- .2 Strainers: Size 2-1/2 inch to 4 inch:
  - .1 Flanged iron body for 175 psig working pressure, Y pattern with 3/64 inch stainless steel perforated screen.
- .3 Strainers: Size 5 inch and Larger:
  - .1 Flanged iron body for 175 psig working pressure, basket pattern with 1/8 inch stainless steel perforated screen.

### 3.5 PUMP SUCTION FITTINGS

- .1 Fitting: Angle pattern, cast-iron body, threaded for 2 inch and smaller, flanged for 2-1/2 inch and larger, rated for 175 psig working pressure, with inlet vanes, cylinder strainer with 3/16 inch diameter openings, disposable fine mesh strainer to fit over cylinder strainer, and permanent magnet located in flow stream and removable for cleaning.
- .2 Accessories: Adjustable foot support, blowdown tapping in bottom, gauge tapping in side.

### 3.6 COMBINATION PUMP DISCHARGE VALVES

- .1 Valves: Straight or angle pattern, flanged cast-iron valve body with bolt-on bonnet for 175 psig operating pressure, non-slam check valve with spring-loaded bronze disc and seat, stainless steel stem, and calibrated adjustment permitting flow regulation.

### 3.7 FLOW CONTROLS

- .1 Construction: Brass or bronze body with union on outlet and temperature/pressure test plug on inlet and outlet.
- .2 Calibration: Control flow within 5% of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psig.
- .3 Control Mechanism: Stainless steel or nickel plated brass piston or regulator cup, operating against stainless steel helical or wave formed spring.
- .4 Accessories: In-line strainer on inlet and ball valve on outlet.

### 3.8 RELIEF VALVES

- .1 Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labelled.

## Part 4 Execution

### 4.1 INSTALLATION

- .1 Install specialties to manufacturer's written instructions.
- .2 Where large air quantities can accumulate, provide enlarged air collection standpipes.
- .3 Provide manual air vents at system high points and as indicated.

- .4 For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain.
- .5 Provide air separator on suction side of system circulation pump and connect to expansion tank.
- .6 Provide valved drain and hose connection on strainer blow down connection.
- .7 Provide pump suction fitting on suction side of base mounted centrifugal pumps where indicated. Remove temporary strainers after cleaning systems.
- .8 Provide combination pump discharge valve on discharge side of base mounted centrifugal pumps
- .9 Support pump fittings with floor mounted pipe and flange supports.
- .10 Provide radiator valves on water inlet to terminal heating units such as radiation, unit heaters, and fan coil units.
- .11 Provide radiator balancing valves on water outlet from terminal heating units such as radiation, unit heaters, and fan coil units.
- .12 Provide relief valves on pressure tanks, low pressure side of reducing valves, heat exchangers, and expansion tanks.
- .13 Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.
- .14 Pipe relief valve outlet to nearest floor drain.
- .15 Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.
- .16 Clean and flush glycol system before adding glycol solution.
- .17 Perform tests determining strength of glycol and water solution and submit written test results.

**END OF SECTION**

**Part 1 General**

**1.1 SECTION INCLUDES**

- .1 Pipe and equipment hangers and supports.
- .2 Equipment bases and supports.
- .3 Sleeves and seals.
- .4 Flashing and sealing equipment and pipe stacks.

**1.2 RELATED SECTIONS**

- .1 Section 23 07 19 - Piping Insulation.
- .2 Section 23 07 16 - Equipment Insulation.
- .3 Section 22 10 00 - Plumbing Piping.
- .4 Section 23 21 00 - Hydronic Piping.

**1.3 REFERENCES**

- .1 ASME B31.1-2007/B31.3-2008 - Power Piping and Process Piping (Set).
- .2 ASME B31.2-1968 - Fuel Gas Piping.
- .3 ASME B31.5-2010 - Refrigeration Piping and Heat Transfer Components.
- .4 ASME B31.9-2011 - Building Services Piping.
- .5 ASTM F708-92(2008) - Standard Practice for Design and Installation of Rigid Pipe Hangers.
- .6 MSS SP-58-2009 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.
- .7 MSS SP-69-2002 - Pipe Hangers and Supports Selection and Application.
- .8 NFPA 13 - Standard for the Installation of Sprinkler Systems, 2010 Edition.
- .9 NFPA 14 - Standard for the Installation of Standpipe and Hose Systems, 2010 Edition.
- .10 UL 203-2005 - Pipe Hanger Equipment for Fire-Protection Service (9th Edition).

**1.4 SUBMITTALS FOR REVIEW**

- .1 Product Data: Provide manufacturers catalogue data including load capacity.
- .2 Shop Drawings: Indicate system layout with location and detail of trapeze hangers.

**1.5 SUBMITTALS FOR INFORMATION**

- .1 Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- .2 Installation Data: Indicate special installation procedures and assembly of components.

**1.6 REGULATORY REQUIREMENTS**

- .1 Conform to applicable code for support of hydronic and plumbing piping.



- .2 Supports for Sprinkler Piping: To NFPA 13.
- .3 Supports for Standpipes: To NFPA 14.

## **Part 2 Products**

### **2.1 PIPE HANGERS AND SUPPORTS**

- .1 Acceptable Manufacturers:
  - .1 Myatt
  - .2 Grinnel
  - .3 Or approved equivalent product
- .2 Fire Protection Piping:
  - .1 Conform to NFPA 14.
  - .2 Hangers for Pipe Sizes 13 to 38 mm: Malleable iron, adjustable swivel, split ring.
  - .3 Hangers for Pipe Sizes 50 mm and Over: Carbon steel, adjustable, clevis.
  - .4 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
  - .5 Wall Support for Pipe Sizes to 75 mm: Cast iron hook.
  - .6 Wall Support for Pipe Sizes 100mm and Over: Welded steel bracket and wrought steel clamp.
  - .7 Vertical Support: Steel riser clamp.
  - .8 Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
  - .9 Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- .3 Plumbing Piping - DWV:
  - .1 Conform to MSS SP-69.
  - .2 Hangers for Pipe Sizes 13 to 38 mm: Malleable iron, adjustable swivel, split ring.
  - .3 Hangers for Pipe Sizes 50 mm and Over: Carbon steel, adjustable, clevis.
  - .4 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
  - .5 Wall Support for Pipe Sizes to 75 mm: Cast iron hook.
  - .6 Wall Support for Pipe Sizes 100 mm and Over: Welded steel bracket and wrought steel clamp.
  - .7 Vertical Support: Steel riser clamp.
  - .8 Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
  - .9 Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- .4 Plumbing Piping - Water:
  - .1 Conform to ASME B31.9
  - .2 Hangers for Pipe Sizes 13 to 38 mm Malleable iron, adjustable swivel, split ring.
  - .3 Hangers for Cold Pipe Sizes 50 mm and Over: Carbon steel, adjustable, clevis.
  - .4 Hangers for Hot Pipe Sizes 50to 100 mm: Carbon steel, adjustable, clevis.

- .5 Hangers for Hot Pipe Sizes 150 mm and Over: Adjustable steel yoke, cast iron roll, double hanger.
  - .6 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
  - .7 Multiple or Trapeze Hangers for Hot Pipe Sizes 150 mm and Over: Steel channels with welded spacers and hanger rods, cast iron roll.
  - .8 Wall Support for Pipe Sizes to 76 mm: Cast iron hook.
  - .9 Wall Support for Pipe Sizes 100 mm and Over: Welded steel bracket and wrought steel clamp.
  - .10 Wall Support for Hot Pipe Sizes 150 mm and Over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast-iron roll.
  - .11 Vertical Support: Steel riser clamp.
  - .12 Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
  - .13 Floor Support for Hot Pipe Sizes to 100 mm: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
  - .14 Floor Support for Hot Pipe Sizes 150 mm and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
  - .15 Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- .5 Hydronic Piping:
- .1 Conform to MSS SP-69.
  - .2 Hangers for Pipe Sizes 13 to 38 mm: Malleable iron, adjustable swivel, split ring.
  - .3 Hangers for Cold Pipe Sizes 50 mm and Over: Carbon steel, adjustable, clevis.
  - .4 Hangers for Hot Pipe Sizes 50 to 100 mm: Carbon steel, adjustable, clevis.
  - .5 Hangers for Hot Pipe Sizes 150 mm and Over: Adjustable steel yoke, cast iron roll, double hanger.
  - .6 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
  - .7 Multiple or Trapeze Hangers for Hot Pipe Sizes 150 mm and Over: Steel channels with welded spacers and hanger rods, cast iron roll.
  - .8 Wall Support for Pipe Sizes to 76 mm: Cast iron hook.
  - .9 Wall Support for Pipe Sizes 100 mm and Over: Welded steel bracket and wrought steel clamp.
  - .10 Wall Support for Hot Pipe Sizes 150 mm and Over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
  - .11 Vertical Support: Steel riser clamp.
  - .12 Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
  - .13 Floor Support for Hot Pipe Sizes to 100 mm: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
  - .14 Floor Support for Hot Pipe Sizes 150 mm and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
  - .15 Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

## **2.2 ACCESSORIES**

- .1 Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

## **2.3 INSERTS**

- .1 Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

## **2.4 FLASHING**

- .1 Metal Flashing: 26-gauge galvanized steel.
- .2 Metal Counterflashing: 22-gauge galvanized steel.
- .3 Lead Flashing:
  - .1 Waterproofing: 5 lb/sq ft sheet lead.
  - .2 Soundproofing: 1 lb/sq ft sheet lead.
- .4 Flexible Flashing: 1.2 mm thick sheet compatible with roofing.
- .5 Caps: Steel, 22 gauge minimum; 16 gauge at fire resistant elements.

## **2.5 SLEEVES**

- .1 Sleeves for Pipes Through Non-fire Rated Floors: 18 gauge galvanized steel.
- .2 Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gauge galvanized steel.
- .3 Sleeves for Pipes Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed,
- .4 Sleeves for Round Ductwork: Galvanized steel.
- .5 Sleeves for Rectangular Ductwork: Galvanized steel or wood.
- .6 Firestopping and Insulation: Glass fibre type, non-combustible
- .7 Sealant: Acrylic

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install components to manufacturer's written instructions.

### **3.2 INSERTS**

- .1 Provide inserts for placement in concrete formwork.
- .2 Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- .3 Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
- .4 Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

- .5 Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with above flush with top of slab.

### 3.3 PIPE HANGERS AND SUPPORTS

- .1 Support horizontal piping as scheduled.
- .2 Install hangers to provide minimum 13 mm space between finished covering and adjacent work.
- .3 Place hangers within 300 mm of each horizontal elbow.
- .4 Use hangers with 38 mm minimum vertical adjustment.
- .5 Support horizontal cast iron pipe adjacent to each hub, with 1.5 m maximum spacing between hangers.
- .6 Support vertical piping at every other floor. Support vertical cast iron pipe at each floor at hub.
- .7 Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- .8 Support riser piping independently of connected horizontal piping.
- .9 Provide copper plated hangers and supports for copper piping.
- .10 Design hangers for pipe movement without disengagement of supported pipe.
- .11 Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

### 3.4 EQUIPMENT BASES AND SUPPORTS

- .1 Provide housekeeping pads of concrete, minimum 100 mm thick and extending 150 mm beyond supported equipment.
- .2 Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.
- .3 Construct supports of steel members. Brace and fasten with flanges bolted to structure.
- .4 Provide rigid anchors for pipes after vibration isolation components are installed.

### 3.5 FLASHING

- .1 Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
- .2 Flash vent and soil pipes projecting 75 mm minimum above finished roof surface with lead worked 25 mm minimum into hub, 200mm minimum clear on sides with 600 x 600 mm sheet size. For pipes through outside walls, turn flanges back into wall and caulk, metal counterflash and seal.
- .3 Flash floor drains in floors with topping over finished areas with lead, 250 mm clear on sides with minimum 910 x 910 mm sheet size. Fasten flashing to drain clamp device.
- .4 Seal mop sink and drains watertight to adjacent materials.
- .5 Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms, installed to manufacturer's written instructions for sound control.

- .6 Provide curbs for mechanical roof installations 350 mm minimum high above roofing surface. Flash and counterflash with sheet metal; seal watertight. Attach counterflashing mechanical equipment and lap base flashing on roof curbs. Flatten and solder joints.
- .7 Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

### 3.6 SLEEVES

- .1 Set sleeves in position in formwork. Provide reinforcing around sleeves.
- .2 Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- .3 Extend sleeves through floors 25 mm above finished floor level. Caulk sleeves.
- .4 Install chrome plated steel escutcheons at finished surfaces.

### 3.7 SCHEDULES

PIPE SIZE	MAX. HANGER SPACING	DIAMETER
12 - 32 mm	2 m	9 mm
38 - 50 mm	3 m	9 mm
62 - 75 mm	3 m	13 mm
100 - 150 mm	3 m	15 mm
200 - 300 mm	4.25 m	22 mm
350 and over mm	6 m	25 mm
PVC (All Sizes)	1.8 m	9 mm

END OF SECTION

**Part 1 General**

**1.1 SECTION INCLUDES**

- .1 Vibration isolation.

**1.2 RELATED SECTIONS**

- .1 Section 23 05 16 - Piping Expansion Compensation.
- .2 Section 23 05 29 - Supports And Anchors..

**1.3 PERFORMANCE REQUIREMENTS**

- .1 Provide vibration isolation on motor driven equipment over 0.5 HP, plus connected piping and ductwork.
- .2 Provide minimum static deflection of isolators for equipment as indicated.
  - .1 Basement, Under 20 HP:
    - .1 400 - 600 rpm: 1 inch.
    - .2 600 - 800 rpm: 0.5 inch.
    - .3 800 - 900 rpm: 0.2 inch.
    - .4 1100 - 1500 rpm: 0.14 inch.
    - .5 Over 1500 rpm: 0.1 inch.
- .3 Consider upper floor locations critical unless otherwise indicated.

**1.4 SUBMITTALS FOR REVIEW**

- .1 Product Data: Provide schedule of vibration isolator type with location and load on each.
- .2 Shop Drawings: Indicate inertia bases and locate vibration isolators, with static and dynamic load on each.

**1.5 SUBMITTALS FOR INFORMATION**

- .1 Installation Data: Indicate special procedures and setting dimensions.
- .2 Manufacturer's Certificate: Certify that isolators are properly installed and adjusted to meet or exceed project requirements.

**1.6 CLOSEOUT SUBMITTALS**

- .1 Record Documentation: Record actual locations of hangers including attachment points.

**Part 2 Products**

**2.1 VIBRATION ISOLATORS**

- .1 Spring Hanger:
  - .1 Spring Isolators:
    - .1 For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
    - .2 Code: Colour code springs for load carrying capacity.

- .2 Springs: Minimum horizontal stiffness equal to 75% vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
- .3 Housings: Incorporate rubber hanger with threaded insert.
- .4 Misalignment: Capable of 20 degree hanger rod misalignment.
- .2 Neoprene Pad Isolators:
  - .1 Rubber or neoprene waffle pads:
    - .1 30 durometer.
    - .2 Minimum 1/2 inch thick.
    - .3 Maximum loading 40 psi.
    - .4 Height of ribs: maximum 0.7 times width.
  - .2 Configuration: Single layer.
  - .3 Configuration: 1/2 inch thick waffle pads bonded each side of 1/4 inch thick steel plate
- .3 Glass Fibre Pads: Neoprene jacketed pre-compressed moulded glass fibre.
- .4 Rubber Mount or Hanger: Moulded rubber designed for 13 mm deflection with threaded insert.

### **Part 3 Execution**

#### **3.1 INSTALLATION**

- .1 Install to manufacturer's written instructions.
- .2 Install isolation for motor driven equipment and as required by acoustical consultant..
- .3 Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.
- .4 Provide pairs of horizontal limit springs on fans with more than 6 inch static pressure, and on hanger supported, horizontally mounted axial fans.
- .5 Support piping connections to isolated equipment resiliently as follows.
  - .1 Up to 4-inch Diameter: First three points of support.
  - .2 Select three hangers closest to vibration source for minimum 1.0-inch static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 1.0-inch static deflection or 1/2 static deflection of isolated equipment.
- .6 Connect wiring to isolated equipment with flexible hanging loop.

#### **3.2 MANUFACTURER'S FIELD SERVICES**

- .1 Inspect isolated equipment after installation and submit report. Include static deflections.

**END OF SECTION**

**Part 1 General**

**1.1 SECTION INCLUDES**

- .1 Nameplates.
- .2 Tags.
- .3 Pipe Markers.

**1.2 REFERENCES**

- .1 ASME A13.1-2007 - Scheme for the Identification of Piping Systems.

**1.3 SUBMITTALS FOR REVIEW**

- .1 Product Data: Provide manufacturers catalogue literature for each product required.
- .2 Identification Information:
  - .1 Submit list of wording, symbols, letter size, and colour coding for mechanical identification.
  - .2 Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

**1.4 CLOSEOUT SUBMITTALS**

- .1 Record Documentation: Record actual locations of tagged valves.

**Part 2 Products**

**2.1 NAMEPLATES**

- .1 Description: Laminated three-layer plastic with engraved black letters on light contrasting background colour.

**2.2 TAGS**

- .1 Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background colour
- .2 Metal Tags: Brass and with stamped letters; tag size minimum , with smooth edges.
- .3 Chart: Typewritten letter size list in anodized aluminum frame.

**2.3 PIPE MARKERS**

- .1 Colour: Conform to ASME A13.1.
- .2 Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- .3 Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.



- .4 Underground Plastic Pipe Markers: Bright coloured continuously printed plastic ribbon tape, minimum <150 mm><<6 inches>> wide by <0.10 mm><<4 mil>> thick, manufactured for direct burial service.

## 2.4 CEILING TACKS

- .1 Description: Steel with 3/4 inch diameter colour coded head.
- .2 Colour code as follows:
  - .1 Yellow - HVAC equipment.
  - .2 Red - Fire dampers/smoke dampers.
  - .3 Green - Plumbing valves.
  - .4 Blue - Heating/cooling valves.

## Part 3 Execution

### 3.1 PREPARATION

- .1 Degrease and clean surfaces to receive adhesive for identification materials.

### 3.2 INSTALLATION

- .1 Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- .2 Install tags with corrosion resistant chain.
- .3 Install plastic pipe markers to manufacturer's written instructions.
- .4 Install plastic tape pipe markers complete around pipe to manufacturer's written instructions.
- .5 Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.
- .6 Identify thermostats relating to terminal boxes or valves with nameplates.
- .7 Identify valves in main and branch piping with tags.
- .8 Identify air terminal units and radiator valves with numbered tags.
- .9 Tag automatic controls, instruments, and relays. Key to control schematic.
- .10 Identify piping, concealed or exposed, with plastic tape pipe markers. Use tags on piping 3/4-inch diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 ft on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
- .11 Identify ductwork with plastic nameplates. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.
- .12 Provide ceiling tacks to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

**Part 1 General**

**1.1 SECTION INCLUDES**

- .1 Testing, adjustment, and balancing of air systems.
- .2 Testing, adjustment, and balancing of hydronic systems.

**1.2 REFERENCES**

- .1 AABC-2002 - National Standards for Total System Balance.
- .2 ADC 1062: GRD-84 - Test Code for Grilles, Registers, and Diffusers.
- .3 ASHRAE 111-2008 - Testing, Adjusting, and Balancing of Building HVAC Systems.
- .4 NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.
- .5 SMACNA - HVAC Systems Testing, Adjusting, and Balancing (3rd Edition).

**1.3 ADMINISTRATIVE REQUIREMENTS**

- .1 Pre-installation Meetings: Convene 2 weeks before starting work of this section.
- .2 Sequencing: Sequence work to commence after completion of systems and schedule completion of work before Substantial Completion of Project.

**1.4 SUBMITTALS FOR INFORMATION**

- .1 Submit name of adjusting and balancing agency for approval within thirty (30) days after award of Contract.
- .2 Field Reports: Submit procedures for submitting Field Reports.
  - .1 Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
  - .2 Prior to commencing work, submit report forms or outlines indicating adjusting, balancing, and equipment data required.
  - .3 Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for consultant and for inclusion in operating and maintenance manuals.
  - .4 Provide reports complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
- .3 Test Reports: Indicate data on forms containing information indicated in Schedules. Submit data in SI (metric) units.

**1.5 CLOSEOUT SUBMITTALS**

- .1 Record Documentation: Record actual locations of flow measuring stations, balancing valves and rough setting.

**1.6 QUALITY ASSURANCE**

- .1 Perform total system balance to ASHRAE 111.

- .2 Maintain 2 copies of each document on site.
- .3 Agency Qualifications: Company specializing in the testing, adjusting, and balancing of systems specified in this Section with minimum five (5) years' experience.
- .4 Perform Work under supervision of registered Professional Engineer experienced in performance of this Work and licensed in the Province of Ontario.

## **Part 2 Execution**

### **2.1 EXAMINATION**

- .1 Verify that systems are complete and operable before commencing work. Ensure the following conditions:
  - .1 Systems are started and operating in a safe and normal condition.
  - .2 Temperature control systems are installed complete and operable.
  - .3 Proper thermal overload protection is in place for electrical equipment.
  - .4 Final filters are clean and in place. If required, install temporary media in addition to final filters.
  - .5 Duct systems are clean of debris.
  - .6 Fans are rotating correctly.
  - .7 Fire and volume dampers are in place and open.
  - .8 Air coil fins are cleaned and combed.
  - .9 Access doors are closed and duct end caps are in place.
  - .10 Air outlets are installed and connected.
  - .11 Duct system leakage is minimized.
  - .12 Hydronic systems are flushed, filled, and vented.
  - .13 Pumps are rotating correctly.
  - .14 Proper strainer baskets are clean and in place.
  - .15 Service and balance valves are open.
- .2 Submit field reports. Report defects and deficiencies noted during performance of services which prevent system balance.
- .3 Beginning of work means acceptance of existing conditions.

### **2.2 PREPARATION**

- .1 Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Consultant to facilitate spot checks during testing.
- .2 Provide additional balancing devices as required.

### **2.3 INSTALLATION TOLERANCES**

- .1 Air Handling Systems: Adjust to within plus or minus 5% of design for supply systems and plus or minus 10% of design for return and exhaust systems.
- .2 Air Outlets and Inlets: Adjust total to within plus 10% and minus 5% of design to space. Adjust outlets and inlets in space to within plus or minus 10% of design.
- .3 Hydronic Systems: Adjust to within plus or minus 10% of design.

## 2.4 ADJUSTING

- .1 Ensure recorded data represents actual measured or observed conditions.
- .2 Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- .3 After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- .4 Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- .5 At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.
- .6 Check and adjust systems approximately six months after final acceptance and submit report.

## 2.5 AIR SYSTEM PROCEDURE

- .1 Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities.
- .2 Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- .3 Measure air quantities at air inlets and outlets.
- .4 Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- .5 Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
- .6 Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- .7 Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- .8 Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50% loading of filters.
- .9 Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- .10 Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- .11 Where modulating dampers are provided, take measurements and balance at extreme conditions.
- .12 Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches positive static pressure near the building entries.
- .13 Check multi-zone units for motorized damper leakage. Adjust air quantities with mixing dampers set first for cooling, then heating, then modulating.

- .14 For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.

## 2.6 WATER SYSTEM PROCEDURE

- .1 Adjust water systems to provide required or design quantities.
- .2 Use calibrated fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.
- .3 Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
- .4 Effect system balance with automatic control valves fully open to heat transfer elements.
- .5 Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.
- .6 Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

## 2.7 SCHEDULES

- .1 Equipment requiring testing, adjusting and balancing:
  - .1 Plumbing Pumps.
  - .2 HVAC Pumps.
  - .3 Boilers.
  - .4 Air Coils.
  - .5 Air Handling Units.
  - .6 Fans.
  - .7 Air Filters.
  - .8 Air Inlets and Outlets.
- .2 Report Forms:
  - .1 Title Page:
    - .1 Name of Testing, Adjusting, and Balancing Agency.
    - .2 Address of Testing, Adjusting, and Balancing Agency.
    - .3 Telephone number of Testing, Adjusting, and Balancing Agency.
    - .4 Project name.
    - .5 Project location.
    - .6 Project Architect.
    - .7 Project Engineer.
    - .8 Project Contractor.
    - .9 Project altitude.
    - .10 Report date.
  - .2 Summary Comments:
    - .1 Design versus final performance.

- .2 Notable characteristics of system.
- .3 Description of systems operation sequence.
- .4 Summary of outdoor and exhaust flows to indicate amount of building pressurization.
- .5 Nomenclature used throughout report.
- .6 Test conditions.
- .3 Instrument List:
  - .1 Instrument.
  - .2 Manufacturer.
  - .3 Model number.
  - .4 Serial number.
  - .5 Range.
  - .6 Calibration date.
- .4 Electric Motors:
  - .1 Manufacturer.
  - .2 Model/Frame.
  - .3 HP/BHP.
  - .4 Phase, voltage, amperage; nameplate, actual, no load.
  - .5 RPM.
  - .6 Service factor.
  - .7 Starter size, rating, heater elements.
  - .8 Sheave Make/Size/Bore.
- .5 V-Belt Drive:
  - .1 Identification/location.
  - .2 Required driven RPM.
  - .3 Driven sheave, diameter and RPM.
  - .4 Belt, size and quantity.
  - .5 Motor sheave diameter and RPM.
  - .6 Centre to centre distance, maximum, minimum, and actual.
- .6 Pump Data:
  - .1 Identification/number.
  - .2 Manufacturer.
  - .3 Size/model.
  - .4 Impeller.
  - .5 Service.
  - .6 Design flow rate, pressure drop, BHP.
  - .7 Actual flow rate, pressure drop, BHP.
  - .8 Discharge pressure.
  - .9 Suction pressure.
  - .10 Total operating head pressure.
  - .11 Shut off, discharge and suction pressures.
  - .12 Shut off, total head pressure.
- .7 Heat Exchanger:

- .1 Identification/number.
- .2 Location.
- .3 Service.
- .4 Manufacturer.
- .5 Model number.
- .6 Serial number.
- .7 Steam pressure, design and actual.
- .8 Primary water entering temperature, design and actual.
- .9 Primary water leaving temperature, design and actual.
- .10 Primary water flow, design and actual.
- .11 Primary water pressure drop, design and actual.
- .12 Secondary water leaving temperature, design and actual.
- .13 Secondary water leaving temperature, design and actual.
- .14 Secondary water flow, design and actual.
- .15 Secondary water pressure drop, design and actual.
- .8 Heating Coil Data:
  - .1 Identification/number.
  - .2 Location.
  - .3 Service.
  - .4 Manufacturer.
  - .5 Air flow, design and actual.
  - .6 Water flow, design and actual.
  - .7 Water pressure drop, design and actual.
  - .8 Entering water temperature, design and actual.
  - .9 Leaving water temperature, design and actual.
  - .10 Entering air temperature, design and actual.
  - .11 Leaving air temperature, design and actual.
  - .12 Air pressure drop, design and actual.
- .9 Air Moving Equipment.
  - .1 Location.
  - .2 Manufacturer.
  - .3 Model number.
  - .4 Serial number.
  - .5 Arrangement/Class/Discharge.
  - .6 Air flow, specified and actual.
  - .7 Return air flow, specified and actual.
  - .8 Outside air flow, specified and actual.
  - .9 Total static pressure (total external), specified and actual.
  - .10 Inlet pressure.
  - .11 Discharge pressure.
  - .12 Sheave Make/Size/Bore.
  - .13 Number of Belts/Make/Size.



- .14 Fan RPM.
- .10 Return Air/Outside Air Data:
  - .1 Identification/location.
  - .2 Design air flow.
  - .3 Actual air flow.
  - .4 Design return air flow.
  - .5 Actual return air flow.
  - .6 Design outside air flow.
  - .7 Actual outside air flow.
  - .8 Return air temperature.
  - .9 Outside air temperature.
  - .10 Required mixed air temperature.
  - .11 Actual mixed air temperature.
  - .12 Design outside/return air ratio.
  - .13 Actual outside/return air ratio.
- .11 Exhaust Fan Data:
  - .1 Location.
  - .2 Manufacturer.
  - .3 Model number.
  - .4 Serial number.
  - .5 Air flow, specified and actual.
  - .6 Total static pressure (total external), specified and actual.
  - .7 Inlet pressure.
  - .8 Discharge pressure.
  - .9 Sheave Make/Size/Bore.
  - .10 Number of Belts/Make/Size.
  - .11 Fan RPM.
- .12 Duct Traverse:
  - .1 System zone/branch.
  - .2 Duct size.
  - .3 Area.
  - .4 Design velocity.
  - .5 Design air flow.
  - .6 Test velocity.
  - .7 Test air flow.
  - .8 Duct static pressure.
  - .9 Air temperature.
  - .10 Air correction factor.
- .13 Duct Leak Test:
  - .1 Description of ductwork under test.
  - .2 Duct design operating pressure.
  - .3 Duct design test static pressure.

- .4 Duct capacity, air flow.
- .5 Maximum allowable leakage duct capacity times leak factor.
- .6 Test apparatus.
  - .1 Blower.
  - .2 Orifice, tube size.
  - .3 Orifice size.
  - .4 Calibrated.
- .7 Test static pressure.
- .8 Test orifice differential pressure.
- .9 Leakage.

**END OF SECTION**

**Part 1 General**

**1.1 SECTION INCLUDES**

- .1 Duct work insulation.
- .2 Duct Liner.
- .3 Insulation jackets.

**1.2 RELATED SECTIONS**

- .1 Section 23 05 53 - Mechanical Identification.
- .2 Section 23 31 00 - Duct Work: Glass fibre duct work.
- .3 Section 23 31 00 - Duct Work: Duct liner.

**1.3 REFERENCES**

- .1 ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
- .2 ASTM C518-10 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
- .3 ASTM C553-08 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
- .4 ASTM C921-10 - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .5 ASTM E162-09 - Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source.
- .6 ASTM E84-10b - Standard Test Method for Surface Burning Characteristics of Building Materials.
- .7 ASTM E96/E96M-10 - Standard Test Methods for Water Vapor Transmission of Materials.
- .8 NAIMA - National Insulation Standards.
- .9 NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials, 2006 Edition.
- .10 SMACNA - HVAC Duct Construction Standards - Metal and Flexible (2005).
- .11 UL 723 - Tests for Surface Burning Characteristics of Building Materials (10th Edition).

**1.4 SUBMITTALS FOR REVIEW**

- .1 Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

**1.5 SUBMITTALS FOR INFORMATION**

- .1 Installation Data: Indicate installation procedures which ensure acceptable workmanship and installation standards will be achieved.

## 1.6 QUALITY ASSURANCE

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five (5) years' experience.
- .2 Installer Qualifications: Company specializing in performing the work of this section with minimum five (5) years documented experience and approved by the General Contractor.

## 1.7 REGULATORY REQUIREMENTS

- .1 Materials: Flame spread/smoke developed rating of 25/50 to ASTM E84.

## 1.8 DELIVERY, STORAGE, AND PROTECTION

- .1 Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.
- .2 Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

## 1.9 ENVIRONMENTAL REQUIREMENTS

- .1 Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- .2 Maintain temperature during and after installation for minimum period of twenty-four (24) hours.

## Part 2 Products

### 2.1 GLASS FIBRE, FLEXIBLE

- .1 Insulation: ASTM C553; flexible, non-combustible blanket.
  - .1 Thermal Conductivity: ASTM C518, .25Btu.in/h.sq ft at 75 degrees F
  - .2 Maximum service temperature: 250 degrees F.
  - .3 Maximum moisture absorption: 0.20% by volume.
- .2 Vapour Barrier Jacket:
  - .1 Kraft paper with glass fibre yarn and bonded to aluminized film .
  - .2 Moisture vapour transmission: ASTM E96/E96M; 0.02 perm.
  - .3 Secure with pressure sensitive tape.
- .3 Vapour Barrier Tape:
  - .1 Kraft paper reinforced with glass fibre yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.
- .4 Outdoor Vapour Barrier Mastic:
  - .1 Vinyl emulsion type acrylic or mastic, compatible with insulation, black colour.
- .5 Tie Wire: Annealed steel, 16 gauge.

### 2.2 GLASS FIBRE, RIGID

- .1 Insulation: ASTM C612; rigid, non-combustible blanket.
  - .1 Thermal Conductivity: ASTM C518, 0.25Btu.in/h.sq ft at 75 degrees F.

- .2 Maximum service temperature: 250 degrees F.
- .3 Maximum moisture absorption: 0.20% by volume.
- .4 Density: 3.0 lb/cu ft.
- .2 Vapour Barrier Jacket:
  - .1 Kraft paper with glass fibre yarn and bonded to aluminized film.
  - .2 Moisture vapour transmission: ASTM E96/E96M; 0.04 perm.
  - .3 Secure with two (2) coats of vapour barrier mastic and pressure sensitive tape.
- .3 Vapour Barrier Tape:
  - .1 Kraft paper reinforced with glass fibre yarn and bonded to aluminized film, with pressure sensitive rubber-based adhesive.
- .4 Indoor Vapour Barrier Finish:
  - .1 Cloth: Untreated; 9 oz/sq yd weight, glass fabric.
  - .2 Vinyl emulsion type acrylic, compatible with insulation, white colour.

## 2.3 JACKETS

- .1 Canvas Jacket: UL listed.
  - .1 Fabric: 6 oz/sq yd plain weave cotton treated with dilute fire-retardant lagging adhesive.
  - .2 Lagging Adhesive:
    - .1 Compatible with insulation.
- .2 Mineral Fibre (Outdoor) Jacket: Asphalt impregnated and coated sheet, 36 lb/square.
- .3 Aluminum Jacket: ASTM B209M.
  - .1 Thickness: 0.016 inch sheet.
  - .2 Finish: Smooth.
  - .3 Joining: Longitudinal slip joints and 2-inch laps.
  - .4 Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
  - .5 Metal Jacket Bands: 3/8-inch-wide thick aluminum.

## Part 3 Execution

### 3.1 EXAMINATION

- .1 Verify that duct work has been tested before applying insulation materials.
- .2 Verify that surfaces are clean, foreign material removed, and dry.

### 3.2 INSTALLATION

- .1 Install to manufacturer's written instructions and to NAIMA - National Insulation Standards.
- .2 Insulated duct work conveying air below ambient temperature:
  - .1 Provide insulation with vapour barrier jackets.
  - .2 Finish with tape and vapour barrier jacket.

- .3 Continue insulation through walls, sleeves, hangers, and other duct penetrations.
- .4 Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
- .3 Insulated duct work conveying air above ambient temperature:
  - .1 Provide with or without standard vapour barrier jacket.
  - .2 Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.
- .4 Duct Work Exposed in Mechanical Equipment Rooms or Finished Spaces above finished floor: Finish with canvas jacket sized for finish painting.
- .5 Exterior Applications: Provide insulation with vapour barrier jacket.
- .6 External Duct Insulation Application:
  - .1 Secure insulation with vapour barrier with wires and seal jacket joints with vapour barrier adhesive or tape to match jacket.
  - .2 Secure insulation without vapour barrier with staples, tape, or wires.
  - .3 Install without sag on underside of duct work. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct work off trapeze hangers and insert spacers.
  - .4 Seal vapour barrier penetrations by mechanical fasteners with vapour barrier adhesive.
  - .5 Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.
- .7 Plenum Liner and Duct Liner Application:
  - .1 Adhere insulation with adhesive for 90% and coverage.
  - .2 Secure insulation with mechanical liner fasteners. Refer to SMACNA Standards for spacing.
  - .3 Seal and smooth joints. Seal and coat transverse joints.
  - .4 Seal liner surface penetrations with adhesive.
  - .5 Duct dimensions indicated are net inside dimensions required for air flow. Increase duct size to allow for insulation thickness.

**END OF SECTION**

**Part 1 General**

**1.1 SECTION INCLUDES**

- .1 Equipment insulation.
- .2 Covering.

**1.2 RELATED SECTIONS**

- .1 Section 23 05 53 - Mechanical Identification.
- .2 Section 22 10 00 - Plumbing Piping: Placement of hangers and hanger inserts.
- .3 Section 23 21 00 - Hydronic Piping: Placement of hangers and hanger inserts.

**1.3 REFERENCES**

- .1 ASTM A167-99 (2009) - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- .2 ASTM C177-10 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
- .3 ASTM C553-08 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
- .4 ASTM C921-10 - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .5 ASTM E84-10b - Standard Test Method for Surface Burning Characteristics of Building Materials.
- .6 ASTM E96/E96M-10 - Standard Test Methods for Water Vapor Transmission of Materials.
- .7 NAIMA - National Insulation Standards.
- .8 NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials, 2006 Edition.
- .9 UL 723 - Tests for Surface Burning Characteristics of Building Materials (10th Edition).

**1.4 SUBMITTALS FOR REVIEW**

- .1 Product Data: Provide product description, thermal characteristics, list of materials and thickness for equipment scheduled.

**1.5 SUBMITTALS FOR INFORMATION**

- .1 Installation Data: Indicate installation procedures which ensure acceptable workmanship and installation standards will be achieved.

**1.6 QUALITY ASSURANCE**

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five (5) years' experience.
- .2 Installer Qualifications: Company specializing in performing the work of this section with minimum five (5) years documented experience and approved by the General Contractor.

## 1.7 REGULATORY REQUIREMENTS

- .1 Materials: Flame spread/smoke developed rating of 25/50 to ASTM E84.

## 1.8 DELIVERY, STORAGE, AND PROTECTION

- .1 Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.
- .2 Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

## 1.9 ENVIRONMENTAL REQUIREMENTS

- .1 Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- .2 Maintain temperature during and after installation for minimum period of twenty-four (24) hours.

## Part 2 Products

### 2.1 GLASS FIBRE, FLEXIBLE

- .1 Calcium Silicate Insulation: ASTM C553; Type Type II – pipe and Type I - block, preformed, high temperature insulation.
  - .1 Thermal Conductivity (k-factor): 0.24.
  - .2 Maximum Service Temperature: 250 degrees F.
  - .3 Maximum Moisture Absorption: 0.2% by volume.
  - .4 Density: 1 lb/cu ft.
- .2 Vapour Barrier Jacket:
  - .1 Kraft paper reinforced with glass fibre yarn and bonded to aluminized film.
  - .2 Moisture vapour transmission: ASTM E96/E96M, 0.02 perm.
  - .3 Secure with self-sealing longitudinal laps and butt strips.
  - .4 Secure with outward clinch expanding staples and vapour barrier mastic.
- .3 Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centres.
- .4 Vapour Barrier Lap Adhesive: compatible with insulation.
- .5 Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

### 2.2 GLASS FIBRE, RIGID

- .1 Insulation: ASTM C592; rigid, non-combustible.
  - .1 Thermal Conductivity (k-factor): ASTM C177 or ASTM C518, 0.24.
  - .2 Maximum Service Temperature: 450 degrees F.
  - .3 Maximum Moisture Absorption: 0.1% by volume.
  - .4 Density: 1.0 lb/cu ft.
- .2 Vapour Barrier Jacket:
  - .1 Kraft paper reinforced with glass fibre yarn and bonded to aluminized film.



- .2 Moisture vapour transmission: ASTM E96/E96M; 0.02 perm.
- .3 Secure with self-sealing longitudinal laps and butt strips.
- .4 Secure with outward clinch expanding staples and vapour barrier mastic.
- .3 Facing: 1 inch, galvanized steel hexagonal wire mesh stitched onto both faces of insulation.
- .4 Vapour Barrier Lap Adhesive: compatible with insulation.
- .5 Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

## 2.3 JACKETS

- .1 PVC Plastic Jacket: Sheet material, off-white colour.
  - .1 Minimum Service Temperature: -40 degrees F.
  - .2 Maximum Service Temperature: 150 degrees F.
  - .3 Moisture Vapour Transmission: ASTM E96/E96M; 0.002 perm-inches.
  - .4 Thickness: 10 mil
  - .5 Connections: Pressure sensitive colour matching vinyl tape.
  - .6 Covering Adhesive Mastic: compatible with insulation.
- .2 Canvas Jacket: UL listed.
  - .1 Fabric: ASTM C921, 6 oz/sq yd, plain weave cotton treated with dilute fire retardant lagging adhesive.
  - .2 Lagging Adhesive: compatible with insulation.

## Part 3 Execution

### 3.1 EXAMINATION

- .1 Verify that equipment has been tested before applying insulation materials.
- .2 Verify that surfaces are clean and dry, with foreign material removed.

### 3.2 INSTALLATION

- .1 Install components to manufacturer's written instructions.
- .2 Factory Insulated Equipment: Do not insulate.
- .3 Exposed Equipment: Locate insulation and cover seams in least visible locations.
- .4 Apply insulation close to equipment by grooving, scoring, and bevelling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
- .5 Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapour barrier cement.
- .6 Fibre glass insulated equipment containing fluids below ambient temperature: Provide vapour barrier jackets, factory-applied or field-applied. Finish with glass cloth and vapour barrier adhesive.
- .7 For hot equipment containing fluids 140 degrees F or less, do not insulate flanges and unions, but bevel and seal ends of insulation.

- .8 For hot equipment containing fluids over 140 degrees F, insulate flanges and unions with removable sections and jackets.
- .9 Fibre glass insulated equipment containing fluids above ambient temperature: Provide standard jackets, with or without vapour barrier, factory-applied or field-applied. Finish with glass cloth and adhesive.
- .10 Inserts and Shields:
  - .1 Application: Equipment 2 inch diameter or larger.
  - .2 Shields: Galvanized steel between hangers and inserts.
  - .3 Insert location: Between support shield and equipment and under the finish jacket.
  - .4 Insert configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
  - .5 Insert material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
- .11 Finish insulation at supports, protrusions, and interruptions.
- .12 Equipment in Mechanical Equipment Rooms or Finished Spaces: Finish with PVC jacket and fitting covers.
- .13 Exterior Applications: Provide vapour barrier jacket or finish with glass mesh reinforced vapour barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal equipment.
- .14 Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.
- .15 Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation so it can be easily removed and replaced without damage.

### 3.3 SCHEDULES

- .1 Heating Systems:
  - .1 Pump Bodies:
  - .2 Heat Exchangers/Converters
  - .3 Air Separators:
  - .4 Expansion Tanks

**END OF SECTION**

**Part 1 General**

**1.1 SECTION INCLUDES**

- .1 Piping insulation.
- .2 Jackets and accessories.

**1.2 RELATED SECTIONS**

- .1 Section 23 05 53 - Mechanical Identification.
- .2 Section 23 21 00 - Hydronic Piping: Placement of hangers and hanger inserts.

**1.3 REFERENCES**

- .1 ASTM C195-07 - Standard Specification for Mineral Fiber Thermal Insulating Cement.
- .2 ASTM C335/C335M-10e1 - Standard Test Method for Steady-State Heat Transfer Properties of Pipe Insulation.
- .3 ASTM C449-07 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
- .4 ASTM C518-10 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
- .5 ASTM C547-07e1 - Standard Specification for Mineral Fiber Pipe Insulation.
- .6 ASTM C578-10a - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
- .7 ASTM C585-10 - Standard Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing.
- .8 ASTM C921-10 - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .9 ASTM E84-10b - Standard Test Method for Surface Burning Characteristics of Building Materials.
- .10 ASTM E96/E96M-10 - Standard Test Methods for Water Vapor Transmission of Materials.
- .11 NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials, 2006 Edition.
- .12 UL 723-2008 - Tests for Surface Burning Characteristics of Building Materials (10th Edition).

**1.4 SUBMITTALS FOR REVIEW**

- .1 Product Data: Provide product description, list of materials and thickness for each service, and locations.

**1.5 QUALITY ASSURANCE**

- .1 Applicator: Qualifications: Company specializing in performing the work of this section with minimum five (5) years documented experience .

## 1.6 DELIVERY, STORAGE, AND PROTECTION

- .1 Deliver materials to site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.
- .2 Store insulation in original wrapping and protect from weather and construction traffic.
- .3 Protect insulation against dirt, water, chemical, and mechanical damage.

## 1.7 ENVIRONMENTAL REQUIREMENTS

- .1 Ambient Condition:
  - .1 Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
  - .2 Maintain temperature during and after installation for minimum period of twenty-four (24) hours.

## Part 2 Products

### 2.1 GLASS FIBRE MOULDED PIPE INSULATION

- .1 Manufacturers:
  - .1 Owens Corning or approved equivalent product
- .2 Insulation: ASTM C547; rigid moulded, non-combustible.
  - .1 Thermal Conductivity (K-factor): ASTM C335, 0.035 at 24 degrees C.
  - .2 Minimum Service Temperature: -20 degrees F.
  - .3 Maximum Service Temperature: 250 degrees F.
  - .4 Maximum Moisture Absorption: 0.2% by volume.
  - .5 1.5" thick
- .3 Vapour Barrier Jacket:
  - .1 ASTM C921, White kraft paper reinforced with glass fibre yarn and bonded to aluminized film.
  - .2 Moisture Vapour Transmission: ASTM E96; 0.03 ng/Pa s sq m.
  - .3 Secure with self-sealing longitudinal laps and butt strips.
  - .4 Secure with outward clinch expanding staples and vapour barrier mastic.
- .4 Vapour Barrier Lap Adhesive:
  - .1 Compatible with insulation.
- .5 Insulating Cement/Mastic:
  - .1 ASTM C195; hydraulic setting on mineral wool.
- .6 Indoor Vapour Barrier Finish:
  - .1 Vinyl emulsion type acrylic, compatible with insulation, white colour.
- .7 Insulating Cement: ASTM C449.

## 2.2 JACKETS

- .1 PVC Plastic:
  - .1 Jacket: ASTM C921, One piece moulded type fitting covers and sheet material, off white colour.
    - .1 Minimum Service Temperature: -40 degrees F.
    - .2 Maximum Service Temperature: 150 degrees F.
    - .3 Moisture Vapour Transmission: ASTM E96; 0.002 perm inches.
    - .4 Maximum Flame Spread: ASTM E84; 25.
    - .5 Maximum Smoke Developed: ASTM E84; 50.
    - .6 Thickness: 0.38 mm.
    - .7 Connections: Pressure sensitive colour matching vinyl tape.
  - .2 Covering Adhesive Mastic:
    - .1 Compatible with insulation.
- .2 Stainless Steel Jacket FOR EXTERIOR PIPEWORK: Type 304 stainless steel.
  - .1 Thickness: 0.016 inch.
  - .2 Finish: Smooth.
  - .3 Metal Jacket Bands: 3/8-inch-thick stainless steel.

## Part 3 Execution

### 3.1 EXAMINATION

- .1 Verify that piping has been tested before applying insulation materials.
- .2 Verify that surfaces are clean, foreign material removed, and dry.

### 3.2 INSTALLATION

- .1 Install materials to manufacturer's written instructions.
- .2 On exposed piping, locate insulation and cover seams in least visible locations.
- .3 Insulated dual temperature pipes or cold pipes conveying fluids below ambient temperature:
  - .1 Provide vapour barrier jackets, factory applied or field applied.
  - .2 Insulate fittings, joints, and valves with moulded insulation of like material and thickness as adjacent pipe.
  - .3 Finish with glass cloth and vapour barrier adhesive.
  - .4 PVC fitting covers may be used.
  - .5 Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations.
  - .6 Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, [pump bodies] and expansion joints.
- .4 For insulated pipes conveying fluids above ambient temperature:
  - .1 Provide standard jackets, with or without vapour barrier, factory applied or field applied.

- .2 Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe.
- .3 Finish with glass cloth and adhesive.
- .4 PVC fitting covers may be used.
- .5 For hot piping conveying fluids 60 degrees C or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
- .6 For hot piping conveying fluids over 60 degrees C, insulate flanges and unions at equipment.
- .5 Inserts and Shields:
  - .1 Application: Piping 2 inch diameter or larger.
  - .2 Shields: steel between pipe hangers or pipe hanger rolls and inserts.
  - .3 Insert Location: Between support shield and piping and under the finish jacket.
  - .4 Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
  - .5 Insert Material: other heavy density insulating material suitable for the planned temperature range.
- .6 Finish insulation at supports, protrusions, and interruptions.
- .7 For pipe exposed in mechanical equipment rooms or in finished spaces below 10 ft above finished floor, finish with stainless steel jacket.

### 3.3 TOLERANCE

- .1 Substituted insulation materials: Thermal resistance within 10% at normal conditions, as materials indicated.

**END OF SECTION**

**Part 1 General**

**1.1 SECTION INCLUDES**

- .1 Pipe and pipe fittings for:
  - .1 Heating water (and glycol) piping system.
  - .2 Equipment drains and overflows.
- .2 Valves:
  - .1 Gate valves.
  - .2 Ball valves.
  - .3 Butterfly valves.
  - .4 Check valves.

**1.2 RELATED SECTIONS**

- .1 Section 23 05 16 - Piping Expansion Compensation.
- .2 Section 23 05 53 - Mechanical Identification.
- .3 Section 23 05 48 - Vibration Isolation.
- .4 Section 23 07 19 - Piping Insulation.
- .5 Section 23 05 20 - Hydronic Specialties.

**1.3 REFERENCES**

- .1 ASME Boiler and Pressure Vessel Code-2010 - BPVC Section IX - Welding and Brazing Qualifications.
- .2 ASME B16.3-2006 - Malleable Iron Threaded Fittings.
- .3 ASME B16.18-2001 (R2005) - Cast Copper Alloy Solder Joint Pressure Fittings.
- .4 ASME B16.22-2001 (R2005) - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- .5 ASME B31.5-2010 - Refrigeration Piping and Heat Transfer Components.
- .6 ASME B31.9-2011 - Building Services Piping.
- .7 ASTM A53/A53M-10 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- .8 ASTM A234/A234M-10b - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
- .9 ASTM B32-08 - Standard Specification for Solder Metal.
- .10 ASTM B88-09 - Standard Specification for Seamless Copper Water Tube.
- .11 ASTM D1785-06 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
- .12 ASTM D2235-04(2011) - Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.

- .13 ASTM D2241-09 - Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
- .14 ASTM D2310-06 - Standard Classification for Machine-Made "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.
- .15 ASTM D2466-06 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
- .16 ASTM D2467-06 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
- .17 ASTM D2680-01(2009) - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping.
- .18 ASTM D2683-10 - Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.
- .19 ASTM D2751-05 - Standard Specification for Acrylonitrile Butadiene Styrene (ABS) Sewer Pipe and Fittings.
- .20 ASTM D2855-96(2010) - Standard Practice for Making Solvent Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings.
- .21 ASTM F477-10 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
- .22 ASTM F876-10 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing.
- .23 ASTM F877-07 - Standard Specification for Crosslinked Polyethylene (PEX) Plastic Hot and Cold Water Distribution Systems.
- .24 AWS A5.8/A5.8M-2004 - Specification for Filler Metals for Brazing and Braze Welding.
- .25 AWS D1.1/D1.1M-2010 - Structural Welding Code - Steel.
- .26 AWWA C105/A21.5-10 - American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
- .27 AWWA C110/A21.10-08 - Ductile-Iron and Gray-Iron Fittings for Water.
- .28 AWWA C111/A21.11-07 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .29 AWWA C151/A21.51-09 - Ductile-Iron Pipe, Centrifugally Cast.
- .30 MSS SP-58-2009 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.
- .31 MSS SP-69-2002 - Pipe Hangers and Supports Selection and Application.

#### 1.4 SYSTEM DESCRIPTION

- .1 Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
- .2 Use grooved mechanical couplings and fasteners in accessible locations.
- .3 Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.



- .4 Use non-conducting dielectric connections whenever jointing dissimilar metals in open systems.
- .5 Provide pipe hangers and supports to ASTM B31.9 unless indicated otherwise.
- .6 Use ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- .7 Use ball valves for throttling, bypass, or manual flow control services.
- .8 Use plug cocks for throttling service.
- .9 Use butterfly valves in heating systems interchangeably with gate and globe valves.
- .10 Use lug end butterfly valves to isolate equipment.
- .11 Use 3/4 inch ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment. Pipe to nearest floor drain.

#### **1.5 SUBMITTALS FOR REVIEW**

- .1 Product Data: Include data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalogue information. Indicate valve data and ratings.

#### **1.6 SUBMITTALS FOR INFORMATION**

- .1 Welders Certificate: Include welders' certification of compliance with ASME SEC 9.
- .2 Installation Data: Manufacturer's special installation requirements including hanging and support methods, joining procedures.

#### **1.7 CLOSEOUT SUBMITTALS**

- .1 Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.
- .2 Record Documentation: Record actual locations of valves

#### **1.8 QUALITY ASSURANCE**

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five (5) years' experience.
- .2 Installer Qualifications: Company specializing in performing the work of this section with minimum five (5) years' experience.
- .3 Welders: Certified to ASME SEC 9

#### **1.9 REGULATORY REQUIREMENTS**

- .1 Conform to ASME B31.9 code for installation of piping system.
- .2 Welding Materials and Procedures: Conform to ASME SEC 9 and applicable provincial labour regulations.

#### **1.10 DELIVERY, STORAGE, AND PROTECTION**

- .1 Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- .2 Provide temporary protective coating on cast iron and steel valves.

- .3 Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- .4 Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

#### 1.11 ENVIRONMENTAL REQUIREMENTS

- .1 Ambient Conditions: Do not install underground piping when bedding is wet or frozen.

### Part 2 Products

#### 2.1 HEATING WATER AND GLYCOL PIPING (STEEL OR COPPER), ABOVE GROUND

- .1 Steel Pipe: ASTM A53, Schedule 40, 0.375 inch wall for sizes 12 inch and over, black.
  - .1 Fittings: ASTM B16.3, malleable iron or ASTM A234, forged steel welding type fittings.
  - .2 Joints: Threaded, or AWS D1.1, welded.
- .2 Copper Tubing: ASTM B88, Type M hard drawn.
  - .1 Fittings: ASME B16.18, cast brass, or ASME B16.22, solder wrought copper.
  - .2 Tee Connections: Mechanically extracted collars with notched and dimpled branch tube.
  - .3 Joints: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range

#### 2.2 EQUIPMENT DRAINS AND OVERFLOWS

- .1 Steel Pipe: ASTM A53, Schedule 40 galvanized.
  - .1 Fittings: Galvanized cast iron, or ASTM B16.3 malleable iron.
  - .2 Joints: Threaded, or grooved mechanical couplings.
- .2 Copper Tubing: ASTM B88, Type M hard drawn.
  - .1 Fittings: ASME B16.18, cast brass, or ASME B16.22 solder wrought copper.
  - .2 Joints: Solder, lead free, or tin and silver, with melting range 430 to 535 degrees F.
- .3 PVC Pipe: ASTM D1785, Schedule 40, and Schedule 80 for sizes 8 inches and larger.
  - .1 Fittings: ASTM D2466 or D2467, PVC.
  - .2 Joints: ASTM D2855, solvent weld.
- .4 ABS Pipe: ASTM D2680 or D2751.
  - .1 Fittings: ASTM D2751.
  - .2 Joints: ASTM D2235, solvent weld.

#### 2.3 UNIONS, FLANGES, AND COUPLINGS

- .1 Unions for Pipe 2 inches and Under:
  - .1 Ferrous Piping: 150 psig malleable iron, threaded.
  - .2 Copper Pipe: Bronze, soldered joints.

- .2 Flanges for Pipe Over 2 inches:
  - .1 Ferrous Piping: 150 psig forged steel, slip-on.
  - .2 Copper Piping: Bronze.
  - .3 Gaskets: 1/16 inch thick preformed neoprene.
- .3 Grooved and Shouldered Pipe End Couplings:
  - .1 Housing Clamps: Malleable iron to engage and lock, designed to permit some angular deflection, contraction, and expansion.
  - .2 Sealing Gasket: C-shape elastomer composition for operating temperature range from -30 degrees F to 230 degrees F.
  - .3 Accessories: Steel bolts, nuts, and washers.
- .4 Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

## 2.4 GATE VALVES

- .1 Up To and Including 2 inches:
  - .1 Nibco or approved equivalent product
  - .2 Bronze body, bronze trim, union bonnet, rising stem, lockshield stem, inside screw, solid wedge disc, threaded ends.
- .2 Over 2 inches:
  - .1 Manufacturers:
    - .1 Nibco or approved equivalent product
    - .2 Iron body, bronze trim, bolted bonnet, rising stem, handwheel, outside screw and yoke, solid wedge disc with bronze seat rings, flanged ends.

## 2.5 BALL VALVES

- .1 Up To and Including 2 inches:
  - .1 Manufacturers:
    - .1 Crane or approved equivalent product
    - .2 Bronze, one (1) or two (2) piece body, stainless steel ball, teflon seats and stuffing box ring, lever handle], threaded ends with union.
- .2 Over 2 inches:
  - .1 Manufacturers:
    - .1 Crane or approved equivalent product
    - .2 Cast steel body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle, or gear drive handwheel for sizes 10" and over, flanged.

## 2.6 BUTTERFLY VALVES

- .1 Manufacturers:
  - .1 Nibco or approved equivalent product
- .2 Body: Cast or ductile iron with resilient replaceable EPDM seat, wafer or lug ends, extended neck.
- .3 Disc: Aluminum bronze.

- .4 Operator: 10 position lever handle or Handwheel/gear drive for sizes 10" and over.

## 2.7 SWING CHECK VALVES

- .1 Up To and Including 2 inches:
  - .1 Manufacturers:
    - .1 Crane or approved equivalent product
  - .2 Bronze body, bronze trim, bronze rotating swing disc, with composition disc, threaded ends.

## Part 3 Execution

### 3.1 PREPARATION

- .1 Ream pipe and tube ends. Remove burrs.
- .2 Remove scale and dirt on inside and outside before assembly.
- .3 Prepare piping connections to equipment with flanges or unions.
- .4 Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
- .5 After completion, fill, clean, and treat systems. Refer to Section 23 25 00.

### 3.2 INSTALLATION (Steel or Copper Risers)

- .1 Install to manufacturer's written instructions.
- .2 Install heating water and glycol piping to ASME B31.9.
- .3 Route piping in orderly manner, parallel to building structure, and maintain gradient.
- .4 Install piping to conserve building space, and not interfere with use of space.
- .5 Group piping whenever practical at common elevations.
- .6 Sleeve pipe passing through partitions, walls and floors.
- .7 Slope piping and arrange to drain at low points.
- .8 Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 23 05 16.
- .9 Inserts:
  - .1 Provide inserts for placement in concrete formwork.
  - .2 Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
  - .3 Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
  - .4 Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
  - .5 Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.
- .10 Pipe Hangers and Supports:

- .1 Refer to section 23 05 29
- .11 Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 23 07 19.
- .12 Provide access where valves and fittings are not exposed
- .13 Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
- .14 Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
- .15 Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting. Refer to Section 09 91 10.
- .16 Install valves with stems upright or horizontal, not inverted.

### 3.3 SCHEDULES

- .1 Hanger Rod:

PIPE SIZE	MAX. HANGER SPACING	DIAMETER
1/2-1-1/4 inch	6.5 inch	3/8 inch
1-1/2-2 inch	10 inch	3/8 inch
2-1/2-3 inch	10 inch	1/2 inch
4-6 inch	10 inch	5/8 inch
8-12 inch	14 inch	7/8 inch
14inch and over	20 inch	1 inch
PVC (All Sizes)	6 inch	3/8 inch

**END OF SECTION**

## **Part 1 General**

### **1.1 SECTION INCLUDES**

- .1 Metal duct work.
- .2 In-slab ventilation ductwork.
- .3 Duct cleaning.

### **1.2 RELATED SECTIONS**

- .1 Section 23 07 13 - Duct Insulation: External insulation and duct liner.
- .2 Section 23 33 00 - Duct Work Accessories.
- .3 Section 23 05 93 - Testing, Adjusting, And Balancing.

### **1.3 REFERENCES**

- .1 ASTM A90/A90M-09 - Standard Test Method for Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
- .2 ASTM A167-99 (2009) - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- .3 ASTM A568/A568M-09a - Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for.
- .4 ASTM A653/A653M-10 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .5 ASTM A1008/A1008M-10 - 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.
- .6 ASTM A1011/A1011M-10 - 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.
- .7 NFPA 90A -Standard for Installation of Air Conditioning and Ventilating Systems, 2009 edition.
- .8 NFPA 90B - Standard Installation of Warm Air Heating and Air-Conditioning Systems, 2009 edition.
- .9 SMACNA - HVAC Air Duct Leakage Test Manual (1985).
- .10 SMACNA - HVAC Duct Construction Standards - Metal and Flexible (2005).
- .11 UL 181-2005 - Standard for Factory-Made Air Ducts and Air Connectors (10th Edition).

### **1.4 PERFORMANCE REQUIREMENTS**

- .1 No variation of duct configuration or sizes permitted except by written permission. Size round ducts installed in place of rectangular ducts to ASHRAE table of equivalent rectangular and round ducts.

### **1.5 SUBMITTALS FOR REVIEW**

- .1 Product Data: Provide data for duct materials and duct connectors.

## **1.6 SUBMITTALS FOR INFORMATION**

- .1 Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA HVAC Air Duct Leakage Test Manual.

## **1.7 CLOSEOUT SUBMITTALS**

- .1 Record Documentation: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

## **1.8 QUALITY ASSURANCE**

- .1 Perform Work to SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- .2 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience.

## **1.9 ENVIRONMENTAL REQUIREMENTS**

- .1 Ambient Conditions:
  - .1 Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
  - .2 Maintain temperatures during and after installation of duct sealants.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Galvanized Steel Ducts: ASTM A653/A653M galvanized steel sheet, lock-forming quality, having Z275/G90 and zinc coating tested to ASTM A90/A90M.
- .2 Fasteners: Rivets, bolts, or sheet metal screws.
- .3 Sealant:
  - .1 Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used alone or with tape, or heavy mastic.
- .4 Hanger Rod: ASTM A36; steel galvanized; threaded both ends, threaded one end, or continuously threaded.

### **2.2 DUCT WORK FABRICATION**

- .1 Fabricate and support to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.
- .2 Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centreline. Where not possible and where rectangular elbows are used, provide turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fibre insulation.
- .3 Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

- .4 Fabricate continuously welded round duct fittings two gauges heavier than duct gauges indicated in SMACNA Standard.
- .5 Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.

### **2.3 MANUFACTURED DUCT WORK AND FITTINGS**

- .1 Manufacture to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install to manufacturer's written instructions.
- .2 Install and seal ducts to SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- .3 Duct Sizes are inside clear dimensions.
- .4 Provide openings in duct work where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated duct work, install insulation material inside a metal ring.
- .5 Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- .6 Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with crimp in direction of air flow.
- .7 Use double nuts and lock washers on threaded rod supports.
- .8 During construction provide temporary closures of metal or taped polyethylene on open duct work to prevent construction dust from entering duct work system.

### **3.2 CLEANING**

- .1 Clean duct systems with high power vacuum machines. Protect equipment which may be harmed by excessive dirt with filters, or bypass during cleaning. Provide adequate access into duct work for cleaning purposes.

**END OF SECTION**



**Part 1 General**

**1.1 SECTION INCLUDES**

- .1 Backdraft dampers.
- .2 Duct test holes.
- .3 Fire dampers.
- .4 Flexible duct connections.

**1.2 RELATED SECTIONS**

- .1 Section 23 05 48 - Vibration Isolation.
- .2 Section 23 31 00 - Duct Work.
- .3 Section 23 36 00 - Air Terminal Units: Pressure regulating damper assemblies.

**1.3 REFERENCES**

- .1 NFPA 90A -Standard for Installation of Air Conditioning and Ventilating Systems, 2009 edition.
- .2 NFPA 92A - Standard for Smoke-Control Systems Utilizing Barriers and Pressure Differences, 2009 Edition.
- .3 SMACNA - HVAC Duct Construction Standards - Metal and Flexible (2005).
- .4 UL 33-2010 - Standard for Heat Responsive Links for Fire-Protection Service (8th Edition).
- .5 UL 555-2006 - Standard for Fire Dampers (7th Edition).
- .6 UL 555S-1999 - Standard for Smoke Dampers (4th Edition).
- .7 CSA (Canadian Standards Association).
- .8 UL (Underwriters Laboratories Inc.).

**1.4 SUBMITTALS FOR REVIEW**

- .1 Product Data
- .2 Shop Drawings: Indicate for shop fabricated assemblies including duct test holes and duct access doors.

**1.5 SUBMITTALS FOR INFORMATION**

- .1 Installation Data: Manufacturer's special installation requirements

**1.6 CLOSEOUT SUBMITTALS**

- .1 Record Documentation: Record actual locations of access doors.

**1.7 QUALITY ASSURANCE**

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five (5)] years' experience.

## **1.8 REGULATORY REQUIREMENTS**

- .1 Products Requiring Electrical Connection: Listed and classified by ULc or CSA and as suitable for the purpose specified and indicated.

## **1.9 DELIVERY, STORAGE, AND PROTECTION**

- .1 Protect dampers from damage to operating linkages and blades.

## **Part 2 Products**

### **2.1 BACKDRAFT DAMPERS.**

- .1 Manufacturers:
  - .1 Ruskin
- .2 Gravity Backdraft Dampers, Size 18 x 18 inches or Smaller, Provided with Air Moving Equipment: Air moving equipment manufacturer's standard construction.
- .3 Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: extruded aluminum, with centre pivoted blades of maximum 6-inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

### **2.2 DUCT TEST HOLES**

- .1 Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.
- .2 Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation;

### **2.3 FIRE DAMPERS**

- .1 Manufacturers:
  - .1 Ruskin
- .2 Fabricate to NFPA 90A and UL 555, and as indicated.
- .3 Ceiling Dampers: Galvanized steel, 16-gauge flap, two layers 0.125 inch ceramic fibre on top side and one layer on bottom side for round flaps, with locking clip.
- .4 Horizontal Dampers: Galvanized steel, 22-gauge frame, stainless steel closure spring, and lightweight, heat retardant non-asbestos fabric blanket.
- .5 Curtain Type Dampers: Galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for closure under air flow conditions. Configure with blades out of air stream except for 1.0-inch pressure class ducts up to 12 inches in height.
- .6 Multiple Blade Dampers: 16-gauge galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, 1/8 x 1/2 inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.
- .7 Fusible Links: UL 33, separate at 160 degrees F and with adjustable link straps for combination fire/balancing dampers.

## **2.4 FLEXIBLE DUCT CONNECTIONS**

- .1 Fabricate to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.
- .2 Connector: Fabric crimped into metal edging strip.
  - .1 Fabric: UL listed fire-retardant neoprene coated woven glass fibre fabric to NFPA 90A, minimum density 30 oz/sq yd.
  - .2 Net Fabric Width: Approximately 2 inches wide.
  - .3 Metal: 3 inch wide, galvanized steel 24 gauge and.
- .3 Leaded Vinyl Sheet: Minimum 0.87 lbs/sq ft, 10 dB attenuation in 10 to 10,000 Hz range.

## **Part 3 Execution**

### **3.1 PREPARATION**

- .1 Verify that electric power is available and of the correct characteristics.

### **3.2 INSTALLATION**

- .1 Install accessories to manufacturer's written instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible. Refer to Section 23 31 00 for duct construction and pressure class.
- .2 Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
- .3 Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide for cleaning kitchen exhaust duct work to NFPA 96 Provide minimum 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access, and as indicated. Review locations prior to fabrication.
- .4 Provide duct test holes where indicated and required for testing and balancing purposes.
- .5 Provide combination fire and smoke dampers and at locations indicated, where ducts and outlets pass through fire rated components and where required by authorities having jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
- .6 Install smoke dampers and combination smoke and fire dampers to NFPA 92A.
- .7 Demonstrate re-setting of fire dampers to Owner's representative.
- .8 Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment and supported by vibration isolators. Refer to Section 23 05 48.
- .9 Use splitter dampers only where indicated.
- .10 Provide balancing dampers on high velocity systems where indicated.
- .11 Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION

**Part 1 General**

**1.1 SECTION INCLUDES**

- .1 Propeller fans.
- .2 Motors and drives.
- .3 Accessories.

**1.2 RELATED WORK**

- .1 Section 23 05 13 - Motors.
- .2 Section 23 05 48 - Vibration Isolation.
- .3 Section 23 31 00 - Duct Work.
- .4 Section 23 33 00 - Duct Work Accessories: Backdraft dampers.
- .5 Section 23 73 23 - Air Handling Units.

**1.3 REFERENCES**

- .1 ABMA 9-1990(2008) - Load Ratings and Fatigue Life for Ball Bearings.
- .2 ABMA 11-1990 - Load Ratings and Fatigue Life for Roller Bearings.
- .3 AMCA 99-10 - Standards Handbook.
- .4 AMCA 210-07 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
- .5 AMCA 300-08 - Reverberant Room Method for Sound Testing of Fans.
- .6 AMCA 301-06 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- .7 SMACNA - HVAC Duct Construction Standards - Metal and Flexible (2005).

**1.4 SUBMITTALS FOR REVIEW**

- .1 Product Data: Provide data on axial fans and accessories including fan curves with specified operating point clearly plotted, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements.
- .2 Shop Drawings: Indicate assembly of axial fans and accessories including fan curves with specified operating point clearly plotted, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements.

**1.5 SUBMITTALS FOR INFORMATION**

- .1 Installation Data: Manufacturer's special installation requirements.

**1.6 CLOSEOUT SUBMITTALS**

- .1 Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

**1.7 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Extra Stock Materials: Provide two (2) sets of belts for each fan.

## 1.8 DELIVERY, STORAGE, AND PROTECTION

- .1 Protect motors, shafts, and bearings from weather and construction dust.

## Part 2 Products

### 2.1 PROPELLER FANS

- .1 Manufacturers:
  - .1 Reversomatic
  - .2 Carnes (LWBK – Size 24, Drive Range M1, 675 RPM – 2000 CFM)
  - .3 Greenheck
  - .4 Equivalent alternatives
- .2 Impeller: Shaped steel or steel reinforced aluminum blade with heavy hubs, statically and dynamically balanced, keyed and locked to shaft, and provided with belt drive.
- .3 Electrical Characteristics and Components:
  - .1 Electrical Characteristics:
    - .1 120V single phase, and 60 Hz.
  - .2 1/3 motor hp.
  - .3 Motor: Refer to Section 23 05 13. Self-aligning pre-lubricated ball or sleeve bearings affixed to mounting plate permitting belt tensioning, neoprene vibration isolation between fan assembly and mounting plate.
  - .4 Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to code.
- .4 Frame: All welded schedule 40 steel pipe frame construction, electrostatically coated with enamel paint.
- .5 Backdraft Damper: Multiple blades with offset hinge pin, blades linked.
- .6 Safety Screens: damper guard and motor side guard.
- .7 Fan manufacturer to also supply weather hood, wall sleeve, cabinet accessories

## Part 3 Execution

### 3.1 INSTALLATION

- .1 Install to manufacturer's written instructions.
- .2 Provide damper guard and motorside guard.
- .3 Provide backdraft dampers on discharge of exhaust fan.
- .4 Do not operate fans for any purpose until bearings are lubricated and fan has been test run under observation.

END OF SECTION

**Part 1 General**

**1.1 SECTION INCLUDES**

- .1 Cabinet exhaust fans.
- .2 Ceiling exhaust fans.

**1.2 RELATED SECTIONS**

- .1 Section 23 05 13 - Motors.
- .2 Section 23 05 48 - Vibration Isolation.
- .3 Section 23 31 00 - Duct Work.
- .4 Section 23 33 00 - Duct Work Accessories: Back-draft dampers.
- .5 Section 23 34 13 - Axial Fans.

**1.3 REFERENCES**

- .1 AMCA 210-07 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
- .2 AMCA 261-98 - Directory of Products Licensed to Use the AMCA Certified Ratings Seal.
- .3 AMCA 300-08 - Reverberant Room Method for Sound Testing of Fans.
- .4 AMCA 301-06 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- .5 AMCA 99-10 - Standards Handbook.
- .6 NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations, 2011 Edition.
- .7 UL 705 - Standard for Power Ventilators (6th Edition).

**1.4 SUBMITTALS FOR REVIEW**

- .1 Product Data: Provide data on fans and accessories including fan curves with specified operating point clearly plotted, sound power levels at rated capacity, and electrical characteristics and connection requirements.

**1.5 SUBMITTALS FOR INFORMATION**

- .1 Installation Data: Manufacturer's special installation requirements.

**1.6 CLOSEOUT SUBMITTALS**

- .1 Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

**Part 2 Products**

**2.1 CABINET AND CEILING EXHAUST FANS**

- .1 Manufacturers:

- .1 Carnes (VCDD050C)
- .2 Greenheck
- .3 Equivalent alternatives
- .2 Performance.
  - .1 Air Flow: 470 cfm at 0.35 in wg.
  - .2 Fan RPM: 810 RPM.
- .3 Centrifugal Fan Unit: resilient mounted motor, gravity backdraft damper in discharge.
- .4 Electrical Characteristics and Components.
  - .1 Electrical Characteristics:
    - .1 221 W.
    - .2 120 volts, single phase, 60 Hz.
    - .3 2.2 amperes
  - .2 Motor: Refer to Section 23 05 13.
  - .3 Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to code.
- .5 Brick Vent, Model VXCCB, 4" Deep

### **Part 3 Execution**

#### **3.1 INSTALLATION**

- .1 Install to manufacturer's written instructions.
- .2 Do not operate fans for any purpose until ductwork is clean, filters in place, bearings lubricated, and fan has been test run under observation.

**END OF SECTION**



**Part 1 General**

**1.1 SECTION INCLUDES**

- .1 Diffusers.
- .2 Registers/grilles.
- .3 Door grilles.
- .4 Louvres.

**1.2 REFERENCES**

- .1 ADC 1062: GRD-84 - Test Code for Grilles, Registers and Diffusers.
- .2 AMCA 500-L-07 - Laboratory Methods of Testing Louvers for Rating.
- .3 AMCA 500-D-07 - Laboratory Methods of Testing Dampers for Rating.
- .4 ASHRAE 70-2006 (R2011) - Method of Testing the Performance of Air Outlets and Air Inlets.
- .5 NFPA 90A -Standard for Installation of Air Conditioning and Ventilating Systems, 2009 edition.
- .6 SMACNA - HVAC Duct Construction Standards - Metal and Flexible (2005).

**1.3 SUBMITTALS FOR REVIEW**

- .1 Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

**1.4 SUBMITTALS FOR INFORMATION**

- .1 Installation Data: Manufacturer's special installation requirements.

**1.5 CLOSEOUT SUBMITTALS**

- .1 Record Documentation: Record actual locations of air outlets and inlets.

**1.6 QUALITY ASSURANCE**

- .1 Test and rate air outlet and inlet performance to ADC Equipment Test Code 1062 and ASHRAE 70.
- .2 Test and rate louvre performance to AMCA 500.
- .3 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years experience.

**Part 2 Products**

**2.1 ROUND CEILING DIFFUSERS**

- .1 Manufacturers:
  - .1 Ruskin

- .2 Type: Round, adjustable pattern stamped or spun, multi-core diffuser to discharge air in 360 degree pattern, with sectorizing baffles where indicated. Project diffuser collar maximum 1 inch above ceiling.
- .3 Fabrication: Steel with baked enamel finish.
- .4 Accessories: Butterfly damper and multi-louvred equalizing grid with damper adjustable from diffuser face.

## **2.2 RECTANGULAR CEILING DIFFUSERS**

- .1 Type: Square and rectangular, multi-louvred diffuser to discharge air in three-way pattern with sectorizing baffles where indicated.
- .2 Frame: Snap-in or Surface mount type.
- .3 Fabrication: Aluminum with baked enamel finish.
- .4 Accessories: Butterfly damper and multi-louvred equalizing grid with damper adjustable from diffuser face.

## **2.3 PERFORATED FACE CEILING DIFFUSERS**

- .1 Type: Perforated face with fully adjustable pattern and removable face.
- .2 Frame: Snap-in or Surface mount type.
- .3 Fabrication: Steel with aluminum frame and baked enamel finish.
- .4 Accessories: Butterfly damper and multi-louvred equalizing grid with damper adjustable from diffuser face.

## **2.4 CEILING EXHAUST AND RETURN REGISTERS/GRILLES**

- .1 Type: Streamlined blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with blades set at 45 degrees, vertical face.
- .2 Frame: 1-1/4 inch margin with countersunk screw mounting.
- .3 Fabrication: Steel with 20 gauge minimum frames and 22 gauge minimum blades, steel and aluminum with 20 gauge minimum frame, or aluminum extrusions, with factory baked enamel finish "colour to be selected".
- .4 Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face where not individually connected to exhaust fans.

## **2.5 CEILING GRID CORE EXHAUST AND RETURN REGISTERS/GRILLES**

- .1 Type: Fixed grilles of 1/2 x 1/2 x 1/2 inch louvres.
- .2 Fabrication: Aluminum finish.
- .3 Frame: 1-1/4 inch margin with countersunk screw mounting.
- .4 Frame: Channel lay-in frame for suspended grid ceilings.
- .5 Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.

## **2.6 CEILING LINEAR EXHAUST AND RETURN GRILLES**

- .1 Type: Streamlined blades with 90 degree two-way deflection, 1/8 x 3/4 inch on 1/2 inch centres.

- .2 Frame: 1-1/4 inch margin with countersunk screw mounting.
- .3 Fabrication: Steel with 20 gauge minimum frames and 22 gauge minimum blades, steel and aluminum with 20 gauge minimum frame, or aluminum extrusions, with factory finish, colour to be selected.
- .4 Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.

## **2.7 CEILING SLOT DIFFUSERS**

- .1 Type: Continuous 1 inch wide slot, two (2) slots wide, with adjustable vanes for left, right, or vertical discharge;
- .2 Fabrication: Aluminum extrusions with factory finish, colour to be selected.
- .3 Frame: 1-1/4 inch margin with countersunk screw mounting and gasket, mitred end border.
- .4 Plenum: Integral, galvanized steel, insulated or un-insulated where shown on drawings.

## **2.8 WALL SUPPLY REGISTERS/GRILLES**

- .1 Type: Streamlined and individually adjustable blades, 3/4 inch minimum depth, 3/4 inch maximum spacing with spring or other device to set blades, horizontal face double deflection.
- .2 Frame: 1 inch margin with countersunk screw mounting and gasket.
- .3 Fabrication: Steel with 20 gauge minimum frames and 22 gauge minimum blades, steel and aluminum with 20 gauge minimum frame, or aluminum extrusions, with factory finish, colour to be selected.
- .4 Damper: Integral, gang-operated opposed blade type with removable key operator, operable from face.

## **2.9 WALL SUPPLY REGISTERS/GRILLES**

- .1 Type: Streamlined and individually adjustable curved blades to discharge air along face of grille with two-way deflection.
- .2 Frame: 1-1/4 inch margin with countersunk screw mounting and gasket.
- .3 Fabrication: Aluminum extrusions with factory finish.
- .4 Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.

## **2.10 WALL EXHAUST AND RETURN REGISTERS/GRILLES**

- .1 Type: Streamlined blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with spring or other device to set blades, vertical face.
- .2 Frame: 1-1/4 inch margin with countersunk screw mounting.
- .3 Fabrication: Aluminum extrusions with 20 gauge minimum frames with factory baked enamel finish, colour to be selected.
- .4 Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.

- .5      Gymnasiums: Provide front pivoted or welded in place blades, securely fastened to be immobile.

## **2.11            WALL GRID CORE EXHAUST AND RETURN REGISTERS/GRILLES**

- .1      Type: Fixed grilles of 1/2 x 1/2 x 1/2 inch louvres.
- .2      Frame: 1-1/4 inch margin with countersunk screw mounting. .
- .3      Fabrication: Aluminum with factory baked enamel finish; colour to be selected.
- .4      Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.

## **2.12            LINEAR WALL REGISTERS/GRILLES**

- .1      Type: Streamlined blades with 15 degree deflection, 1/8 x 3/4 inch on 1/4 inch centres.
- .2      Frame: 1 inch margin with countersunk screw mounting and gasket.
- .3      Fabrication: Aluminum extrusions, with factory prime coat finish.
- .4      Damper: Integral hinged single blade damper with removable key operator, operable from face.

## **2.13            LINEAR FLOOR SUPPLY REGISTERS/GRILLES**

- .1      Type: Streamlined blades with 15 degree deflection, 1/8 x 3/4 inch on 1/2 inch centres.
- .2      Frame: 1 inch margin frame with concealed mounting and gasket.
- .3      Fabrication: Aluminum extrusions with factory off-white enamel finish.
- .4      Damper: Integral hinged single blade damper with removable key operator, operable from face.

## **2.14            FLOOR SUPPLY REGISTERS/GRILLES**

- .1      Individually adjustable blades, wide stamped border, single or double blade damper with set screw adjustment.
- .2      Fabricate of steel, welded construction, with factory baked enamel finish.

## **2.15            DOOR GRILLES**

- .1      Type: V-shaped louvres of 20 gauge thick steel, one inch deep on 1/2 inch centres.
- .2      Frame: 20 gauge steel with auxiliary frame to give finished appearance on both sides of door, with factory prime coat finish.

## **2.16            LOUVRES**

- .1      Manufacturers:
  - .1      Ruskin
- .2      Type: 6 inch deep with blades on 45 degree slope, heavy channel frame, birdscreen with 1/2 inch square mesh for exhaust and 3/4 inch for intake.
- .3      Fabrication: 16 gauge welded assembly, with factory baked enamel finish; colour to be selected.
- .4      Mounting: Provide with exterior or interior angle flange for installation.

**2.17 GOOSENECKS**

- .1 Fabricate to SMACNA HVAC Duct Construction Standards - Metal and Flexible, of minimum 18 gauge galvanized steel.
- .2 Mount on minimum 12 inch high curb base where size exceeds 9 x 9 inch.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Install to manufacturer's written instructions.
- .2 Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.
- .3 Install diffusers to duct work with air tight connection.
- .4 Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly.
- .5 Paint ductwork visible behind air outlets and inlets matte black. Refer to Section 09 91 10.

**END OF SECTION**

**Part 1 General**

**1.1 SECTION INCLUDES**

- .1 Packaged air handling units.
- .2 Heating/cooling coils.
- .3 Filter sections.
- .4 Face and bypass dampers.

**1.2 RELATED SECTIONS**

- .1 Section 22 10 00 - Plumbing Piping: Equipment drains.
- .2 Section 23 05 13 - Motors.
- .3 Section 23 05 16 - Piping Expansion Compensation.
- .4 Section 23 05 48 - Vibration Isolation.
- .5 Section 23 07 13 - Duct Insulation.
- .6 Section 23 31 00 - Duct Work.
- .7 Section 23 33 00 - Duct Work Accessories: Flexible duct connections.
- .8 Section 23 34 13 - Axial Fans.
- .9 Section 23 40 00 - Air Cleaning Devices.
- .10 Section 23 82 16 - Air Coils.

**1.3 SUBMITTALS FOR REVIEW**

- .1 Product Data:
  - .1 Provide literature which indicates dimensions, weights, capacities, ratings, fan performance, gauges and finishes of materials, and electrical characteristics and connection requirements.
  - .2 Provide data of filter media, filter performance data, filter assembly, and filter frames.
  - .3 Provide fan curves with specified operating point clearly plotted.
  - .4 Submit sound power level data for both fan outlet and casing radiation at rated capacity.
  - .5 Submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.
- .2 Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.

**1.4 SUBMITTALS FOR INFORMATION**

- .1 Installation Data: Manufacturer's special installation requirements.

## **1.5 CLOSEOUT SUBMITTALS**

- .1 Operation and Maintenance Data: Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

## **1.6 QUALITY ASSURANCE**

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum [five (5)] years experience, who issues complete catalogue data for the total product.

## **1.7 DELIVERY, STORAGE, AND PROTECTION**

- .1 Accept products on site in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs. Inspect for damage.
- .2 Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

## **1.8 ENVIRONMENTAL REQUIREMENTS**

- .1 Ambient Conditions: Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

## **Part 2 Products**

### **2.1 MANUFACTURERS**

- .1 Engineered Air

### **2.2 GENERAL**

- .1 Air Handling Units shall be built to the level of quality as herein specified and to the description of the Air Handling Unit Schedule.
- .2 Unless stated otherwise, air-handling units are to be shipped to the job in one piece, factory assembled. Modular units assembled to achieve a close proximity to the intent of this specification will not be considered equal. All equipment shall where specified and applicable, be pre-wired, and factory certified by an approved testing agency such as cETL, ETLus, UL, CSA prior to shipment.
- .3 Pre-wired air handling units shall bear an approved label with all the necessary identification marks, electrical data.
- .4 All electrical circuits shall undergo a dielectric strength test, and shall be factory tested and checked as to proper function.
- .5 The air handling units and major components shall be products of manufacturers regularly engaged in the production of such equipment and with a minimum of fifteen continuous years of proven production experience.

### **2.3 UNIT CONSTRUCTION**

- .1 Unit casing shall be of minimum 18 gauge satin coat galvanized sheet metal. Surfaces shall be cleaned with a degreasing solvent to remove oil and metal oxides and primed

- with a two-part acid based etching primer. Finish coat shall be electrostatically applied enamel, to all exposed surfaces. All unprotected metal and welds shall be factory coated.
- .2 All walls, roofs and floors shall be of formed construction, with at least two breaks at each joint. Joints shall be secured by sheet metal screws or pop rivets. Wall and floor joints shall be broken in and on all outdoor units roof joints broken out (exposed) for rigidity. All joints shall be caulked with a water resistant sealant.
  - .3 Units shall be provided with access doors to the following components: fans and motors, filters, dampers and operators, access plenums and humidifiers/wet cells, electrical control panels, burner compressor compartments. Access doors shall be large enough for easy access. Removal of screwed wall panels will not be acceptable.
  - .4 Whenever possible, hinged access doors to areas of negative pressure shall open out, and to areas of positive pressure shall open in. Where space constrictions require the use of outward opening doors to an area of positive pressure, a clear warning label and safety chain must be affixed
  - .5 Units shall be provided with hinged access doors complete with tieback clips and pad lock hasps (lock by others). Doors shall be fully lined, come complete with bulb trim seal gasket and lever handles, operable from both sides.
  - .6 All units shall be internally insulated with 1" (24mm) thick 1-1/2 lb./cu.ft. (24 kg./cu.m.) density insulation.
  - .7 1 1/2 lb./cu.ft. (24 kg/cu.m.) insulation shall be secured to metal panels with a fire retardant adhesive and welded steel pins at 16" (400mm) o/c. All longitudinal insulation joints and butt ends shall be covered by a sheet metal break to prevent erosion of exposed edges. Drain pans and all floor areas shall be insulated on the underside.
  - .8 Cooling coil drain pans shall be fabricated of stainless steel and are an integral part of the floor paneling, a minimum of 2" (51mm) deep, with welded corners. Drain pans shall extend a minimum of 6" (152mm) downstream of coil face and be provided with a 1 1/2" (38mm) S.S. M.P.T. drain connection. Drain pans must have a fast pan and be sloped and pitched such that there is no standing water. Intermediate fast pans shall be provided between cooling coils where required for effective moisture removal.
  - .9 Air handling units shall be weatherproofed and equipped for installation outdoors. This shall include generally for the prevention of infiltration of rain and snow into the unit, louvers or hoods on air intakes and exhaust openings with 1"(25mm) galvanized inlet screens; rain gutters or diverters over all access doors; all joints caulked with a water resistant sealant; roof joints turned up 2" (51mm) with three break interlocking design; outer wall panels extend a minimum of 1/4"(6mm) below the floor panel; drain trap(s) connections for field supply and installation of drain traps.
  - .10 Outdoor units with water coils shall be provided with a fully insulated and weatherproofed piping vestibule to allow for the entry of piping from the building into the air-handling unit, and for connection to the coil(s). The piping vestibule shall be designed to accommodate piping only as shown on the drawings. Control valves to be located elsewhere, by others. Access panels shall be large enough for easy access.
  - .11 Provide full perimeter roof mounting curb of heavy gauge sheet metal, minimum of 18" (458mm) high, and complete with wood nailer, neoprene sealing strip, and fully welded "Z" bar with 1" (25mm) upturn on inner perimeter, to provide a complete seal against the elements. External insulation and flashing of the roof-mounting curb shall be provided by the Roofing Subcontractor.



## 2.4 FANS

- .1 Centrifugal fans shall be rated in accordance with AMCA Standard Test Code, Bulletin 210. Fan manufacturer shall be a member of AMCA. All fans and fan assemblies shall be dynamically balanced during factory test run. Fan shafts shall be selected for stable operation at least 20% below the first critical RPM. Fan shafts shall be provided with a rust inhibiting coating.
- .2 Supply fan to be direct drive airfoil, plenum type configuration. Thrust restraint isolators shall be provided parallel to the shaft centerline when required to minimize axial movement and bending movements of the blower assembly(s). Drive side bearings on plenum fans shall be adapter style to ensure even clamping of the bearing sleeve to the shaft.
- .3 For plenum type fans, provide inlet screen and open wire mesh protective discharge screen. Removable screens at access doors are not acceptable.
- .4 Airfoil and plenum type fans shall be as manufactured by Twin City Fan and Blower.
- .5 Motor, fan bearings and drive assembly shall be located inside the fan plenum to minimize bearing wear and to allow for internal vibration isolation of the fan-motor assembly, where required. Motor mounting shall be adjustable to allow for variations in belt tension.
- .6 Fan-motor assemblies shall be provided with vibration isolators. Isolators shall be bolted to steel channel welded to unit floor, which is welded to the structural frame of the unit. The isolators shall be vertical spring type with leveling bolts, bridge bearing waffled pads with minimum 1" (25mm) static deflection designed to achieve high isolation efficiency. Use of separate bumper or snubber is not acceptable. Fans shall be attached to the discharge panel by a polyvinyl chloride coated polyester woven fabric, with a sealed double locking fabric to metal connection.
- .7 Fan motors shall be ODP (open, drip proof) Super E high efficiency.
- .8 Provide variable air volume fan control for units via a adjustable frequency drive which shall be mounted in the unit controls cabinet.
- .9 Sine wave carrier input, PWM output. IGBT transistors. Adjustable acceleration and deceleration timing.
- .10 Keypad to be removable, with alphanumeric display able to provide output status monitoring, output frequency, output voltage, output RPM, and output current. Include fault log display with capacity for the recent 30 faults with a time stamp. Diagnostic display menus to include reference speed command, heat sink temp, bus voltage, active I/O command status, time from power up, and current setting.
- .11 Unit mounted manual VFD bypass switch locks out VFD, fan runs on maximum set volume. Bypass switch and all interlock contacts are factory mounted, pre-wired and external to the drive to allow for removal and repair if necessary.
- .12 Line and load reactors required for all 575 volt applications.
- .13 Drive shall be factory supplied and installed.
- .14 Minimum supply and return airflow of 35%.

## 2.5 COILS

- .1 Coils shall be 5/8" O.D. as manufactured by Engineered Air, constructed of copper tube, aluminum fin, and copper headers with schedule 40 steel pipe connectors.

- .2 Fins constructed of aluminum or copper shall be rippled for maximum heat transfer and shall be mechanically bonded to the tubes by mechanical expansion of the tubes. The coils shall have a galvanized steel casing. All coils shall be factory tested with air at 300 psig (2070 kPa) while immersed in an illuminated water tank.
- .3 Headers with schedule 40 steel pipe connections utilize male N.P.T. up to 4"(100mm) connections.
- .4 Headers shall be outside the air-handling unit for maximum serviceability except for blow through applications where headers are internal. The non-headered end of the coil shall be fully concealed. Provide auxiliary drain pan complete with ½" (13mm) MPT drain connection at headered end of cooling coils.
- .5 Coils shall be removable from the unit at the header end, unless shown otherwise on the drawings. All water coils shall be equipped with a ½" threaded and capped vent tapping at the top of the return header or connection, and a ½" threaded and capped drain tapping at the bottom of the supply header or connection.
- .6 Water and glycol coils shall be circuited to provide adequate tube velocities to meet design requirements. Internal turbulators are not acceptable.
- .7 5/8" O.D. tube diameter water coils shall be ARI Certified.
- .8 Multiple row coils shall be of staggered tube design circuited to optimize capacity with minimum pressure drop.
- .9 Provide two position bypass damper over coil to open for cooling operation.

## 2.6 FILTERS

- .1 Filter sections shall be provided with adequately sized access doors to allow easy removal of filters. Filter removal shall be from one side as noted on the drawings.
- .2 For units with filter banks up to 72" (1825mm) high, the filter modules shall be designed to slide out of the unit. Side removal 2" (50mm) filters shall slide into a formed metal track, sealing against metal spacers at each end of the track.
- .3 2"(50mm) Pleated Panel Disposable Filters: An optimum blend of natural and synthetic fiber media with a rust resistant support grid and high-wet strength beverage board enclosing frame with diagonal support members bonded to the air entering and air exiting side of each pleat. Permanent re-usable metal enclosing frame. The filter media shall have a minimum efficiency of 30-35% on ASHRAE Standard 52.1-92, and a minimum of MERV 8 per ASHRAE 52.2. Rated U.L. Class 2.
- .4 Filter media shall meet UL Class 2 standards.

## 2.7 DAMPERS

- .1 Damper frames shall be U-shaped galvanized metal sections securely screwed or welded to the air handling unit chassis. Pivot rods of 1/2" (13mm) aluminum shall turn in nylon or bronze bushings. Rods shall be secured to the blade by means of straps and set screws.
- .2 Blades shall be 18 gauge (1.3mm) galvanized metal with two breaks on each edge and three breaks on centerline for rigidity. The pivot rod shall "nest" in the centerline break. Damper edges shall interlock. Maximum length of damper between supports shall be 48"(1219 mm). Damper linkage brackets shall be constructed of galvanized metal.
- .3 Dampers shall be standard construction and include blade ends sealed with an adhesive backed foamed polyurethane gasketing. Outdoor air dampers also include an all weather

PVC seal fastened with a positive lock grip and pliable overlap edge on entering air side of interlocking edges. Dampers are interlocked from the center.

- .4 Two position inlet dampers shall be parallel blade type.

## 2.8 DISCHARGE TEMPERATURE CONTROL

- .1 Provide combination hot water/chilled water coil utilizing 40% propylene glycol.
- .2 Cooling Control
  - .1 The controller shall automatically start in heating, economizer, or cooling mode based on continuously monitored ambient temperature and load requirements.
  - .2 The controller shall include an adjustable low limit set point for freeze protection to cease equipment operation in the event of low discharge temperature. If the discharge air temperature falls below the adjusted set point, the blowers will shut down and the outside air dampers shall close.
  - .3 Control function
    - .1 Heat/economizer/cool function shall be modulating discharge air with 0-10 VDC reset. Minimum discharge air set point reverts to minimum set point if the BMS control fails.
    - .2 The discharge air set point shall be adjusted from a 0-10VDC BMS signal.
  - .4 Cooling devices
    - .1 The electronic temperature control system shall provide a modulating control signal to the coil control valve and actuator
  - .5 Heating devices
    - .1 When in heating mode, the electronic temperature control system shall provide a modulating control signal to the coil control valve and actuator
  - .6 Heating Controls
    - .1 The minimum heater protection when using the DJM module as a secondary controller shall be a high temperature limit switch, an induced draft motor speed sensor, flame proving controls.
    - .2 The controller shall continuously monitor the pilot valve and flame relay operation.
  - .7 Communication

The controller shall have indication and troubleshooting LED lights, multi-meter set point and sensor temperature test points, and a common alarm contact in the event of equipment failure.

## 2.9 FACTORY SUPPLIED CONTROLS/WIRING

- .1 Provide a system of motor control, including all necessary terminal blocks, motor contactors, motor overload protection, grounding lugs, control transformers, auxiliary contactors and terminals for the connection of external control devices or relays.
- .2 Fire alarm circuits (where required) shall be powered from a relay in unit circuitry.
- .3 Unit to come with two power connections:
- .4 One connection for 575V/3/60 unit power.

- .5 One connection for a unit mounted 120V/1/60 20A GFCI. GFCI to be factory supply and mounted on the exterior of the unit casing.
- .6 Provide factory mounted non-fused disconnect switches for each circuit in CEMA/NEMA 3 configuration.
- .7 Unit control strip for BMS to include:
  - .1 Unit on/off
  - .2 BMS discharge air reset (0-10VDC)
  - .3 Heating on contact (cooling locked out)
  - .4 Cooling on contact (heating locked out)
  - .5 Clogged filter indication
- .8 Automatic controls shall be housed in a control panel mounted in or on the air handling unit, which will meet that standard of the specific installation.
- .9 Provide a discharge air low limit equipped with an automatic by-pass time delay to allow for cold weather start-up. On a heating system failure, this device will shut down the fan and close the outdoor air damper.

### **Part 3 Execution**

#### **3.1 INSTALLATION**

- .1 Install to manufacturer's written instructions.
- .2 Install to AHRI 435.
- .3 Install assembled unit on concrete foundation.

**END OF SECTION**

## Part 1 Introduction

- .1 This Specification, attachments, and references noted herein define the minimum general requirements for materials, installation, inspection, testing and touch-up painting of the steel supports, conduit, tray, power, instrument and control cables, data, communication signal and fiber optic cable, instruments, PLC equipment, enclosures, motors, lighting, grounding and electrical equipment.
- .2 The Summary of Work, technical standards and specifications, materials, methods and documents are defined and described by the documents listed in the Section 00 01 10 – Electrical Specification Index.
- .3 The requirements of this Specification are intended to supplement the requirements of the applicable codes. It is not the intent of this Specification to relax any requirements specified in the applicable codes, on the reference drawings or in the purchase order.
- .4 Compliance with this specification does not relieve the Contractor/Supplier of their responsibility to follow the applicable codes, use sound engineering, installation, testing and fabrication practices throughout in order to install all electrical equipment and instruments as defined in the Scope of Work, which is durable, safe and reliable for the service described.
- .5 The Contractor/Supplier shall assume final responsibility for the installation, fabrication, and conformance with code and legal requirements for the electrical equipment and instruments as defined in the Scope of Work.
- .6 If conflicts arise between documents, the Contractor/Supplier shall obtain a clarification of the governing requirements in writing from the Owner Project Manager.
- .7 Unless the Contractor/Supplier takes specific exception to the requirements in the specification package, strict conformance is implied and will be enforced.
- .8 Units of measure shall be in Metric, U.S. English.

## Part 2 Safety

### 2.1 GENERAL

- .1 The Contractor shall ensure that the relevant safety rules of the Owner are adhered to.
- .2 In addition to the requirements listed in this document, all requirements in the safety section of the attached Special Provisions 0700 shall be followed.
- .3 The contractor will be responsible for all of his workers having the proper “Personal Protective Equipment” for working in the area, namely:
  - .1 Personnel wear hard hats and protective glasses in designated area.
  - .2 Personnel wear protective boots at all times.
  - .3 Personnel wear clothing that has no tears and/or loose ends.
- .4 That Contractor's electrical tools are in good working condition and have no bare wires or frayed ends.
- .5 Personnel work in strict accordance with the Owner's work to permit rules and isolation procedure.

- .6 The contractor must be familiar with all aspects of the Safety program that is in place for the area in which he is working. He will be responsible to schedule all his workers for required training.

## 2.2 SAFETY SIGNS

- .1 The Contractor shall be responsible for the installation of temporary and permanent safety signs as required by local regulations or stipulated by the Engineer.

### .2 Signage and Warning Labels

- .1 Signs indicating electrical dangers, highest voltage present and warnings or information shall be located at the following locations:
  - .1 On doors, gates, and fence locations for substations and MCC rooms.
  - .2 On doors to switchgear rooms or other similar compartments where exposed, energized electrical parts are located.
  - .3 On transmission, distribution and barrier structures where affected persons or the public may be present.
  - .4 Signs shall use internationally accepted symbols as much as is practicable and be located on all sides so that a sign is visible from any approach direction.
- .2 Where an electrical bus is supplied from two or more sources and an interlock system is not provided thereby creating a back feed opportunity to the supply system, signs warning of this potential problem shall be conspicuously displayed. Information signs with diagrams explaining complex interlocking schemes, key exchange, shall be provided.
- .3 Permanent framed copies of main supply power distribution (upstream) and local distribution (downstream) single line diagrams shall be wall mounted in each substation, MCC room and power distribution center.
- .4 Warning labels shall be provided inside each equipment enclosure which contains circuits supplied from more than one source.

### .3 Warning Signs

- .1 External warning sign material shall be an engraved phenolic (white on red) with two inch letters.
- .2 Warning signs and operating instructions shall be provided for the ground and test devices.
- .3 All doors and hinged bolted panels providing access to high voltage shall be provided with "DANGER - HIGH VOLTAGE 25 KV - QUALIFIED PERSONS ONLY" signs.
- .4 All doors providing access to main breakers and tie breakers shall be provided with warning signs indicating "WARNING – THIS BREAKER MAY BE ENERGIZED FROM EITHER SIDE".
- .5 In addition, each breaker cell shall be provided with the following warning label adjacent to the breaker racking mechanism access door: "WARNING – PERSONNEL SHALL WEAR FLASH PROTECTION SUITS WHEN RACKING BREAKERS IN OR OUT". The label shall be engraved phenolic (white on red), size 125 mm x 100 mm, lettering 12.5 mm high.

### .4 Arc Flash and Shock Hazard Warning Labels

- .1 Arc Flash and Shock hazard warning labels, in accordance with CEC and NFPA requirements, shall be applied to electrical equipment compartment doors and panels covering exposed energized components. The labels shall include the following information:
  - .1 Flash hazard boundary distance.
  - .2 Incident energy at prescribed distance of 450 mm.
  - .3 CEC Z462, NFPA 70E Class of PPE and List of specific arc flash PPE required.
  - .4 Insulated Glove Class.
  - .5 Limited Approach Distance.
  - .6 Restricted Approach Distance.
  - .7 Prohibited Approach Distance.

## **Part 3 Codes and Standards**

### **3.1 GENERAL**

- .1 This Specification Package references codes and standards to establish minimum acceptable requirements of materials and workmanship, where the Specification Package does not otherwise establish such requirements. The Contractor/Supplier shall comply with the latest published edition and supplements of the referenced codes and standards, effective at the date of contract award, unless otherwise stated.
- .2 In the event of a conflict between this Specification Package and any of the referenced codes and standards, the Contractor/Supplier shall contact the Owner Project Manager in writing for interpretation and resolution.

### **3.2 INDUSTRY STANDARDS AND CODES**

- .1 The electrical installation in general shall conform to the latest edition of the Canadian Electrical Code (CEC).
- .2 Other specifications and standards governing design, installation, fabrication and testing shall include: American National Standard Institute (ANSI), and the specifications of The Institute of Electrical and Electronic Engineers (IEEE), the latest edition or revision of the codes and standards, or specifications shall apply.
- .3 All work shall be carried out in accordance with the latest edition and addenda of all applicable standards and codes initiated and issued by the following organizations:
  - AISC American Institute of Steel Construction, Manual of Steel Construction
  - AISE Association of Iron and Steel Engineers
  - ANSI American National Standards Institute
  - EPA Environmental Protection Agency
  - NEMA National Electrical Manufacturer Association
  - ULc Underwriters Laboratory, Inc.
  - CSA Canadian Standards Association
  - ICEA Insulated Cable Engineers Association
  - ASTM American Society of Testing and Materials
  - NFPA National Fire Protection Agency

OSHA Occupational Safety and Health Act  
AWS American Welding Society  
IRI Industrial Risk Insurers  
ISA Instrumentation, Systems, and Automation Society

#### **Part 4 Drawings and Specifications**

- .1 The drawings listed in drawing G01 (coversheet) form part of this Specification.
- .2 The Contractor/Supplier shall thoroughly study the Drawings and Specifications that have been incorporated and made part of the Contract Documents and shall familiarize himself as to the scope, schedule, method of shipment of electrical equipment and instruments.
- .3 Contract value is to be based on cabling as listed in the cable schedule, on layouts, one line diagrams, P&I diagrams, instrument lists and specifications, loop drawings and equipment Vendor's drawings.
- .4 The Contractor will assume, when formulating his contract value, that each conductor of a multicore cable, individual conductors, power and instrument cables are all to be terminated at both ends. Equipment for which Vendor drawings are not yet available, size, weight and location of installation will be given on the layout drawings.
- .5 Drawings which are for information only and not essential for pricing shall be issued with/or after the construction issue package. The following drawings are in this category:
  - .1 Elementary Connection diagrams.
  - .2 I/O Schematic diagrams.
  - .3 Panel Wiring diagrams, etc.
- .6 It shall be the responsibility of the Contractor to determine the interface of its Work with other related Work to be performed under other Sections and the Specifications.
- .7 Electrical Drawings indicate general location and routing of conduits and wire, including fittings and boxes. They do not indicate structural, architectural, and mechanical equipment location interfaces.
- .8 In order to provide sufficient detail and maximum degree of clarity on Drawings, electrical devices are shown by the use of standard engineering symbols indicating their approximate location. The Contractor shall refer to dimensions on detail Drawings, or take field measurements for exact placement of equipment.
- .9 The Contractor shall be responsible for quantity take-offs. The lengths indicated on the Cable and Tray Schedules are not to be taken by the Contractor as exact lengths.
- .10 Structural, architectural, mechanical, vendor and other Drawings and related Work of other trades shall be examined by the Contractor to ensure the Work can be satisfactorily carried out. Conflicts or additional Work beyond limits of Work covered by the Contract Documents shall be brought to the attention of the Engineer for resolution.

#### **Part 5 Hazardous Locations**

- .1 It is the Contractor's responsibility to ensure that work undertaken by him in hazardous areas meets the necessary standards and conditions applicable to such an installation as outlined in the latest edition of Canadian Electrical Code (C22.1).



## **Part 6            Quality Assurance**

### **6.1            GENERAL**

- .1      Work shall be executed in a neat and workmanlike manner by qualified Electrical/ Instrument Trades people, and shall be done in accordance with the requirements of the latest editions and revisions of the ISO 9001 and all applicable standards that may apply to this Specification.
- .2      All materials used in the fabrication and/or assembly of the electrical work shall be new and of the type and grade specified on the Contractor/Supplier drawings and data sheet.
- .3      Materials and workmanship shall be of good industrial quality, suitable for the purpose intended and in accordance with the highest standards and practices for items on this data sheet. Materials of construction shall be selected by the Contractor/Supplier based on the contract drawings, experience in similar applications and the operating conditions defined in this specification.
- .4      The Owner shall have the right to require, at no additional cost, complete rechecking, inspection and replacement of any part of the work, which does not conform to drawings, specifications, or currently accepted concepts of high quality performance, materials or workmanship. Any conflicts between specification and/or drawings are to be resolved in a timely fashion prior to start of any construction by contacting the Owner.
- .5      Waiving all or part of the inspection, failure on the part of the Owner to inspect, and/or failure to reject on inspection, work which later proves to be defective shall not release the Contractor/Supplier from warranties, commitments or obligations stipulated by the purchase documents. The Contractor/Supplier is solely responsible for the accuracy, quality and completeness of his work and supply.

### **6.2            NON-CONFORMANCES**

- .1      The Contractor shall submit a plan to the Owner for Approval by the Engineer for the repair of all electrical installation which did not meet the design or manufacturer requirements. This submittal shall include a clear statement of the problem, marked –up drawings to illustrate the problem, and the proposed method of repair.

## **Part 7            Products and Materials**

### **7.1            CONTRACTOR SUPPLIED MATERIALS AND EQUIPMENT**

- .1      The Contractor shall supply all materials and equipment, not otherwise supplied by the Owner, required for the complete installation.
- .2      The contractor must ensure that materials are supplied in a timely manner to support the installation schedule. Contractor must keep the Engineer/Owner apprised of any delays in delivery of material that would affect the completion of work.

### **7.2            GENERAL**

- .1      Materials shall be new, of the quality specified and shall conform to the applicable NEMA, ANSI/IEEE standard and carry a Canadian Standards Association (CSA) or Underwriters Laboratories (ULc) label of certification. Where equipment or materials are specified by technical description only, they shall be of the best industrial quality obtainable for the purpose.

- .2 The Contractor shall be completely responsible for ascertaining that equipment and materials comply, in all respects, with the Specifications and Drawings.
- .3 Methods of fabrication, assembly and installation shall be the responsibility of the Contractor, provided that this Work achieves its intended purpose and is co-ordinated with other ongoing work in order to avoid delays.

#### **Part 8 Submittals by Contractor**

- .1 The Contractor shall regularly submit to the Engineer for review such information and drawings as are necessary for the proper performance of the Work or as required by laws, ordinances or regulations governing the Work, as required by other specification sections and in the Contract.
- .2 Prior to submission to the Engineer, the Contractor shall review the Contractor's Submittals. By this review, the Contractor represents that he has determined and verified field measurements, field construction criteria, materials, catalogue numbers and similar data and that he has checked and coordinated each drawing with the requirements of the Work and of the Contract Documents. The review by the Contractor of each drawing shall be indicated by stamp, date and signature of a person authorized for such purpose by the Contractor.
- .3 The Contractor shall submit Contractor's Submittals to the Engineer in orderly sequence for review in sufficient time as determined by the Engineer. At the time of such submission the Contractor shall notify the Engineer of any deviations in the Contractor's Submittals from the requirements of the Contract Documents.
- .4 Changes to Contractor's drawings made by the Contractor shall be submitted to the Engineer for review.
- .5 Review of the drawings by the Engineer shall not relieve the Contractor from responsibility for any errors contained therein nor from the Contractor's obligation to perform the Work in accordance with the Contract Documents.
- .6 The Contractor shall submit to the Engineer for evaluation purposes four copies of literature from the manufacturer applicable to items to be provided by the Contractor.
- .7 The Contractor shall submit to the Engineer, samples required by the Engineer to enable the Engineer to evaluate the item proposed to be furnished by the Contractor.
- .8 Documentation such as equipment details, test results, certificates, reports, delivery tickets, as specified in the various Sections of these Specifications shall be submitted to the Engineer, for use and review.

#### **Part 9 "As-Built" Drawings**

- .1 The Contractor shall maintain current two sets of prints marked up to show the "As-built" status, taking into account all variations from the contract drawings.
- .2 The Contractor shall maintain two full-size sets of as-built drawings, which shall be updated on a continuous basis, taking into account all variations from the contract drawings, and shall provide the Owner marked-up copies weekly. Completed drawings marked as-built shall be submitted to the Owner at the end of the project.
- .3 The Contractor/Supplier shall legibly mark each item to record actual construction, including:

- .1 Field changes of dimension and detail.
- .2 Changes made by change orders.
- .3 Details not on original Contract Drawings.
- .4 References to related shop drawing and modifications.

## **Part 10 Installation and Workmanship - General**

### **10.1 MOUNTING**

- .1 Electrical equipment mounted on channels embedded in slabs shall be plug-welded to the channels. Electrical equipment mounted directly on finished slabs shall be fastened with expansion anchors, Ramset or similar devices. In either case, the finished work shall result in an installation which is true, plumb and secure.
- .2 Manufacturer's instructions for the installation of Employer-supplied equipment shall be made available to the Contractor. It shall be the Contractor's responsibility to familiarise themselves with these instructions and to follow them in the work of installation, testing and operation.
- .3 Electrical equipment and their supporting bracket shall be affixed to structural steel members with bolts through drilled or tapped holes only. Torch cutting and welding of any kind is not permitted.
- .4 Wall and column mounted electrical equipment may be fastened with expansion anchors, Ramset, on metal brackets or other approved means so long as the finished work results in an installation that is true, plumb and secure.
- .5 Brackets, anchors, gaskets, nuts, bolts, shims and other similar materials incidental to or needed for the complete installation of equipment shall be furnished and installed by the Contractor.

### **10.2 FASTENERS**

- .1 Nuts, bolts, etc., forming part of an assembly or sub-assembly will normally be supplied by the manufacturer of the pieces of machinery concerned. However, other fasteners may be required to fasten the assembly to supporting steelwork and in these cases, it is the responsibility of the Contractor to supply these fasteners.
- .2 Fasteners supplied by the Contractor are to be stainless steel, electro-galvanized or other non-corroding material, which shall be approved in writing by the Engineer before use.

### **10.3 BURIED SERVICES**

- .1 All buried conduits and cables to be inspected by Owner/Consultant as specified.

### **10.4 PAINTING AND RESTORING**

- .1 The Contractor/Supplier shall thoroughly clean and paint any structural steel supports and ductwork fabricated and installed by the Contractor/Supplier.
- .2 Miscellaneous support or structural steelwork installed by the Contractor shall be treated and painted per the Owner's painting standards.
- .3 The Contractor shall be responsible for touch-up of any paint surfaces damaged during installation subject to an inspection and acceptance by the Owner.

- .4 Galvanized metal finishes shall be repaired with zinc rich cold galvanizing compound, applied in a minimum of three coats. Items requiring repair includes conduit threads, exposed saw cut edges, tool marks, etc.
- .5 Paint for touch-up of owner supplied equipment will be provided.

#### **10.5 INTERFERENCE**

- .1 Circumstances may prevent mounting an electrical device or apparatus in the location shown on the drawings. In such cases the exact locations shall be determined in the field by the Contractor and approved by the Engineer.
- .2 Prior to commencing installation, the Contractor/Supplier shall thoroughly examine the work upon which this Work is dependent. Report any deficiencies discovered and propose adjustments to the manager and obtain written authorization before proceeding.
- .3 The Contractor/Supplier shall check that the position of anchor bolt settings.

#### **10.6 DEMOLITION AND RELOCATION**

- .1 Relocation work shall include disconnecting existing cables, rerouting and reconnection or replacement if existing length are not sufficient for rerouting, as directed by the Engineer.
- .2 The Contractor shall demolish and remove existing instruments, control devices, control stations, cables, wiring, support devices and other materials as indicated on the drawings, specifications or implied by virtue of related work which make any item redundant or replaced by a new device. Return removed materials to the Owner's salvage yard.

#### **10.7 FIELD WELDING**

- .1 During welding operations the surrounding area shall be protected in accordance with the Owner's standards for fire safety.
- .2 All welding shall be performed in accordance with AWS, AISC, ASME codes and other applicable requirements of the standards, codes and specifications referenced herein or in other contract documents.
- .3 Structural Steel Welding shall be performed by qualified welders and welding operators and in accordance with written procedures and AWS code requirements.
- .4 The Contractor/Supplier shall provide Welding Procedure Specifications, Procedure Qualification Records and Welder Qualification Records prior to commencing work.
- .5 The Owner reserves the right to preclude use of other welding processes.
- .6 All surfaces to be welded shall be free of oil, grease, mill scale, dirt, paint and all other detrimental materials before welding.
- .7 The Contractor/Supplier shall have all weld joint edge preparations made by machining, grinding, or thermal cutting in the fabrication shop. When thermal cutting is performed, the joint surfaces shall be ground to sound metal and checked for the presence of cracks or other injurious defects prior to welding.
- .8 All filler metals and consumable materials used in the performance of the work shall be suitable for the intended application and in accordance with AWS and AISC codes.
- .9 Components shall not be welded until they have been properly aligned. The sequence of placing welds shall be such as to avoid distortion of the components.

- .10 Tack welds not incorporated in final welds shall be removed and the area ground smooth.
- .11 Completed welds shall be regular in appearance, smooth and free of undercutting, cavities, inclusions, depressions, or cracks.
- .12 After welding, the surfaces shall be cleaned free of weld splatter, flux, slag, and other such materials.
- .13 Prepare surfaces of both existing steel and new steel in accordance with ANSI/AWS D1.1.
- .14 Store all open containers of electrodes in drying ovens. Supply welders with only enough electrodes for 3 hours at any time. Use thoroughly dry electrodes only.
- .15 Perform structural welding and weld inspection in accordance with ANSI/AWS D1.1.
- .16 Complete welded connections on Site in accordance with the final shop and erection drawings.
- .17 Remove slag, splatter, scale and discoloration.
- .18 The Engineer will inspect, and approve in writing all field welding not specifically called for on the Drawings. The Contractor shall make good plated or galvanised metal finishes and painted surfaces damaged by field welding.
- .19 Field welding shall be performed by welders qualified in accordance with AWS QC1.
- .20 Welding electrodes shall be of the E70 Series.

#### **10.8 CLEAN-UP**

- .1 The Contractor shall provide protective coverings and equipment covers closed whenever possible to prevent entry of water, dust and foreign debris.
- .2 Upon Completion of the Work:
  - .1 The Contractor shall thoroughly clean electrical rooms. Holes and openings in the floors and walls of these rooms shall be completely sealed with fire resisting material e.g. Flamastic, Selastic or approved equal.
  - .2 The Contractor shall make a thorough inspection of electrical equipment, remove any left-over packing braces or shipping supports and thoroughly clean equipment by hand-operated vacuum machine.
  - .3 The Contractor shall remove dust from devices, terminals, etc., and vacuum the inside of control panels and enclosures.
  - .4 The Contractor shall clean and vacuum power and distribution panel boards, and make sure that directory cards are neatly typed showing the final circuit designation; and placed in the card holder on the inside of the door of each panel board.
  - .5 Contractor shall dispose of debris and waste material from his area of work.
  - .6 Contractor shall touch up painted surfaces where required.
  - .7 Contractor shall ensure prior to switch-on of equipment, that no condensation that could form inside equipment.

**END OF SECTION**

**Part 1 General**

- .1 The Contractor shall be responsible for receiving, storage, handling, installation, testing of low voltage power cables and connectors, fittings and termination as required and detailed on the Drawings, Specifications and in accordance with Section 26 05 00 - Electrical Installation Common Works.
- .2 Cable shall be supplied for installing all equipment shown on the drawings.

**Part 2 Submittals**

- .1 Technical information for all materials shall be submitted in accordance with Section 26 05 00 Electrical Installation Common Works.
- .2 The submission shall include descriptive literature of the manufacturer and published details with complete performance and rated capacity schedules or chart, dimensions, etc., as applicable.
- .3 The following documents shall be submitted and reviewed by the Engineer, prior to the procurement fabrication and installation of the following:
  - .1 Bulletins from the manufacturers of all cable types.
  - .2 Bulletins from the manufacturers of all wire terminals, compression and screw lugs.
  - .3 Bulletins from the manufacturers of all terminations, insulating materials including tape, tubing and heat shrinkable tubing.
- .4 The Contractor shall submit at the completion of the Work, the exact cable and wire routings on the cable schedules.

**Part 3 Products and Materials**

**3.1 GENERAL**

- .1 Low voltage cables will be supplied by Contractor.
- .2 Cable shall be new, within one year of manufacture when delivered to the site, and bear the UL label, insulation type, voltage level, and manufacturer's name at regular intervals on the exterior jacket.
- .3 Overall cable jackets shall be outdoor grade, low acid gas emitting and fire retardant PVC as per ICEA-T-29-520. Temperature rating shall be -40° C to 90° C.
- .4 Power colour code:
  - .1 Single-Phase AC or DC (2 wires) Hot – Black  
Neutral - White
  - .2 Single-Phase AC or DC (3 wires) Hot – Black  
Hot – Red  
Neutral - White
  - .3 Three-Phase AC A – Red  
B – Black  
C – Blue  
N - White
  - .4 All Ground wires Green or Bare

- .5 These colours shall be identified on wires terminating at each motor and equipment.

### 3.2 WIRE AND CABLE MARKERS

- .1 Both ends of individual wires shall be labeled with a printed sleeve bearing the circuit number as designated on the wiring diagrams or conduit cable schedules or provided by Electrical Vendors.
- .2 Where a cable passes through a wall, it shall be labeled on either side of the wall.
- .3 Both ends of cables shall be labeled with a printed tag bearing the cable number as designated on the wiring diagrams or conduit and cable schedules provided or provided by Electrical Vendors.
- .4 Special control and/or instrumentation cable shall be as specified on the Contract Drawings and Cable Schedules or in this specification.

### 3.3 WIRE SIZE

- .1 Wire sizes shall be as follows:
- .1 No. 12 AWG minimum for low voltage power cables.
  - .2 No. 14 AWG for low voltage control cables.
  - .3 No. 16 AWG for instrument and signal cables.
  - .4 No. 18 AWG for RTDs.
- .2 The sizes of wire and cable indicated on the Contract Drawings and Cable Schedules are based on preliminary engineering data. The Contractor shall check all wire and cable sizes based on the actual equipment supplied.

### 3.4 TERMINATIONS

- .1 Connectors shall be designed and approved for the type and size of cable to which they connect.
- .2 Connectors shall be indented, all around high compression, long barrel type.

### 3.5 WIRE AND CABLE

- .1 Teck 90 Cable, 600V and 1000V
- .1 Conductor and ground wire: Class B stranded copper
  - .2 Insulation: RW90 XLPE
  - .3 Inner jacket: PVC
  - .4 Armour: Aluminum
  - .5 Outer jacket: PVC, black colour for 600/1000V;
  - .6 Flexibility at low temperature: suitable for installation at -40°C
  - .7 Standard: CSA C22.2 No. 131
  - .8 Flame retardant: CSA C22.2 No. 03 FT1, FT4
  - .9 Acid gas evolution: CSA C22.2 No. 03 M1985
  - .10 Hazardous Locations: CSA C22.2 No. 174 M1984, File No. LR50467-1
- .2 VSD Shielded Power Cable
- .1 Teck 90 Cable, 1000V

- .2 Conductor and ground wire: Class B stranded copper
- .3 Insulation: RW90 XLPE
- .4 Shielded for use in VSD service
- .5 Inner jacket: PVC
- .6 Armour: Aluminum
- .7 Outer jacket: PVC, black colour for 600/1000V;
- .8 Flexibility at low temperature: suitable for installation at -40°C
- .9 Standard: CSA C22.2 No. 131
- .10 Flame retardant: CSA C22.2 No. 03 FT1, FT4
- .11 Acid gas evolution: CSA C22.2 No. 03 M1985
- .12 Hazardous Locations: CSA C22.2 No. 174 M1984, File No. LR50467-1
- .3 Portable Power Cable
  - .1 Indoor
    - .1 SOW 600 V cable shall be rated at 90°C complete with stranded, copper conductors, and overall jacket.
  - .2 Outdoor
    - .1 S00W (600V) EPDM insulation / CPE jacket 105°C to -50°C.
- .4 Wire, 600 Volts and Lower
  - .1 Conductor: Class B stranded copper
  - .2 Type: TEW for MCC and control room wiring RW90 X Link or T90 for all others
  - .3 Instrumentation Cable: Single pair and triad, #16 AWG and multi-pair #16 AWG, stranded bare copper, PVC/Nylon insulation, color coded, individual aluminum / polyester foil tape plus tinned copper drain, polyester binder, overall aluminum / polyester foil tape plus tinned copper drain, inner PVC jacket, continuously welded and corrugated aluminum alloy sheath, grey PVC jacket.
  - .4 RTD Cable: Multi conductor instrumentation cable, #18 AWG, 90 deg. C, 300 Volt stranded copper, PVC insulation, twisted shielded triads, overall shield, inner PVC jacket, continuously welded and corrugated aluminum alloy sheath, black PVC jacket.
- .5 Instrumentation Cable, Non-Metallic Sheathed, 300V, Single Pair and Triad
  - .1 Conductor: Class B stranded copper
  - .2 Insulation: PVC
  - .3 Shield Over Pair/Triad: 100% coverage by aluminum-mylar tape shield and tinned copper stranded drain wire
  - .4 Lay of Twist: 50 mm nominal
  - .5 Identification: black and white for pair black, white, and red for triad
  - .6 Jacket: PVC, grey, except blue for intrinsically safe installations
  - .7 Standard: CSA 22.2 No.239 Type CIC Control and Instrumentation Cable
  - .8 Hazardous Location: CSA C22.2 No. 174 M1984, File No. LR50467-1
- .6 Instrumentation Cable, Armoured, 300V, Pairs and Triads
  - .1 Conductor: Class B stranded copper
  - .2 Insulation: PVC



- .3 Shield over pair/triad: 100% coverage by aluminum-mylar tape shield and tinned copper stranded drain wire
- .4 Lay of twist: 50 mm nominal
- .5 Identification: conductors black and white, pair stamped with pair numeral  
conductors black, white and red, triad stamped with triad numeral
- .6 Armour: Aluminum
- .7 Jacket: PVC, grey, except blue for intrinsically safe installations
- .8 Overall shield: 100% coverage by aluminum-mylar tape shield and tinned copper stranded drain wire
- .9 Standard: CSA 21.2 Control Cable (+75°C, -40°C) CSA C22.2 No.174-M  
Hazardous Locations

#### Part 4 Execution

- .1 Cables shall be run in single lengths with no splices permitted. Any and all wiring revisions shall be completely recorded and noted by the Contractor on the record set of "As-built" drawings. Pulling eyes shall be used for any cable pulled through ducts.
- .2 All wiring and cable shall be enclosed in a raceway. The Contractor shall require the Engineer's approval in writing for any exposed work.
- .3 Where practical, cables shall be terminated at the bottom (first preference) or side (second preference) of panels, enclosures or boxes to reduce damage due to ingress of water.
- .4 All wiring shall be properly grounded, color coded, and polarized throughout.
- .5 No conductor shall be installed until the raceway system that contains it is complete.
- .6 In general, the use of lubrication material to aid in the installation of conductors is to be avoided. Where it is absolutely necessary, a lubricating material that is compatible with the insulation and that will leave a minimum of residue shall be utilized.
- .7 Cables run in cable tray shall be securely fastened with ultraviolet resistant nylon heavy duty lashing ties (Ty-Raps) every 3 m minimum) in horizontal runs.
- .8 All debris and foreign matters shall be removed from the cable trays and trenches prior to installation of the cables, and on completion of the work, the Contractor shall thoroughly check all cable trays and trenches again and remove all accumulated dirt and debris.
- .9 Cables shall be installed with radii of bends not less than the minimum recommended by the cable manufacturer or twelve times the diameter of the cable over the armour whichever is the larger.
- .10 During installation of the cables, extreme care shall be exercised to avoid kinking or bending which may damage the cable insulation or sheath. Cables which are accidentally damaged during installation shall be repaired to the satisfaction of the Engineer. In no case shall a cable, on which the outer sheath has been punctured, be installed in this condition.
- .11 A flame retardant material shall be applied to all cable in tray runs inside electrical rooms and for 1 m outside each electrical room. In addition, all penetrations need to be properly re-sealed and fire-stopped after new cables are installed.
- .12 All terminations shall be made to terminal blocks, bus, or connectors in approved enclosures.

- .13 Conductors shall be clearly identified with wire identification marker numbers as indicated on the equipment supplier's drawings at all pull boxes, equipment enclosures, devices, and termination points.
- .14 Conductors shall be installed and terminated without damaging the insulation.
- .15 Shielded signal cables shall have the shield grounded at one end only (the power source end).
- .16 For 50 HP and larger motors, apply two half-lapped layers of Scotch 3M heat shrunk boots to motor lead connections.
- .17 For applications that include multi-conductor cables entering or exiting outdoor electrical equipment (such as feeders from a secondary unit substation); if the multi-conductor cable fitting is installed through the top of the metal enclosure, a bead of silicone caulk must be applied at (1) the joint of the fitting and sheet metal and (2) at the joint of the cable and fitting. This precaution is above and beyond the rubber grommet seals provided with the fitting.
- .18 Raceways shall be inspected for sharp edges and proper bushings prior to the installation of wires and cables.
- .19 Conductors in vertical raceways shall be supported independently of the terminal connections and at intervals not exceeding five meters.
- .20 Approved non-corrosive and non-conductive cleaning agents or lubricants shall be used when inserting conductors in raceways.
- .21 Power and motor feeder cables shall be installed in one continuous length free of joints, splices and taps by looping through conduits, pull boxes, raceways and cable trays.
- .22 Conductors shall be terminated in terminal blocks with insulated compression lugs or insulated with hermetically sealing heat shrinkable tubing.
- .23 Cables shall be installed in the trays in logical order such that they will lie flat and with a minimum of cross overs. Cables entering or leaving tray shall be routed to prevent possible mechanical damage due to abrasion.
- .24 Cables for systems or different voltage levels shall not be routed together. Where an alternative route is not available an earthed metallic barrier shall be installed as required.
- .25 Debris and foreign matter shall be removed from the cable trays and trenches prior to installation of the cables, and on completion of the Work, the Contractor shall thoroughly check cable trays and trenches and again remove accumulated dirt and debris. On completion of the cable installation, the Contractor shall ensure that covers are in place on the trenches and trays where applicable.
- .26 Low voltage shielded (screened) instrument cable and thermocouple extension wire shall be run in separate tray or conduit, physically separate from power cable.
- .27 The spacing shall be maintained by securely fastening cables with "Ty-Rap" cable ties, every 300 mm in horizontal runs of tray, and by "Kellems" type woven stainless steel support grips, at every 3 m in vertically run trays.
- .28 Single core cables run in trefoil formation shall be clamped to trays by means of aluminum or non-magnetic stainless steel trefoil clamps. The clamps shall be spaced at a distance such that they can withstand the fault level of the various systems. The successful Contractor shall submit the necessary calculations to prove compliance.
- .29 Cable ends shall be sealed if they are to be left for a period exceeding 1 week before termination.

- .30 Adequate rollers/support shall be provided when pulling cables to ensure minimum strain and no damage to cable outer sheaths. Should any damage occur, this must be brought to the attention of the Engineer and corrected as instructed.

## **Part 5 Acceptance Testing**

### **5.1 VISUAL INSPECTIONS**

- .1 Inspect for physical damage, proper connections, correct size compression lugs, etc.

### **5.2 TEST AND MEASUREMENTS**

- .1 Insulation Resistance (Megger) Test:
- .1 Phase-Phase.
  - .2 Phase-Ground.
- .2 Measure resistance of all bolted connections.
- .3 1000V cable used for 575V motors or 600V power distribution feeders shall be field tested after installation and before being placed in service. Field testing shall consist of 1000V Megger testing. The minimum insulation resistance shall be one megohm.
- .4 A satisfactory field test result is when the trend of currents (after final test voltage is applied), as seen on a graph of leakage current versus test voltage, exhibits a slope which is negative or flat. A test result with a positive slope shall be considered a failed cable.
- .5 All graphic results shall be submitted to and reviewed by the Engineer before final acceptance of the installation.
- .6 All failed cables shall be totally replaced with no additional cost to the Owner.

## **END OF SECTION**

**Part 1 General**

- .1 The Work shall include the installation of a new electrical bonding and grounding system consisting of surface or underground run conductors and their interconnection to equipment, devices, raceways and existing grounding grids as detailed on the Drawings and Specifications, and in accordance with latest applicable codes, standards.

**Part 2 Submittals**

- .1 Technical information for all materials shall be submitted in accordance with Section 26 05 00 - Electrical Installation Common Work.
- .2 The submission shall include descriptive literature of the manufacturer and published details with complete performance and rated capacity schedules or chart, dimensions, etc., as applicable.
- .3 The following documents shall be submitted and reviewed by the Engineer, prior to the procurement fabrication and installation of the following:
  - .1 Bulletins from the manufacturer of mechanical, compression and exothermic welded connectors.
  - .2 Bulletins from the manufacturer of multi-segment ground rods.

**Part 3 Products and Materials**

**3.1 GENERAL**

- .1 The grounding and bonding material will be supplied by the Contractor.
- .2 Grounding Conductors
  - .1 Main ground grid cable shall be 2/0 AWG bare stranded soft drawn annealed Copper as indicated on the Drawings.
  - .2 Equipment and enclosure ground shall be:
    - .1 2/0 AWG or as indicated on the Drawings and
    - .2 Stranded uncoated bare copper or
    - .3 Stranded uncoated copper with a green PVC insulation and nylon jacket.

**3.2 GROUND RODS**

- .1 Grounding rods shall be copper clad steel, 75 mm diameter by 3 m long, formed by a maximum of 4 sections welded or screwed together as indicated on the Drawings.
- .2 Ground rods shall be accessible and installed with protective access covers, where indicated. The cover shall be labeled as "Grounding Inspection".

**3.3 CONNECTIONS AND ACCESSORIES**

- .1 The grounding systems shall be continuous including electrodes, conductors, connections and accessories.
- .2 Grounding grid testing stations shall have bolted connections to each ground conductor and be located and installed in accordance with the Drawings.
- .3 Accessories required to complete the grounding system shall be of the non-corroding type.

- .4 Mechanical connections shall be made of high strength electrical bronze with silicon bronze clamping bolts and hardware. The design shall be such that bolts, nuts, lock washers and similar hardware which could nick or damage the earth wire shall not contact the ground wire.
- .5 Compression connections shall be supplied from one manufacturer only and shall be produced for the specific application as indicated.

#### **Part 4 Execution**

- .1 Wherever applicable, connections for the grounding system shall be made with Compression connections. Connection to structural steel and buried piping shall be by Compression or Mechanical type. Soldered connections shall not be used.
- .2 All non-metallic raceways and enclosures shall be provided with a system ground conductor sized according to the CEC and included within the raceway.
- .3 Cable connections for the grounding system shall be Compression type. Connections to motors, metal enclosures, raceways, etc. shall be solidly bolted. Soldering shall not be allowed.
- .4 Grounding conductors installed inside the building shall be neatly clipped and installed as inconspicuously as possible. In routing to the nearest building ground, the conductor should be attached to structural steel and avoid interference with any other equipment.
- .5 Where the ground conductor bonds to building steel, the location shall not be subject to mechanical damage. Bond points shall be accessible for inspection.
- .6 Where a ground conductor passes through floors, slabs, walls, etc. and is not encased in rigid metal conduit, the Contractor shall supply and install PVC sleeves of the required size and length. Sleeve to extend a minimum of 50 mm beyond finished floor, slab, wall, etc. to provide physical protection.
- .7 Bonding jumpers shall be installed where required to maintain grounding continuity. Jumpers shall be sized per the CEC.
- .8 The Contractor shall provide a ground conductor to all light switches, receptacles, and light fixtures.
- .9 Transformer neutrals shall be grounded only at the transformer.
- .10 Where exothermic welds have been made to structural steel, the Contractor shall supply and apply touch-up paint. Prepare the surface by wire brush cleaning.
- .11 Ground conductors shall not be installed in any way that would interfere with electrical, mechanical, or piping equipment removal.
- .12 Areas to be bonded shall be thoroughly cleaned to remove grease, oil, corrosion preventatives, dust, dirt and moisture prior to bonding. Aluminum surfaces to be bonded shall be thoroughly cleaned and a conductive oxide inhibiting compound applied to the mating surfaces.
- .13 Care shall be taken to prevent moisture ingress to contact surfaces. Bonds and welds shall be protected from the weather, corrosive atmospheres and mechanical damage. Bonds and welds shall be sealed with at least one complete layer of denzil tape within one hour of joining.

- .14 Joints between sections of conduit, fittings and boxes shall be made electrically continuous. Pipe and locknut threads shall be treated with a conductive lubricant and then tightened. Gouging locknuts shall penetrate paint and other protective finishes to form an electrically continuous bond.
- .15 Grounding conductors installed in the buildings shall be neatly clipped and installed as inconspicuously as possible. Junction boxes and equipment not provided with grounding screws shall be drilled and tapped as necessary to provide these facilities.
- .16 Grounding bars integral to panels, control stations and equipment enclosures shall be bonded to separate points in the building grounding system with a minimum of two grounding conductors routed from the ends of the bar.
- .17 All motor frames shall be grounded. Low voltage motors rated 600 Volt and lower shall be grounded by connection to the grounding conductor in the supply cable which must be connected to the motor starter grounding bar.
- .18 In addition to the supply cable grounding, a separate surface run grounding conductor shall be installed between all medium voltage motor frames and the nearest building ground grid conductor. The cross sectional area of all motor grounding conductors shall not be less than one half the area of the motor power conductors.
- .19 Where grounding cables pass through floor slabs, building walls, etc., and are not encased in rigid metal conduit; sleeves or fiber or other approved non-metallic material of the required size, shape, and length shall be provided.
- .20 Grounding connections of individual equipment assemblies or raceways shall be made in radial connection to the grounding system. Loop connections shall be avoided as much as possible.
- .21 Single conductors and metallic armored cables shall be bonded to the cabinet at the supply end only. A non-metallic entry plate shall be provided at the load end.
- .22 The penetrations of grounding conductors through building and vault enclosures shall be waterproof protected. The sealants shall be bituminous resins, highly cohesive and adhesive to metals and concrete.
- .23 Cable trays shall be grounded by running a 4/0 AWG ground conductor along the entire length or all tray runs and bonding this to every tray section, by means of grounding clamps. The ground conductor shall be installed in the highest voltage tray in each run and jumpered to the other trays below every 15 m.
- .24 Flexible conduit, conduit expansion joints and cable armor shall not be used for grounding or bonding. A separate bonding jumper or conductor and approved connectors or fittings shall be installed for electrical continuity of the grounding system.
- .25 The Contractor shall perform any excavation, backfilling, grading and disposal of excess soil required for the complete installation of the system.

## Part 5 Acceptance Testing

- .1 Visual Inspections
  - .1 Check ground connections for looseness, corrosion, etc.
  - .2 Check that ground cables are of correct size.
  - .3 Check that major electrical equipment (Transformers, MCCs, HV and LV Switchgears, etc) are two-point grounded.

- .2 Test and Measurements
  - .1 Measure Substations and Process Building Grid ground resistance.
  - .2 Measure soil resistivity in proximity of Substations (for future reference).
- .3 A ground resistance test shall be conducted at a relatively dry period of time utilizing equipment of proven accuracy and applying the "Fall-of-Potential-Method" as described in the IEEE Std. 81. Individual ground rods shall be tested and recorded. The integrity of the ground grid shall also be tested and recorded.
- .4 The maximum resistance to ground shall be three ohms (3  $\Omega$ ).

**END OF SECTION**

**Part 1 General**

- .1 The Work includes furnishing the labour, material and equipment for the supply and installation of electrical conduit systems, as required and detailed on the Drawings and Specifications and in accordance with applicable Codes and Standards
- .2 The Work shall also include placement of surface and recessed conduits, and conduit extensions of embedded conduits all of which shall be field routed by the Contractor.
- .3 The Work shall also include excavation, backfill and concrete surround for conduits below grade.

**Part 2 Submittals**

- .1 Technical information for all materials shall be submitted in accordance with Section 26 05 00 Electrical Installation Common Work.
- .2 The submission shall include descriptive literature of the manufacturer and published details with complete performance and rated capacity schedules or chart, dimensions, etc., as applicable.
- .3 The following documents shall be submitted and reviewed by the Engineer, prior to the procurement fabrication and installation of the following:
  - Bulletins from the manufacturer of rigid and flexible conduit, fittings.
  - Bulletins from the manufacturer of outlet and pull boxes.

**Part 3 Products and Materials**

**3.1 CONCRETE**

- .1 The concrete used for embedded conduits shall comply with Section 03 30 00 – Cast-in-Place Concrete.

**3.2 CONDUIT**

- .1 Heavy Walled rigid galvanized steel (RGS) conduit shall be installed in all locations unless otherwise specified or indicated on the Contract Drawings.
- .2 The minimum size shall be 19.1 mm diameter for surface runs and 25.4 mm for embedment in concrete.
- .3 Embedded conduit shall be a minimum of 50.8 mm diameter.
- .4 Conduit fittings shall be of the same material as the conduit. Fittings shall be cadmium or zinc-coated and shall be threaded type. Set-screw couplings are not acceptable.
- .5 Expansion joints and couplings shall be Crouse Hinds type XJ have a packing ring and a pressure ring to prevent the entrance of moisture and shall have either a grounding ring or bonding conductor.
- .6 Tapped water-tight conduit hubs with nylon-insulated throats shall be provided for enclosures and gutters in wet locations. Conduit joints shall be made with three-piece unions.



- .7 Conduit thread coating compound shall be lead free, conductive, zinc-rich, anti-seize type, pipe fitting compound, and shall be applied prior to joining.
- .8 Exposed conduit or cables shall be fastened to building construction or support system using the following straps:
  - Surface conduits and cables up to one inch diameter shall use one-hole malleable iron straps.
  - Surface conduits and cables above one inch diameter shall use two-hole steel straps.

### 3.3 OUTLET BOXES

- .1 Outlet boxes and conduit boxes shall be sized accordingly.
- .2 101.6 mm square or larger boxes shall be installed as indicated on the Drawings for special devices.
- .3 Outlet boxes shall be feralloy, 'FS or FD' Type, single and multi-gang flush device boxes with stainless steel covers for flush installations as indicated on the Drawings. 101.6 mm square boxes shall be used when more than one conduit enters one side.
- .4 Lighting fixture outlet boxes shall be four inch square or round feralloy boxes.
- .5 Only cast feralloy boxes or hot-dip galvanised boxes, accepted by the Engineer, shall be used for embedding in concrete.
- .6 Outlet boxes installed outside buildings or in damp locations shall be weatherproof NEMA 4 degree of protection, outlet boxes installed inside buildings in an industrial environment shall be NEMA 3 and boxes installed in pressurized control and electrical room environments shall be NEMA 1.

### 3.4 CONDUIT FITTINGS

- .1 Bushings and connectors shall have nylon insulated throats.
- .2 Knock-out fillers shall be installed to prevent entry of foreign materials.

### 3.5 PULL BOXES

- .1 Galvanized sheet steel or cast feralloy pull boxes shall be used for conduit larger than 38.1 mm as indicated on the Drawings. Standard cast feralloy outlet boxes and fittings shall be used for conduits smaller than 31.8 mm
- .2 Cast pull boxes shall be suitable for embedding in concrete and shall be water and dust-tight with NEMA 4.
- .3 The fabricated pull boxes embedded in concrete shall be made of minimum 2 mm thick cold-rolled steel, fully seam welded hot-dip galvanized complete with oil resistant solid neoprene die-cut gasket.
- .4 Covers for embedded sheet steel pull boxes shall be NEMA 4 formed of minimum 2 mm thick cold-rolled steel, hot-dip galvanized, removable screw type, with nickel plated captive screws and threaded inner seal.
- .5 Pull boxes and covers for surface mounted boxes shall be phosphated, primed, painted with grey enamel and baked.
- .6 Pull boxes shall be designed for the degrees of protection as specified in Clause 3.2, 'Outlet Boxes'.

- .7 Pull boxes shall be installed at intervals of no more than 15.24 m apart and after every third 90 degree bend in a conduit system. Additional pull boxes shall be provided between designated boxes as required.
- .8 Pull boxes will not be designated on the Drawings.

### 3.6 FLEXIBLE CONDUIT

- .1 Flexible metal conduit for use in dry exposed locations shall be fabricated from hot-dip galvanized steel strip or aluminum. Minimum conduit size shall be 19.1 mm
- .2 Flexible metal conduit for use in wet locations shall be as above except that it shall be the "liquid-tight" type and complete with an overall thermoplastic jacket.
- .3 Conduit fittings for flexible conduit shall be made of the same materials as the conduit and approved for use in each particular application. Fittings shall be cadmium or zinc-coated and shall be threaded type.

### 3.7 UNDERGROUND DUCTS

- .1 Underground ducts will usually be normal duty, un-plasticized PVC pipe. Minimum size shall be three-inch diameter.

## Part 4 Execution

- .1 Conduit cut in the field shall have ends cut square with a power hack saw. Cut ends shall be reamed to remove burrs and sharp edges. All field threads shall be cut to the same dimensions and taper as the factory cut threads.
- .2 Rigid steel conduit shall be terminated using NPT threaded ends only. Compression fittings are not allowed. All conduit joints shall be made up tight and no running threads will be permitted - Erickson couplings or unions must be used. Expansion joints or equal must be used when crossing building expansion joint. Setscrew or threadless couplings are not acceptable.
- .3 Running threads for conduit joints shall not be permitted.
- .4 There shall not be more than the equivalent of three quarter bends or 270° total between pull points such as condulets or pull boxes.
- .5 Conduit that connects to metal enclosures or pull boxes shall utilize double lock nuts and a protective, nylon insulated bushing. One lock nut shall be used on the outside and the second lock nut and bushing shall be utilized inside. The bushing must be screwed on fully before the lock nuts are set.
- .6 The conduit shall be provided with grounding fittings as necessary to provide bonding connections.
- .7 Open ends of spare conduits shall be capped with proper threaded steel caps immediately after installation. The use of wooden plugs or duct tape shall not be allowed. Exact location of spare conduits shall be indicated on the "As-Installed" Contract Drawings.
- .8 A 6.3 mm thick nylon pull string shall be installed in each spare or empty conduit.
- .9 Embedded conduits shall in general be sloped away from panels to provide drainage with a minimum slope of five millimeters per metre.

- .10 Joints shall be staggered in adjacent layers at least 152.4 mm apart and made watertight.
- .11 Conduits shall be cleaned before use. The end of conduits shall be capped during construction and after installation to prevent entry of foreign materials.
- .12 Protection against galvanic action shall be provided where dissimilar materials are in contact. Protection shall consist of either painting the contact surfaces with bituminous paint or separating the contact surfaces with material especially manufactured to prevent galvanic action.
- .13 Where conduits become blocked, corrosive agents shall not be used. The blocked section shall be removed and replaced.
- .14 Conduits shall be protected from damage where they stub out of concrete surfaces.
- .15 Where conduits pass through slabs or walls, sleeves shall be provided. Sleeves shall be installed prior to pouring of concrete. Sleeves through concrete shall be Schedule 40 steel pipe, sized for free passage of conduit and protruding 50.8 mm minimum.
- .16 Necessary flashing and pitch pockets shall be provided to make water tight joints where conduits pass through roofs.
- .17 Conduit and boxes shall be identified and labeled in accordance with Section 26 05 11 - Electrical Equipment Identification.
- .18 Steel conduits shall be mechanically bent cold such that no conduit at any point is flattened more than one-tenth of its original diameter. Conduits exceeding this flattening or with any kink shall be considered defective and shall be replaced.
- .19 Field threads on rigid steel conduit shall be of sufficient length to draw conduits up tight.
- .20 Field cut conduit shall be cut square without restriction of the conduit openings. Conduits shall be reamed to remove burrs and sharp edges and be thoroughly cleaned.
- .21 No more than the equivalent of three 90 degree bends shall be permitted per run or between pull boxes. For internal telephone conduit runs no more than the equivalent of two 90 degree bends shall be permitted per run or between pull boxes. Additional pull boxes shall be provided between designated boxes as required.
- .22 Boxes shall be supported independently of connecting conduits or cables and shall provide adequate support for equipment or devices to be mounted or suspended from the box.
- .23 The correct size of openings in boxes for conduit shall be supplied. Reducing washers shall not be used.
- .24 Any damage to the galvanized finish of conduits, tray or equipment caused by threading, tool marks or abrasion, etc. shall be repaired in accordance with the manufacturer's instructions and Section 26 05 00 - Electrical Installation Common Work, Clause 10.3, 'Painting and Restoring'.
- .25 The Contractor shall verify that raceways, both surface and embedded are sized according to the number and construction of wires and cables to be pulled, such that the maximum permissible fill is not exceeded.
- .26 Conduits shall be identified in accordance with Section 26 05 11 - Electrical Equipment Identification.

## Part 5      **Underground Cable Ducts**

- .1      The Contractor shall be responsible for the excavation of trenches, supply and installation of ducts, protective tiles, warning tape, backfilling and compacting.
- .2      Arrangements shall be made by the Contractor to make good damages to existing road surfaces, pavements, retaining walls, curbs, etc., done in the performance of the work.
- .3      Trenches shall be cut as square as possible and the bottom made flat and free from stones or hard projections.
- .4      Special care shall be taken at intersections with existing services.
- .5      The Contractor shall be responsible for ensuring that permission for such crossings has been obtained from the appropriate Authorities, and also for compliance with the relevant regulations for such crossings.
- .6      Any damage to existing services of known locations shall be made good and paid for by the Contractor.
- .7      Trenches shall be well marked and roped. During dark periods, red lamps shall mark open trench locations.
- .8      The Contractor shall be held fully responsible for any damage which may occur because of either not or ineffectively complying with safety regulations.
- .9      Care shall be taken, when excavating ground that has been soil-cement stabilized, that the trench is of the minimum width required for the cables.
- .10     The minimum width of the trench shall be 406.4 mm and the minimum depth of the duct below grade shall be 50.8 mm - 101.6 mm unless otherwise indicated on the drawings.
- .11     The final burial depth of the cables and conduits shall be marked on the as-builts.
- .12     The spacing between ducts carrying cables of different voltages, shall be minimum 203.2 mm and maximum 508 mm between signal cable and power cables rated 600 V AC and over.
- .13     Trenches shall be cleared of stones, rocks and rubble which might have collected after excavation.
- .14     Trenches shall be bedded to a depth of 152.4 mm with fine stone on which the ducts and the earthing cable shall be installed. This would be followed by a layer of fine, stone-free soil, minimum 203.2 mm, following which concrete cable protection tiles shall be laid, where called for on the project drawings.
- .15     Backfilling, utilizing soil from alongside the trenches, shall then proceed and this fill shall be compacted in layers of about 101.6 mm thick at a time, until the fill level is about 406.4 mm or as indicated, above the ducts, at which level PVC cable warning tapes shall be laid to completely cover the underlying ducts.
- .16     Backfilling shall then continue with compaction in layers of about 101.6 mm until finally consolidated at approximately 101.6 mm above the adjoining ground level. Excess soil shall be removed from the site.
- .17     The number and size of ducts to be installed shall be as per drawings.
- .18     The ducts shall be cleaned internally before cables are passed through them.
- .19     Unoccupied ducts shall be plugged to prevent the ingress of mud or sand.

- .20 During the process of preparing trenches and laying ducts in the trenches, the Contractor shall arrange for the Engineer or his representative to make inspections and give approval of work completed at the following stages:
  - .1 When the trenches are ready for the laying of pipes.
  - .2 When the ducts and earthing cables have been laid.
  - .3 When the trenches are ready for protection tiling and warning taping.
  - .4 When the trenches have been fully backfilled and compacted to about 101.6 mm above adjacent ground levels.
- .21 The Contractor shall be responsible for obtaining from the Engineer written classification of the materials excavated during trenching processes, and prior to backfilling. Failure to observe these requirements will result in affected materials being classified as Soft Pickable as defined hereunder:
  - .1 Soft pickable material is material removable by pick and shovel.
  - .2 Hard material is material that requires powered (e.g. pneumatic) tools for its removal. It shall include soft rock.
- .22 Rock shall mean material that requires blasting processes for its removal.

**END OF SECTION**

## PART 1 - GENERAL

### 1.1 SUMMARY

#### A. Related Documents:

1. Drawings and general provisions of the Subcontract apply to this Section.
2. Review these documents for coordination with additional requirements and information that apply to work under this Section.

#### B. Section Includes:

1. Dry type transformers rated 600 volts and less used for power distribution, lighting and control purposes.

### 1.2 REFERENCES

#### A. General:

1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.
2. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.
3. Refer to Division 01 Section "General Requirements" for the list of applicable regulatory requirements.
4. Refer to Division 26 Section "Common Results for Electrical" for codes and standards, and other general requirements.

#### B. Canadian Electrical Code

#### C. ANSI/IEEE C57.12.01-89 General Requirements for Dry-Type Distribution and Power Transformers.

#### D. LBNL Facilities Department Lateral Force Design Criteria.

#### E. Canadian Standards Association

#### F. NEMA – National Electrical Manufacturers Association:

1. NEMA ST 1 Specialty Transformers
2. NEMA ST 20 Dry Type Transformers for General Applications.

### 1.3 SUBMITTALS

- #### A. Product Data:
- Provide outline and support point dimensions of enclosures and accessories, unit weight, voltage, KVA, current and percent impedance ratings, characteristics, tap configurations, insulation system type, and rated temperature rise. Provide common mode noise attenuation and coupling capacitance data for Special Purpose Transformers.
- #### B. Certified Test Reports:
- Indicate loss data, efficiency at 25, 50, 75 and 100 percent rated load, and sound level.
- #### C. Manufacturer's Instructions:
- Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

- D. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

- A. Products shall be tested, approved and labeled/listed by CSA
- B. Electrical equipment and materials shall be new and within one year of manufacture, complying with the latest codes and standards. No used, re-built, refurbished and/or re-manufactured electrical equipment and materials shall be furnished on this project.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

## PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Eaton/Cutler-Hammer.
- B. Hammond
- C. Siemens Transmission & Distribution
- D. Approved equal.

2.2 GENERAL PURPOSE TRANSFORMERS

- A. Description: NEMA ST 20, factory-assembled, air cooled dry type, energy efficient transformers, ratings as indicated.
- B. Insulation system and average winding temperature rise for rated KVA as follows in an ambient temperature of 40 degrees C:
  - 1. 1-10 KVA: Class 185 with 115 deg C winding temperature rise.
  - 2. 15-500 KVA: Class 220 with 115 deg C winding temperature rise.
- C. Enclosure temperature shall not exceed the temperature rise above ambient at warmest point in accordance with the applicable Codes and Standards.
- D. Winding Taps:
  - 1. Transformers Less than 15 KVA: As minimum, two 5 percent below rated voltage, full capacity taps on primary winding.
  - 2. Transformers 15 KVA and Larger: NEMA ST 20. Two 2-1/2 percent full capacity taps above and four 2-1/2 percent full capacity taps below normal voltage on primary winding.
- E. Sound Levels: Maximum sound levels shall be as follows in accordance w2.03ith NEMA ST-20:
  - 1. 0-9 KVA: 40dB.
  - 2. 10-50 KVA: 45 dB.
  - 3. 51-150 KVA: 50dB.
  - 4. 151-300 KVA: 55 dB.

- 5. 301-500 KVA: 60 dB.
- F. Basic Impulse Level: 10 KV for transformers less than 300 KVA, 30 KV for transformers 300 KVA and larger.
- G. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.
- H. Mounting: Transformers 75 kVA and less shall be suitable for wall, floor, or trapeze mounting. Transformers larger than 75 KVA shall be suitable for floor or trapeze mounting.
- I. Coil Conductors: Continuous copper windings with terminations brazed or welded. The winding shall be epoxy encapsulated providing rigid construction and quieter operation. The windings shall withstand short circuit stresses up to 25 times normal load current for two seconds. Furnish primary and secondary pads with minimum two holes for each cable connection.
- J. Enclosure: NEMA ST 20; Type 1 ventilated. Provide lifting eyes or brackets.
- K. Isolate core and coil from enclosure using vibration-absorbing mounts.
- L. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install Products in accordance with manufacturer's instructions.
- B. Set transformer plumb and level.
- C. Use flexible conduit, under the provisions of Division 26 Section "Electrical Conduit", 2 ft (0.6 m) minimum length, for connections to transformer case. Make conduit connections to side panel of the enclosure in locations identified by the manufacturer.
- D. Mount transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure.
- E. Provide seismic restraints which will comply with California Administrative Code (CAC) Title 24, Seismic Requirements for Zone 4.
- F. Provide grounding and bonding in accordance with Section 26 05 26

#### **3.2 INSPECTIONS AND TESTS**

- A. Perform insulation tests and all other tests prior to energizing transformer as required by the applicable Codes and Standards.
- B. Inspect for damage and properly torqued connections prior to energizing transformer.
- C. Measure primary and secondary voltages and make appropriate tap adjustments. Record final voltages and tap settings.



END OF SECTION

## **PART 1 GENERAL**

### **1.01 SECTION INCLUDES**

- A. Low Voltage Switchboard – Furnish and install switchboard(s) as specified herein and where shown on the associated drawings.

### **1.02 REFERENCES**

The switchboard and overcurrent protection devices referenced herein are designed and manufactured according to the latest revision of the following specifications.

- A. Switchgear assemblies: CSA C22.2 No.31
- B. UL891
- C. Panelboards: CSA C22.2 No.29
- D. Molded Case Circuit Breakers: CSA C22.2 No. 5
- E. UL489
- F. Enclosed Switches: CSA C22.2 No. 4

### **1.03 SUBMITTAL AND RECORD DOCUMENTATION**

- A. Approval documents shall include drawings. Drawings shall indicate front and side enclosure elevations with overall dimensions shown; conduit entrance location and requirements, single-line diagrams, equipment schedule and switchboard instrument details.

### **1.04 DELIVERY, STORAGE, AND HANDLING**

- A. Inspect and report concealed damage to carrier within their required time period.
- B. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.
- C. Store in a clean, dry environment. Maintain factory packaging and, if required, provide an additional heavy canvas or heavy plastic cover to protect enclosure(s) from dirt, water, construction debris, and traffic.

### **1.05 OPERATIONS AND MAINTENANCE MATERIALS**

- A. Manufacturer shall provide installation instructions:
  - Instructions for Safe Installation, Operation and Maintenance of Switchboards Rated 600 Volts or less.

### **1.06 WARRANTY**

- A. Manufacturer shall warrant specified equipment free from defects in materials and workmanship for the lesser of one (1) year from the date of installation or eighteen (18) months from the date of purchase.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Shall be Square D Company or approved equivalent from Eaton, Commercial Switchgear, Schneider or Siemens.
- B. Substitutions must be submitted in writing with supporting documentation demonstrating that the alternate manufacturer meets all aspects of the specification herein.

### **2.02 TERMINATIONS**

- A. Termination lugs shall be CSA/UL Listed to accept solid or stranded copper and aluminum conductors. Termination lugs shall be suitable for cables sized per the 75C column of the CE Code table. It is permissible for primary cables terminating in a bussed auxiliary section to be sized to the 90C column of the CE Code.

### **2.03 ENCLOSURE**

- A. The switchboard shall be totally enclosed, dead front, freestanding or freestanding wall supported and rear aligned with front, side or rear access.
- B. The switchboard shall be NEMA Type 1 - General Purpose.
- C. NEMA Type 1 enclosure shall be Sprinkler Protection CEC26-008
- D. The framework shall be formed steel and secured together to support all cover plates, bussing and component devices during shipment and installation. All closure plates are to be single tool, screw removable. Ventilation shall be provided when required. Each section shall include a single-piece removable top plate.
- E. The switchboard enclosure shall be painted on all exterior surfaces. The paint finish shall be ASA49 grey unless otherwise specified.
- F. Steel base channels shall be bolted to the frame to rigidly support the entire shipping section for moving on rollers and for floor mounting. An option of a steel base channel shall be made available

### **2.04 BUSSING**

- A. The switchboard shall be silver-plated copper.
- B. The through bus shall have a maximum ampacity of 1,000A. The switchboard bussing shall be of sufficient cross-sectional area to meet the CSA C22.2 No. 31 standard for temperature rise.
- C. The switchboard shall be rated with a minimum short circuit rating of 25,000A at 600Vac
- D. Provisions shall be made for future splicing of additional sections.
- E. All bolts used on bus bar joints shall be a minimum of grade 5.
- F. The utility metering compartment shall have provisions for window type current transformers as supplied by the applicable public utility.

## 2.05 MAIN DISCONNECT DEVICES

### A. Main Circuit Breaker

1. Electronic trip molded case, full function, circuit breaker
  - a. Shall be rated for 80% continuous current and be PowerPact P style breaker with MICROLOGIC trip system.
  - b. Rated ampacity shall be 1,000A

## 2.06 GROUND FAULT PROTECTION

- A. 3-phase 4-wire, connected equipment having multiple sources shall have a modified differential ground fault system (MDGF). The manufacturer shall complete the MDGF design prior to building equipment to ensure that the proper main or tie breaker (s) operate properly during the following occurrences on the main bus.
  1. Ensure the system will trip with the occurrence of a ground fault at any location in the switchgear.
  2. Ensure system will not trip without ground fault and with normal current flow.
  3. Ensure system will not trip due to large single-phase currents.
  4. Ensure system will trip with combination of normal current flow and ground fault current flowing together.
  5. Ensure system will not trip with circulating currents through the neutral due to multiple grounds and sources external to the immediate low voltage power sources.
- B. The manufacturer shall be required to include additional CT's, ground fault relays, interlocks, wiring, components etc. to ensure the ground fault systems operates without nuisance tripping on the main bus of the switchgear.
- C. The manufacturer shall include a wiring diagram of the MDGF system along with a test procedure using high current injection equipment.

## 2.07 DISTRIBUTION SECTION DEVICES

- A. Group mounted circuit breakers through 1200A
  1. Breakers and all components shall be designed, manufactured and tested in accordance with applicable UL and CSA standards.
  2. Circuit breakers shall be rated for 80% continuous current.
  3. Circuit breakers(s) shall have 25 kA interrupting capacity at 600Vac. Two tier CSA or UL listed series ratings are acceptable. When series ratings are applied with integral or remote upstream devices, a label or manual shall be provided showing the CSA or UL approved series ratings including:
    - Voltage
    - Size and type of upstream fuses or breakers
    - Size and type of branch devices that can be used
  4. Circuit breakers shall be group mounted plug-on with mechanical restraint on a common pan or rail assembly.
  5. The interior shall have three flat bus bars stacked and aligned vertically with glass reinforced polyester insulators laminated between phases. The molded polyester insulators shall support and provide phase isolation to the entire length of bus.
  6. Circuit breakers equipped with line terminal jaws shall not require additional external mounting hardware. Circuit breakers shall be held in mounted position by a self-contained bracket secured to the mounting pan by fasteners. Circuit breakers of different frame sizes shall be

capable of being mounted across from each other.

7. Line-side circuit breaker connections are to be jaw type.
8. All unused spaces provided, unless otherwise specified, shall be fully equipped for future devices, including all appropriate connectors and mounting hardware.
  - a. Electronic trip molded case standard function 80% rated circuit breakers
    - (i) All electronic circuit breakers shall have the following time/current response adjustments: Long Time Pickup, Long Time Delay, Short Time Pickup, Short Time Delay, Ground Fault Pickup, Ground Fault Delay and Instantaneous settings. Each adjustment shall have discrete settings (fully adjustable) and shall be independent of all other adjustments.
    - (ii) Circuit breaker trip system shall be a microprocessor-based true RMS sensing designed with sensing accuracy through the thirteenth (13<sup>th</sup>) harmonic. Sensor ampere ratings shall be as indicated on the associated [schedule] [drawing].
    - (iii) Local visual trip indication for overload, short circuit and ground fault trip occurrences.
    - (iv) Long Time Pickup indication to signal when loading approaches or exceeds the adjustable ampere rating of the circuit breaker shall be provided.
    - (v) Furnish thermal magnetic molded case circuit breakers for 250A frames and below.
  - b. Thermal magnetic molded case circuit breakers
    - (i) Molded case circuit breakers shall have integral thermal and instantaneous magnetic trip in each pole.
    - (ii) Circuit protective devices shall be Square D molded case circuit breakers or approved equivalent. Circuit breakers shall have 25kA interrupting capacity at 600Vac. Ampere ratings shall be as shown on the drawings.  
\* Manufacturer shall submit one set of published  $I_p$  and  $I^2t$  let-through curves (as required by CSA or UL) to the owner.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install switchboards in accordance with manufacturer's written instructions, and applicable standards and safety codes.

### **3.02 FIELD QUALITY CONTROL**

- A. Inspect complete installation for physical damage, proper alignment, anchorage, and grounding.
- B. Measure steady state load currents at each switchboard feeder; rearrange circuits in the switchboard to balance the phase loads within 20% of each other. Maintain proper phasing for multi-wire branch circuits.
- C. Check tightness of bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written specifications.

**END OF SECTION**

## PART 1 - GENERAL

### 1.1 SUMMARY

- A. Related Documents:
  - 1. Drawings and general provisions of the Subcontract apply to this Section.
  - 2. Review these documents for coordination with additional requirements and information that apply to work under this Section.
- B. Section Includes:
  - 1. Provide the following panelboards:
    - a. Service entrance rated main distribution panelboards.
    - b. Distribution panelboards.
    - c. Lighting and appliance branch circuit panelboards.
    - d. Electronic Power Metering on panelboards per Section 2.5, when specified.

### 1.2 REFERENCES

- A. General:
  - 1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.
  - 2. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.
- B. Canadian Standard Association
- C. NFPA – National Fire Protection Association:
  - 1. Standard for Electrical Safety in the Workplace (NFPA 70E)
- D. NEMA – National Electrical Manufacturers Association:
  - 1. NEMA AB 1 Molded Case Circuit Breakers.
  - 2. NEMA PB 1 Panelboards.
  - 3. NEMA PB 1.1 Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
  - 4. NEMA PB 1.2 Application Guide for Ground-fault Protective Devices for Equipment.
- E. UL – Underwriters' Laboratories:
  - 1. UL 67 Panelboards
  - 2. UL 50 Enclosures for Electrical Equipment
  - 3. UL489 Molded Case Circuit breakers and Circuit Breaker Enclosures

### 1.3 SUBMITTALS

- A. Shop Drawings for equipment and component devices.
- B. Outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker arrangement, sizes and numbering system.
- C. Product description and data sheets on circuit breakers, trip units, accessories, locking hardware, shunt trip, under-voltage release mechanism, typical thermal-magnetic curves for each size and type circuit breaker or trip unit.

1.4 QUALITY ASSURANCE

- A. Products shall be tested, approved and labeled/listed by CSA
- B. Electrical equipment and materials shall be new and within one year of manufacture, complying with the latest codes and standards. No used, re-built, refurbished and/or re-manufactured electrical equipment and materials shall be furnished on this project.

**PART 2 - PRODUCTS**

2.1 MANUFACTURERS

- A. Cutler-Hammer.
- B. General Electric.
- C. Siemens.
- D. Approved equivalent product

2.2 BUS AND HARDWARE

- A. Panelboards shall be completely factory assembled and equipped with a main circuit breaker and the type, size and number of branch circuit breakers, arranged and numbered as shown on the attached panel schedule(s). Panelboards shall be fully rated. Series rated panelboards are not acceptable.
- B. All multi-pole breakers shall be common trip. Branch circuits shall be arranged using double row construction. Bus sequence shall be ABC top to bottom, left to right for both top and bottom fed panels. Provisions or space for future breakers shall be located at the bottom of the panel and be fully bussed, complete with the necessary mounting hardware. Use at least 100 ampere breaker-connecting bus straps and mounting hardware.
- C. Where SPARE is indicated on the panel schedule(s), the specified circuit breaker and 100 ampere (minimum) branch-circuit busing and mounting hardware shall be installed.
- D. Where SPACE is indicated on the panel schedule(s), 100 ampere (minimum) branch-circuit busing and mounting hardware shall be installed, ready for future installation of circuit breakers, furnished by others. A minimum of 20 percent spare pole spaces, grouped in multiple of three, shall be provided in each panelboard, for future installation by the University. Provide single pole filler plates in the spaces, as required.
- E. A nameplate shall be provided, and located near the top of the front trim on the exterior surface, listing panel type and ratings, as required by UL. Each circuit shall be permanently numbered to agree with the panel schedule, using plastic or metal buttons mounted adjacent to the breaker and secured by rivets or grommets with an engraved or depressed number. Adhesive numbering tape, painted numbers, or use of more than one number per breaker is not acceptable.
- F. Main vertical bus bars shall be copper and plated per UL requirements. Bus bars shall be supported by glass-filled polyester-type insulators. Bolts used to connect current-carrying parts together, shall be accessible for tightening from the front of the panel. Bus bars shall be factory drilled and tapped with spacing arranged to permit breaker interchange, from the front, while the panel is energized.

- G. Neutral bus shall be copper, 200 percent rated and insulated from the cabinet and other parts. It shall be rigidly mounted in the panel and shall be provided with a solderless cable connector for each circuit breaker and each space in the panelboard and the main connecting lug(s).
- H. A copper equipment ground bus, of sufficient width and length, shall be solidly bolted and grounded to the enclosure at the bottom and shall leave clear space for the bottom cable entries. The bus shall have sufficient termination points in number to agree with branch circuits and spaces. A solderless connector, for No. 2 to No. 4/0 cable size, shall be bolted to the ground bus.
- I. Copper bus bars shall be of sufficient size to provide a current density of not more than 1000 amperes per square inch of cross section, and not more than 200 amperes per square inch at bolted connections.
- J. Minimum Short Circuit Rating for Bus Bracing: The bus shall be braced for the minimum symmetrical short circuit rating of the panel, as shown on the panel schedule.
- K. Provide main bus pressure connectors (main lugs) and separately supported sub-feed pressure connectors (lug landings) where noted. Provide additional bottom raceway space to accommodate pressure connectors and lug landings. In no instance shall the gutter space be less than required by NFPA-70.
- L. Pre-installed locking devices shall be provided for locking the main circuit breaker and each branch circuit breaker in the OPEN position, by means of a padlock. Locking devices shall not be removable from the front of the panel with the trim in place. Attachment of the locking device to the panel with adhesives is not acceptable.

## 2.3 CIRCUIT BREAKERS

- A. Molded Case Circuit Breakers: NEMA AB 1, FS W-C-375; Provide bolt-on type circuit breakers with integral thermal and instantaneous magnetic trip in each pole (common trip type). Provide circuit breakers, UL listed as Type HACR, for air conditioning equipment branch circuits. Provide circuit breakers, UL listed as Type SWD, for lighting circuits.
- B. Trip Unit:
  - 1. Instantaneous magnetic trips shall be accessible and adjustable from the front of the breaker on frame size 100 amperes.
  - 2. Trip units shall be interchangeable and adjustable for trip pick up and delay settings on frame size 225 amperes.
  - 3. Breakers sized 400 amperes and higher shall be equipped with solid state trip units with long-time, short-time, instantaneous, and ground fault (LSIG) tripping characteristics.
- C. Breakers shall be rigidly mounted, separately removable and independent of trim plates for their support.
- D. Breakers shall be industrial grade

## 2.4 CABINETS (BOXES)

- A. All details of construction and methods of assembly shall meet the requirements of the "Enclosures for Electrical Equipment" of the Underwriters' Laboratories. The panel box shall not be less than 20" (510 mm) wide, 4.5 inches (115 mm) deep and of sufficient height to enclose the specified main and branch circuit breakers, buses, metering equipment and wire gutter. The panelboard enclosure shall be fabricated from code-gauge galvanized or galvanized-annealed steel without knockouts and with full front flange. The panel front shall be surface, as indicated on the drawings and fabricated from



cold rolled steel. Surface mounted panel boxes shall be finished with an ANSI-61 light grey baked enamel. There shall be no screws projecting into the wiring raceways. The panelboard enclosure type shall be NEMA 1.

- B. The front trim shall have full-length hinged outer door designed to expose the wiring raceways and breakers, when open. Another, inner hinged door shall expose breakers only, when open, making this a door-in-door construction. Both doors shall open to the right.
- C. Both doors shall be provided with concealed butt or piano hinges. A suitable latch, which can be operated without tools, shall be provided to properly hold the inner door closed. For doors 30 inches (765 mm) high or less, a flush-type latch is satisfactory. For doors more than 30 inches (765 mm) high, a vault-type handle shall be provided with a three-point latch that holds the door closed at the top and bottom. The outer door shall be secured with at least 4 captured oval head machine screws.
- D. A sturdy metal frame, with a clear plastic cover, for an 8-1/2 by 11 inch (216 by 280 mm) panelboard schedule, shall be attached inside of the panel door with the RTV adhesive.
- E. Panel trim and doors, and surface mounted cabinets shall be thoroughly cleaned, given a rust-inhibiting treatment, and finished with an ANSI-61 light grey baked enamel.
- F. Panelboards shall bear the CSA label.

## 2.5 ELECTRONIC POWER METERING

- A. The panelboard shall be provided with the electronic power metering, where shown on the Drawings and/or panelboard schedule.
- B. An advanced digital electronic energy meter shall be used. The meter shall measure the real-time RMS values of the phase currents (Ampere), Ampere demand, phase and line voltages (Volts), KW, KW demand, KWHR, KVA, KVA demand, KVAR, KVAR demand, power factor, and frequency.
- C. A communications module shall be provided using a 10Base-T Ethernet and industry standard RS-485 serial bus.
- D. The advanced digital electronic energy meter shall have non-volatile memory to record at least 100 time-stamped alarms and events.
- E. Potential, control power and current transformers, shorting terminal block, fuse blocks and fuses shall be completely installed and wired to the energy meter in the panelboard.
- F. The electronic power meter shall be Square D PowerLogic ION7350 or higher, Siemens Model 9350 or higher, Power Measurement Limited Model 7350 or higher

## 2.6 EXCEPTIONS

- A. The bidders shall list the exceptions taken from the specification with their quote. If no exceptions are listed with the bid, it is understood that the bidder shall meet the requirements of this specification and applicable Codes and Standards.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install panelboards plumb [and flush with wall finishes], in conformance with NEMA PB 1.1. Where surface mounted, provide suitable supports and rack branch circuit conduits. Where mounted on concrete wall, install with 1/2 inches (15 mm) steel spacers behind the panel. Mounting attachments and connections shall be designed in conformance with the minimum lateral seismic force of 0.5W per CBC.
- B. Height: Install top of trim 78 inches (1980 mm) above finished floor, unless otherwise noted on drawings.
- C. Provide filler plates for unused spaces in panelboards.
- D. Provide typed [or neatly hand printed] 8-1/2 by 11-inch (216 by 280 mm) circuit directory (panel schedule) for each panelboard, in the format as shown on the [panel schedules] [drawings]. Revise directory to reflect circuiting changes required to balance phase loads.
- E. Stub 4 empty 1 inch (25 mm) conduits to accessible location above ceiling out of each recessed panelboard.

### 3.2 FIELD QUALITY CONTROL

- A. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers.
- B. Test insulation of panelboard buses and circuit breakers (phase-to-phase and phase-to-ground) prior to applying power.
- C. Measure steady state load currents at each panelboard feeder. Should the difference at panelboard between phases exceed 20 percent, rearrange circuits in the panelboard to balance the phase loads within 20 percent. Maintain proper phasing for multi-wire branch circuits.

### 3.3 FINAL SUBMITTALS

- A. After completion of the installation, wiring and testing, the Subcontractor shall submit the following information to the University within two weeks of the equipment acceptance:
  - 1. As-Built Panel Schedules.
  - 2. Copy of the certified test report described in 3.2 above.

### 3.4 REFERENCE DRAWINGS AND PANELBOARD SCHEDULES

Include drawings numbers for the panelboard schedules. Schedules shall provide the following information:

- A. Panelboard Number :
  - 1. Panelboard type.
  - 2. Number of phases.
  - 3. Main bus ampacity.
  - 4. Main circuit breaker trip rating.
  - 5. Branch circuit breaker arrangement.
  - 6. Branch circuit breaker trip sizes.
  - 7. Flush or surface mounting.
  - 8. Enclosure type.
  - 9. Service entrance rating requirement (indicate 'Y', if required).
  - 10. Power Metering Requirement (indicate 'Y', if required).

Circuit load.

**END OF SECTION**

**Part 1 General**

- .1 The Work shall include the furnishing of labour, materials and equipment for the installation and testing of low voltage and welding receptacle distribution systems as specified and as indicated on the Drawings.
- .2 The Contractor shall make available building electrical services and lighting to other Contractors and Vendor representatives as required.

**Part 2 Submittals**

- .1 Technical information for all materials shall be submitted in accordance with Section 26 05 00 - Electrical Installation Common Work.
- .2 The submission shall include descriptive literature of the manufacturer and published details with complete performance and rated capacity schedules or chart, dimensions, etc., as applicable.
- .3 The following documents shall be submitted and reviewed by the Engineer, prior to the procurement fabrication and installation of the following:
  - .1 Bulletins from the manufacturer of each small power receptacle type and rating.
  - .2 Bulletins from the manufacturer of each ground fault interrupter type receptacle and rating.
  - .3 Bulletins from the manufacturer of each type of welding receptacle and rating.

**Part 3 Products and Materials**

**3.1 GENERAL WIRING DEVICES**

- .1 All wiring devices shall be heavy duty, of the highest available quality and manufactured in accordance with the latest standards and codes and bearing a CSA or cUL certification label.
- .2 Line voltage switches; 250 volt AC, quiet, slow-make, slow-break design, toggle handle, with totally enclosed case, rated at 20 amp, specification grade. Three-way switches shall be of matching type.
- .3 Manually operated general purpose AC switches shall be supplied as indicated on the Drawings, with the following features:
  - .1 Urea or melamine molding for parts subject to carbon tracking.
  - .2 Brown toggle handle.
  - .3 Silver alloy contacts.
  - .4 Suitable for back and side wiring.
- .4 Two-gang socket outlets shall be 15 amp, 125 Volt, and grounding with the following features:
  - .1 Urea-moulded housing, colour coded as follows:
    - .1 Brown for service areas and non-emergency circuits.
    - .2 Orange for emergency circuits (UPS).
    - .3 Cover plates shall be brushed stainless steel, Type 302.

- .5 Weatherproof gasketed cover plates complete with spring-loaded gasketed flaps shall be used for all wiring devices in wet locations or where they might possibly be subject to exposure to wash water or as indicated on the drawings.
- .6 Cast cover plates shall be used for wiring devices mounted in surface-mounted conduit boxes.
- .7 Convenience receptacles and lighting switches shall be heavy duty suitable for heavy industrial installation.
- .8 Convenience receptacles and local lighting switches shall be mounted in cast ferrous (Ferroalloy) "FD" boxes with cover plates or as indicated on drawings.
- .9 Weather/GFI protected receptacles will be provided where indicated on the drawings and/or required by the CEC.

#### **Part 4 Execution**

##### **4.1 INSTALLATION**

- .1 Electrical services shall be installed in accordance with the CEC.
- .2 Electrical drawings indicate general location of wiring devices and routing of conduits and wire. They do not necessarily indicate all structural, architectural and mechanical equipment location interfaces and details.
- .3 The Contractor shall coordinate and interface the work of this section with the work of all other sections. Any discrepancies shall be reported immediately to the Engineer.
- .4 The Contractor shall supply and install convenience outlets as per the drawings.
- .5 Single-phase 120 V convenience receptacles shall be mounted with the ground prong down for vertical oriented outlets; and with the ground prong to the left for horizontal oriented outlets.
- .6 Welding outlets shall be installed as per the drawings.
- .7 Suitable space shall be allowed for in front of the outlet to allow for the welder and cable, per CEC regulations.

##### **4.2 IDENTIFICATION**

- .1 Each socket receptacle and welding receptacle shall be fitted with an engraved label, indicating the panel board and circuit numbers from which it is supplied, in accordance with Section 26 05 11 - Electrical Equipment Identification.

**Part 5      Testing**

- .1      Electrical services and welding receptacle power circuits shall be tested as follows:
  - .1      All circuits shall be tested for continuity.
  - .2      Insulation resistance shall be tested for each non-grounded conductor and shall not be less than 10 megohms.
  - .3      Each equipment enclosure shall be checked for each connection, and ground resistance to the ground grid shall not be more than 2 ohms.
  - .4      Each circuit breaker shall be checked for proper manual operation and for tight electrical connections.
  - .5      Each circuit shall be energized continuously for not less than 30 minutes.
- .2      The circuit load balance shall be checked and shall be adjusted by reconnecting circuits to ensure the panel is phase balanced and panel circuit directories and field cable identification revised accordingly. The unbalanced load shall not exceed 5% of the total load.

**END OF SECTION**

## PART 1 GENERAL

### 1. SUMMARY

1. This section includes the following items from a single supplier:
  1. Engine Generator Set.
  2. Related Accessories as specified
2. Related Requirements
  1. It is the intent of this specification to secure an engine-driven generator set that has been prototype tested, factory built, production-tested, and site-tested together with all accessories necessary for a complete installation as shown on the plans and drawings and specified herein.
  2. Any exceptions to the published specifications shall be subject to the approval of the engineer and submitted minimum 10 days prior to the closing of the bid with a line by line summary description of all the items of compliance, any items that have been are omitted or have been taken exception to, and a complete description of all deviations.
  3. It is the intent of this specification to secure a generator set system that has been tested during design verification, in production, and at the final job site. The generator set will be a commercial design and will be complete with all of the necessary accessories for complete installation as shown on the plans, drawings, and specifications herein. The equipment supplied shall meet the requirements of the Canadian Electrical Code and applicable local codes and regulations.
  4. All equipment shall be new and of current production by an international, power system manufacturer of generators, transfer switches, and paralleling switchgear. The manufacturer shall be a supplier of a complete and coordinated system. There will be single-source responsibility for warranty, parts, and service through a factory-authorized representative with factory-trained technicians.

### 2. SUBMITTALS

1. Action Submittals
  1. Product Data
    1. The submittal shall include prototype test certification and specification sheets showing all standard and optional accessories to be supplied; schematic wiring diagrams, dimension drawings, and interconnection diagrams identifying by terminal number each required interconnection between the generator set, the transfer switch, and the remote annunciator panel if it is included elsewhere in these specifications.
2. Maintenance Material Submittals
  1. Provide three (3) copies of the following documents and manuals for the engine, the alternator, and the generator set:
    - .1 Operation Manuals
    - .2 Parts Catalogs

.3 Wiring Diagrams.

3. QUALITY ASSURANCE

1. Regulatory Agency

1. The generator set shall conform to the requirements of the following codes and standards:
  1. CSA C22.2, No. 14-M91 Industrial Control Equipment.
  2. EN50082-2, Electromagnetic Compatibility-Generic Immunity Requirements, Part 2: Industrial.
  3. EN55011, Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical Equipment.
  4. IEC8528 part 4, Control Systems for Generator Sets.
  5. IEC Std 61000-2 and 61000-3 for susceptibility, 61000-6 radiated and conducted electromagnetic emissions.
  6. IEEE446 Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.
  7. CSA-C22.1, Canadian Electrical Code
  8. CSA-C282-15, Emergency Electrical Power Supply for Buildings.
  9. CSA-B149-15, Propane and Natural Gas Installation Code
  10. O. Reg. 524-98, Environmental Compliance Approvals Exemptions

2. Qualifications

1. The equipment shall be produced by a manufacturer who is ISO 9001 certified for the design, development, production and service of its complete product line.
2. The power system shall be produced by a manufacturer who has produced this type of equipment for a period of at least 10 years and who maintains a service organization available twenty-four hours a day throughout the year.

3. Manufacturers

1. The power system shall be furnished by a single manufacturer who shall be responsible for the design, coordination, and testing of the complete system. The entire system shall be installed as shown on the plans, drawings, and specifications herein.

4. Suppliers

1. Paramount Power Systems
2. Toromont Industries
3. Wajax Power Systems
4. Generac
5. Total Power
6. Or approved equivalent product

4. FIELD OR SITE CONDITIONS

1. Ambient Conditions

1. Engine- generator set shall operate in the following conditions without any damage to the unit or its loads.
  1. Ambient Temperature: -40 to +40 °C



2. Altitude: 100 m ASL
3. Relative Humidity: 95%

5. WARRANTY

1. Manufacturer's Warranty
  1. The generator set shall include a standard warranty covering two (2) years or 2000 hours, whichever occurs first, to guarantee against defective material and workmanship in accordance with the manufacturer's published warranty from the date of initial startup.
  2. The generator set manufacturer and its distributor shall maintain a 24-hour parts and service organization. This organization shall regularly engage in maintenance contract programs to perform preventive maintenance and service on equipment similar to that specified. A service agreement shall be available and shall include system operation under simulated operating conditions; adjustment to the generator set, transfer switch, and switchgear controls as required, and certification in the owner's maintenance log of repairs made and functional tests performed on all systems.

**Part 2 PRODUCTS**

1. EQUIPMENT

1. Equipment
  1. The generator set shall be the unit as specified on the plans, or similar equivalent from Caterpillar, Generac Total Power etc. It shall provide the rating as specified on the plans and drawings when operated 120/208 volts, 60 Hz, 0.80 power factor. The generator set shall be capable of a 130°C Standby rating while operating in an ambient condition of less than or equal to 40 °C and a maximum elevation of 100 m above sea level. The standby rating shall be available for the duration of the outage.
2. Engine
  1. The minimum 5.7-liter displacement engine shall deliver a minimum of 155 HP at a governed engine speed of 1800 rpm, and shall be equipped with the following:
    1. Electronic isochronous governor capable of 0.5% steady-state frequency regulation
    2. 12-volt positive-engagement solenoid shift-starting motor
    3. 70-ampere automatic battery charging alternator with a solid-state voltage regulation
    4. Positive displacement, full-pressure lubrication oil pump, cartridge oil filters, dipstick, and oil drain
    5. Dry-type replaceable air cleaner elements for normal applications
  2. The engine shall be turbocharged and fueled by Natural Gas.
  3. The engine shall have a minimum of 8 cylinders and be liquid-cooled
  4. The engine shall be EPA certified from the factory
  5. The generator must accept rated load in one-step.
3. Cooling System
  1. The engine shall be liquid-cooled by a closed loop, unit mounted radiator rated to operate the generator set at full load at an ambient temperature of 50 degrees C

(122 degrees F). The radiator fan and other rotating engine parts shall be guarded against accidental contact.

4. Standard Air Cleaner
  1. The air cleaner shall provide engine air filtration which meets the engine manufacturer's specifications under typical operating conditions.
5. Battery
  1. Each genset requires a maintenance free BCI group 24 battery which must meet the engine manufactures' specifications for the ambient conditions specified in Part 1 Project Conditions and shall comply with the CSA-C282 requirements for engine cranking cycles. This battery shall be rated according to SAE Standards J-537 with a minimum cold cranking amp of 650 amps and a minimum reserve capacity of 120 Minutes at 80F. The battery plates shall be constructed of a Calcium-Lead alloy to provide long waterless operation and extended battery life. The battery must contain a handle to aid in lifting and the case must be constructed of polypropylene to resist breakage and extend service life.
  2. Battery rack and battery cables capable of holding the manufacturer's recommended batteries shall be supplied.
6. Controller
  1. The generator set controller shall be a microprocessor-based control system that will provide automatic starting, system monitoring, and protection. The controller system shall also provide local monitoring and remote monitoring. The control system shall be capable of PC based updating of all necessary parameters, firmware, and software.
  2. The controller shall be mounted on the generator set and shall have integral vibration isolation. The controller shall be prototype and reliability tested to ensure operation in the conditions encountered.
2. CODES AND STANDARDS
  1. The generator set controller shall meet CSA-C282-15, Table-1 requirements and shall include an integral alarm horn.
  2. The controller shall be UL 508 listed.
3. APPLICABILITY
  1. The controller shall be a standard offering in the manufacturer's controller product line.
  2. The controller shall support 12-volt and 24volt starting systems.
  3. The controller's environmental specification shall be: -40°C to 70°C operating temperature range and 5-95% humidity, non-condensing.
  4. The controller shall mount on the generator or remotely within 40 feet with viewable access.
4. HARDWARE REQUIREMENTS
  1. Control Panel shall include:
    1. The control shall have a run-off/reset-auto three-position selector switch
    2. Emergency Stop Switch. The controller mounted, latch type remote stop switch shall be red in color with a "mushroom" type head. Depressing the stop button will immediately stop the generator set and lockout the generator set for any automatic remote starting.
    3. Five indicating lights (LED):
      1. System Ready - green

2. Not in Auto - yellow
  3. Programming Mode - yellow
  4. System Warning – yellow
  5. System Shutdown – red
4. Digital Display. The digital display shall be a vacuum fluorescent display with two lines of alphanumeric, with 2 lines of data and 20 characters. The display shall be viewable in all light conditions. The display shall display status of all faults and warnings. The display shall also display any engine faults. The 16-button keypad gives the user information access and local programming capability.
5. Sixteen-position snap action environmentally sealed tactile-feel membrane keypad for menu selection and data entry.
6. For ease of use, an operating guide shall be printed on the controller faceplate.
7. Alarm Horn. The controller shall provide an alarm horn that sounds when any faults or warnings are present. The horn shall also sound when the controller is not in the AUTO mode.
8. Lamp Test Button. When this button is depressed, it shall test all controller lamps.
9. Alarm Off. This button will silence the alarm horn when the unit is AUTO.
10. Panel lights shall be supplied as standard.
2. Control Functional Requirements
  1. The generator controller shall display and monitor the following engine and alternator functions and allow adjustments of certain parameters at the controller:
  2. Field-programmable time delay for engine start. Adjustment range 0-5 minutes in 1 second increments.
  3. Field-programmable time delay engine cool down. Adjustment range 0-10 minutes in 1 second increments.
  4. Capability to start and run at user-adjustable idle speed during warm-up for a selectable time period (0-10 minutes), until engine reaches preprogrammed temperature, or as supported by ECM-equipped engine.
  5. The idle function including engine cool down at idle speed.
  6. Real-time clock and calendar for time stamping of events.
  7. Output with adjustable timer for an ether injection starting system. Adjustment range, 0-10 seconds
  8. Output for shedding of loads if the generator set reaches a user programmable percentage of its kW rating. Load shed shall also be enabled if the generator set output frequency falls below 59 Hz.
  9. Programmable cyclic cranking that provides up to 30 seconds of programmable cyclic cranking and up to 60 seconds rest with up to 6 cycles.
  10. The capability to reduce controller current battery draw, for applications where no continuous battery charging is available. The controller vacuum fluorescent display should turn off automatically after the controller is inactive for 5 minutes.
  11. Control logic with alternator protection for overload and short circuit matched to each individual alternator and duty cycle.
  12. Control logic with RMS digital voltage regulation. The system shall have integral microprocessor based voltage regulator system that provides +/- 0.25% voltage regulation no-load to full load with three phase sensing. A separate voltage regulator is not acceptable. The digital voltage regulator shall be applicable to single- or three-phase systems. The system shall be prototype tested and control variation of voltage to frequency. The

- voltage regulator shall be adjustable at the controller with maximum +/- 20% adjustable of nominal voltage.
13. The capability to exercise the generator set by programming a running time into the controller. This feature shall also be programmable through the PC software.
  14. Alternator thermal overload protection. The system shall have integral alternator overload and short circuit protection matched to each alternator for the particular voltage and phase configuration.
  15. Control function shall include output voltage adjustment.
  16. Battle switch function selection to override normal fault shutdowns, except emergency stop and over speed shutdowns.
  17. The control shall detect the following conditions and display on control panel:
    1. Emergency stop
    2. High coolant temperature
    3. High oil temperature
    4. Controller internal fault
    5. Locked rotor - fail to rotate
    6. Low coolant level
    7. Low oil pressure
    8. Master switch error
    9. Common alarm
    10. Overcrank
    11. Overspeed with user-adjustable level, range 60-70 Hz.
    12. Overvoltage with user adjustable level, range 105% to 135%
    13. Overfrequency with user adjustable level, range 102% to 140%
    14. Underfrequency with user adjustable level, range 80% to 90%
    15. Undervoltage with user adjustable level, range 70% to 95%
    16. Coolant temperature signal loss
    17. Oil pressure gauge signal loss
  18. Conditions resulting in generator warning:
    1. Battery charger failure
    2. Power system supplying load
    3. Ground fault detected - detection by others
    4. High battery voltage - Level shall be user adjustable. (Range 29-33 volts for 24-volt systems.)
    5. High coolant temperature
    6. Load shed
    7. Loss of AC sensing
    8. Underfrequency
    9. Low battery voltage - level shall be user adjustable (Range 20-25 volts for 24-volt systems.)
    10. Low coolant temperature
    11. Low fuel level or pressure
    12. Low oil pressure
    13. Common alarms
    14. Overcurrent
    15. Speed sensor fault
    16. Weak battery
    17. Alternator protection activated
  3. Control Monitoring Requirements
    1. The generator set shall have alarms and status indication lamps that show non-automatic status and warning and shutdown conditions. The controller

shall indicate with a warning lamp and or alarm and on the digital display screen any shutdown, warning or engine fault condition that exists in the generator set system. The following alarms and shutdowns shall exist as a minimum:

2. All monitored functions must be viewable on the control panel display.
3. The following generator set functions shall be monitored:
  1. All output voltages - single phase, three phase, line to line, and line to neutral, 0.25% accuracy
  2. All single phase and three phase currents, 0.25% accuracy
  3. Output frequency, 0.25% accuracy
  4. Power factor by phase with leading/lagging indication
  5. Total instantaneous kilowatt loading and kilowatts per phase, 0.5% accuracy
  6. kVARs total and per phase, 0.5% accuracy
  7. kVA total and per phase, 0.5% accuracy
  8. kW hours
  9. A display of percent generator set duty level (actual kW loading divided by the kW rating)
4. Engine parameters listed below shall be monitored:
  1. Coolant temperature both in English and metric units
  2. Oil pressure in English and metric units
  3. Battery voltage
  4. RPM
  5. Lube oil temperature
  6. Lube oil level
  7. Coolant level
  8. Coolant temperature
5. Operational records shall be stored in the control beginning at system startup.
  1. Run time hours
  2. Run time loaded hours
  3. Run time unloaded hours
  4. Number of starts
  5. Factory test date
  6. Run time kilowatt hours
6. The following operational records shall be a resettable for maintenance purposes:
  1. Run time hours
  2. Run time loaded hours
  3. Run time unloaded hours
  4. Run time kilowatt hours
  5. Days of operation
  6. Number of starts
  7. Start date after reset
7. The controller shall store the last one hundred generator set system events with date and time of the event.
8. For maintenance and service purposes, the controller shall store and display on demand the following information:
  1. Manufacturer's model and serial number
  2. Battery voltage
  3. Generator set kilowatt rating
  4. Rated current

5. System voltage
6. System frequency
7. Number of phases
8. Inputs and Outputs
  1. Inputs
    1. There shall be 10 dry contact inputs that can be user-configured to shut down the generator set or provide a warning.
    2. Each analog input can accept 0-5 volt analog signals
    3. Each input shall include range settings for 2 warnings and 2 shutdowns.
    4. All values shall be on the control panel display.
    5. Additional standard inputs required:
      1. Input for an external ground fault detector. Digital display shall show "ground fault" upon detection of a ground fault.
      2. Reset of system faults.
      3. Remote two-wire start.
      4. Remote emergency stop.
      5. Idle mode enable.
  2. Outputs
    1. All NFPA 110 Level 1 outputs shall be available.
    2. Thirty outputs shall be available for interfacing to other equipment
    3. All outputs shall be user-configurable from a list of 25 functions and faults
    4. These outputs shall drive optional dry contacts.
    5. A programmable user-defined common fault output with over 40 selections shall be available.
9. Generator Overcurrent and Fault Protection
  1. The generator shall be provided with a factory installed, 100% rated line circuit breaker rated at 400.00 amperes that is CSA listed. This circuit breaker shall be labelled "Generator Circuit Breaker – 400A (100%)" and shall be fitted with auxiliary/alarm contacts wire to generator controller to alarm on "Breaker Not Closed".
  2. The generator shall be provided with a 2<sup>nd</sup> factory installed, 80% rated line circuit breaker, if applicable, rated at 400.00 amperes that is CSA listed. This circuit breaker shall be labelled "Load Bank Breaker – 400A" and shall be fitted with a DC shunt trip and wired to trip in the event of a normal power failure during a load bank test.
  3. The circuit breaker(s) shall incorporate an electronic trip device with the following characteristics:
    1. Adjustable long time delay
    2. Instantaneous
  4. Load side lugs shall be provided from the factory.
10. Alternator
  1. The alternator shall be salient-pole, brushless, 2/3-pitch, with 4 bus bar provision for external connections, self-ventilated, with drip-proof construction and amortisseur rotor windings, and skewed for smooth voltage waveform. The ratings shall meet the NEMA standard (MG1-32.40) temperature rise limits. The

insulation shall be class H per UL1446 and the varnish shall be a vacuum pressure impregnated, fungus resistant epoxy. Temperature rise of the rotor and stator shall be limited to 130°C Standby. The PMG based excitation system shall be of brushless construction controlled by a digital, three phase sensing, solid-state, voltage regulator. The AVR shall be capable of proper operation under severe nonlinear loads and provide individual adjustments for voltage range, stability and volts-per-hertz operations. The AVR shall be protected from the environment by conformal coating. The waveform harmonic distortion shall not exceed 5% total RMS measured line-to-line at full rated load. The TIF factor shall not exceed 50.

2. The alternator shall have a maintenance-free bearing, designed for 40000 hour B10 life. The alternator shall be directly connected to the flywheel housing with a semi-flexible coupling between the rotor and the flywheel.
3. The generator shall be inherently capable of sustaining at least 300% of rated current for at least 10 seconds under a 3-phase symmetrical short circuit without the addition of separate current-support devices.
4. Motor starting performance and voltage dip determinations shall be based on the complete generator set. The generator set shall be capable of supplying 289.00 LRKVA for starting motor loads with a maximum instantaneous voltage dip of 35%, as measured by a digital RMS transient recorder in accordance with IEEE Standard 115. Motor starting performance and voltage dip determination that does not account for all components affecting total voltage dip, i.e., engine, alternator, voltage regulator, and governor will not be acceptable. As such, the generator set shall be prototype tested to optimize and determine performance as a generator set system.

11. Vibration Isolation

1. Vibration isolators shall be provided between the engine-alternator and heavy-duty steel base.

5. ACCESSORIES

1. **THE GENERATOR PACKAGE SHALL BE AN OUTDOOR WEATHERPROOF AND ACOUSTICALLY TREATED PACKAGE, AS SHOWN ON THE PLANS. THE GENERATOR CONTRACTOR SHALL BE RESPONSIBLE FOR THE FOUNDATION HOUSEKEEPING PAD. THE MECHANICAL CONTRACTOR SHALL BE RESPONSIBLE FOR CONNECTING THE GAS LINE TO THE ENBRIDGE GAS DISTRIBUTION SERVICE.**
2. **The electrical contractor shall be responsible for the control wiring between the Enbridge gas valve and the generator package.**
3. The generator set shall be supplied with a 10-ampere automatic float/equalize battery charger capable of charging both lead-acid and ni-cad type batteries, with the following features:
  1. Automatic 3-stage float to equalization charge
  2. Voltage regulation of 1% from no to full load over 10% AC input line voltage variations
  3. Battery charging current Ammeter and battery voltage voltmeter with 5% full-scale accuracy
  4. LED lamp for power ON indication
  5. Current limited during engine cranking, short circuit, and reverse polarity conditions
  6. Alarm circuit board featuring alarm contacts for low battery voltage, high battery voltage, and battery charger malfunction.
  7. UL 1012 Listed



8. CSA Certified
  4. Battery rack and battery cables capable of holding the manufacturer's recommended batteries shall be supplied.
  5. The generator set shall be supplied with a means to manually adjust the speed of the generator.
  6. The generator set shall be furnished with rodent guards to prevent rodent intrusion and protect internal components.
  7. The air cleaner restriction indicator shall indicate the need for maintenance of the air cleaners.
  8. The generator set shall be supplied with a common failure relay to provide means of signaling fault and/or shutdown conditions.
    1. The common failure relay shall remotely signal auxiliary faults, emergency stop, high engine temperature, low oil pressure, overcrank, and over speed via one single-pole, double-throw relay with 10 amps at 120 VAC contacts.
    2. The relay contacts shall be gold flashed to allow use of low current draw devices (100ma @ 28VDC min.).
    3. Once energized the relay shall remain latched until the system is reset by the main controller switch.
  9. The exhaust piping shall be gas proof, seamless, stainless steel, flexible exhaust bellows and includes the flex exhaust tube and the mounting hardware.
  10. A radiator duct flange to provide a convenient connection to duct work for the radiator discharge air shall be included.
  11. Supply flexible fuel lines to provide a flexible connection between the engine fuel fittings and the fuel supply tank piping and for the fuel return lines from the injector pump per engine manufacturer's recommendations. Flex line shall have a protective steel wire braid to protect the hose from abrasion.
  12. The generator set shall be provided with a run relay which shall provide a three-pole, double-throw relay with 10-amp/ 250 VAC contacts to indicate that the generator is running. The run relay dry contacts can be used for energizing or de-energizing customer devices while the generator is running (e.g. louvers, indicator lamps, etc.)
  13. Remote annunciator panel – The remote annunciator shall meet NFPA 110, Level 1 requirements and enable remote viewing of the generator status. The panel shall be connected to the generator controller via either network communication wires or via hard wired connections. Options shall be available to provide ATS source availability, contactor position, and loaded or unloaded test for up to four transfer switches. The panel shall have the capability to be either flush- mounted or surface-mounted. The annunciator shall meet UL508 requirements.
  14. Block Heater - The block heater shall be thermostatically controlled, 1,500 watts, 110-120 VAC - single phase, to maintain manufacturers recommended engine coolant temperature to meet the start-up requirements of CSA-C282.
6. SOURCE QUALITY CONTROL
1. Non-Conforming Work
    1. To ensure that the equipment has been designed and built to the highest reliability and quality standards, the manufacturer and/or local representative shall be responsible for three separate tests: design prototype tests, final production tests, and site tests.
7. DESIGN PROTOTYPE TESTS.
1. Components of the emergency system, such as the engine/generator set, transfer switch, and accessories, shall not be subjected to prototype tests because the tests are potentially damaging. Rather, similar design prototypes and preproduction



models shall be subject to the following tests:

1. Maximum power (kW)
2. Maximum motor starting (kVA) at 35% instantaneous voltage dip.
3. Alternator temperature rise by embedded thermocouple and/or by resistance method per NEMA MG1-32.6.
4. Governor speed regulation under steady-state and transient conditions.
5. Voltage regulation and generator transient response.
6. Harmonic analysis, voltage waveform deviation, and telephone influence factor.
7. Three-phase short circuit tests.
8. Alternator cooling air flow.
9. Torsional analysis to verify that the generator set is free of harmful torsional stresses.
10. Endurance testing.

8. FINAL PRODUCTION TESTS.

1. Each generator set shall be tested under varying loads with guards and exhaust system in place. Tests shall include:
  1. Single-step load pickup
  2. Safety shutdown device testing
  3. Rated Power @ 0.8 PF
  4. Maximum power
2. Upon request, a witness test, or a certified test record sent prior to shipment.

9. SITE TESTS.

1. The manufacturer's distribution representative shall perform an installation check, startup, and building load test. The engineer, regular operators, and the maintenance staff shall be notified of the time and date of the site test. The tests shall include:
  1. Fuel, lubricating oil, and antifreeze shall be checked for conformity to the manufacturer's recommendations, under the environmental conditions present and expected.
  2. Accessories that normally function while the set is standing by shall be checked prior to cranking the engine. These shall include: block heaters, battery chargers, alternator strip heaters, remote annunciators, etc.
  3. Generator set startup under test mode to check for exhaust leaks, path of exhaust gases outside the building, cooling air flow, movement during starting and stopping, vibration during operation, normal and emergency line-to-line voltage and frequency, and phase rotation. Test load shall be provided by portable resistive load bank and shall be set for 100% full load. The duration of this shall be 4 hours.
  4. Automatic start by means of a simulated power outage to test remote-automatic starting, transfer of the load, and automatic shutdown. Prior to this test, all transfer switch timers shall be adjusted for proper system coordination. Engine coolant temperature, oil pressure, and battery charge level along with generator set voltage, amperes, and frequency shall be monitored throughout the 1-hour building load test.

END OF SECTION

## Part 1 GENERAL

### .1 SCOPE

- .1 Furnish and install automatic transfer switches with bypass operation (ATB) with number of poles, amperage, voltage, and withstand current ratings as shown on the plans. Each automatic transfer bypass switch shall consist of an inherently double throw power transfer switch unit and a microprocessor controller, interconnected to provide complete automatic operation. All transfer switches and control panels shall be the product of the same manufacturer.

### .2 CODES AND STANDARDS

- .1 The automatic transfer switches and accessories shall conform to the requirements of:
  - .1 CSA C22.2 No. 178 Standard for Transfer Switch Equipment

## Part 2 PRODUCTS

### .1 MECHANICALLY HELD TRANSFER SWITCH

- .1 The transfer switch unit shall be electrically operated and mechanically held. The electrical operator shall be a single-solenoid mechanism, momentarily energized. Main operators which include overcurrent disconnect devices will not be accepted. The switch shall be mechanically interlocked to ensure only one of two possible positions, normal or emergency.
- .2 The switch shall be positively locked and unaffected by momentary outages so that contact pressure is maintained at a constant value and temperature rise at the contacts is minimized for maximum reliability and operating life.
- .3 All main contacts shall be silver composition. Switches rated 600 amperes shall have segmented, blow-on construction for high withstand current capability and be protected by separate arcing contacts.
- .4 Inspection of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. A manual operating handle shall be provided for maintenance purposes. The handle shall permit the operator to manually stop the contacts at any point throughout their entire travel to inspect and service the contacts when required.
- .5 Designs utilizing components of molded-case circuit breakers, contactors, or parts thereof which are not intended for continuous duty, repetitive switching or transfer between two active power sources are not acceptable.
- .6 Where neutral conductors are to be solidly connected, a neutral terminal plate with fully-rated AL-CU pressure connectors shall be provided.
- .7 A one-way bypass-isolation switch shall provide manual bypass of the load to the Emergency source and permit isolation of the automatic transfer switch from all source and load power conductors. All main contacts shall be manually driven

### .2 MICROPROCESSOR CONTROLLER WITH MEMBRANE INTERFACE PANEL

- .1 The controller shall direct the operation of the transfer switch. The controller's sensing and logic shall be controlled by a built-in microprocessor for maximum reliability, minimum maintenance, and inherent serial communications capability. The controller shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the controller to be disconnected from the transfer switch for routine maintenance.
- .2 The controller shall be enclosed with a protective cover and be mounted separate from the transfer switch unit for safety and ease of maintenance. Sensing and control logic shall be provided on printed circuit boards. Interfacing relays shall be industrial grade plug-in type with dust covers.
- .3 The controller shall meet or exceed the requirements for Electromagnetic Compatibility (EMC) as follows:
  - .1 ANSI C37.90A/IEEE 472 Voltage Surge Test
  - .2 NEMA ICS – 109.21 Impulse Withstand Test
  - .3 IEC801-2 Electrostatic discharge (ESD) immunity
  - .4 ENV50140 and IEC 801 – 3 Radiated electromagnetic field immunity
  - .5 IEC 801 – 4 Electrical fast transient (EFT) immunity
  - .6 ENV50142 Surge transient immunity
  - .7 ENV50141: Conducted radio-frequency field immunity
  - .8 EN55011: Group 1, Class A conducted and radiated emissions
  - .9 EN61000 –4 – 11 Voltage dips and interruptions immunity
- .3 ENCLOSURE
  - .1 The ATB shall be furnished in a NEMA type 1 enclosure unless otherwise shown on the plans.
  - .2 Controller shall be flush-mounted display with LED indicators for switch position and source acceptability. It shall also include test and time delay bypass switches.

### Part 3 OPERATION

- .1 VOLTAGE AND FREQUENCY SENSING
  - .1 The voltage of each phase of the normal source shall be monitored, with pickup adjustable to 95% of nominal and dropout adjustable from 70% to 90% of pickup setting.
  - .2 3-phase voltage and frequency sensing of the emergency source shall be provided.
- .2 TIME DELAYS
  - .1 An adjustable time delay shall be provided to override momentary normal source outages and delay all transfer and engine starting signals.
  - .2 An adjustable time delay shall be provided on transfer to emergency, adjustable from 0 to 5 minutes for controlled timing of transfer of loads to emergency.
  - .3 A generator stabilization time delay shall be provided after transfer to emergency.

- .4 An adjustable time delay shall be provided on retransfer to normal, adjustable to 30 minutes. Time delay shall be automatically bypassed if emergency source fails and normal source is acceptable.
  - .5 A 5-minute cooldown time delay shall be provided on shutdown of engine generator.
  - .6 All adjustable time delays shall be field adjustable without the use of special tools.
- .3 ADDITIONAL FEATURES
- .1 A set of contacts rated 5 amps, 32 VDC shall be provided for a low-voltage engine start signal. The start signal shall prevent dry cranking of the engine by requiring the generator set to reach proper output, and run for the duration of the cool down setting, regardless of whether the normal source restores before the load is transferred.
  - .2 A push-button type test switch shall be provided to simulate a normal source failure.
  - .3 A push-button type switch to bypass the time delay on transfer to emergency, the engine exerciser period on the retransfer to normal time delay whichever delay is active at the time the push-button is activated.
  - .4 Terminals shall be provided for a remote contact which opens to signal the ATS to transfer to emergency and for remote contacts which open to inhibit transfer to emergency and/or retransfer to normal.
  - .5 Auxiliary contacts, rated 10 amps, 250 VAC shall be provided consisting of one contact, closed when the ATS is connected to the normal source and one contact, closed, when the ATS is connected to the emergency source.
  - .6 Indicating lights shall be provided, one to indicate when the ATS is connected to the normal source (green) and one to indicate when the ATS is connected to the emergency source (red). Also provide indicating lights for both normal and emergency source availability.
  - .7 Engine Exerciser - An engine generator exercising timer shall be provided, including a selector switch to select exercise with or without load transfer.
  - .8 Inphase Monitor - An Inphase monitor shall be inherently built into the controls. The monitor shall control transfer so that motor load inrush currents do not exceed normal starting currents, and shall not require external control of power sources. The inphase monitor shall be specifically designed for and be the product of the ATS manufacturer.
  - .9 Selective Load Disconnect - A double throw contact shall be provided to operate after a time delay, adjustable to 20 seconds prior to transfer and reset 0 to 20 seconds after transfer. This contact can be used to selectively disconnect specific load(s) when the transfer switch is transferred. Output contacts shall be rated 6 amps at 28 VDC or 120 VAC.

## Part 4 ADDITIONAL REQUIREMENTS

- .1 WITHSTAND AND CLOSING RATINGS

- .1 The ATS shall be rated to close on and withstand the available rms symmetrical short circuit current at the ATS terminals with the type of overcurrent protection shown on the plans.
- .2 TESTS AND CERTIFICATION
  - .1 The complete ATS shall be factory tested to ensure proper operation of the individual components and correct overall sequence of operation and to ensure that the operating transfer time, voltage, frequency and time delay settings are in compliance with the specification requirements.
  - .2 Upon request, the manufacturer shall provide a notarized letter certifying compliance with all of the requirements of this specification including compliance with the above codes and standards, and withstand and closing ratings. The certification shall identify, by serial number(s), the equipment involved. No exceptions to the specifications, other than those stipulated at the time of the submittal, shall be included in the certification.
  - .3 The ATS manufacturer shall be certified to ISO 9001: 2000 International Quality Standard and the manufacturer shall have third party certification verifying quality assurance in design/development, production, installation and servicing in accordance with ISO 9001: 2000.
- .3 SERVICE REPRESENTATION
  - .1 The ATS manufacturer shall maintain a national service organization of company-employed personnel. The service center's personnel must be factory trained and must be on call 24 hours a day, 365 days a year.
  - .2 The manufacturer shall maintain records of each switch, by serial number, for a minimum of 20 years.
  - .3 For ease of maintenance, the transfer switch nameplate shall include drawing numbers and serviceable part numbers.

**Part 1 General**

- .1 The following are the mandated qualifications required by the certified testing agency that shall perform the field inspections, testing and commissioning of the electrical equipment, systems and installations associated with the Project to ensure system integrity prior to start-up. The checks and testing shall be documented and signed off by the Testing Agency, Contractor, and field engineer, and approved by the Owner prior to initial energization.
- .2 The Testing Agency shall have good working knowledge of SaskPower's Generation Interconnection Requirements as attached with this Tender.

**Part 2 Qualifications of Testing Agency and Personnel**

- .1 The term "Testing Agency" generally implies a testing contractor, or laboratory, or a third party with corporate independency of any Contactor/Seller whose work may be within the scope of the project inspection and testing.
- .2 The Testing Agency shall be an independent, third party, testing organization that can function as an unbiased testing authority, professionally independent of any Contractor/Seller being evaluated by the Testing Agency.
- .3 The Testing Agency shall be regularly engaged in the testing of electrical equipment devices, installations and systems and have been engaged in such practices for a minimum of five years.

**Part 3 Qualifications of Testing Agency Personnel**

- .1 The Testing Agency shall utilize technicians who are regularly employed for medium voltage testing services.
- .2 Each on-site crew leader shall hold a current registered certification in electrical testing applicable to each type of apparatus to be inspected or tested. The certification in electrical testing shall be issued by an independent, nationally recognized, technician certification agency.
- .3 The testing agency should have a designated and qualified safety representative on the project.

**Part 4 Agency Qualification Submittals**

- .1 At Tender submission, the bidder advises the Owner of the Testing Agency that will perform the work.
- .2 The Testing Agency shall submit qualifications including:
  - .1 Qualifications of project and quality management personnel designated for the project.
  - .2 Inspection procedures manual and operations quality control manual.
  - .3 Qualification records for inspector and technicians designated for the project.
  - .4 Inspection and testing procedures, equipment calibration records and personnel training records.

- .3 The review of Testing Agency qualifications will be performed in a timely manner. Disputes over the qualification of an Agency will be resolved by the Owner/Buyer or Agent/Company.
- .4 A pre-mobilization testing meeting shall be held with the Agent's/Company's Quality Control, Inspection and Testing personnel to plan and discuss:
  - .1 Inspection and test procedures.
  - .2 Overall scope of work for the project.
  - .3 Any special considerations required by the contract documents.
  - .4 Inspection responsibilities.
  - .5 The necessity for test or inspection witnessing.
  - .6 Any specific testing requirements which apply to the project.

#### **Part 5 Test Equipment**

- .1 The Testing Agency shall provide all testing equipment, devices, test leads and cables, accessories test procedures, test documentation and reports as required to complete the inspections and testing specified in the attached equipment specific specification sections.
- .2 Testing Agency personnel will be provided information regarding project-specific requirements and access to Owner supplied equipment operating and maintenance manuals.
- .3 The test equipment shall reflect a new generation/technology of test equipment. This requirement assures that the owner's "state-of-the-art equipment will be tested by state-of-the-art test equipment".
- .4 The testing agency shall have a calibration program with direct traceability, in an unbroken chain, to the National Institute of Standards and Technology (NIST). Dated calibration labels should be visible on all test equipment.

**END OF SECTION**



1 General

1.1 **SECTION INCLUDES**

- .1 Labour, Products, equipment and services necessary for earthwork Work in accordance with the Contract Documents.

1.2 **REFERENCES**

- .1 ASTM D698, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort.
- .2 ASTM D4253, Test Method for Maximum Index Density and Unit Weight of Soil Using a Vibratory Table.
- .3 OPSS, Ontario Provincial Standard Specification.

1.3 **SUBMITTALS**

- .1 Shop drawings:
  - .1 Submit shop drawings in accordance with Section 01 33 00 indicating:
    - .1 Adjacent construction, elevations, sections and details, dimensions, and relationship to adjacent construction.
    - .2 Include design calculations, design concept, construction method, sequence and means by which existing structures, utilities and equipment will be protected; Location of in-use, maintained, re-routed and abandoned underground lines.
- .2 Reports:
  - .1 Submit written laboratory test reports.
  - .2 Submit written field inspection and test report results after each inspection.
- .3 Submit dewatering methods 30 days in advance for review by consultant. If well point system is required, Engineer shall design system and supervise installation.
- .4 Submit to Consultant details of locations where surplus soils and other materials are to be disposed of or reused. Include each disposal/reuse Site and type of surplus soil or other material, location of the disposal/reuse Site, operator's name and business address, type of license under which Site operates, and criteria used by Site to access suitability of surplus material for disposal.
- .5 Submit to Consultant, within 48 hours of a load of surplus soil or other material leaving the Site, a daily register recording the time and place of disposal/reuse of each load signed by a representative of the disposal site. Such documentation must be submitted before payment for excavation will be made.

1.4 **QUALITY ASSURANCE**

- .1 Have shop drawings signed and sealed by a Professional Engineer licensed in Province of Ontario and having experience in design and inspection of shoring, bracing, underpinning and dewatering (if required) required to complete Work.

1.5 **SITE CONDITIONS**

- .1 Geotechnical conditions: For information on subsurface conditions refer to document appended to this Specification. **See 02 32 00, 02 32 00a & 02 32 00b.**
- .2 Cultural heritage resources: If Cultural Heritage Resources (such as archaeological sites, artifacts, building and structural remains, and/or human burials) are encountered during performance of Work, contact Consultant immediately and suspend Work in immediate area until assessment has been completed by Ministry of Culture, Tourism and Recreation. Perform required measures to mitigate negative impacts on found resources to acceptance of consultant.

1.6 **PROTECTION**

- .1 Existing buried utilities and structures:
  - .1 Size, depth and location of known existing utilities and structures are indicated for guidance only. Completeness and accuracy is not guaranteed.
  - .2 Prior to commencing any excavation Work, have authorities stake out utility locations to prevent disturbance during Work.
  - .3 Confirm locations of buried utilities by careful test excavations. Hand dig test excavations as necessary.
  - .4 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered. Obtain permission of consultant before moving or otherwise disturbing utilities or structures.
- .2 Existing surface features:
  - .1 Conduct with Consultant, a condition survey of existing trees and other plants, lawns, fencing, service poles, wires, rail tracks and paving, survey benchmarks and monuments which may be affected by Work.
  - .2 Protect existing surface features which may be affected by Work from damage while Work is in progress and repair damage resulting from Work.
  - .3 Where excavation necessitates root or branch cutting, perform Work in accordance with Authorities having Jurisdiction.
  - .4 Confirm with Consultant, condition Survey of buildings and structures undertaken by consultant.
- .3 Temporarily cover local existing catch basins and maintenance holes to prevent entry of earth or debris. Ensure adequate surface drainage in affected area is maintained.
- .4 Protect Work or work of other Contracts in progress or completed and protect existing properties, stored Products, services, utilities, trees, landscaping and natural features from damage.

- .5 Protect excavations against flooding and damage and install and maintain appropriate warning devices during construction and during time when Work is closed down for any cause.
- .6 Protect bottom of excavations that will support foundations, slabs, pavements etc. from frost or freezing.
- .7 Keep access roads clear of debris and dirt resulting from Work of this Section to acceptance of Authorities having jurisdiction.
- .8 Shoring, bracing and underpinning: Comply with local regulations, authorities having jurisdictions and requirements specified.

## 2 Products

### 2.1 MATERIALS

- .1 Select fill: Subject to approval of consultant consisting of reusable fill excavated from Site or imported fill that is free of organic matter, rubble and material other than soil. Maximum particle size of half thickness of lift specified, moisture content at time of placing 2% maximum over its optimum moisture content and is either non-plastic or has a plasticity index of 25% maximum.
- .2 Granular A fill: Imported Granular A fill, free of organic matter and, in accordance with OPSS 1010.
- .3 Granular B Fill: Imported Granular B fill free of organic matter and in accordance with OPSS 1010.
- .4 Granular D fill: In accordance with OPSS-1004, containing 100% crushed aggregates, free of organic matter.
- .5 Clear Stone fill: 19 mm clear stone in accordance with OPSS 1004, free of organic material.
- .6 Unshrinkable fill: 0.7 MPa cement stabilized backfill conforming to requirements of CAN/CSA A23.1/A23.2-M.

## 3 Execution

### 3.1 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.

### 3.2 **LINES AND ELEVATIONS**

- .1 Establish lines and elevations from Control Points shown on Contract Drawings.
- .2 Have lines and elevations established by Registered Ontario Land Surveyor or qualified Civil Engineer registered in Province of Ontario.
- .3 Protect and maintain Control Points and Benchmarks as long as they are required.

### 3.3 **STRIPPING**

- .1 Do not handle topsoil while in wet or frozen condition or in manner in which soil composition is adversely affected.
- .2 Strip topsoil from working area in locations shown.
- .3 Strip topsoil to depths indicated. Avoid mixing topsoil with subsoil.
- .4 Stockpile topsoil in locations directed by consultant. Stockpile to height not exceeding 2 m. Remove excess topsoil from Site.

### 3.4 **REMOVAL OF WATER**

- .1 Obtain letter of conditional approval from Municipality to dispose of ground water into sewer drainage system. Apply for and pay for water disposal permit, if applicable.
- .2 Keep excavations and trenches free of water throughout construction period.
- .3 Groundwater removal:
  - .1 Lower groundwater level and maintain at depth below lowest point of excavation to ensure a dry stable surface.
  - .2 Dewater to prevent loss of soil and maintain stability of sides and bottom of excavation and of adjacent structures.
  - .3 Dispose of water in conformance with applicable by-laws and in a manner not detrimental to public and private property, or portion of Work completed or under construction.
  - .4 Supply and install flocculation tanks, settling basins, or other treatment facilities to remove suspended solids or other materials before discharging to sewers, water courses or drainage areas in accordance with authorities having jurisdiction. Perform testing on settlement tank discharge to confirm that effluent meets sewer bylaw requirements. Locate tanks to acceptable area determined by consultant.
  - .5 Should method of dewatering fail to achieve conditions specified above, Consultant reserves right to revise methods and procedures at no cost to Owner.

- .4 Surface water removal:
  - .1 Remove surface run-off in a manner that will prevent loss of soil and maintain stability of sides and bottom of excavation. Obtain Consultant's approval of dewatering method to be used.
  - .2 Discharge surface water into existing storm drainage system to acceptance of consultant and local authorities.
- .5 Do not obstruct flow of surface drainage or natural water courses.

### 3.5 **EXCAVATION**

- .1 Remove concrete, masonry, paving, demolished foundations and rubble and other obstructions encountered during excavation Work.
- .2 Do not disturb soil within drip line of trees or shrubs that are to remain. If excavating through roots, excavate by hand and cut roots with sharp axe or saw in a manner acceptable to authorities having jurisdiction.
- .3 Excavate to required lines and grades shown on Contract Drawings with allowance for subsequent Work including shoring, bracing and formwork. Make excavation clean and clear of loose material and true to size.
- .4 Protect stockpiles of fill against contamination and moisture absorption.
- .5 Do not undermine adjacent structures. Where it is necessary to have footings at different levels, found upper footing below imaginary 10-horizontal-to-7 vertical line, or as otherwise indicated, drawn up from base of lower footing. Protect adjacent foundations from frost.
- .6 Have excavations in excess of 1200 mm in depth conform to requirements of Occupational Health and Safety Act, and Regulations for Construction Projects.
- .7 Do not expose shale at subgrade elevation to drying cycles and in any case, following inspection, cover with minimum 50 mm of lean concrete within 4 hours after exposure.
- .8 Fill excavations for foundations which are, through error, carried below elevation shown or approved depth, with 15 MPa concrete, or as directed by consultant.
- .9 Trim, and remove loose material, debris and organic material from excavations. Where material at bottom of excavation is disturbed, remove disturbed material and re-compact to density equal to or better than undisturbed soil or backfill with lean concrete as directed by consultant.
- .10 When excavations are complete, prior to commencement of subsequent Work, request Consultant for inspection of excavation Work.

**3.6 TRENCHING**

- .1 Excavate trenches to lines and grades indicated and to a depth of 75 mm minimum below invert elevation and slope established for pipe and backfill to invert elevation of pipe with specified granular material.
- .2 Unless otherwise authorized by consultant, do not excavate more than 30 m of trench in advance of installation operations and do not leave open more than 15 m at end of day's operation. Remove unsuitable material from trench bottom to extent and depth as directed by consultant.
- .3 Backfill Over-excavation with granular material and compact.
- .4 If unstable soil conditions are encountered, excavate trenches to depth directed by consultant and backfill to correct elevation with backfill material.
- .5 Remove loose material from bottom of trenches to ensure granular material is placed against undisturbed soil.
- .6 Compact bedding and grade as required for even and uniform support on each length of pipe.
- .7 Where excavating is required adjacent to and parallel with and below any footing, submit excavation and backfill procedures to consultant for review prior to start of excavating.
- .8 Keep width of trenches to a minimum to ensure minimum span for pipe to be supported.
- .9 Make excavations for fire hydrants of sufficient size and depth to accommodate a minimum 0.75 m<sup>3</sup> of crushed stone. Hand place stone and tamp around and below hydrant elbow to ensure proper drainage of hydrant.

**3.7 EXCAVATED MATERIAL DISPOSAL**

- .1 Except for material to be used as select fill, immediately remove and dispose of excavated material from Site.
- .2 Remove and dispose of construction rubble, abandoned gas, water and sewer pipes, valves, valve boxes and fittings, maintenance holes, frames and covers and other material which may be encountered during excavation but not indicated on Contract Drawings.

**3.8 BACKFILLING**

- .1 Do not proceed with backfilling operations until walls, slabs, waterproofing and below grade Work has been inspected and accepted by consultant.
- .2 Backfill areas which are free from debris, snow, ice, water and frozen ground.

- .3 Do not use backfill material which is frozen or contains ice, snow or debris.
- .4 Do not backfill on or against any membrane or protection board covered waterproofing with jagged rock or other sharp objects which might damage waterproofing.
- .5 Limit vertical drop of backfill material to 2000 mm.
- .6 Use only rubber-tired vehicles over roof of structure during backfilling, maximum tire pressure 70 kPa. Metal-tracked vehicles will not be allowed on roofs for compaction purposes.
- .7 To avoid pockets and voids, remove sheathing and shoring materials that require removal, as backfilling progresses.
- .8 Prior to backfilling or placing concrete on exposed soil subgrade, proof roll subgrade to identify soft or loose areas. Proceed with placing backfill or concrete only after inconsistencies identified by above procedure have been reworked and compacted or excavated, backfilled and compacted as required to eliminate such conditions to acceptance of consultant.
- .9 Place backfill material, grade and compact to levels shown on Contract Drawings.
- .10 Place backfill materials in uniform layers 200 mm maximum loose thickness unless specified otherwise.
- .11 Ensure each layer is compacted, and accepted by consultant, before placing succeeding layers.
- .12 Unless otherwise indicated, use specified granular material from bottom of trench to 300 mm above top of pipe or 150 mm above top of electrical conduits. Hand place in 150 mm layers and compact carefully to ensure proper backfilling and compaction around bottom quadrants and sides of pipe.
- .13 For backfill from 300 mm above top of pipe or 150 mm above electrical conduits to sub-grade level, use select fill unless otherwise noted. Compact either by hand or by machine.
- .14 Do not backfill trenches until piping, conduits and cables therein have been inspected, tested, and approved by inspection authorities having jurisdiction and Consultant.
- .15 Prior to backfilling of trenches, remove wood block or wedges used to prevent movement of piping during tests.

- .16 Where there is a common boundary between select fill and granular fill or unshrinkable fill, place select fill after granular fill has been compacted. Place and compact fill around free-standing structures evenly on all sides of structure simultaneously in layers sloping away from structure.
- .17 During backfilling, take care to avoid displacing or damaging Utilities Work and Services.
- .18 Notify Consultant prior to commencement of backfilling and compacting operations.

### 3.9 **COMPACTION**

- .1 Compaction densities for select fill, granular fill, and sand fill materials will be determined by ASTM D698. Compaction densities for clear stone will be determined by ASTM D4253.
- .2 Add water if necessary to obtain required densities. Correct irregularities or depressions that may develop during compaction by removing or adding material to form a smooth and uniform surface.
- .3 Shape and roll alternately to obtain smooth, even and uniformly compacted base.
- .4 If material is excessively moist, aerate by scarifying with suitable equipment until moisture content is corrected.
- .5 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers acceptable to consultant.
- .6 Compact backfill materials in accordance with Geotechnical Report providing the following as a minimum:
  - .1 Imported fill: 98% standard Proctor maximum dry density (SPMDD).
  - .2 Under slabs, walks and pavements: 100% (SPMDD).
  - .3 All other areas: 95% (SPMDD).

### 3.10 **GRADING**

- .1 Prior to placing fill over existing ground, scarify surface to depth of 150 mm. Maintain fill and existing surface at approximately same moisture content to facilitate bonding.
- .2 Place material only on clean unfrozen surface, properly shaped and compacted and free from snow and ice. Ensure no frozen material is used in placing.
- .3 Grade as necessary to bring Work areas to required elevations. Supply additional material required to obtain new grade levels. Place and compact as specified.
- .4 Grade drainage ditches to elevations indicated on Contract Drawings.
- .5 Maintain positive drainage.



- .6 Grade materials using methods which do not lead to segregation or degradation of aggregate.
- .7 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.
- .8 Remove and replace that portion of layer in which material becomes segregated during spreading.
- .9 Slope grade away from buildings 1:50 minimum.
- .10 Make graded areas smooth to profile, free of debris, with local excavations and depressions filled and compacted.
- .11 Do not disturb soil within branch spread of trees and shrubs remaining.
- .12 Cultivate entire area which is to receive topsoil to a depth of 100 mm. Repeat cultivation in those areas where equipment used for hauling and spreading has compacted soil.
- .13 Remove surface debris, roots, vegetation, branches and stones in excess of 50 mm in diameter.

**3.11 FINISH GRADING**

- .1 Fine grade and loosen topsoil. Eliminate rough spots and low areas to ensure positive drainage. Prepare loose friable bed by means of cultivation and subsequent raking.
- .2 Roll to consolidate topsoil for areas to be seeded or sodded leaving surface smooth, uniform, firm against deep foot printing, and with fine loose texture to approval of consultant.

**3.12 UNSHRINKABLE FILL**

- .1 Place unshrinkable fill in locations indicated on Contract Drawings or where Work area is too limited to permit proper placing and compaction. Obtain Consultants approval prior to placing unshrinkable fill. Place in accordance with supplier's written instructions.
- .2 If embedded items occur in area being backfilled, coordinate with appropriate trades to ensure that disturbance of embedded items during backfilling is prevented.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

- .1 Labour, Products, equipment, tools, and services necessary for asphaltic concrete paving Work in accordance with the Contract Documents.

1.2 **REFERENCES**

- .1 ASTM D 698, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort.
- .2 ASTM D1559, Test Method for Resistance to Plastic flow of Bituminous Mixtures Using Marshall Apparatus.
- .3 CAN/CGSB 1.74, Alkyd Traffic Paint.
- .4 OPSS, Ontario Provincial Standard Specification.

1.3 **SUBMITTALS**

- .1 Shop drawings: Submit shop drawings in accordance with Section 01 33 00 indicating sections, materials, dimensions, and relation to adjacent construction.
- .2 Reports:
  - .1 Submit written mix designs for each type of asphalt concrete for acceptance.
  - .2 8 weeks prior to commencing Work test materials for conformance with requirements of Specifications. Submit written test report verifying compliance 4 weeks minimum prior to commencing Work.
  - .3 Submit written field inspection and test reports.
  - .4 Submit certification that testing laboratory is accredited for asphalt mix design through the Canadian Council of Independent Laboratories (CCIL).

1.4 **QUALITY ASSURANCE**

- .1 Pre-installation meetings: Arrange with Contractor, asphalt Subcontractor, and Consultant to inspect substrates, and to review installation procedures 48 hours in advance of installation.

1.5 **SITE CONDITIONS**

- .1 Do not install Work of this Section outside of following environmental ranges without Consultant's and Product manufacturer's written acceptance:
  - .1 Air and surface temperature: OPSS 310.
  - .2 Precipitation: None within 24 hours prior to placement.

1.6 **EXTENDED WARRANTY**

- .1 Submit a extended warranty for Work of this Section in accordance with General Conditions, except that warranty period is extended to two years.

2 Products

2.1 **MATERIALS**

- .1 Granular base and sub-base material: Granular "A" OPSS 1010, crushed or screened stone or gravel.
- .2 Asphalt materials:
  - .1 Hot mixed, hot laid asphalt meeting OPSS 1150, designation H.L. 8 for binder course and H.L. 3 for surface course.
  - .2 Tack and primer coat: OPSS 1103 Grade SS-1.
- .3 Traffic paint: CAN/CGSB 1.74, new pavement markings, white or yellow as selected by Consultant.

2.2 **MIXES**

- .1 Mix asphalt materials in accordance with OPSS 1003 for H.L. 8 and H.L. 3.
- .2 Do not change mix without prior approval of consultant.

2.3 **SOURCE QUALITY CONTROL**

- .1 Source approval:
  - .1 Inform Consultant of proposed source of Products and afford access for sampling and testing of quality of Products at least 4 weeks prior to commencing production.
  - .2 Ensure that source of Products to be incorporated into Work or stockpiled is acceptable to consultant.
  - .3 Submit laboratory test results for samples of specified Products to be supplied by this Section. Include in laboratory test results those tests required to demonstrate that Product meets requirements of this Section.
  - .4 If Products from proposed source do not meet, or cannot reasonably be processed to meet specified requirements, locate an alternative source or demonstrate that Products source in questions can be processed to meet specified requirements.
  - .5 Should a change of Products source be proposed during Work, advise Consultant 14 days in advance of proposed change to allow sampling and testing.

- .6 Acceptance of Product at source does not preclude future rejection if it is subsequently found to lack uniformity, or if it fails to conform to requirements specified, or if its field performance is found to be unacceptable. Remove and dispose rejected material.
- .2 Production sampling:
  - .1 Products may be subject to continual sampling by consultant during production.
  - .2 Afford Consultant ready access to source and processed Products for sampling and testing.
  - .3 If Products fail to meet Specifications, bear cost of additional sampling and testing of aggregates and fill.
  - .4 Supply necessary personnel and equipment to permit adequate investigation and sampling. Advise Consultant at least 14 days in advance of use of Products, to allow sufficient time for sampling and testing.
- 3 Execution
- 3.1 **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.
- 3.2 **PREPARATION**
  - .1 Verify grades of items set in paving area for conformity with elevations and sections before placing granular base and subbase material.
  - .2 Obtain approval of subgrade by consultant before placing granular subbase and base.
  - .3 Coordinate elevations of maintenance holes and other appurtenances and make flush with top of finish asphalt concrete paving.
- 3.3 **SUBBASE AND BASE**
  - .1 Comply with OPSS 314.
  - .2 Prior to placing subbase and base proof roll subgrade to identify soft spots. Excavate soft spots and backfill with granular material to 100% standard Proctor maximum dry density in accordance with ASTM D698.
  - .3 Place granular base and subbase material on clean unfrozen surface, free from snow and ice.
  - .4 Place granular base and subbase to compacted thicknesses as indicated. Do not place frozen material.

- .5 Place in layers not exceeding 150 mm compacted thickness. Compact to density not less than 100 % standard Proctor maximum dry density in accordance with ASTM D698.
- .6 Finished base surface to be within 5 mm of specified grade, but not uniformly high or low.

#### 3.4 **ASPHALT PRIMER**

- .1 Apply primer coat in accordance with OPSS 302.
- .2 Do not apply primer when air temperature is less than 5 degrees Celsius or when rain is forecast within 2 hours.
- .3 If asphalt primer fails to cure within 24 hours, spread sand blotter material in amounts required to absorb excess material. Sweep and remove excess blotter material.

#### 3.5 **EQUIPMENT**

- .1 Pavers: mechanical grade-controlled self-powered pavers capable of spreading mix within specified tolerances, true to line, grade and crown indicated.
- .2 Rollers: sufficient number of rollers of type and weight to obtain specified density of compacted mix.
- .3 Vibratory rollers:
  - .1 Minimum drum diameter: 750 mm.
  - .2 Maximum amplitude of vibration (machine setting): 0.5 mm for lifts less than 40 mm thick.
- .4 Haul trucks: of sufficient number and of adequate size, speed, and condition to ensure orderly and continuous operation and as follows.
- .5 Suitable hand tools.

#### 3.6 **ASPHALT PAVING**

- .1 Comply with requirements of OPSS 310.
- .2 Obtain approval of tack coat base and primer from consultant before placing asphalt mix.
- .3 Place asphalt mix only when base or previous course is dry and air temperature is above 5 degrees Celsius.
- .4 Place asphalt concrete in compacted layers not exceeding 50 mm per lift.
- .5 Minimum 135-degree Celsius mix temperature required when spreading.

- .6 Maximum 160-degree Celsius mix temperature permitted at any time.
- .7 Compact each course with roller as soon as it can support roller weight without undue cracking or displacement.
- .8 Compact paving to density not less than 97% of density obtained with Marshall specimens prepared in accordance with ASTM D1559. Roll until roller marks are eliminated.
- .9 Keep roller speed slow enough to avoid mix displacement and do not stop roller on fresh pavement.
- .10 Moisten roller wheels with water to prevent pick up of material.
- .11 Compact mix with hot tampers or other equipment approved by consultant, in areas inaccessible to roller.
- .12 Finish surface to be within 5 mm of design elevation and with no irregularities greater than 10 mm in 4.5 m.
- .13 Repair areas showing checking, rippling or segregation as directed by consultant.

### 3.7 **JOINTS**

- .1 Remove surplus material from surface of previously laid strip. Do not deposit on surface of freshly laid strip.
- .2 Paint contact surfaces of existing structures such as catch basins, manholes, curbs or gutters with tack coat prior to placing adjacent pavement.
- .3 For cold joints, cut back to full depth vertical face and tack face with hot asphalt.
- .4 For longitudinal joints, overlap previously laid strip with spreader by 25 to 50 mm.

### 3.8 **PAVEMENT MARKINGS**

- .1 Spray paint parking zone lines and other pavement markings indicated, included, but not limited to, hash marks for no parking areas, direction arrows and handicap parking symbols.
- .2 Use suitable compressor type striping machine. Use templates for symbols, arrows, lettering.
- .3 Unless otherwise indicated, paint lines 125 mm wide.
- .4 Paint lines straight, or uniformly curved, with well-defined edges and full paint coverage in all locations.

3.9            **FIELD QUALITY CONTROL**

- .1      Conduct following field tests, submit report to consultant:
  - .1      Granular materials for composition and gradation.
  - .2      Granular material and asphalt concrete compaction.

3.10          **PROTECTION**

- .1      Keep vehicular traffic off newly paved areas until paving surface temperature has cooled below 38 degrees Celsius. Do not permit stationary loads on pavement until 24 hours after placement.

3.11          **SCHEDULE**

- .1      Refer to Geotechnical Report for compacted thicknesses of pavement structures for asphaltic concrete paving, unless otherwise indicated.
- .2      Paving on public property, meet requirements of municipality.

END OF SECTION

1 General

1.1 **SECTION INCLUDES**

- .1 Design, labour, Products, equipment and services necessary for concrete curbs and pavements Work in accordance with the Contract Documents.

1.2 **REFERENCES**

- .1 ASTM A53/A53-M, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
- .2 ASTM A185/A185-M, Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
- .3 ASTM C260, Specification for Air-Entraining Admixtures for Concrete.
- .4 ASTM C309, Specification for Membrane-Forming Compounds for Curing Concrete.
- .5 ASTM C494/C494-M, Specification for Chemical Admixtures for Concrete.
- .6 ASTM D994, Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
- .7 CAN/CSA A23.1/A23.2-M, Concrete Materials and Methods of Concrete Construction/Methods of Tests for Concrete.
- .8 CAN/CSA A3000, Cementitious Materials Compendium.
- .9 CAN/CSA G30.18-M, Billet-Steel Bars for Concrete Reinforcement.
- .10 CSA O121, Douglas Fir Plywood.
- .11 CAN/CSA S269.3-M, Concrete Formwork.

1.3 **DESIGN REQUIREMENTS**

- .1 Concrete: 30 Mpa unless otherwise indicated on drawings. Exterior concrete to have 5-7% entrained air.
- .2 Design concrete so that material will not segregate and excessive bleeding will not occur.
- .3 Comply to the MTC Manual of Uniform Traffic Control Devices for signs and flagging when working within existing road ways. Any requirements to restrict local traffic due to the contractors works, must be reviewed and approved by the Consultant.



**1.4 SUBMITTALS**

- .1 Product data:
  - .1 Submit duplicate copies of manufacturer's Product data in accordance with Section 01 33 00 for each material indicating:
    - .1 Performance criteria, compliance with appropriate reference standard(s), and characteristics.
    - .2 Product transportation, storage, handling and installation requirements.
- .2 Shop drawings: Submit shop drawings in accordance with Section 01 33 00 indicating elevations, sections, details, materials, joint assemblies, finishes and relationships to adjacent construction.

**1.5 QUALITY ASSURANCE**

- .1 Inspection and testing:
  - .1 Materials: CAN/CSA A23.1/A23.2-M; Inspect and test for conformance to requirements of this Standard and to Specifications.
  - .2 Tests will be made in accordance with CAN/CSA A23.2-M.
  - .3 Remove defective materials and completed Work which do not conform to the Contract Documents.

**1.6 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver and store materials on Site in accordance with CAN/CSA A23.1/A23.2-M.

**1.7 SITE CONDITIONS**

- .1 Conform to CAN/CSA A23.1/A23.2-M.
- .2 Do not deposit concrete on frozen ground. When deposited in forms concrete shall have a temperature between 10 degrees Celsius and 30 degrees Celsius and these limits shall be maintained for 72 hours.

**2 Products**

**2.1 MATERIALS**

- .1 Forms: Plywood to CSA O121, G1S; Douglas Fir plywood, seven ply, exterior grade, waterproof glue, edges sealed with oil based sealer.
- .2 Form ties: Adjustable snap ties, formed to break 25 mm or more from surface of concrete after form removal, with a minimum working strength of 1360 kg.
- .3 Form release agent: Chemically active, non-staining, VOC compliant, release agents containing compounds that react with free lime present in concrete forming water insoluble soaps, preventing concrete from sticking to forms.

- .4 Reinforcing steel: CAN/CSA G30.18-M; Billet-steel bars, deformed unless indicated otherwise, Grade 400R.
- .5 Welded steel wire fabric: ASTM A185/A185-M; Resistance welded in size and spacing shown for smooth wire fabric, in flat sheets only.
- .6 Chairs, bolsters, supports, spacers: CAN/CSA A23.1-M with sufficient strength to rigidly support weight of reinforcement and construction loads. Manufactured by NCA/Acrow - Richmond or Dayton Superior.
- .7 Cement: CAN/CSA A3000; Portland, Type 10.
- .8 Coarse and fine aggregate: CAN/CSA A23.1/A23.2-M.
- .9 Water: CAN/CSA A23.1/A23.2-M.
- .10 Water reducing admixture: ASTM C494/C494-M, Type A.
- .11 Set retarding admixture: ASTM C494/C494-M, Type D.
- .12 Air entraining admixture: CAN/CSA A23.1/A23.2-M and ASTM C260.
- .13 Pigmented curing compound: ASTM C309, Type 2, Class B; White pigmented resin based.
- .14 Joint filler: ASTM D994, Asphalt impregnated; 'Asphalt Joint Expansion Joint Filler' by W. R. Meadows Ltd., in thickness shown on Contract Drawings. Furnish kraft paper or polyethylene sheet as bond breaker between sealant and joint filler
- .15 Joint Sealant: Two component, non-tracking, chemically reactive urethane/coal tar modified sealant; 'Sealtight Gardox' by W. R. Meadows Ltd. or 'Vulkem 202' by Tremco.
- .16 Bonding Agent: Furnish 'Sika-Dur' by Sika, or 'Intralock' by W. R. Meadows.

## 2.2 **MIXES**

- .1 Acceptance of any concrete mix proportion or material, does not preclude its future rejection if it is subsequently found to lack uniformity, or if it fails to conform to requirements specified, or if its field performance is found to be unacceptable.
- .2 Mix concrete and concrete proportions in accordance with CAN/CSA A23.1/A23.2-M.

## 2.3 **ADMIXTURES**

- .1 Use admixtures for concrete from single manufacturer, unless otherwise acceptable to Consultant.
- .2 Have manufacturer certify that admixtures are compatible.

- .3 Add admixtures to concrete mix in accordance with manufacturer's recommendations.
- .4 Except as specified otherwise, comply with requirements of CAN/CSA A23.1/A23.2-M.
- .5 Use of calcium chloride or additional admixtures, other than those specified, is not acceptable.

3 Execution

3.1 **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.

3.2 **GENERAL**

- .1 Give Consultant at least 2 working days' notice prior to placement of concrete to permit a review of compaction, placement of formwork, reinforcing steel, and associated items embedded in concrete for conformance to reviewed shop drawings and Contract Documents.
- .2 Do not place concrete on surfaces which contain frost, water or debris.
- .3 Provide concrete curb cuts and sidewalk handicap access ramps as indicated, in accordance with the authorities having jurisdiction.

3.3 **PREPARATION**

- .1 Verify grades of items set in paving area for conformity with elevations and sections before placing granular base and subbase material.
- .2 Obtain approval of subgrade by Consultant before placing granular subbase and base.
- .3 Set out work from lines and levels shown on drawings.
- .4 Prevent damage to adjacent and/or existing buildings and/or properties, and existing curbs, sidewalks and asphalt paving.
- .5 Accurately saw-cut and modify existing sidewalks to nearest adjacent dummy/expansion joint as directed on site by Consultant.
- .6 Remove and dispose of debris from the work of this section in accordance with authorities having jurisdiction.

- .7 Fine grade, shape and compact subgrade to minimum of 95% Standard Proctor Density.
- .8 Wet base immediately in advance of concreting to ensure a firm moist surface without ponding.
- .9 Repair damage to base resulting from hauling or equipment operations.

#### 3.4 **FORMWORK**

- .1 Construct formwork in accordance with CAN/CSA S269.3-M to produce finished concrete conforming to shape, dimensions, locations and elevations indicated. Ensure no lumber remains in concrete.
- .2 Set forms true to line and grade, join neatly and tightly, and stake securely to resist concrete pressure and impact from tampers without springing.
- .3 Apply release agent by spray in accordance with manufacturer's recommendations. Ensure form surfaces receive a uniform coating.

#### 3.5 **REINFORCING**

- .1 Place reinforcing steel as shown on reviewed shop drawings and in accordance with CAN/CSA A23.1-M. Make bars as long as possible.
- .2 Make splices in locations shown on Drawings. Lap lengths in accordance with CSA A23.3 unless otherwise shown.
- .3 Lap ends and sides of wire fabric not less than 150 mm.

#### 3.6 **PLACING OF CONCRETE**

- .1 Before placing fresh concrete against set or partially set concrete, clean surfaces to remove dirt, scum, shavings, debris, laitance, etc. on set surfaces, brush generously with bonding agent.
- .2 Place concrete in accordance with CAN/CSA A23.1/A23.2-M.
- .3 Slope concrete to levels shown on Contract Drawings.
- .4 Do not place concrete at such a rate as to endanger formwork or to prevent proper compaction.
- .5 Place concrete to prevent cold joints and segregation and vibrate sufficiently to ensure thorough compaction, maximum density in accordance to CAN/CSA A23.1/A23.2-M
- .6 Check Work frequently with accurate instruments during placing of concrete.

- .7 When completing concrete placement for day, carry placement through to a scheduled joint location.
- .8 Where concrete placement is stopped for more than 30 minutes due to breakdowns, weather or any other reasons, construct extra bulkhead and construction joint as directed.

### 3.7 **CONCRETE CURBS**

- .1 Align concrete curbs with curves and tangents indicated on drawings. Concrete curb to be in accordance to details indicated on drawings.
- .2 Where existing curb is met, the contractor must make the required transition to style and grade of existing curb to the satisfaction of the Consultant.
- .3 Curbs shall have expansion joints at minimum 4500 mm o.c. and in accordance with authorities having jurisdiction. Place reinforcing bars at top and base of curb, with minimum 50 mm concrete cover.
- .4 All restoration of the existing road structure for the transition to existing curb is the responsibility of the contractor.
- .5 Finish edges of dummy joints and expansion joints with 3 mm radius edging tool.

### 3.8 **CONCRETE PAVEMENTS**

- .1 Concrete sidewalk to be in accordance with details indicated on drawings.
- .2 Concrete for standard sidewalk to be 150 mm thick, except through entrances where the concrete shall be 200 mm thick with wire mesh. The compacted granular 'A' is to be 150 mm thick at all locations.
- .3 Where existing sidewalk is met, make the required transition to grade, to the satisfaction of the Consultant. Furthermore, co-ordinate with the municipality and Consultant, to insure compatibility of existing and or future adjacent works by municipality forces.
- .4 All structural concrete, such as but not limited to, concrete walkway adjacent to building, concrete pads for loading docks, and concrete slabs for loading areas to be constructed in accordance with reviewed shop drawings.
- .5 Dummy joints: 6 mm deep at 1500 mm o.c. Tool joints with 6 mm wide steel trowel, radiusing edges 6 mm.
- .6 Expansion joints: 6000 mm o.c. maximum.
- .7 Tool edges of sidewalk with 50 mm wide steel trowel, radiusing edges 6 mm.
- .8 Install sealant in expansion/isolation joints as shown and specified.

**3.9 CONSOLIDATING**

- .1 Consolidate concrete in accordance with CAN/CSA A23.1/A23.2-M
- .2 Work concrete into complete contact with forms and embedded items. Consolidate concrete adjacent to side forms and along entire length of forms to ensure a smooth surface finish after stripping of formwork.

**3.10 CURING AND PROTECTION**

- .1 Cure and protect concrete in accordance with CAN/CSA A23.1/A23.2-M.
- .2 Apply curing compound after finishing operations have been completed, at rate recommended by compound manufacturer. Ensure compound application is uniform and continuous over entire area being cured.

**3.11 CONSTRUCTION JOINTS**

- .1 Obtain Consultant's acceptance to install construction joints in locations other than those shown.
- .2 Construct construction joints to CAN/CSA A23.1-M and as shown. Supply and install dowels in construction joints unless otherwise detailed.
- .3 Joints at building face or other abutments: place 12 mm joint filler keeping top 12 mm below concrete surface; apply kraft paper or polyethylene bond over filler and fill with self-levelling sealant applied in accordance with manufacturer's printed instructions.
- .4 For sawn joints:
  - .1 Do sawn joints in accordance with drawing details. Prepare sample sawn joint for approval by Consultant.
  - .2 Ensure joints are straight. Mark alignment with chalk line or other suitable guide. Layout to be approved by Consultant.
  - .3 Saw joints using approved equipment and methods to produce joint dimensions indicated.
  - .4 Supply sufficient men and equipment including standby equipment, to maintain a satisfactory sawing schedule.
  - .5 Schedule sawing operations on 24 hour basis and consistent with concrete placing.
  - .6 Make initial saw cuts in a progressive manner and as soon as possible without excessive raveling.
  - .7 If a crack occurs ahead of saw cut, stop immediately. Move ahead several joints and cut one or more joints before returning to saw intermediate joints. Where cracking persists, make 1060 mm saw cut from one edge and complete sawing from opposite edge. Adjust sawing schedule accordingly.
  - .8 If uncontrolled cracking or other surface damage results from inadequate or improper sawing techniques suspend further concrete operations until situation is corrected and immediately remove and replace damaged slabs.

- .9 Immediately on completion of sawing, flush joints with water to remove laitance.

### 3.12 **FINISHING**

- .1 When striking off concrete surface, maintain a uniform roll of concrete ahead of first screed for its full length when finishing machine is on first pass.
- .2 Where joints are formed rather than sawn, form longitudinal and transverse joints after final pass of finishing machine.
- .3 Hand finish areas inaccessible to finishing machine to same quality and surface characteristics as machine finished surfaces.
- .4 Finish concrete surface with an approved float at proper time. Operate from edge to edge with a wiping motion while advancing, with each succeeding pass overlapping previous one.
- .5 Check surface with approved straightedge 4500 mm long. Correct irregularities exceeding 5 mm before concrete takes initial set.
- .6 Finish edges of slabs with edging tool to form a smooth squared surface. Do not patch with cement paste.

### 3.13 **IDENTIFICATION STAMP**

- .1 For sidewalks in the public right-of-way, mark concrete at each end of the work and at least every 18000 mm or such other places as the Consultant may select.
- .2 The stamp shall be located on the centre of the bay of walk, next to and parallel to a transverse joint.
- .3 The size and shape of the stamp shall be as shown on the Municipalities drawings.
- .4 The imprint shall be clear and legible and satisfactory to the Consultant.

### 3.14 **BROOM FINISH**

- .1 Commence texturing immediately after float finishing.
- .2 Use soft bristled broom to produce an approved light, non-slip concrete surface finish with fine granular or sandy texture free from disfigurations. Finishes to be approved by Consultant.
- .3 Apply broom finish at right angles to curb and parallel to joints. All trowel and tool marks to be removed with broom. Do not contaminate joints by over-brooming.

- .4 Finish to match existing striped concrete sidewalk to remain, and to Consultant's approval.

### 3.15 **REMOVAL OF FORMS**

- .1 Do not disturb forms until concrete has hardened and developed sufficient strength to safely support its own weight and load on it.
- .2 Strip formwork in accordance with CAN/CSA A23.1-M.

### 3.16 **DEFECTIVE CONCRETE**

- .1 Concrete is defective when:
  - .1 Containing excessive honeycombing or embedded debris.
  - .2 Concrete damaged by freezing or which is unsatisfactory due to placement at too high a temperature.
  - .3 Average 28 day strength of any three consecutive strength tests is less than specified minimum 28 day strength.
  - .4 Any 28 day strength test result is less than 80% of specified minimum 28 day strength.
  - .5 Surface texturing, joint type and placement and tolerances are unacceptable in the opinion of the Consultant.
- .2 Repair of defective concrete work:
  - .1 Repair defective areas while concrete is still plastic, otherwise wait until curing is completed. Use repair methods approved by Consultant.
  - .2 Grind off high surface variations where directed.
- .3 Remove and replace defective concrete where directed.
  - .1 Remove minimum 3000 mm of pavement by sawing through concrete across full lane width.
  - .2 Replace with new concrete to this specification.
  - .3 Construct dummy contraction joint between sawn face of existing concrete and face of new concrete.

### 3.17 **PROTECTION**

- .1 Do not open concrete pavement to traffic or construction equipment until concrete reaches 70% of specified strength or until approved by Consultant.

END OF SECTION